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P920015/R11/C1

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May 4, 2005

Food and Drug Administration
Center for Devices and Radiological Health
Document Mail Center (HFZ-401)
9200 Corporate Blvd.
Rockville, MD 20850

Re: P920015 - Eleventh Annual Report

This report covers a one-year period from December 10, 2003 through December 9, 2004.

Enclosed, in compliance with 21 CFR 814.84, is the eleventh annual report for the following devices, approved under PMA P920015:

- Model 6963, 6966, and 6999 leads for the initial Transvene® lead system
- Model 6933, 6936, and 6939 leads for Transvene® DF-1 system
- Model 6943S Transvene® RV leads
- Model 6937 Transvene® SVC lead
- Model 6707 lead adaptor
- Model 6932 Sprint™ lead
- Model 6943 and 6945 Sprint™ leads
- Model 6944 Sprint™ Quattro™ lead
- Model 6947 Sprint™ Quattro Secure™ lead
- Model 6996 SQ lead system and 6996T tunneling tool
- Model 6726 DF-1 Y-Adaptor/Extender Kit
- Model 6949 and 6931 Sprint Fidelis™ leads
- Model 6948 and 6930 Sprint Fidelis™ leads

The following information is included in this report:

- Summary of changes reportable under 21 CFR 814.39(a) and (b)
- Summary and Bibliography of Published and Unpublished Reports
- Device Experience Information

Two copies of this submission are provided. This submission contains confidential commercial and trade secret information and Medtronic requests it be given the maximum protection provided by law.

Please contact the undersigned to obtain additional information concerning this report.

Sincerely,

MEDTRONIC, INC.

Mary Ellen Best

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SUMMARY OF CHANGES MADE

Changes Pursuant to 21 CFR 814.39(a) - PMA Supplements to PMA P920015

Supplement 29
Description: Models 6949 and 6931 Leads
Filed: November 06, 2003
Status: Approved June 08, 2004

This supplement requested approval for the Medtronic Model 6949 and 6931 leads.

Supplement 30
Description: Model 6948 and 6930 leads
Filed: December 22, 2003
Status: Approved June 08, 2004

This supplement requested approval for the Medtronic Model 6948 and 6930 leads.

Changes Made Pursuant to 21 CFR 814.39(b)

CHANGE 1: Package Labeling Modification

Description of Modification

Addition of Bar Codes to boxes, labels, and literature.

Model Affected: 6940

Reasons for Change

This change was implemented to streamline the manufacturing/packaging operations, prepare for future plans to automate the final packaging assembly process and to provide consistency and standardization for global markets.

Rationale

These changes:

- Do not affect safety or effectiveness of the device.
- Do not affect the indications for use.
- Do not affect the contraindications, warning and precautions.
- Do not correct real or potential device performance concerns. The change was not initiated in response to field performance issues.
- Do not result in any changes to the product specification.

Based on the draft guidance document, "Modifications to Devices Subject to Premarket approval -the PMA Supplement Decision Making Process," this change does not require a new PMA submission, but fulfills requirements for reporting in the PMA Annual Report.

CHANGE 2: Updated Manual

Description of Modification

Manual changed to add number of rotations for the 52 cm lead.

Models Affected: 6931, 6949

Reasons for Change

The number of rotations for the 52 cm lead length was not included in the lead technical manual.

Rationale

This length falls within the approved range of lengths, listed in the PMA supplement for this product (40 – 110cm).

The change:

- Does not affect the indications for use.
- Does not affect the contraindications, warning and precautions.
- Does not correct real or potential device performance concerns. The change was not initiated in response to filed performance issues.

Based on the draft guidance document, "Modifications to Devices Subject to Premarket approval -the PMA Supplement Decision Making Process," this change does not require a new PMA submission, but fulfills requirements for reporting in the PMA Annual Report.

CHANGE 3: Packaging Modification of Contents

Description of Modification

Add two additional introducer sheaths to the 6996 lead package.

Model Affected: 6996

Reasons for Change

End users requested that additional sheaths be included with the lead for convenience.

Rationale

The change:

- Was not the result of a recall, labels or materials change.
- Was not required to improve safety based on clinical experience nor did it affect indications for use.
- Does not require clinical data necessary to establish safety and effectiveness.
- Was qualified using the original product specifications.

Based on the draft guidance document, "Modifications to Devices Subject to Premarket approval -the PMA Supplement Decision Making Process," this change does not require a new PMA submission, but fulfills requirements for reporting in the PMA Annual Report.

BIBLIOGRAPHY AND SUMMARY OF PUBLISHED AND UNPUBLISHED REPORTS

Medtronic is not aware of any unpublished reports of data from any clinical investigation or non-clinical laboratory studies involving the device or related devices which relate to the safety and efficacy of the device or related devices during the period covered by this annual report. (Related devices include devices which are the same or substantially similar to Medtronic's devices.)

- The following bibliography pertaining to Medtronic leads and/or related devices includes reports identified in the scientific literature that were published or appeared during the reporting period. Abstracts are included, if available. The search was conducted using the following databases: Medline, Health Devices Alerts, BIOSIS and EmBase. Keywords included "high voltage pacing leads" and all applicable Medtronic model numbers. (Some searches only allow queries by "year" resulting in reports slightly outside the reporting period.)

BIBLIOGRAPHY

1. Luedemann M: **Implantable cardioverter defibrillator in a child using a single subcutaneous array lead and an abdominal active can.** 2004 Jan;27(1): 117-119.
Abstract: The authors describe the use of an implantable cardioverter-defibrillator (ICD) with a single subcutaneous array lead and an abdominal active can in an 8-year-old male patient with hypertrophic cardiomyopathy. Steroid-eluting, dual-chamber, bipolar pacing leads were attached to the right ventricle and right atrium and sutured to the myocardium after good pacing thresholds were confirmed. A 58 cm subcutaneous array lead was introduced through an axillary incision and tunneled subfascially below the sixth rib under fluoroscopic guidance. The proximal end of the lead was tunneled subcutaneously to the abdominal ICD pouch and connected. Induced ventricular tachycardia was correctly detected. A defibrillation threshold (DFT) of <less than or equal to>15 joules (J) was established. The atrial and ventricular leads demonstrated sensitivities of 2.2 mV and 24 mV, respectively, and pacing thresholds were 1.1 mV/0.5 msec and 0.9 mV/0.5 msec, respectively. The patient had an uneventful postoperative course but required analgesics for mobilization during the first few days. The patient was discharged after 6 days. DFT of <less than or equal to>20 J was confirmed at 3 months. Sensing and pacing thresholds of the epicardial leads remained unchanged. No sustained ventricular tachycardia and no ICD discharges occurred 8 months after implantation. The authors conclude that implantation of an ICD system with a single subcutaneous array lead and an abdominal active can using a nonthoracotomy approach appears to be a safe method of preventing sudden cardiac death with little surgical trauma and with preservation of an intact vascular system in smaller children for whom a transvenous approach is not feasible
While a specific product is identified in this report, ECRI believes that the intention of the article was not, necessarily, to implicate this particular product and that this problem and/or these results may occur with similar products of other manufacturers.

2. Messali A: **Death due to an implantable cardioverter defibrillator. "J Cardiovasc Electrophysiol" 2004 Aug;15(8):953-6.** 2004 Aug;15(8): 953-956.
Abstract: The authors report a case of death caused by inappropriate therapy due to noise oversensing in a Model 7227B GEM VR implantable cardioverter-defibrillator (ICD) in a 49-year-old man with nonischemic dilated cardiomyopathy. In 1991, the patient received a single-chamber ICD connected to a right atrial/superior vena caval vein Model 6963 polyurethane defibrillator lead; a right ventricular Model 6966 Transvene single-coil, tripolar, coaxial polyurethane defibrillator lead; and a subcutaneous defibrillation patch. The generator was replaced in 1995. In

March 2000, a Model 7227B GEM VR ICD was implanted and connected to the same leads. Standard device interrogation 3 days later demonstrated ventricular pacing threshold of 2 V/0.5 msec, pacing impedance of 521 <Greek omega>, defibrillation impedance of 21 <Greek omega>, ventricular sensitivity of 8 mV, and no ventricular oversensing. Lead positions were unchanged on chest x-ray examination. Ventricular tachycardia and ventricular fibrillation (VF) zones were programmed with detection rates of 167 and 200 beats/min, respectively. The patient died suddenly on June 29, 2000. ICD interrogation revealed ventricular oversensing during sinus rhythm that was diagnosed as VF because of short cycle lengths <.300 msec. 6 shocks were delivered within approximately 2 min. The sixth shock induced true VF, which could not be treated because the end of the therapeutic procedure had been reached. Interrogation also revealed that the patient experienced an inappropriate shock 9 days earlier because of the same oversensing, as well as multiple nonsustained episodes of ventricular arrhythmia that may have been oversensing in the 12 days before the patient's death. The authors conclude that lead insulation failure may have induced oversensing and inappropriate shock in this case, and they emphasize the need for careful follow-up after ICD shock delivery to reveal any device abnormalities and to prevent serious side effects.

3. Molina JE, Benditt DG: **An epicardial subxiphoid implantable defibrillator lead: Superior effectiveness after failure of standard implants.** *PACE - Pacing and Clinical Electrophysiology* 2004, 27(11): 1500-1506.
Abstract: A single epicardial implantable lead using the subxiphoid approach is described in this article. It consists of a single halo-shaped coil that is implanted under the inferior surface of the heart, including the right and left inferior ventricular surfaces. It has been implanted in four patients who could not be defibrillated with a transvenous system, even with the adjunct use of subcutaneous leads or left chest wall patch. Three of the patients had progressive heart failure due to ischemic myocardiopathy; the fourth patient had a dilated idiopathic myocardiopathy. The approach is simple and appears to be effective due to its ability to encompass the left and right ventricles. This vector seems to significantly lower the threshold for defibrillation, and may offer substantial benefit in the setting of high defibrillation thresholds with conventional leads, or when conventional systems are inadequate to achieve consistent defibrillation.

4. Nandakumar R, Broadhurst P: **An unusual obstacle in lead extraction.** *PACE - Pacing and Clinical Electrophysiology* 2004, 27(11): 1576-1577.
Abstract: This case report deals with an unusual complication in the removal of an active fixation implantable cardioverter defibrillator (ICD) lead. We were not able to pass the stylet beyond the point of lead fracture and this was subsequently found to be due to the stylet passing between the electrode and the outer layer of the lead insulation. The lead was removed by rotation extraction of the entire lead.

5. Rashba EJ: **Distal right ventricular coil position reduces defibrillation thresholds. "J Cardiovasc Electrophysiol" 2003 Oct;14(10):1036-40.** 2003 Oct;14(10): 1036-1040.
Abstract: The authors evaluated whether use of a distal right ventricular (RV) coil position and transvenous defibrillator leads lowers defibrillation thresholds (DFTs) compared to a more proximal RV coil position. The authors developed a defibrillator lead with multiple RV coils in order to compare proximal and distal positions without lead repositioning. DFT testing was performed using both RV coil positions in 31 patients with a mean left ventricular ejection fraction of 30% <plus/minus>16%. 1 patient had a DFT of >.24 joules (J) with the proximal configuration and 9 J with the distal configuration and was excluded from paired comparisons. With the RV coil in a proximal position, mean delivered energy was 11.2 <plus/minus>6.1 J, mean voltage was 393 <plus/minus>118 V, mean peak current was 14.9 <plus/minus>7.3 A, and mean resistance was 28.8 <plus/minus>9.0 <Greek omega>. With the RV coil in a distal position, mean delivered energy was 8.2 <plus/minus>5.3 J, mean voltage was 335 <plus/minus>109 V, mean peak current was 11.6 <plus/minus>5.2 A, and mean resistance was 31.7 <plus/minus>9.6 <Greek omega>. Mean delivered energy, leading-edge voltage, and peak current were all significantly lower with the distal RV configuration compared to the proximal RV configuration, and mean resistance was slightly higher with the distal RV configuration, which was expected with lower shock energy. DFT energy with the distal RV configuration compared to the proximal RV configuration was lower in 19 cases, equivalent in 8 cases, and higher in 4 cases, and the proportion of patients with elevated DFTs was significantly lower with the distal RV configuration. The authors conclude that DFTs are significantly reduced with use of a distal RV configuration and transvenous defibrillator leads compared to a proximal RV configuration and that transvenous defibrillator leads should be designed with the shortest tip-to-coil distance that does not compromise ventricular fibrillation sensing.

6. Shah P, 27(5):677-80.: **Inappropriate therapy from a defibrillator complicating transcoronary ablation of septal hypertrophy in a patient with hypertrophic obstructive cardiomyopathy.** 2004 May;27(5): 677-680.
Abstract: The authors report a case in which a defibrillator delivered inappropriate therapy in a 46-year-old man with obstructive hypertrophic cardiomyopathy. The patient received a Model V-232 dual-chamber Photon Micro DR automatic implantable cardioverter-defibrillator (ICD) with a Model 6945 Sprint active-fixation, dual-coil defibrillator ventricular lead and a Model 1488TC Pacesetter Tendril SDX endocardial, steroid-eluting, screw-in atrial lead. Over a 6-month period, the patient experienced progressive exertional chest pain, dyspnea, and fatigue, and episodes of atrial arrhythmia continued. The patient was scheduled to undergo transcoronary ablation of septal hypertrophy (TASH) and was in atrial fibrillation on the day of the procedure. Post-TASH, the patient continued to

be in atrial fibrillation, with a complete right bundle branch block (RBBB). The width of the device intracardiac electrogram (EGM) increased from 120 msec preprocedure to 200 msec postprocedure. When tachyarrhythmia detection was reactivated, the patient received a shock because widening of the EGM resulted in double counting of the QRS complex. After the shock, the patient was paced in the ventricle, without evidence of double counting. The electrocardiogram confirmed that the patient was in sinus rhythm with complete RBBB. The active-fixation ventricular lead was replaced. Defibrillation threshold was <.20 J after replacement-lead implantation, without evidence of double counting. 10 days later, the patient experienced another inappropriate shock from double counting. The width of the ventricular EGM was narrower than the width of the right ventricular apex but greater than the programmed refractory period. The ventricular sensed refractory period was reprogrammed from 125 to 157 msec, and the morphology discriminator algorithm was activated. There was no further double counting of the EGM. Defibrillation threshold confirmed excellent detection of ventricular fibrillation without over- or undersensing. At 12 months, the patient remained asymptomatic and received no inappropriate shocks. The authors conclude that careful post-TASH evaluation of ICD function and EGM morphology is required to ensure satisfactory ICD operation.

7. Snow JS, Larsen A, Cohen TJ: **Transvenous biventricular defibrillation can improve defibrillation threshold.** *PACE - Pacing and Clinical Electrophysiology* 2004, 27(9): 1327-1328.
Abstract: A case report of a patient with a high defibrillation threshold at initial implantation that was improved by the insertion of a shocking coil in the left lateral cardiac vein is discussed.

8. Usui M, Takagi Y, Masumoto H, Ueda Y: **[Subpectoral implantable cardioverter defibrillator implantation in a 20 kg-weighted child].** *Kyobu geka The Japanese journal of thoracic surgery* 2004, 57(5): 364-366.
Abstract: An 11-year-old boy (weight 20 kg, height 124 cm), who was survived from ventricular fibrillation due to hypertrophic cardiomyopathy, admitted to our institution for implantable cardioveter defibrillator (ICD) implantation. We implanted a transvenous single coil lead and a device (Medtronic model 6943 , GEM II VR 7229 Cx) in the subpectoral pocket. We selected this system because of less restriction on normal cardiac function, low operative morbidity, and expectation of long-term defibrillation threshold stability. Subpectoral implantation is cosmetically acceptable comparing with abdominal area. Lead insertion by cut-down technique is feasible and recommended to avoid lead-related complications. ICDs are infrequently used in pediatric patients and prospective study with long-term follow-up will be required to ascertain the prognosis for young survivors from sudden cardiac death.

DEVICE EXPERIENCE INFORMATION

The Tachyarrhythmia Product Performance Report (TPPR) presents device survival estimates for Medtronic implantable cardioverter defibrillators and leads approved for market release in the United States. In this report, "survival" refers to the proper function of the device, not the survival of the respective patient.

In this report, lead survival is calculated from data collected in Medtronic's TCSS, a multicenter, prospective study specifically designed to actively collect data on our tachyarrhythmia systems. Data collected include lead-related adverse events such as failure to capture, failure to sense, oversensing, etc. This data enables us to monitor and report chronic performance of our leads.

Lead-related observations and clinical responses are found starting on page 43 (page 27) of the attached CRM Product Performance Report.

ATTACHMENT A - Product Performance Report (PPR)

Medtronic

CRM PRODUCT PERFORMANCE REPORT

Important Patient Management Information for Physicians

Pages removed for the following reason: Copywrite material

Medtronic

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March 2, 2006

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Re: P920015 - Twelfth Annual Report

This report covers a one-year period from December 10, 2004 through December 9, 2005.

Enclosed, in compliance with 21 CFR 814.84, is the twelfth annual report for the following devices, approved under PMA P920015:

- Model 6963, 6966, and 6999 leads for the initial Transvene® lead system
- Model 6933, 6936, and 6939 leads for Transvene® DF-1 system
- Model 6937 Transvene® SVC lead
- Model 6707 lead adaptor
- Model 6932 Sprint™ lead
- Model 6942 Sprint™ lead
- Model 6943 and 6945 Sprint™ leads
- Model 6944 Sprint™ Quattro™ lead
- Model 6947 Sprint™ Quattro Secure™ lead
- Model 6996 SQ lead system and 6996T tunneling tool
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The following information is included in this report:

- Summary of changes reportable under 21 CFR 814.39(a) and (b)
- Summary and Bibliography of Published and Unpublished Reports
- Device Experience Information

Two copies of this submission are provided. This submission contains confidential commercial and trade secret information and Medtronic requests it be given the maximum protection provided by law.

Please contact the undersigned to obtain additional information concerning this report.

Sincerely,

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SUMMARY OF CHANGES MADE

Changes Pursuant to 21 CFR 814.39(a) - PMA Supplements to PMA P920015

Supplement 31
Description/Models: This supplement requested approval for a change to the monolithic controlled-released device (MCRD) and addition of dexamethasone sodium phosphste (DSP) to the Models 6945, 6943 and 6947 Leads.
Filed: September 10, 2004
Status: Approved February 7, 2006

This supplement requested approval for material and steroid changes to the monolithic controlled release device (MCRD) used in selected models of Medtronic pacing leads. The binder material changed from polyurethane to silicone and the steroid changed from dexamethasone sodium phosphate (DSP) to dexamethasone acetate (DXAC).

Supplement 32
Description/Models: This supplement requested approval for a change in aeration time following sterilization of Models 6930/6931 and 6948/6949 Leads.
Filed: September 2, 2005
Status: Approved December 1, 2005

A 30-Day Notice PMA Supplement was submitted for approval to optimize the aeration process used to remove steriliant residuals for the lead models listed above, following ethylene oxide sterilization performed at the Medtronic - (b)(4) (b)(4)

Supplement 33

Status: Withdrawn
PMA Supplement P920015/S033 filed December 7, 2005 was withdrawn on December 19, 2005. The changes referenced as part of the

P890003/S093 bundled submission did not apply to PMA P920015, as it was erroneously referenced.

Supplement 34

Status: Withdrawn
PMA Supplement P920015/S034 filed December 6, 2005 was withdrawn on December 19, 2005. The changes referenced as part of the P890003/S097 bundled submission did not apply to PMA P920015, as it was erroneously referenced.

Changes Made Pursuant to 21 CFR 814.39(b)

CHANGE 1: Improve Process for Crimping

Process Change

Revised crimping operation from a manual four indent crimper to a manual eight indent crimper.

Description of Modification

To optimize the contact area between the connector pin and connector pin cap, the crimp was changed from four to eight indents to allow an increase in the contact area. Leads now are built with a manual eight indent crimper.

Models Affected: 6943, 6945, 6947, 6949, 6948, 6930 and 6931.

Reasons for Change

This change was implemented to reduce the potential of intermittent continuity between the pin cap and the pin of the lead. Increasing the number of indents at the crimp from four to eight, allows an increase in contact area.

The new crimp was validated and documented. (Reports 05VR.016 and 05VR.049). Three lots of thirty (30) were used for the validation of this process to demonstrate a confidence level of 95% with 95% reliability. The process met a Cpk of greater than 1.33 meeting pre-determined acceptance criteria.

Rationale

This change was determined to be Annual Reportable because the change:

- Does not affect the performance or design specifications, circuits, components, ingredients, principal of operation or physical layout of the devices.
- Does not affect the contraindications, warning and precautions or other information contained in the product labeling.
- Does not affect the indications for use of the devices.
- Does not affect safety or effectiveness of the devices and is considered a minor manufacturing change.

BIBLIOGRAPHY AND SUMMARY OF PUBLISHED AND UNPUBLISHED REPORTS

Medtronic is not aware of any unpublished reports of data from any clinical investigation or non-clinical laboratory studies involving the device or related devices which relate to the safety and efficacy of the device or related devices during the period covered by this annual report. (Related devices include devices which are the same or substantially similar to Medtronic's devices.)

- The following bibliography pertaining to Medtronic leads and/or related devices includes reports identified in the scientific literature that were published or appeared during the reporting period. Abstracts are included, if available. The search was conducted using the following databases: Medline, Health Devices Alerts, BIOSIS and EmBase. Keywords included "high voltage pacing leads" and all applicable Medtronic model numbers. (Some searches only allow queries by "year" resulting in reports slightly outside the reporting period.)

BIBLIOGRAPHY

1. Almquist AK, Montgomery J, V, Haas TS, Maron BJ: **Cardioverter-defibrillator implantation in high-risk patients with hypertrophic cardiomyopathy.** *Heart rhythm - the official journal of the Heart Rhythm Society* 2005, 2(8): 814-819.
Abstract: BACKGROUND: Implantable cardioverter-defibrillators (ICDs) are used with increasing frequency in hypertrophic cardiomyopathy (HCM) patients of all ages for primary and secondary sudden death prevention. Concerns may arise regarding the safety of device implantation because of unique clinical and phenotypic expressions of HCM. OBJECTIVES: The purpose of this study was to assess the efficacy and safety of ICD placement in high-risk patients with HCM. METHODS: We analyzed the experience with ICDs and transvenous lead systems in 75 consecutive HCM patients at the Minneapolis Heart Institute from 1993 to 2004. RESULTS: The age of the study group patients was 12 to 79 years (mean 36 +/- 16). Patients received ICDs for secondary (n = 4, after cardiac arrest) or primary prevention (n = 71, with > or = 1 risk factor). Thirty-one patients demonstrated disease features that potentially impacted methodology and safety of the implant procedure, most commonly massive left ventricular (LV) hypertrophy and outflow obstruction > or = 50 mmHg. There were no procedure-related deaths; defibrillator implants were successful and uneventful in 71 of 75 patients (95%). In 3 of the 75 patients (4%), defibrillation was unsuccessful because of high thresholds, associated with extreme hypertrophy (wall thickness > 45 mm) and/or ongoing amiodarone therapy. In two of these patients, thoracotomy with epicardial lead placement achieved successful defibrillation; ICD therapy was abandoned in the other patient. CONCLUSION: ICD placement in children and adults with HCM is generally safe and effective. However, in some patients with massive LV hypertrophy and/or prior administration of amiodarone, transvenous defibrillation proved difficult, and epicardial lead placement was required. High-energy ICD devices and defibrillation threshold testing are recommended for most high-risk HCM patients

2. Barold SS, Herweg B: **Phantom crosstalk.** *PACE - Pacing and Clinical Electrophysiology (PACE PACING CLIN ELECTROPHYSIOL)* ACE.

3. Bolad I, Karanam S, Mathew D, John R, Piemonte T, Martin D: **Percutaneous treatment of superior vena cava obstruction following transvenous device implantation.** *Catheterization and cardiovascular interventions - official journal of the Society for Cardiac Angiography & Interventions* 2005, 65(1): 54-59.
Abstract: The aim of this study is to assess the feasibility and safety of percutaneous treatment of superior vena cava (SVC) obstruction following transvenous device implantation. SVC obstruction is an uncommon but serious complication that can occur following permanent pacemaker or cardioverter defibrillator implantation utilizing transvenous endocardial leads . The treatment has traditionally been surgical but with the advent of stents, percutaneous approach is becoming popular. We report on the prevalence of SVC obstruction and the safety of its percutaneous catheter-based treatment. This is a retrospective study of SVC obstruction following device implantation in our institution from January 1993 through November 2003. A total of 1,850 permanent pacemaker and 1,200 implantable cardioverter defibrillator initial implants were performed during that period. Three patients developed SVC obstruction following implant (prevalence, 1/1,000 implant). Two patients were males and the mean age at implant was 57 +/- 13 years. Laser lead extraction and SVC angioplasty with or without stenting were performed in all patients. In two of them, this was followed by reimplantation of new systems. There were no procedural complications or mortality. The patients remain free of SVC obstruction symptoms 24 +/- 19 months after treatment. SVC obstruction prevalence after device implantation is low. Percutaneous treatment of SVC obstruction can be safely performed and appears to be effective in maintaining medium-term patency. (c) 2005 Wiley-Liss, Inc

4. Bongiorni MG, Giannola G, Arena G, Soldati E, Bartoli C, Lapira F *et al.*: **Pacing and implantable cardioverter- defibrillator transvenous lead extraction.** *Italian heart journal - official journal of the Italian Federation of Cardiology* 2005, 6(3): 261-266.
Abstract: During the last 20 years, the transvenous techniques for the extraction of chronically implanted pacing (PL) and defibrillating leads (DL) achieved a high success rate. However the procedures are often complex and are associated with a small but significant risk. The operators' experience and the availability of different approaches for difficult cases seem to affect both the results and the complications. This paper represents a review of indications, techniques and results of a 10-year experience in the field of transvenous lead extraction. Since January 1997, extraction was attempted in 1330 leads; among these 1137 were successfully extracted with the standard mechanical approach (success rate 85.4%); in 12 leads was performed a partial extraction (0.9%) and 1 was inapplicable (0.07%). The jugular approach was performed in 180 leads (164 PL and 16 DL): 39 were intravascular free-floating leads (38 PL and 1 DL) and 141 were difficult exposed leads (126 PL and 15 DL) allowing extraction in 178/180 (98.8%) cases. After this approach, the final results were: total extraction 98.88%, partial extraction 0.90%, unextracted 0.15%, and not applicable 0.07%. Major complications occurred in 4 cases (0.3%) and were cardiac tamponade (2 underwent successful pericardiocentesis, 1 surgical repair, and 1 patient died). No complications were directly related to the jugular approach. In conclusion, transvenous lead extraction is an effective and safe procedure. The success rate and the incidence of complications are highly affected by the staff experience. The use of the jugular approach, in the presence of free-floating or difficult exposed leads, increases both safety and success rate

5. Chan NY, Ho LWL: **Inappropriate implantable cardioverter-defibrillator shock due to external alternating current leak: Report of two cases.** *Europace (Europace)* EUROPACE.
Abstract: AB- Two cases are reported of inappropriate implantable cardioverter-defibrillator shocks due to external alternating current leak. Electromagnetic interference (EMI) can mimic cardiac signals and cause inappropriate implantable cardioverter-defibrillator (ICD) shocks. EMI can arise from the normal functioning of electrical appliances or from alternating current leak. The two cases had inappropriate ICD shocks due to alternating current leak from a power drill in one and a washing machine in the other. The need for detailed advice on handling electrical equipment is emphasized. (c) 2005 The European society of Cardiology. Published by Elsevier Ltd. All rights reserved

6. Chang J, Chen M, Guo GB-F, Kao C: **Less-invasive surgical extraction of problematic or infected permanent transvenous pacemaker system.** *Annals of thoracic surgery* 2005, 79(4): 1250-1254.
Abstract: BACKGROUND: The best management of problematic or infected transvenous permanent pacemaker system is complete surgical or percutaneous intravascular extraction of the pacemaker leads and removal of the generator. We present our experiences in 13 such patients in whom the leads were removed with the less-invasive technique. METHODS: From 1996 to 2003, 13 patients, from 31 to 83 years of age (mean, 66.9 +/- 14.0 years), with problematic or infected transvenous permanent pacemaker systems were referred to our department for surgical treatment. In 6 patients, the original pacemakers were dual-chamber. A subxiphoid pericardiotomy was used as the monitoring port during the ventricular lead extraction. In addition, a right parasternal pericardiotomy through the third intercostal space was used as the monitoring port during the atrial lead extraction. RESULTS: Pacemaker systems were completely removed in all patients. Three bleeding episodes (23%), including two right atrial tears and one right ventricular rupture, were successfully circumvented through these monitoring ports. Concomitantly, a new epicardial single-chamber device was implanted through the subxiphoid pericardiotomy whenever indicated in 9 patients. All patients recovered and were discharged uneventfully. At a mean follow-up of 24.8 months (range, 1 to 90 months), no recurrent infections were observed. CONCLUSIONS: A less-invasive technique for explantation of the complete pacemaker system is feasible. This is a reliable method to eradicate infection. Neither cardiopulmonary bypass nor specific intravascular lead extraction devices, such as locking stylets or laser-assisted sheath, are needed

7. Chintala K, Forbes TJ, Karpawich PP: **Effectiveness of transvenous pacemaker leads placed through intravascular stents in patients with congenital heart disease.** *American journal of cardiology* 2005, 95(3): 424-427.
Abstract: Eight patients with venous obstruction secondary to Mustard baffle obstruction or previous transvenous pacemaker leads underwent intravascular stent relief of their obstructions followed by the insertion of new leads . Patients were followed from 1.3 to 6.3 years (median 3) by clinical, hemodynamic, angiographic, and intravascular ultrasound methods and pacemaker evaluations. The median stent patency was 84%, with 1 patient developing complete stent occlusion. Pacing energy thresholds and impedances remained unchanged

8. Drago F, Silvetti MS, De Santis A, Grutter G, Calcagnini G, Censi F *et al.*: **Beat-to-beat heart rate adaptation in pediatric and late adolescent patients with closed loop rate-responsive pacemakers.** *Pacing and clinical electrophysiology - PACE* 2005, 28(3): 212-218.
Abstract: The aim of this study was to evaluate the efficacy of physiological rate-responsive pacemakers (Closed Loop Stimulation--CLS) to pace pediatric and late adolescent patients undergoing rest, mental, standing, and exercise testing. Dual-chamber pacemaker is increasingly indicated for young patients. A new physiological pacing mode based on the indirect measure of ventricular contractility (CLS), has shown interesting results in adults, while no data on pediatric patients are available. RR intervals and beat-to-beat systolic and diastolic pressures were monitored in 12 pediatric patients (6 males, mean age 17 years [12-22 years]) who had a transvenous implant of Inos2+-CLS dual-chamber pacemaker (Biotronik GmbH, Berlin, Germany) and endocardial leads . All the patients showed correct electrical parameters at the implant and during the follow-ups. Paced RR intervals decreased significantly (F = 7.28, P = 0.01) from 0.85 +/- 0.08 seconds (rest) to 0.73 +/- 0.10 seconds (mental) and to 0.75 +/- 0.010 seconds (standing); systolic/diastolic pressure was significantly higher (F = 12.2, P = 0.002/F = 13.6, P = 0.001) in mental (134.4 +/- 19.9/74.4 +/- 8.1 mmHg) with respect to rest (115.1 +/- 18.3/61.0 +/- 6.1 mmHg), and standing (118.7 +/- 23.9/67.3 +/- 0.1 mmHg). During exercise the paced RR interval showed significant decrease of about 35% from baseline to maximum load (F = 24.90, P = 0.001) and systolic pressure increased significantly (F = 4.91, P = 0.019) by about 34% from baseline to maximum load. The comparison between paced and spontaneous rates showed very similar values and trend. In addition, CLS mode does not seem to overrun the spontaneous heart activity, when present. This is a study to evaluate CLS pacing in pediatric and late adolescent patients. The study shows that CLS pacing responds to both physical and non-physical stressors, providing physiological pacing rates, as previously observed in adults

9. Ellery SM, Paul VE: **Complications of biventricular pacing.** *European Heart Journal, Supplement (EUR HEART J SUPPL)* EUR.
Abstract: AB- Biventricular pacing in patients with drug refractory heart failure is not without risk. In addition to those complications associated with conventional pacing , there are also problems with left ventricular lead insertion using the preferred transvenous approach. (c) 2004 The European Society of Cardiology. Published by Elsevier Ltd. All rights reserved

10. Erdinler I, Okmen E, Turek O, Yapici F, Ozler A, Cam N *et al.*: **Tricuspid valve perforation by permanent pacemaker lead--a case report.** *Angiology* 2005, 56(5): 619-621.
Abstract: Tricuspid valve perforation with pacemaker lead is one of the extremely rare complications of transvenous pacemaker implantation. Approximately all reported cases have been diagnosed at autopsy. The authors present a case of tricuspid valve perforation caused by pacemaker lead that was diagnosed during cardiac surgery and treated successfully by removing the lead and suturing the tricuspid valve

11. Fortescue EB, Berul C, I, Cecchin F, Walsh EP, Triedman JK, Alexander ME: **Comparison of modern steroid-eluting epicardial and thin transvenous pacemaker leads in pediatric and congenital heart disease patients.** *Journal of interventional cardiac electrophysiology - an international journal of arrhythmias and pacing* 2005, 14(1): 27-36.
Abstract: OBJECTIVE: Optimal pacemaker lead choice in pediatric patients eligible for either epicardial or transvenous leads remains unclear. We compared performances of modern thin transvenous (TTV) and steroid-eluting epicardial (SEE) leads in patients followed at one pediatric center. METHODS: Retrospective review of patients with qualifying leads implanted from August 1997 to March 2004. Threshold energy (TE) at implant and follow-up, sensing thresholds, lead complications, and repeat pacing-related procedures were analyzed. Lead performances were compared using t-tests, Wilcoxon rank-sum tests and Cox regression. Survival curves were plotted using Kaplan-Meier analysis. RESULTS: A total of 370 implant procedures, 521 leads, and 1549 visits were evaluated. In all, 256 leads were SEE (49%, 184 implants) and 265 were TTV (51%, 186 implants). Median follow-up was 29 months (range 1-80 months). Patients with SEE systems were younger at implant (6 vs. 17 yrs, $p < 0.001$), and more had congenital heart defects (82% vs. 57%, $p < 0.001$). At follow-up, ventricular TEs were higher for SEE leads at implant ($p < 0.001$), 1 month ($p < 0.001$), and up to 4 years ($p = 0.019$). When compared across all follow-up durations combined, TTV TEs were significantly lower than SEE TEs for both atrial and ventricular leads ($p < 0.001$). A total of 70 repeat procedures were performed in 60 patients during the study period, which comprised 18% of SEE and 14% of TTV system patients (p = NS). In all, 18 TTV and 19 SEE leads failed (p = NS). Estimated freedom from lead failure at 1, 3, and 5 years was 97%, 88%, 85% for TTV leads and 96%, 92%, and 58% for SEE leads (log rank P = NS). CONCLUSIONS: Both SEE and TTV leads showed good mid-term performance and survival in our cohort. Higher TEs seen for SEE leads, especially ventricular and unipolar leads, may result in higher current drain and thus more generator replacements than TTV systems. Lead failure rates were comparable across lead types. TTV leads offer a promising alternative to SEE systems in terms of performance for young patients without intracardiac shunting who do not require open-chest surgery for another indication

12. Gabor S, Prenner G, Wasler A, Schweiger M, Tscheliessnigg KH, Smolle-Juttner FM: **A simplified technique for implantation of left ventricular epicardial leads for biventricular re-synchronization using video-assisted thoracoscopy (VATS).** *European journal of cardio -thoracic surgery - official journal of the European Association for Cardio -thoracic Surgery* 2005, 28(6): 797-800.
Abstract: OBJECTIVE: Cardiac re-synchronization therapy for treatment of heart failure requires transvenous insertion of both a right ventricular and left ventricular pacing lead . Implantation of the latter by way of the coronary sinus often fails. Therefore, alternative techniques for insertion are required. We applied a simple video-assisted surgical technique (VATS) using only two ports for the insertion of left-ventricular screw-in electrodes. METHODS: Fifteen patients (M: 10; F: 5; mean age: 62.2 years; range: 46-76 years) with heart failure meeting the ACC/AHA guidelines for implantation of biventricular pacing underwent transvenous insertion of the right atrial sensor lead and the right ventricular pacing lead . In all of them transvenous implantation of the left ventricular pacing lead failed, and they were planned for VATS. In right-lateral decubitus position and under single-lung ventilation a camera port and a flexible instrumentation port were inserted in the forth intercostal space. By using routine instruments, a T-shaped incision was made lateral to the phrenic nerve and an electrode was screwed in. The lead was guided subcutaneously to the pacemaker. RESULTS: Mean skin-to-skin operating time was 55+/-16 min, no conversion to thoracotomy was necessary. All patients were extubated in the operating room and remained in the intensive care unit for less than 24h. Chest tubes were removed after a mean of 1.6+/-0.5 days and the patients were discharged after a mean of 4+/-1.3 days. Intraoperative and postoperative pacing thresholds at 1 and 7 months were satisfactory in all cases and there was no lead dislocation. All but two patients had an improvement of their NYHA function class. There was neither surgical morbidity nor mortality. CONCLUSIONS: Video-assisted thoracoscopy over two ports seems to be an excellent alternative procedure for epicardial lead implantation. It is readily available and produces good pacing results at a short intervention time and tolerable stress for the patients

13. Geske JB, Goldstein RN, Stambler BS: **Novel steerable telescoping catheter system for implantation of left ventricular pacing leads.** *Journal of interventional cardiac electrophysiology - an international journal of arrhythmias and pacing* 2005, 12(1): 83-89.
Abstract: Advances in left ventricular transvenous lead delivery systems for biventricular pacing are leading to more refined techniques, shorter procedure times and higher implant success rates. Despite these advances, the inability to successfully cannulate the coronary sinus and deliver a lead to a distal location are still major causes of prolonged procedures times and implant failures. The pathophysiologic process of heart failure results in dilatation of the right atrium as well as other morphological changes in cardiac anatomy. Additionally, cannulation can be further complicated by congenital anomalous cardiac anatomy. This report describes the implant of a biventricular pacing system using a novel, steerable 7 French catheter system developed to aid in the cannulation of the coronary sinus ostium and its venous branches. The steerable catheter is used in conjunction with a 9 French braided sheath and guide-wire to create a telescoping system. The use of new tools and methods as described provides insight into available options for left ventricular transvenous lead implantation and dealing with difficult anatomy

14. Gradaus R, Eckardt L, Wedekind H, Loher A, Bocker D: **Transvenous ICD implantation after artificial tricuspid valve replacement. A new approach placing a transvenous ICD lead in the mid cardiac vein of the coronary sinus.** *Zeitschrift fur Kardiologie* 2005, 94(9): 588-591.
Abstract: Implantation of a transvenous device in patients with a tricuspid valve replacement or a complex congenital heart disease with no access to the right ventricle represents problems. The lack of access to the right ventricle might preclude transvenous placement of a defibrillation lead at ICD implantation. A young patient (21 years) with a history of severe chest trauma with rupture of the tricuspid valve as well as the right coronary artery and consecutive inferior myocardial infarction was initially treated with tricuspid valve replacement (St Jude Medical artificial prosthesis, 33 mm) and a bypass graft to the right coronary artery. Four years later, the patient was admitted with a hemodynamically not tolerated ventricular tachycardia (VT: CL 250 ms, LBBB, left axis). The VT could be reproduced during electrophysiological testing. An ICD was implanted subpectorally in combination with a transvenous active fixation ICD lead. The transvenous ICD lead was placed via a guiding catheter into a coronary sinus branch (middle cardiac vein). Acceptable pacing and sensing values could be obtained. The defibrillation threshold was 25 J. In conclusion transvenous ICD lead implantation into a side branch of the coronary sinus in combination with a pectorally implanted "active can" ICD device seems to be an alternative approach. This approach may avoid implantation of additional subcutaneous defibrillation leads or even thoracotomy for ICD implantation

15. Guo GBF: **"What & how" about implantation of AAI/R, DDD/R, and VVI/R pacemakers.** *Acta Cardiologica Sinica (ACTA CARDIOL SIN)* ACTA.
Abstract: AB- Because of new development of active and passive fixation leads that greatly decrease the possibility of dislodgment, the transvenous approach for permanent cardiac pacing has virtually replaced thoracotomy implantation and is generally performed by cardiologists in the catheterization laboratory. This is an overview of selected topics regarding single- and dual-chamber pacemaker implantation (AAIR, VVIR, and DDDR). Transvenous implantation of a pacemaker is typically an easy and safe procedure if the cardiologist pays careful attention to perioperative considerations, which are patient preparation, venous access, site of implantation, lead configuration, alternate pacing sites in the atrium and ventricle, electrical parameter measurements, lead anchoring and final connection, site of pacemaker pocket, and potential complications. However, cardiologists have been challenged by the increasing complexity of programming of pacemakers. In particular, atrioventricular delay (AV delay), mode switch, and rate response need to be carefully programmed to maximize benefits of pacemaker therapy

16. Hansky B, Blanz U, Peuster M, Gueldner H, Sandica E, Crespo-Martinez E *et al.*: **Endocardial pacing after Fontan-type procedures.** *Pacing and clinical electrophysiology - PACE* 2005, 28(2): 140-148.
Abstract: BACKGROUND: Sinus node dysfunction is a frequent complication of Fontan-type procedure. Epicardial pacing is considered as the standard treatment for these patients. METHODS AND RESULTS: We evaluated an endocardial approach in seven patients using a 4.1 French bipolar lumenless lead (SelectSecure) that is positioned through a steerable guiding catheter. Either a purely transvenous or an open transatrial approach can be used for lead placement. The smallest child weighed 12 kg. Individual anatomy was assessed preimplantation using magnetic resonance imaging and injection of radiographic contrast agent through the guiding catheter. A pullback pressure recording was used to confirm unimpaired blood flow into the pulmonary artery. Five of our seven patients underwent de novo transvenous atrial lead implantation for AAIR pacing . In the remaining two patients, both atrial and ventricular leads were inserted. One patient with an intraatrial tunnel underwent transvenous-lead placement. The remaining patient with an extracardiac conduit received atrial and ventricular leads implanted through a guiding catheter inserted through an atriotomy. The postoperative management included short- or long-term oral anticoagulation. CONCLUSIONS: Transvenous endocardial lead implantation avoids the problem of increasing capture thresholds typically observed with epicardial leads. Due to its high tensile strength and lumenless design, the isodiametric lead is expected to remain extractable for an extended period of time

17. Khairy Paul R, Landzberg MJ, Gatzoulis MA, Mercier L, Fernandes SM, Lavoie J *et al.*: **Transvenous pacing leads and systemic thromboemboli in patients with congenital heart disease and intracardiac shunts: A multicenter study.**

18. Kriebel T, Ruschewski W, Paul T: **Implantation of an "extracardiac" internal cardioverter defibrillator in a 6-month-old infant.** *Zeitschrift fur Kardiologie* 2005, 94(6): 415-418.
Abstract: In infants and small children, ICD implantation is a challenge due to technical limitations and a significant number of complications. This report describes ICD implantation in a 6-month-old infant (body weight 5.5 kg). A completely extracardiac defibrillation system was implanted using a transvenous lead subcutaneously in the back below the left scapula as the defibrillation electrode and an active-can device in the right upper abdomen. Defibrillation threshold of implantation was < or =10 J. During the follow-up of 3 months, 8 adequate ICD discharges were noted. The technique described seems feasible to facilitate ICD implantation in small infants

19. Lubinski A, Lewicka-Nowak E, Zienciuk A, Krolak T, Kempa M, Pazdyga A *et al.*: **Clinical predictors of defibrillation threshold in patients with implantable cardioverter-defibrillators <Original> Czynniki kliniczne wpl(Stroke)Ywaja(Cedil)Ce na prog defibrylacji migotania komor u chorych z kardiowerterem-defibrylatorem serca.** *Kardiologia Polska (KARDIOL POL)* KARDIOL. Abstract: AB- Background. Safety of patients with malignant ventricular arrhythmias, treated with implantable cardioverter-defibrillators (ICD), depends on the possibility of immediate and effective intracardiac defibrillation. It is especially important in those patients in whom there is a risk of increased defibrillation threshold (DFT) of ventricular fibrillation (VF). Thus, it is important to know whether some clinical parameters may predict a high DFT. Aim. To assess the relationship between DFT and clinical, demographic and antropometric parameters, type and progression of underlying disease as well as antiarrhyhmic therapy used in ICD recipients. Methods. The study group consisted of 168 patients (47 females, 121 males, mean age 55+/-15 years, range 15-82 years) who were selected to receive an ICD. DFT was systematically tested during ICD implantation in all patients. Various clinical, demographic, antropometric and echocardiographic parameters were analysed as the function of DFT value, examining their accuracy in predicting a high (> 15 J) or a low (< 15 J) DFT, using logistic regression model. Results. Univariate analysis revealed that DFT value was significantly related to the following parameters: idiopathic VF, dilated cardiomyopathy, amiodarone therapy and the use of beta blockers. There was a significant correlation between DFT and LVEDD, height, LVEF and impedance of defibrillating system. Multivariate analysis showed that amiodarone therapy, height, impedance of defibrillating system and LVEDD were independently related to the DFT value. Parameters which predicted a high (> 15 J) DFT, consisted of amiodarone therapy (p=0.005), height (p=0.01), LVEDD (p=0.01), LVEF (p=0.03), dilated cardiomyopathy (p=0.01) and body surface area (p=0.049). Amiodarone therapy occurred to be the only parameter which independently predicted a high DFT (odds ratio 2.78; 95% confidence interval 1.19-6.5). Conclusions. Tall stature, enhanced LVEDD, decreased LVEF and amiodarone therapy increase the risk of a high DFT in ICD recipients. Chronic amiodarone therapy increases three times the risk of elevated DFT. In patients with already implanted ICD in whom amiodarone is started, reassessment of DFT following administration of a loading dose of the drug is required

20. McCotter CJ, Angle JF, Prudente LA, Mounsey JP, Ferguson JD, DiMarco JP *et al.*: **Placement of transvenous pacemaker and ICD leads across total chronic occlusions.** *Pacing and clinical electrophysiology - PACE* 2005, 28(9): 921-925.
Abstract: OBJECTIVE: To establish a method of implantation for device leads across total venous occlusions. BACKGROUND: Indications for pacemaker and implantable cardiac defibrillator implantation continue to expand. Chronic venous occlusions are increasingly encountered with lead placement. Some degree of obstruction can be as high as 13% before device implantation and 50% after transvenous device implantation. We report an approach of venoplasty/dilatation of chronic total occlusions to allow lead placement. METHODS: From January 1, 2002 through December 16, 2004, 1,356 systems (initial and upgrade) were implanted at the University of Virginia. At the time of device implant, seven patients were noted to have chronic venous occlusions and alternative access was precluded. Four of the seven patients had an existing system; the other three received initial implantations. Subsequently, these seven patients had a 5 Fr catheter placed in the basilic/axillary/subclavian vein and a venogram was obtained to demonstrate the area of chronic occlusion. A guide wire was advanced across the lesion for initial recanalization. Dilatation or venoplasty was performed at the occluded site. A guide wire was retained across the lesion and the patient underwent lead implantation. RESULTS: In all seven patients, recanalization was achieved and leads were successfully placed. There were no complications or damage to the vessels or existing leads. CONCLUSIONS: Venoplasty or dilatation of chronic total venous occlusion is a safe and effective technique, which allows for placement of transvenous leads

21. Mickelsen SR, Ashikaga H, DeSilva R, Raval AN, McVeigh E, Kusumoto F: **Transvenous access to the pericardial space: an approach to epicardial lead implantation for cardiac resynchronization therapy.** *Pacing and clinical electrophysiology - PACE* 2005, 28(10): 1018-1024. Abstract: BACKGROUND: Percutaneous access to the pericardial space (PS) may be useful for a number of therapeutic modalities including implantation of epicardial pacing leads . We have developed a catheter-based transvenous method to access the PS for implanting chronic medical devices. METHODS: In eight pigs, a transseptal Mullins sheath and Brockenbrough needle were introduced into the right atrium (RA) from the jugular vein under fluoroscopic guidance. The PS was entered through a controlled puncture of the terminal anterior superior vena cava (SVC) (n = 7) or right atrial appendage (n = 1). A guidewire was advanced through the transseptal sheath, which was then removed leaving the wire in PS. The guidewire was used to direct both passive and active fixation pacing leads into the PS. Pacing was attempted and lead position was confirmed by cine fluoroscopy. Animals were sacrificed acutely and at 2 and 6 weeks. RESULTS: All animals survived the procedure. Pericardial effusion (PE) during the procedure was hemodynamically significant in four of the eight animals. At necropsy, lead exit sites appeared to heal without complication at 2 and 6 weeks. Volume of pericardial fluid was 10.8 +/- 6.2 mL and appeared normal in four of the six chronic animals. Moderate fibrinous deposition was observed in two animals, which had exhibited significant over-procedural PE. CONCLUSIONS: Access to the PS via a transvenous approach is feasible. Pacing leads can be negotiated into this region. The puncture site heals with the lead in place. Further development should focus on eliminating PE and performing this technique in appropriate heart failure models

22. Milasinovic G, Jelic V, Savic D, Pavlovic SU, Velinovic M: **Fracture of the subcutaneous patch electrode in a patient with an implanted cardioverter-defibrillator.** *Circulation Journal (CIRC J)* CIRC. Abstract: AB- There are more than 20 years of experience with implantation of defibrillator devices in humans and the procedure is an important therapeutic option for patients at high risk of life-threatening ventricular arrhythmias. The incidence of new defibrillator implantation has gradually increased, being used even in children, although pediatric use is associated with several complications, especially with epicardial systems, including fracture of the subcutaneous patch, mainly because of growth? We present a case of subcutaneous patch electrode fracture in the left axillary pectoral region of a patient who needed the patch for effective defibrillation, and we discuss the methods of treatment

23. Molina JE, Benditt DG: **An epicardial subxiphoid implantable defibrillator lead : Superior effectiveness after failure of standard implants.** *PACE - Pacing and Clinical Electrophysiology (PACE PACING CLIN ELECTROPHYSIOL)* ACE.
Abstract: AB- A single epicardial implantable lead using the subxiphoid approach is described in this article. It consists of a single halo-shaped coil that is implanted under the inferior surface of the heart, including the right and left inferior ventricular surfaces. It has been implanted in four patients who could not be defibrillated with a transvenous system, even with the adjunct use of subcutaneous leads or left chest wall patch. Three of the patients had progressive heart failure due to ischemic myocardiopathy; the fourth patient had a dilated idiopathic myocardiopathy. The approach is simple and appears to be effective due to its ability to encompass the left and right ventricles. This vector seems to significantly lower the threshold for defibrillation, and may offer substantial benefit in the setting of high defibrillation thresholds with conventional leads , or when conventional systems are inadequate to achieve consistent defibrillation

24. Mond HG, Whitlock RML: **The Australian and New Zealand cardiac pacing and implantable cardioverter-defribillator survey: Calendar year 2001.** *Heart Lung and Circulation (HEART LUNG CIRCUL)* HEART.
Abstract: AB- Aim. A pacemaker (PM) and implantable cardioverter-defibrillator (ICD) survey was undertaken in Australia (Au) and New Zealand (NZ) for calendar year 2001. Results and Conclusions. Compared to the 1997 survey, significant increases in implantation numbers were recorded. For 2001, the total new PMs implanted was 9498 Au (6405 in 1997) and 914 NZ (823 in 1997). The number of new PM implants per million population was 486 Au (345 in 1997) and 245 NZ (228 in 1997). There were also significant increases in PM replacements between surveys with 1536 in Au (735 in 1997) and 195 in NZ (126 in 1997). Dual chamber implants were 71% Au (65% in 1997) and 56% NZ (55% in 1997). Pacing leads were overwhelmingly transvenous and bipolar with an increase in the use of active fixation leads in preference to tined leads, particularly in the atrium. There was a marked increase in the use of ICDs. The implants were 956 Au (449 in 1997) and 86 NZ (31 in 1997) with new implants per million population being 49 Au and 23 NZ. A breakdown of data for the six Au States and well as comparisons of similar surveys from other countries is presented. (c) 2004 Australasian Society of Cardiac and Thoracic Surgeons and the Cardiac Society of Australia and New Zealand. Published by Elsevier Inc.

25. Nandakumar R, Broadhurst P: **An unusual obstacle in lead extraction.** *PACE - Pacing and Clinical Electrophysiology (PACE PACING CLIN ELECTROPHYSIOL)* ACE.
Abstract: AB- This case report deals with an unusual complication in the removal of an active fixation implantable cardioverter defibrillator (ICD) lead . We were not able to pass the stylet beyond the point of lead fracture and this was subsequently found to be due to the stylet passing between the electrode and the outer layer of the lead insulation. The lead was removed by rotation extraction of the entire lead

26. Neuzner J: **[Is DFT testing still mandatory?] <Original> Ist die DFT-Testung noch ein Muss?** *Herz* 2005, 30(7): 601-606.
Abstract: The automatic detection and termination of ventricular fibrillation is still the key function of implantable cardioverter defibrillator (ICD) therapy. The progress in generator and lead technology has overcome limitations in defibrillation efficacy in early transvenous defibrillator devices. Current, active pectoral biphasic devices provide a high defibrillation efficacy. More than 90% of all patients will meet accepted implantation criteria without any intraoperative system modifications. Is this enough to abandon the intraoperative assessment of defibrillation efficacy?Arguments for abandoning intraoperative device testing include: reduction of perioperative complications, time and cost saving, no worse prognosis for defibrillator patients with borderline defibrillation efficacy, DFT testing might be a barrier to an easy access to ICD implantation.Abandoning intraoperative assessment of defibrillation efficacy may result in inadequate defibrillation safety in up to 9% of all patients. The noninferior outcome of patients with nonadequate defibrillation efficacy is not already proven. Intraoperative device testing could be limited to a small number of VF inductions, the safety of these protocols is well established. A significant time and cost reduction is not really existing. The abandoning of defibrillation testing will not lead to an increase in ICD implant capacity.The intraoperative assessment of defibrillation efficacy should be an important part of ICD implantation

27. Nikolaou N, I, Spanodimos SG, Tsaglis EP, Antonatos DG, Patsilinakos SP, Fournarakis GM *et al.*: **Biochemical evidence of cardiac damage following transvenous implantation of a permanent antibradycardia pacemaker lead.** *Pacing and clinical electrophysiology - PACE* 2005, 28(11): 1174-1181.
Abstract: OBJECTIVES: We tested the hypothesis that transvenous permanent pacemaker lead implantation causes clinically detectable myocardial damage. BACKGROUND: Histological evidence of myocardial damage has been reported after antibradycardia pacemaker lead implantation. METHODS: We studied 30 patients undergoing implantation of a full antibradycardia pacemaker system (pulse generator plus leads) and 10 patients in whom only a generator was implanted. Blood samples for cardiac troponin-I (CTNI), CK-MB mass, and myoglobin measurement were drawn at baseline, at the end of the procedure, and at 2, 6, 12, 24, 48, and 72 hours thereafter. RESULTS: Abnormal CTNI levels were noted only in 24 of the 30 patients undergoing a full system implantation. CTNI levels were already abnormal at the end of the procedure in 16 and became so in all 24 during the next 6 hours. Peak levels were reached within 6 hours in 21 patients and were compatible with "minimal" necrosis (CTNI < 1.5 pg/mL) in 20. Maximum ventricular lead diameter and number of implanted leads were independent predictors of peak CTNI levels. CK-MB mass also increased after the procedure, but exceeded the normal range in only 10 patients. Myoglobin levels increased significantly both in patients undergoing a complete system implantation and in those where only a pulse generator was implanted. CONCLUSIONS: Transvenous insertion of endocardial leads for permanent pacing is accompanied in most patients by "minimal" myocardial damage. In this setting CTNI level kinetics are fast, characterized by early elevation and peak

28. Nurnberg J-H, Ovroutski S, Yigitbasi M, Emeis M, Peters B, Lange PE: **Capture Management(TM) in transvenously paced patients with congenital heart disease**
<Original> Anatomische reizschwellenerkennung mit capture management(Tm) Bei transvenos stimulierten patienten mit angeborenem herzfehler. *Zeitschrift fur Herz-, Thorax- und Gefasschirurgie (Z HE* Z.
Abstract: AB- Automatic testing of the ventricular pacing threshold and adjustment of the pacing output are desirable properties of modern pacemakers designed to save energy, prolong battery lifetime and enhance pacing safety. The Medtronic Capture Management(TM) algorithm fulfills these criteria independently of lead polarity and lead polarization amplitude. Our initial experience in 38 paced patients with congenital heart disease with transvenous leads is reported. The age at pacemakerimplantation was 11.59 (2.72-63.7) years, follow-up after lead implantation was 1.49 (0.01-9.39) years and threshold voltage 0.5 (0.25-2.0) V at a pulse width of 0.4 (0.21-1.0) ms. The default limits of Capture Management(TM) were left unchanged initially and adjusted individually during follow-up. A correct adaptive Capture Management(TM) function was observed in all patients. Due to a high pacing threshold late deactivation was necessary in 1 patient. In the complex and inhomogenous patient group with congenital heart disease the Capture Management(TM) algorithm allows safe adjustment of the pacing energy according to the actual pacing threshold using transvenous leads . (c) Steinkopff Verlag 2005

29. Oginosawa Y, Abe H, Nakashima Y: **Prevalence of venous anatomic variants and occlusion among patients undergoing implantation of transvenous leads.** *Pacing and clinical electrophysiology - PACE* 2005, 28(5): 425-428.
Abstract: BACKGROUND: The implantation of transvenous leads may be prohibited by venous occlusion or anatomical variants. The prevalence of these conditions among patients undergoing transvenous pacing or implantable cardioverter defibrillator (ICD) leads implantation has not been systematically studied. This study examined the prevalence of venous anatomic variants and/or venous occlusion, and related risk factors, prior to lead implantation. METHOD: The study included 273 consecutive patients scheduled for implantation of transvenous pacing or ICD leads . Before the procedure, the venous network of arms, neck, and thorax was evaluated by bilateral intravenous digital subtraction angiography (DSA). RESULTS: Complete venous occlusion associated with developed collateral circulation was observed in 12 patients (4.4%); at the site of the left innominate vein in 9, left subclavian vein in 2, and right subclavian vein in 1 patient. Of 12 patients with venous occlusion, 7 patients had a history of prior surgical procedure. A persistent left superior vena cava was observed in 1 patient (0.4%). The presence of abnormal findings on DSA was significantly higher on the left than the right side ($P < 0.001$). The cardio-thoracic ratio (CTR) was significantly greater in patients with venous occlusions than patients with normal circulation ($P = 0.012$). CONCLUSIONS: Asymptomatic venous abnormalities are not rare among patients requiring transvenous pacing lead implantation. Careful attention should be paid when implanting pacing or ICD leads from the left side, especially in patients with an increased CTR or history of prior insertion for central venous catheter

30. Oliveira M, da Silva N, Antunes E, Miranda F, Martins S, Bico P *et al.*: **Detection of minor myocardial damage during implantation of transvenous cardioverter-defibrillators.** *Mediterranean Journal of Pacing and Electrophysiology (MEDITERR J PACING ELECTROPHYSIOL)* MEDITERR.
Abstract: AB- Background: During cardioverter-defibrillator (ICD) implantation multiple shocks may be applied for defibrillation threshold (DFT) determination. Myocardial injury due to transthoracic or epicardial shocks has been described in literature. Plasma troponins are highly sensitive and specific markers for the detection of myocardial necrosis and Troponin T (TnT) levels provide the diagnosis of minor myocardial damage. The AA. investigated on the extent of myocardial damage in patients submitted to repetitive defibrillation shocks during implantation of an ICD with transvenous leads by using measurements of conventional biochemical cardiac markers and TnT. Methods: Creatinine kinase (CK), CK-MB and TnT were measured before, and 6, 24 and 48 hours after ICD implantation in 18 consecutive patients with ventricular tachyarrhythmias. High DFTs were found in 3 patients. Defibrillation testing required 2 to 6 endocardial shocks per patient. In group A, patients received >=3 shocks with a cumulative defibrillation energy between 35J and 120J. In group B, patients received 2 shocks with a DFE of 30J. Results: Elevations of TnT, CK and CK-MB above the reference values were found in 39%, 33% and 11% of the patients (Group A vs Group B; p = NS). Peak TnT values were only minimally elevated (0.1-0.4 mug/L). Conclusion: During transvenous ICD implantation, minimal TnT elevation reflecting minor myocardial damage is a frequent findings. These data should be considered to define the number of intraoperative tests

31. Rashba EJ, Shorofsky SR, Brown T, Peters RW, Gold MR: **Clinical predictors of atrial defibrillation thresholds with a dual-coil, active pectoral lead system.** *Heart Rhythm* 2005, 2(1): 49-54.
Abstract: OBJECTIVES: The purpose of this study was to identify clinical predictors of atrial defibrillation thresholds (DFTs) with standard implantable cardioverter- defibrillator (ICD) leads . BACKGROUND: Atrial defibrillation can be achieved with active pectoral, dual-coil transvenous ICD lead systems. If clinical predictors of atrial defibrillation efficacy with these lead systems were identified, they could be used to predict which patients may require more complex lead systems for atrial defibrillation, such as a coronary sinus electrode. METHODS: This was a prospective study of 135 consecutive patients undergoing initial ICD implant for standard indications. The lead system evaluated was a transvenous defibrillation lead with coils in the superior vena cava (SVC) and right ventricular apex (RV), and a left pectoral pulse generator emulator (CAN). The shocking pathway was RV-->SVC+CAN. Atrial DFT was measured using a step-up protocol. Clinical and echocardiographic parameters were evaluated as predictors of atrial DFT and multiple linear regression was performed. RESULTS: Mean atrial DFT was 4.6 +/- 3.8 J. Atrial DFT was < or =3 J in 70 patients (52%) and < or = 10 J in 97% of patients. The highest atrial DFT was 20 J (one patient). Left atrial size (r = 0.21, P = .01) and left ventricular end-diastolic diameter (r = 0.19, P = .02) were independent predictors of atrial DFT. However, these two predictors accounted for only 6% of the variability in atrial DFT. CONCLUSIONS: Clinical parameters are of limited use in predicting atrial DFT with a dual-coil, active pectoral ICD lead system. Because the RV--> SVC + CAN shocking pathway provides reliable atrial and ventricular defibrillation, this configuration should be preferred for combined atrial and ventricular ICDs

32. Schuler BT, Leon AR: **Cardiac resynchronization therapy.** *Current cardiology reports* 2005, 7(5): 321-328.
Abstract: Cardiac resynchronization therapy (CRT) addresses abnormal left ventricular (LV) activation that produces detrimental effects on cardiac systolic and diastolic function. CRT improves symptoms and ventricular performance, promotes reverse remodeling, and decreases mortality and hospitalization in patients with congestive heart failure (CHF). Atrial-synchronized biventricular stimulation reverses many of the temporal delays in mechanical activation associated with LV dysfunction and conduction system disease. The therapy evolved from anecdotal application through surgical implantation of LV pacing leads to transvenous delivery of LV pacing leads for use with dedicated CRT devices. The controlled clinical trials included specific patient groups, and provided data leading to widely adopted indications for the therapy. Current indications exclude the use of CRT in patients with permanent atrial fibrillation, although small series suggest a benefit of the therapy in these patients. The role of cardiac imaging with echocardiography to detect cardiac dyssynchrony promises to improve patient selection by not only excluding likely nonresponders, but also extending the therapy to those with dyssynchrony in the absence of QRS prolongation. Expanded indications under evaluation include the role of CRT in patients with mildly symptomatic CHF, mild to moderate LV dysfunction, dyssynchrony in the absence of QRS prolongation, and dyssynchrony induced by right ventricular pacing

33. Snow JS, Larsen A, Cohen TJ: **Transvenous biventricular defibrillation can improve defibrillation threshold.** *PACE - Pacing and Clinical Electrophysiology (PACE PACING CLIN ELECTROPHYSIOL)* ACE.
Abstract: AB- A case report of a patient with a high defibrillation threshold at initial implantation that was improved by the insertion of a shocking coil in the left lateral cardiac vein is discussed

34. Sudkamp M, Schmid M, Geissler H-J, Emmel M, Gillor A, Mehlhorn U *et al.*: **VDD-pacemaker in children--a long-term therapy?** *Thoracic and cardiovascular surgeon* 2005, 53(3): 158-161.
Abstract: AIMS: Transvenous AV-synchronous pacing in children started with the invention of smaller sized VDD leads and miniaturization of pacemakers. Whether or not this is a favourable long-term therapy was retrospectively investigated by us based on data from our records. METHODS: From May 1977 to July 2001 we implanted pacemakers in 104 children younger than 15 years of age. In 55 patients transvenous leads were implanted. Twelve of these (21.8 %) received a VDD pacemaker for hemodynamic reasons. RESULTS: Ages ranged from 11 months to 14.5 years (mean 7.7 +/- 4.3 y). Sizes of the children ranged from 67 to 141 cm (mean 105.9 +/- 15.5 cm) and body weight ranged from 5.3 to 62.0 kg (mean 22.5 +/- 9.8 kg). The mean follow-up period was 47.5 +/- 15.1 months. In 86.3 % of the time during follow-up pacemakers of which we obtained data were working in the VDD mode. Five of the twelve VDD patients (41.7 %) had to be reoperated because of severe traction on the leads. In all five patients the VDD systems were explanted and the patients changed to dual chamber pacemakers. The period of time between implantation and VDD lead explantation ranged from 24 to 74 months (48.6 +/- 18.5). CONCLUSIONS: VDD pacemakers can be implanted safely even in children with a low complication rate perioperatively. 41.7 % of our VDD patients had to be reoperated within the surveillance time because of severe lead tension due to thoracic growth. In our experience VDD pacemakers in smaller children seem to be a temporary solution to bridge AV-synchrony from a young age to DDD pacing in young adulthood.

35. Turkie W, Khattar RS: **Right ventricular failure due to postpericardiotomy syndrome following transvenous dual chamber permanent pacemaker implantation.** *International journal of cardiology* 2005, 99(3): 465-466.
Abstract: "Pericardial effusion and tamponade are recognised complications of permanent transvenous pacemakers implantation. This is more common when active fixation leads are used. We describe a patient who developed right ventricular failure with significant pericardial effusion following permanent transvenous pacemaker implantation."

36. Vogt J, Heintze J, Hansky B, Guldner H, Buschler H, Horstkotte D: **Implantation: Tips and tricks - The cardiologist's view.** *European Heart Journal, Supplement (EUR HEART J SUPPL)* EUR.
Abstract: AB- Since the development of the first epicardial left ventricular pacemaker leads , the design of transvenous coronary leads has progressed tremendously. Due to the safe access to the target region independent of previous surgical interventions and a low morbidity, the transvenous placement has become the method of choice. Catheterization of the coronary sinus is required to place the coronary venous lead. The most difficult anatomical situation is the pipe-shaped coronary sinus. A systolic compression of the proximal coronary sinus may be associated with a risk of dissection particularly in elderly patients. Access to the coronary sinus is best made by two combination systems with a steerable electrophysiology catheter or a telescoping inner catheter. Furthermore, special guiding catheters for the access from the right subclavian vein particularly to upgrade right-sided pacemakers and ICD systems have been developed. Complex, i.e. sharp-angled and corkscrew veins may only serve as target veins, if sharp-angled angiography catheters and over the wire technique are used. The pseudobipolar stimulation against the ring of the right ventricular lead has been developed for the safe function of a CRT defibrillator. This design is associated with an anodal stimulation of the right ventricle, which might result in clinical non-responders especially in patients with optimal left ventricular pacing mode (30%). For this reason, coronary sinus leads should basically be designed as bipolar leads. (c) 2004 The European Society of Cardiology. Published by Elsevier Ltd. All rights reserved

37. Wollmann CG, Bocker D, Loher A, Kobe J, Scheld HH, Breithardt GE *et al.*: **Incidence of complications in patients with implantable cardioverter/ defibrillator who receive additional transvenous pace/sense leads.** *Pacing and clinical electrophysiology - PACE* 2005, 28(8): 795-800.
Abstract: BACKGROUND: Implantation of an additional pace/sense (P/S) lead is commonly used in patients with implantable cardioverter/defibrillators (ICDs) to overcome P/S defects of integrated defibrillation leads (HV-P/S leads). No information is available about the clinical outcome and the incidence of complications in these patients. METHODS: Retrospective analysis was performed in 151 patients (125 male, age 54.9 +/- 13.6 years, LVEF 48.1 +/- 17.8%, CAD in 86 [57%], DCM in 24 [16%], ARVCM in 11 [7%]) who received an additional P/S lead between 1990 and 2002 (54 patients with abdominal and 97 patients with pectoral ICD system). Statistical analysis was done using Kaplan-Meier survival curves. RESULTS: The average follow-up (FU) after implantation of the additional P/S lead was 43 +/- 27 months. In total 117 patients [77.5%] remain implanted; 22 patients died due to cardiac-related reasons. After a FU of 23 +/- 23 months, 43 patients [28.5%] experienced lead-related problems after implantation of the additional P/S lead: oversensing in 23 [53.5%], insulation defect in 3 [7.0%], fracture in 1 [2.3%], system infection in 4 [9.3%], and defect of the HV-P/S lead in 6 [14.0%] patients. The event-free cumulative survival of the additional P/S lead after 1, 2, and 5 years was 87.0%, 79.8%, and 59.4%, respectively (for pectoral leads: 89.6%, 82.0%, and 60.0%, respectively). CONCLUSIONS: Implantation of an additional P/S lead in case of failure of an HV-P/S lead is safe. However, it is associated with a substantial rate of complications during FU. Therefore, extraction of damaged defibrillation leads instead of implantation of P/S leads should be favored

38. Yoda M, Hansky B, Schulte-Eistrup S, Koerfer R, Minami K: **Left ventricular pacing through the anterior interventricular vein in a patient with mechanical tricuspid, aortic and mitral valves.** *Annals of thoracic surgery* 2005, 80(1): 328-330.
Abstract: Transvenous endocardial pacemaker implantation is contraindicated in patients after mechanical tricuspid valve replacement. A 76-year-old woman who suffered from bradyarrhythmia was implanted with a left ventricular pacing lead through a transvenous coronary vein after aortic, mitral, and tricuspid valve replacements. There were no complications and the stimulation thresholds were stable. The use of coronary vein leads provides a minimally invasive approach, safety, and effective stimulation for patients with a mechanical tricuspid valve

Health Device Alerts

1. Braunschweig F, Mortensen PT, Gras D, et al. Monitoring of physical activity and heart rate variability in patients with chronic heart failure using cardiac resynchronization devices. *Am J Cardiol* 2005 May 1;95(9):1104-7. The authors evaluated whether trend data of physical activity and heart rate variability (HRV) could be obtained from an InSync III atriobiventricular pacemaker with transvenous left ventricular and conventional right atrial and ventricular leads in 56 patients with chronic heart failure. At baseline (before pacemaker implantation), 0 patients were in New York Heart Association (NYHA) class I, 11 patients were in NYHA class II, 37 patients were in NYHA class III, and 8 patients were in NYHA class IV. 3 months after pacemaker implantation, 18 patients were in NYHA class I, 29 patients were in NYHA class II, 8 patients were in NYHA class III, and 1 patient was in NYHA class IV. 43 patients had improved by =1 NYHA class. Walking distance increased from 361 1104 m at baseline to 429 1135 m at 3 months. Mean daily physical activity (MDPA) was 108 181 min at baseline and 168 1115 min, 211 1130 min, and 225 1140 min at 2, 4, and 12 weeks, respectively. MDPA trend over 3 months was significantly greater in patients with better baseline functional status. MDPA increased significantly in all patients during the first 4 weeks of treatment, increased gradually in NYHA class II patients, and remained stable in NYHA class III and IV patients. Standard deviation of 5-minute medians of all normal atrial-to-atrial intervals (SDANN) was 64 123 msec at baseline, 72 124 msec at 2 weeks, and 72 126 msec at 4 and 12 weeks . Within the first 12 weeks, SDANN trends were significantly different among baseline NYHA classes. SDANN remained large in NYHA class II patients and increased gradually in NYHA class III patients . NYHA class IV patients demonstrated small SDANN values at baseline that remained unchanged over 12 weeks. The authors conclude that MDPA and HRV trend data reflected a response to cardiac resynchronization therapy with the InSync III atriobiventricular pacemaker and that the significant increase in MDPA and HRV could represent a true treatment effect. While a specific product is identified in this report, ECRI believes that the intention of the article was not, necessarily, to implicate this particular product and that this problem and/or these results may occur with similar products of other manufacturers.

2. Nandakumar R, Broadhurst P. An unusual obstacle in lead extraction . *PACE* 2004 Nov;27(11):1576-7.
The authors report a case of obstruction caused by a stylet during pacemaker lead extraction in a 38-year-old man with an implantable cardioverter-defibrillator (ICD) inserted to treat Brugada syndrome. After explantation of 2 previous ICDs because of recurrent infections, a third ICD with a Model 6947 active fixation lead was implanted. The lead was connected to a Marquis VR generator. The ICD functioned normally at 2- and 4-week review . 4 months later, the patient presented with inappropriate shocks. Device interrogation revealed that therapy was delivered during sinus rhythm with associated high-frequency noise that indicated a lead fracture. X-ray scan confirmed that the lead was fractured, and the ICD was disabled. ICD explantation was performed 6 months after implantation, in accordance with the patient's wishes. The old lead was dissected and disconnected from the generator. During attempts to facilitate screw retraction, the stylet could not be passed beyond the fracture. Rotating the distal pin of the IS-1 connector would not transmit torque through the lead, and the screw remained embedded in the myocardium. Rotating the entire lead eventually caused disengagement, and the system was explanted without complications. X-ray scan of the explanted lead revealed that the stylet had passed between the electrode and lead insulation at the point of fracture but remained within the insulation. The authors state that excessive force could have resulted in the stylet breaking through the insulation and lacerating adjacent structures. The authors conclude that passage of the stylet and rotation of the entire pacemaker lead is a reasonable alternative in these situations, although this technique probably would have failed if the lead had been enmeshed in adhesions.

3. Sharifi M, Inbar S, Neckels B, et al. "Twiddling" to the extreme: development of twiddler syndrome in an implanted cardioverter-defibrillator. *J Invasive Cardiol* 2005 Mar;17(3):195-6.
The authors report a case of twiddler's syndrome in a 65-year-old patient implanted with a Marquis VR 7230 CS implantable cardioverter-defibrillator (ICD) and a 58 cm Sprint 6947 implantable lead for ischemic dilated cardiomyopathy, left ventricular ejection fraction of 20%, and nonsustained ventricular tachycardia. The ICD was implanted without an electrophysiologic study because of severe left ventricular systolic dysfunction. Appropriate sensing, pacing, and defibrillation thresholds were obtained. Chest x-ray exam after implantation demonstrated ideal lead position. The patient had no history of psychiatric disease . At 6-month follow-up, the ICD had no capture, even at maximum output. The patient was asymptomatic. At maximum pacing output, repetitive twitching of the left major pectoral muscle was observed at the frequency of the set pacing rate. Chest x-ray exam demonstrated that the lead was withdrawn from the subclavian vein and that the tip was positioned over the major pectoral muscle. The patient denied any manipulation of the ICD and underwent explantation of the ICD and lead. A new Sprint 6947 lead was implanted and tightly secured. The existing ICD was placed in a Dacron mesh pouch, and its header was sutured to underlying muscle. At 5-month follow-up, no further twiddling occurred. The authors conclude that the use of a Dacron pouch and adequate fixation of the device header should be strongly considered in ICD patients at risk for twiddler's syndrome.

4. Van Putte BP, Bakker PF. Subtotal innominate vein occlusion after unsuccessful pacemaker implantation for resynchronization therapy. *PACE* 2004 Nov;27(11):1574-5.
The authors report a case of subtotal innominate vein occlusion following unsuccessful biventricular pacemaker system implantation for cardiac resynchronization therapy in a 63-year-old woman with dilating cardiomyopathy and symptoms of congestive heart failure. The patient was treated with Coumadin for transient ischemic attacks. Electrocardiography demonstrated sinus rhythm, a wide QRS complex of 140 msec with left bundle branch block morphology, and an asynchronously and poorly contracting left ventricle with an ejection fraction of 0.11. Implantation of a biventricular pacemaker system was attempted using a left subclavian approach. The right atrial and ventricular leads were easily positioned, but positioning of the coronary sinus lead failed and the procedure was abandoned. All endocardial leads were removed. 5 months later, 2 Guidant epicardial pacing lead adapters were successfully implanted on the left ventricle using video-assisted thoracoscopic surgery. The first epicardial lead was inserted through the left cephalic vein. High resistance was encountered at the innominate vein site, and the obstruction could not be passed. Digital subtraction venography revealed subtotal occlusion of the innominate vein. The stenosis was passed using a 12 Fr check-flow introducer set with a 30 cm sheath, and the endocardial leads were successfully positioned in the right atrium and ventricle. The authors conclude that venous thrombosis and occlusion can occur after abandoned pacemaker implantation with transvenous lead systems despite anticoagulation therapy and the immediate removal of epicardial leads.

DEVICE EXPERIENCE INFORMATION

The CRM Product Performance Report (PPR) presents device survival estimates, advisory summaries, technical articles and other information pertinent to assessing the performance of Medtronic IPG, ICD and CRT devices, and implantable pacing and defibrillation leads.

Medtronic tracks device performance using returned product analysis and an active multicenter clinical study.

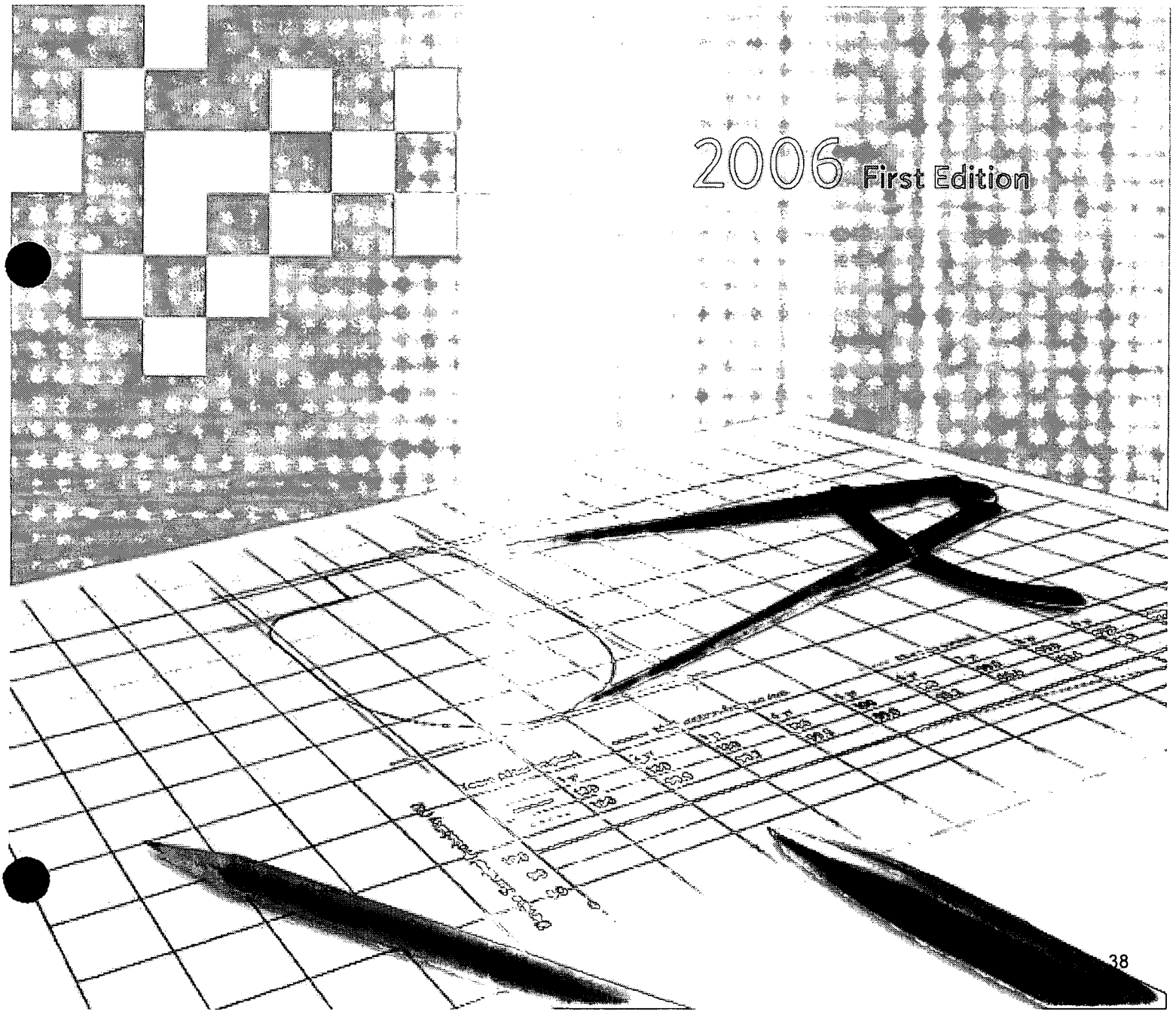
Defibrillation Leads are found starting on page 117 of this submission (page 79 - 86 of the PPR report).

ATTACHMENT A - Product Performance Report (PPR)

Medtronic

CRM PRODUCT PERFORMANCE REPORT

Important Patient Management Information for Physicians



Medtronic Commitment to Quality

For each patient, with each device, quality means everything. Quality is at the core of our Medtronic Mission which has driven our actions since 1960...

"To strive without reserve for the greatest possible reliability and quality in our products, to be the unsurpassed standard of comparison, and to be recognized as a company of dedication, honesty, integrity, and service."

Medtronic instituted the industry's first product performance reports in 1983 by publishing data on our chronic lead studies. Pacemakers and other devices followed as our performance reporting has constantly evolved based on customer need and feedback. One thing has been a constant. It is our sincere commitment to communicate clearly, offering timely and appropriate product performance data and reliability information. This has always been and will continue to be our goal.

In keeping with our commitment, this edition of our product performance report includes a number of updates and additions:

- New, easy-to-use format organized by product family and model number. Data on each model is presented in one place with links provided when additional details are available.
- Extended malfunction listings to include the number of malfunctions that have affected the generator's ability to deliver therapy. This provides a perspective on how often a malfunction may have the potential for more serious clinical impact.
- Addition of a malfunction-free survival curve for all generator models. This allows comparison of overall device survival with and without normal battery depletion data.
- Expanded discussion of the methods and assumptions used to determine survival estimates. This enables comparison of our performance results with those published by others in the industry.

Through the AdvaMed Pacemaker/ICD Working Group, Medtronic is helping lead an effort to standardize the reporting of product performance data across the industry. We feel strongly that uniform standards will further help physicians and patients gain greater understanding that will allow them to weigh the risks and benefits related to individual products or overall device-based therapies. Physician and patient confidence is critical to fully realizing the life saving and quality of life benefits medical device technologies can offer.

Your feedback is of the utmost importance. As in all quality efforts, we must continue to listen and learn while effectively and efficiently providing the information you need.

Please contact CRM Returned Product Quality at 1 (800) 328-2518, extension 48644 or our Technical Services Department at 1 (800) 723-4636 with any comments or questions. Your input will help us continue to advance and improve our communication of vital product performance information.

Thank you for your support and dedication.

Michael D. Baca
Vice President of Quality
Cardiac Rhythm Management
Medtronic, Inc.

Contact Information

We invite our customers to use these telephone numbers to call with suggestions, inquiries, or specific problems related to our products.

US Technical Services Department

Phone: 1 (800) 723-4636 (Tachy)
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Fax: 1 (800) 824-2362

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For questions related to the CRM Product Performance Report, please call US Technical Services at the number above, or write to:

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CRM Product Performance Report

2006 First Edition

Date cutoff for this edition is July 11, 2005 for leads and October 31, 2005 for devices

This report is available online at www.CRMPPR.medtronic.com

New with This Edition

Survival data for:
7297 InSync Sentry
7299 InSync Sentry
7304 InSync Maximo
7288 Intrinsic
7290 Onyx VR
2187 Attain
4076 CapSureFix Novus
E2DR31 EnPulse 2 DR
E2VDD01 EnPulse 2 VDD
P1501DR EnRhythm DR

Sigma Implantable Pulse Generators

Original Date of Advisory: November 2005

Potential Separation of Interconnect Wires

Product

A specific subset of Sigma series pacemakers may fail due to separation of interconnect wires from the hybrid circuit. Approximately 28,000 devices, with approximately 6,650 in the United States, out of an initial implant population of 40,000 worldwide, remain implanted and in service. Specific model and serial numbers of affected devices are available online at http://SigmaSNList.medtronic.com.

Advisory

This subset of Sigma series pacemakers that may fail due to separation of interconnect wires from the hybrid circuit may present clinically as loss of rate response, premature battery depletion, intermittent or total loss of telemetry, or no output. There have been no reported patient injuries or deaths due to this issue.

Separation of redundant interconnect wires has been observed on hybrid terminal blocks. Device failure occurs only where both interconnect wires separate from a hybrid terminal block. In October 2005, testing and analysis identified the root cause of these failures and the affected population. Hybrid circuits used in this subset of devices were cleaned during manufacturing with a particular cleaning solvent that could potentially reduce the strength of the interconnect wire bond over time.

Our modeling predicts a failure rate from 0.17% to 0.30% over the remaining lifetime of these pacemakers. No provocative testing can predict which devices may fail.

Patient Management Recommendations

To assist physicians in their patient care and after discussion with physician consultants, Medtronic offers the following recommendations:

- Medtronic does not recommend replacement of these devices prior to normal elective replacement (ERI), based on the low probability of occurrence of a serious event in this population.
- Continue routine follow-up in accordance with standard practice.
- Advise patients to seek attention immediately if they experience return of symptoms (e.g., syncope or light headedness).
- Determine whether device replacement is warranted on a case-by-case basis based upon consultation with patients, review of the individual patient's medical history and consideration of the relative risks of an invasive procedure.

Status Update (December 2005)

The Sigma Family device performance related to the interconnect wires separation mechanism continues to be within Medtronic's engineering projections and expectations. As of December 31, 2005, 25 devices out of approximately 40,000 devices worldwide (0.063% incidence) have been confirmed as having interconnect wire separation. Sixteen (16) of these devices were returned from the United States. **There have been no reported serious injuries or deaths due to this issue.**

Seventeen (17) of the 25 returns were identified via either a regularly scheduled follow-up or during a non-device related hospital visit. Two (2) devices were identified due to the patient experiencing syncope. The other 6 devices were replaced with no clinical symptoms associated with the interconnect wire separation. Among the 6 devices, 4 were returned due to a device/system upgrade, and 2 were returned due to infection.

Consistent with previous Medtronic projections, the probability of occurrence remains low and is within failure rate predictions. Implant duration for the 25 failures has ranged from 17-44 months.

7274 Marquis DR	7277 InSync Marquis
7230 Marquis VR	7289 InSync II Marquis
7278 Maximo DR	7279 InSync III Marquis
7232 Maximo VR	7285 InSync III Protect

Original Date of Advisory: February 2005

Potential Premature Battery Depletion Due to Battery Short

Product

The specific subset of Marquis family ICD and CRT-D devices having batteries manufactured prior to December 2003 is affected. Devices manufactured with batteries produced after December 2003 are not affected. Specific model and serial numbers of affected devices are available online at http://MarquisSNList.medtronic.com.

Advisory

Medtronic Marquis family of ICD and CRT-D devices having batteries manufactured prior to December 2003 may experience rapid battery depletion due to a specific internal battery short mechanism. Battery design changes were implemented in December 2003 that eliminate the possibility of this internal shorting mechanism.

Highly accelerated bench testing indicated the rate of this shorting mechanism may increase as the battery is depleted. As of February 2005, the rate of shorting was approximately 1 in 10,000 (0.01%); bench test data indicated the rate may increase to between 0.2% and 1.5% over the second half of device life.

No provocative testing can predict which of these devices will experience this issue. Once a short occurs, battery depletion can take place within a few hours to a few days. After depletion the device ceases to function. It is also possible that as the battery depletes quickly, patients may experience temporary warmth in the area surrounding the ICD.

Patient Management Recommendations

The following recommendations apply to the affected population:

- Continue to conduct routine (e.g., quarterly) follow-up procedures.
- Turn on low battery voltage PatientAlert indicator.
- Inform patients that should they experience warmth in the area surrounding the ICD to seek follow-up care.
- Consider providing patients with a hand-held magnet to check device status. Device operation may be monitored periodically (e.g., daily) by patients using the magnet, which will result in a device tone indicating device function (provided PatientAlert is turned on). If no tone is heard, follow-up care should be sought.

Status Update (December 2005)

The Marquis Family device performance related to the battery shorting mechanism continues to be within Medtronic's engineering projections and expectations. As of December 31, 2005, 30 Marquis Family devices have been confirmed as having the internal battery shorting mechanism. Eighteen (18) of these devices were returned from the United States. **There have been no reported serious injuries or deaths due to this issue.**

Fourteen (14) of the 30 returns have been identified via either a regularly scheduled follow-up or during a non-device related hospital visit, 13 by patients reporting warmth in the ICD pocket, 1 for return of bradycardia symptoms, and 2 due to the patient alert sounding.

Consistent with previous Medtronic projections, the observed rate of shorting in the second half of device life is higher than that observed in the first half of device life. Of the devices that have exhibited shorting in the last half of device life, 67% occurred in the last quarter of device life, and 53% in the last 10% of device life.

Discussion of Changes to Report Layout and Format

Medtronic first published a product performance report in 1983. Since that time, the report has evolved to include more information on an ever increasing number of products.

With this issue of the report, we have incorporated a new layout and format for the report with the goal of making the report more valuable and useful.

For the past several months, Medtronic CRM has been helping lead an effort by an industry working group to develop requirements for uniform product performance reporting. The goal of this effort is to have product performance reports provide the most objective, feasible representation of device performance and to make comparison across different manufacturers practical. This report conforms to the latest working draft of those requirements.

In addition, this version of the product performance report has been prepared in accordance to International Standard ISO 5841-2:2000(E).

Highlights of Changes

- Since its inception, Medtronic has used the standard actuarial method to determine survival probabilities and Greenwood's formula for calculating confidence intervals. Medtronic has also routinely adjusted its results to address underreporting of events. While these techniques have not changed, new in this issue is an expanded discussion of how these techniques are applied.
- As long ago as 1987, Medtronic included in its product performance report a table that separately identifies the number of malfunctions as well as the number of normal battery depletions for its implantable pulse generators, and more recently, implantable cardioverter defibrillators. With this issue, malfunctions for many models are further separated into malfunctions with compromised therapy function and malfunctions without compromised therapy function.
- Since 1998 for ICD leads and since 2002 for pacing leads, Medtronic has included tables showing the nature and frequency of lead complications observed via our multicenter prospective clinical studies. With this issue, the complication tables are positioned adjacent to the survival curves for easier reference.
- For over 10 years, safety advisory information has been summarized in the product performance report. With this issue, the advisory summaries have been reformatted and more clearly linked to the affected products.

The intent of these changes, and other changes not highlighted above, is to make this report more useful for anyone seeking to understand the performance of these products. If you have comments or additional suggestions on the content and format of this report, please contact us. Contact information can be found on page 2.

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P920015/RB

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February 14, 2007

Food and Drug Administration
Center for Devices and Radiological Health
Document Mail Center (HFZ-401)
9200 Corporate Blvd.
Rockville, MD 20850

Subject: Annual Report for P920015

Enclosed, in compliance with 21 CFR 814.84, is the Annual Report for the above referenced PMA P920015. It has been written following FDA's "1 Consolidated Annual Report for a Device product line (1-CARD) Pilot Guidance", dated July 6, 2000.

This report covers a one-year period from December 10, 2005 through December 31, 2006 for the following devices approved under PMA P920015:

Model 6963, 6966, and 6999 leads for the initial Transvene® lead system
Model 6933, 6936, and 6939 leads for Transvene® DF-1 system
Model 6934 leads for Transvene® Right Ventricular system
Model 6937 Transvene® SVC lead
Model 6707 Lead adaptor
Model 6932, 6942, 6943 and 6945 Sprint™ leads
Model 6944 Sprint™ Quattro™ lead
Model 6947 Sprint™ Quattro Secure™ lead
Model 6996 SQ lead system and 6996T tunneling tool
Model 6725 Pin-Plug Kit
Model 6726 DF-1 Y-Adaptor/Extender Kit
Model 6948, 6949, 6930, and 6931 Sprint Fidelis™ leads

Three copies (two paper copies and one CD-ROM) of this Annual Report are being submitted to the PMA Document Mail Center.The electronic copy is identical to the paper copy.

Medtronic considers this report to be confidential commercial and trade secret information. We respectfully request that this information be given the maximum protection provided by law.

Please contact the undersigned to obtain additional information concerning this report.

Sincerely,
MEDTRONIC, INC.

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Table of Contents

SUMMARY OF CHANGES

Changes Reported Pursuant to 21 CFR 814.39(a):

The following PMA Supplements were submitted and/or approved during reporting period:

Supplement Number	Submission Description	Date Submitted	Date Approved
P920015/S031	Modify the monolithic controlled-released device (MCRD) and the addition of dexamethasone sodium phospoahte (DSP) arto the diatl tip of the leads: Model 6943 and 6945 Sprint™ leads Model 6947 Sprint™ Quattro Secure™ lead	09/10/04	02/07/06
*P920015/S032	P920015/S032 was approved by FDA on Dec. 1, 2005 and Medtronic reported the change in the 2005-P920015 Annual Report		
**P920015/ S035	The addition of paperless chart recorder to the steriliaztion process: Model 6932, 6942, 6943 and 6945 Sprint™ leads Model 6944 Sprint™ Quattro™ lead Model 6947 Sprint™ Quattro Secure™ lead Model 6948, 6949, 6930, and 6931 Sprint Fidelis™ leads Model 6996 SQ lead system and 6996T tunneling tool	05/10/06	11/07/06

* P920015/S33 -34 do not exist. Subsequent to the P920015/S031 approval, FDA assigned P920015/S035 to the next supplement.

**P920015/S035 is indicated in the FDA database as S036. However, the approval letter from FDA, dated 11/07/06 indicates it as S035.

Changes Reported Pursuant to 21 CFR 814.39(b):

Minor modifications were made to Medtronic's manufacturing operations during the reporting period as described below. These minor modifications were not submitted as PMA supplements because they do not affect fit, form, function, or the safety or effectiveness of the device.

Description of Change:	Minor Editorial Changes to Work Instructions
Reason for the Change:	Editorial changes to the work instructions to notify manufacturing personnel to minimize heptane exposure to hands.
Models Impacted:	6944
Nature/Scope of the Change:	Environmental Health and Safety added a requirement that employees wear nitrile gloves instead of latex wherever heptane is used in the process. Therefore editorial changes were made to the work instructions.
Testing:	Not required. The use of nitril gloves in place of latex gloves has been a long accepted practice during the manual assembly of medical devices in the Medical Device Industry. Nitril material is well characterized and is known that exposing medical device components to nitril gloves will not impact the safety and effectiveness of the device.
Rationale for Annual Reporting:	There is no change to the form, fit, function or safety and effectiveness of the device. The approved manufacturing process did not change nor the materials that are used to manufacture the product. These minor changes do not affect the performance or design specifications, components, materials, principal of operation or physical layout of the devices. They do not affect the contraindications, warning and precautions, indications or other information contained in the product labeling. There have been no field issues or recalls precipitating this change.

Description of Change:	Minor Changes to the Labeling Software System and Manufacturing Traceability Software System.
Reason for the Change:	Replaced the labeling and traceability software to be consistent and current with the same validated software systems used in other Medtronic manufacturing facilities.
Models Impacted:	6725, 6944, 6947, 6948, 6949, and 6996
Nature/Scope of the Change:	The approved (b)(4) facility switched from (b)(4) are system for labelin ftware for manufacturing traceability system to FormScape and Factory Works respectively. The manufacturing operation is not changing, only the software systems are being replaced with software that is currently used in numerous other Medtronic facilities, which had been formerly validated.
Testing:	Manufacturing conducted a process/software verification on the replacement software systems for both the FormScape and Factory Works. The results do verify and confirm that all existing labeling and manufacturing traceability requirements and specifications are still met and the software does perform as is intended.
Rationale for Annual Reporting:	The manufacturing operation is not changing only the software systems are being replaced with software that is currently used in numerous other Medtronic facilities, which had been formerly validated. This change does not affect the labeling or manufacturing traceability. There is no change to the form, fit, function or safety and effectiveness of the device. The approved manufacturing process did not change nor the materials that are used to manufacture the product. These minor changes do not affect the performance or design specifications, components, materials, principal of operation or physical layout of the devices. They do not affect the contraindications, warning and precautions, indications or other information contained in the product labeling. There have been no field issues or recalls precipitating this change.

Description of Change:	Minor Editorial Changes to Work Instructions
Reason for the Change:	Modify the work instructions to explicitly call out 100% inspection of the stylets for bending after the process step where the steroid mix (DSP Solution) is applied to the lead.
Models Impacted:	6930 and 6948
Nature/Scope of the Change:	The current 100% in-process inspections have identified any bent stylets. However, the work instructions were modified to explicitly call out 100% inspection of the stylets for bending after the process step where the steroid mix (DSP Solution) is applied to the lead.
Testing:	Not apply. Validation or verification testing is not required because the process has not changed. The process is still 100% inspected.
Rationale for Annual Reporting:	There is no change to the form, fit, function or safety and effectiveness of the device. The approved manufacturing process did not change nor the materials that are used to manufacture the product. These minor changes do not affect the performance or design specifications, components, materials, principal of operation or physical layout of the devices. They do not affect the contraindications, warning and precautions, indications or other information contained in the product labeling. There have been no field issues or recalls precipitating this change.

BIBLIOGRAPHY AND SUMMARY OF PUBLISHED AND UNPUBLISHED REPORTS

Medtronic is not aware of any unpublished reports of data from any clinical investigation or non-clinical laboratory studies involving the device or related devices which relate to the safety and efficacy of the device or related devices during the period covered by this annual report. (Related devices include devices which are the same or substantially similar to Medtronic's devices.)

The following bibliography pertaining to Medtronic leads and/or related devices includes reports identified in the scientific literature that were published or appeared during the reporting period. Abstracts are included, if available. The search was conducted using the following databases: Medline, Health Devices Alerts, BIOSYS and EmBase. Keywords included "high voltage pacing leads" and all applicable Medtronic model numbers. (Some searches only allow queries by "year" resulting in reports slightly outside the reporting period.)

BIBLIOGRAPHY

Health Device Alerts

1. Gould PA, Krahn AD; **Canadian Heart Rhythm Society Working Group on Device Advisories. Complications associated with implantable cardioverter-defibrillator replacement in response to device advisories**. *JAMA 2006* Apr 26; 295(16):1907-11. The authors determined the rate of complications associated with implantable cardioverter-defibrillator (ICD) replacement in response to ICD advisories. 17 ICD implanting centers were surveyed regarding ICD failure and number of complications associated with generator replacement from October 2004 to October 2005 in response to manufacturer-initiated ICD advisories. During the survey period, 2,915 patients had advisory ICDs. 533 patients underwent elective replacement a mean of 26.5 months after initial implantation. Indications for replacement of advisory ICDs included pacing dependency, previous appropriate shock, patient preference, and secondary prevention indication for an ICD. 43 patients developed complications related to device replacement during mean follow-up of 2.7 months. 12 complications were minor, according to prespecified criteria. Risk of incisional infection was 1.7%, and risk of exacerbation of heart failure, significant site pain, or major psychological morbidity was 0.2%. 31 patients developed major complications, including 10 pocket infections requiring ICD system extraction. 2 patients died after extraction: 1 patient at 24 hr and 1 patient at 1 week. Nonextraction reoperation rate was 3.9%. 3 advisory ICD malfunctions were detected during the survey period, and all the malfunctions were caused by premature battery depletion. 2 of the malfunctions were detected because of the advisory, and the other malfunction was an index advisory case identified incidentally at follow-up. All 3 patients underwent generator replacement. The authors conclude that ICD replacement in patients with advisory devices is associated with a significant risk of complications, including death, and that these risks should be considered during guideline development to determine the appropriate treatment of patients with advisory ICDs.

2. Henrikson CA, Brinker JA, Donahue JK. **Temporary placement of a defibrillating lead in the treatment of infection and ventricular tachycardia.** *Heart Rhythm 2006* Feb; 3(2):222-4. The authors discuss the temporary placement of an active-fixation defibrillating lead attached to an externalized implantable cardioverter-defibrillator (ICD) in a 70-year-old man with frequent ventricular tachycardia (VT) and life-threatening infection. The patient had received a biventricular pacemaker- defibrillator 1 year before presentation and had been treated for methicillin-resistant Staphylococcus aureus (MRSA) pneumonia 2 months before presentation. Systemic MRSA infection, most likely originating from a necrotic toe, was identified at presentation. Transesophageal echocardiography revealed vegetation on the patient's right ventricular ICD lead. Antibiotics were started. The patient experienced a VT storm with multiple ICD shocks and was transferred to the coronary care unit, where he received intravenous amiodarone. Because of the frequent VT episodes, the decision was made to externalize the ICD and implant a defibrillating lead. Greenish, friable tissue was found in the device pocket. The 3 existing leads were easily extracted, and the pocket was debrided and closed, with a drain in place. The active- fixation lead was inserted through the left internal jugular vein to the apical septum and then attached to the externalized ICD. After parameters were set, a 10 J shock restored sinus rhythm. 1 subsequent induction was performed, resulting in a 5 J failure and a 15 J successful rescue.

The patient experienced 16 episodes of VT the first evening after the procedure; all episodes were successfully treated with antitachycardia pacing (ATP) through the externalized ICD. Amiodarone was discontinued because of pulmonary disease, and sotalol was started. The patient experienced no further VT episodes. The bacteremia resolved with antibiotic therapy. A new single-chamber ICD was placed in a right infraclavicular pocket 8 days postprocedure. The authors conclude that defibrillation and ATP using an externalized ICD and a temporary active-fixation defibrillating lead were effective in this case and may be effective for other patients with systemic infection and frequent VT.

3. Tam MM. **Ultrasound for transcutaneous pacing: documentation, usage, and definition [letter].** *Am J Emerg Med* 2005 Mar; 23(2):197-8. The above-referenced abstract discussed a study in which it was reported that use of 2-dimensional ultrasonographs may aid in determining the presence of ventricular capture during transcutaneous pacing (TCP). It was also stated that electrocardiogram (ECG) monitoring and video recording are unnecessary when using ultrasound (US) to determine TCP capture in practice. This update abstracts a letter written in response to the study. The author states that capture must be documented for quality assurance. The author suggests the use of a 3.5 MHz curvilinear transducer with a small footprint to visualize the heart and pericardium in B mode using the subxiphoid or parasternal long-axis views to detect pericardial effusion or tamponade. Overall cardiac contractility is assessed at the same time, and electrical capture is confirmed in the conventional manner. The author states that at this point, the scan setting is changed to B /M mode to display the 2-dimensional image and M-mode tracing, and the image is frozen. Heart rate is calculated on the M-mode tracing using the US scanner's measurement function, confirming mechanical capture if the measured heart rate corresponds to the set pacer rate. The author states that this method allows documentation of mechanical capture in 1 printout, without use of video recording or additional ECG input to the US scanner. The author adds that although the study discussed in the above- referenced abstract defined ventricular capture as "observed ventricular wall motion synchronous with the pacing-spike image on the US screen," this definition may not be applicable in practice because not all US scanners are equipped with ECG input with dampening circuitry, and some US scanners have no ECG input. The author states that when such US scanners are used, visualization of ventricular contractions at a rate that corresponds to the set pacer rate and is synchronous with audible signals from the cardiac monitor or pacer shocks should serve as proof of mechanical capture.

4. **FDA Enforcement** Rep 2005 Aug 17; *Manufacturer.* The above implantable cardioverter-defibrillators and cardiac resynchronization therapy defibrillators were manufactured with polyetheretherketone insulation material on the feed-through wires and were distributed before the premarket approval supplement was approved. The manufacturer initiated a recall by sales representative notification dated June 16, 2005. The firm states that no affected product remains on the market. No further action is required of customers. FDA has designated this recall Class II Recall Nos. Z-1064/1065-05.

5. Braunschweig F, Mortensen PT, Gras D, et al. **Monitoring of physical activity and heart rate variability in patients with chronic heart failure using cardiac resynchronization devices**. *Am J Cardiol* 2005 May 1; 95(9):1104-7. The authors evaluated whether trend data of physical activity and heart rate variability (HRV) could be obtained from an InSync III atriobiventricular pacemaker with transvenous left ventricular and conventional right atrial and ventricular leads in 56 patients with chronic heart failure. At baseline (before pacemaker implantation), 0 patients were in New York Heart Association (NYHA) class I, 11 patients were in NYHA class II, 37 patients were in NYHA class III, and 8 patients were in NYHA class IV. 3 months after pacemaker implantation, 18 patients were in NYHA class I, 29 patients were in NYHA class II, 8 patients were in NYHA class III, and 1 patient was in NYHA class IV. 43 patients had improved by =1 NYHA class. Walking distance increased from 361 1104 m at baseline to 429 1135 m at 3 months. Mean daily physical activity (MDPA) was 108 181 min at baseline and 168 1115 min, 211 1130 min,

and 225 1140 min at 2, 4, and 12 weeks, respectively. MDPA trend over 3 months was significantly greater in patients with better baseline functional status. MDPA increased significantly in all patients during the first 4 weeks of treatment, increased gradually in NYHA class II patients, and remained stable in NYHA class III and IV patients. Standard deviation of 5-minute medians of all normal atrial-to-atrial intervals (SDANN) was 64 123 msec at baseline, 72 124 msec at 2 weeks, and 72 126 msec at 4 and 12 weeks. Within the first 12 weeks, SDANN trends were significantly different among baseline NYHA classes. SDANN remained large in NYHA class II patients and increased gradually in NYHA class III patients. NYHA class IV patients demonstrated small SDANN values at baseline that remained unchanged over 12 weeks. The authors conclude that MDPA and HRV trend data reflected a response to cardiac resynchronization therapy with the InSync III atriobiventricular pacemaker and that the significant increase in MDPA and HRV could represent a true treatment effect.

6. Sharifi M, Inbar S, Neckels B, et al. **"Twiddling" to the extreme: development of twiddler syndrome in an implanted cardioverter- defibrillator. J Invasive Cardiol** 2005 Mar; 17(3):195-6. The authors report a case of twiddler's syndrome in a 65-year-old patient implanted with a Marquis VR 7230 CS implantable cardioverter-defibrillator (ICD) and a 58 cm Sprint 6947 implantable lead for ischemic dilated cardiomyopathy, left ventricular ejection fraction of 20%, and nonsustained ventricular tachycardia. The ICD was implanted without an electrophysiologic study because of severe left ventricular systolic dysfunction. Appropriate sensing, pacing, and defibrillation thresholds were obtained. Chest x-ray exam after implantation demonstrated ideal lead position. The patient had no history of psychiatric disease. At 6-month follow-up, the ICD had no capture, even at maximum output. The patient was asymptomatic. At maximum pacing output, repetitive twitching of the left major pectoral muscle was observed at the frequency of the set pacing rate. Chest x-ray exam demonstrated that the lead was withdrawn from the subclavian vein and that the tip was positioned over the major pectoral muscle. The patient denied any manipulation of the ICD and underwent explantation of the ICD and lead. A new Sprint 6947 lead was implanted and tightly secured. The existing ICD was placed in a Dacron mesh pouch, and its header was sutured to underlying muscle. At 5-month follow-up, no further twiddling occurred. The authors conclude that the use of a Dacron pouch and adequate fixation of the device header should be strongly considered in ICD patients at risk for twiddler's syndrome.

7. Theuns DA, Klootwijk AP, Simoons ML, et al. **Clinical variables predicting inappropriate use of implantable cardioverter- defibrillator in patients with coronary heart disease or nonischemic dilated cardiomyopathy.** *Am J Cardiol* 2005 Jan 15; 95 (2):271-4. The authors studied the clinical variables that may predict who will receive inappropriate therapy in 260 patients with implantable cardioverter-defibrillators (ICDs). Detection enhancements were activated immediately after ICD implantation in all patients. All stored data of tachyarrhythmia episodes was collected at every follow-up visit (at 3-month intervals) or at visits prompted by ICD therapy. Over mean follow-up of 22 <plus/minus>16 months, 107 patients experienced =1 episode of sustained ventricular tachyarrhythmia that triggered ICD therapy. 19 patients experienced inappropriate therapy for atrial fibrillation at least once, and 18 patients received inappropriate therapy for sinus or atrial tachycardia. Actuarial event-free rates for inappropriate therapy were 87.0%, 83.6%, and 80.8% at 1 year, 2 years, and 4 years, respectively. Age, gender, left ventricular ejection fraction, underlying cardiac disease, and pharmacologic treatment did not differ between patients with and without inappropriate therapy. Inappropriate ICD therapy occurred at a greater frequency after a history of atrial tachyarrhythmia. Analysis indicated that independent clinical predictors of inappropriate therapy were history of atrial tachyarrhythmia and recurrent ventricular tachycardia (VT) with a cycle length (CL) =350 msec that triggered device therapy. Relative risk was 2.4 for history of atrial tachyarrhythmia and increased to 3.1 if patients had recurrent VT with a CL =350 msec that triggered device therapy. 17 % of patients with dual-chamber ICDs experienced

inappropriate therapy compared to 6% of patients with single-chamber ICDs. The authors conclude that patients with a history of atrial tachyarrhythmia and recurrent VT with a CL =350 msec that triggered device therapy are more likely to receive inappropriate ICD therapy.

8. Nandakumar R, Broadhurst P. **An unusual obstacle in lead extraction.** *PACE* 2004 Nov; 27(11):1576-7. The authors report a case of obstruction caused by a stylet during pacemaker lead extraction in a 38-year-old man with an implantable cardioverter-defibrillator (ICD) inserted to treat Brugada syndrome. After explantation of 2 previous ICDs because of recurrent infections, a third ICD with a Model 6947 active fixation lead was implanted. The lead was connected to a Marquis VR generator. The ICD functioned normally at 2- and 4-week review. 4 months later, the patient presented with inappropriate shocks. Device interrogation revealed that therapy was delivered during sinus rhythm with associated high-frequency noise that indicated a lead fracture. X-ray scan confirmed that the lead was fractured, and the ICD was disabled. ICD explantation was performed 6 months after implantation, in accordance with the patient's wishes. The old lead was dissected and disconnected from the generator. During attempts to facilitate screw retraction, the stylet could not be passed beyond the fracture. Rotating the distal pin of the IS-1 connector would not transmit torque through the lead, and the screw remained embedded in the myocardium. Rotating the entire lead eventually caused disengagement, and the system was explanted without complications. X-ray scan of the explanted lead revealed that the stylet had passed between the electrode and lead insulation at the point of fracture but remained within the insulation. The authors state that excessive force could have resulted in the stylet breaking through the insulation and lacerating adjacent structures. The authors conclude that passage of the stylet and rotation of the entire pacemaker lead is a reasonable alternative in these situations, although this technique probably would have failed if the lead had been enmeshed in adhesions.

9. Van Putte BP, Bakker PF. **Subtotal innominate vein occlusion after unsuccessful pacemaker implantation for resynchronization therapy.** *PACE* 2004 Nov; 27(11):1574-5. The authors report a case of subtotal innominate vein occlusion following unsuccessful biventricular pacemaker system implantation for cardiac resynchronization therapy in a 63-year-old woman with dilating cardiomyopathy and symptoms of congestive heart failure. The patient was treated with Coumadin for transient ischemic attacks. Electrocardiography demonstrated sinus rhythm, a wide QRS complex of 140 msec with left bundle branch block morphology, and an asynchronously and poorly contracting left ventricle with an ejection fraction of 0.11. Implantation of a biventricular pacemaker system was attempted using a left subclavian approach. The right atrial and ventricular leads were easily positioned, but positioning of the coronary sinus lead failed and the procedure was abandoned. All endocardial leads were removed. 5 months later, 2 Guidant epicardial pacing lead adapters were successfully implanted on the left ventricle using video-assisted thoracoscopic surgery. The first epicardial lead was inserted through the left cephalic vein. High resistance was encountered at the innominate vein site, and the obstruction could not be passed. Digital subtraction venography revealed subtotal occlusion of the innominate vein. The stenosis was passed using a 12 Fr check-flow introducer set with a 30 cm sheath, and the endocardial leads were successfully positioned in the right atrium and ventricle. The authors conclude that venous thrombosis and occlusion can occur after abandoned pacemaker implantation with transvenous lead systems despite anticoagulation therapy and the immediate removal of epicardial leads.

10. Schuchert A, Seidl K, Pfeiffer D, et al. **Two-year performance of a preshaped lead for left ventricular stimulation.** *PACE* 2004 Dec; 27 (12):1610-4. The authors report the performance of Model 1055 K 4.8 Fr Aescula left ventricular (LV) unipolar leads permanently implanted with 8 Fr guiding sheaths for cardiac resynchronization therapy (CRT) in 96 patients. 8 patients received LV stimulation alone, and 88 patients received biventricular stimulation. Coronary sinus (CS) dissection occurred in 9 patients and was

related to use of ablation catheters to catheterize the CS. At final follow-up, 12 patients were in New York Heart Association (NYHA) Class I, 64 patients were in NYHA Class II, 12 patients were in NYHA Class III, and 8 patients were in NYHA Class IV. 2 patients underwent reoperation for phrenic nerve stimulation, and 1 patient underwent reoperation for pulse generator pocket hematoma. Phrenic nerve stimulation occurred in 6 additional patients but was eliminated by reprogramming of the stimulation output. LV and biventricular capture threshold increased from 1.4 <plus/minus>0.9 V and 1.7 < plus/minus>0.5 V, respectively, at implantation to 2.0 <plus/ minus>1.2 V and 2.1 <plus/minus>0.7 V, respectively, at 1 month. Thresholds remained between 1.6 and 1.9 V over the next 2 years. LV and biventricular mean R-wave amplitudes were 14.3 <plus/ minus>5.9 mV and 8.9 <plus/minus>3.2 mV, respectively, at implantation and 13.8 <plus/minus>7 mV and 12.8 <plus/minus>4.8 mV, respectively, at 24 months. LV and biventricular pacing impedance was 798 <plus/minus>348 <Greek omega> and 746 <plus/minus >372 <Greek omega>, respectively, at implantation and 698 <plus/ minus>296 <Greek omega> and 380 <plus/minus>67 <Greek omega>, respectively, after interfacing the pulse generator. The authors conclude that use of Model 1055 K 4.8 Fr Aescula LV unipolar leads is safe, expeditious, and successful for long-term delivery of CRT.

11. Lau EW, Green MS, Birnie DH, et al. **Ventricular tachycardia terminated by an ICD: is there more than what meets the eye?** *PACE* 2004 Dec; 27(12):1656-8. The authors discuss the discovery of an unexpected device problem during examination of a ventricular tachycardia (VT) episode terminated by a Marquis DR dual-chamber implantable cardioverter- defibrillator in a 39-year-old patient with hypertrophic obstructive cardiomyopathy. Ventricular fibrillation (VF) zone detection was set at a VV interval of =320 msec. Therapy comprised 6 consecutive shocks. VT zone detection was set at a VV interval of 320 to 360 msec. Therapy comprised antitachycardia pacing and shocks. Pacing function was set to DDD mode, with a lower rate of 40 beats/min, an upper tracking rate of 120 beats/min, and a sensed atrioventricular delay of 150 msec. The postventricular atrial refractory period was fixed at 310 msec. The patient experienced shock despite beta blockade. Device interrogation revealed that slow tachycardia at 120 beats/min that preceded VT of 214 beats/min had a 1:1 A: V (arteriolar: venous) ratio and comprised repeated sequences of atrial sensing and ventricular pacing. The rapid VT terminated the slower tachycardia and revealed an underlying prevailing sinus rhythm at 600 msec cycle length. AA and VV intervals decreased from approximately 600 to 500 msec for 6 min before the VT episode. The rate of the slower tachycardia was the same as the upper tracking rate of the ICD, suggesting pacemaker-mediated tachycardia (PMT). Ventricular threshold testing demonstrated that retrograde ventriculoatrial (VA) conduction was intact, with a VA time of 380 msec. Prolonged telemetry monitoring revealed PMT initiated by premature ventricular complexes and terminated with retrograde VA conduction block. The authors state that PMT would not have been detected if it had not immediately preceded an episode of VT, but even the clues in the ICD tracings easily could have been overlooked. The authors conclude that close observation of ICD interrogation can identify unexpected problems.

Medline, BIOSYS and EmBase Bibliographies

1. **CARE-HF: 'Unequivocal benefits' of CRT in heart failure.** *British Journal of Cardiology (BR J CARDIOL)* /20, BR.

2. **Annual Conference of G-MEX/MICC, Manchester, ENGLAND, May 23 -26, 2005.** Abstract: This meeting of the Annual Scientific Conference of the British Heart Society contains 248 meeting abstracts, all written in English, 12 of which are from the young research workers' prize finalists. Topics include the treatment of human atrial fibrillation, atherosclerosis, ischemic cardiomyopathy, chronic heart failure, acute coronary syndromes, ST elevation myocardial infarction, congenital heart disease and diabetic heart complications. Mitral valve surgery, drug eluting stents, myocardial perfusion scintigraphy, percutaneous coronary intervention, cardiovascular magnetic resonance, triple cardiac marker test, echocardiography, implantable cardioverter defibrillators and cardiac resynchronization therapy were used in the diagnosis and therapy of cardiovascular disease

3. **CRT proven to reduce heart failure mortality.** *Cardiology Review (CARDIOL REV)* /20, CARDIOL.

4. **The effect of cardiac resynchronization on morbidity and mortality in heart failure: Comments.** *Indian Heart Journal (Indian Heart J)* /20, INDIAN.

5. **Summaries for patients. Using electrocardiography to detect problems with cardiac resynchronization devices.** *Annals of internal medicine* 2005, 142(12 Pt 1)**:** I24.

6. **I have pretty bad heart failure and can't do too much anymore. I've heard of cardiac resynchronization therapy. What is it, and will it help my heart failure?** *Heart advisor / the Cleveland Clinic* 2005, 8(4)**:** 8.

7. Abraham WT: **Cardiac resynchronization therapy.** *Progress in cardiovascular diseases* 2006, 48(4)**:** 232-238.
Abstract: Left ventricular (LV) dysynchrony, generally defined as the effect of intraventricular conduction defects or bundle branch block to produce nonsynchronous ventricular activation, places the failing heart at a further mechanical disadvantage. The deleterious effects of ventricular dysynchrony include suboptimal ventricular filling, paradoxical septal wall motion, reduced LV contractility, increased mitral regurgitation, and poor clinical outcomes (eg, increased hospitalization and mortality). The clinical and mechanical manifestations of ventricular dysynchrony can be treated by simultaneously pacing both the right and left ventricles usually in association with right atrial sensing, resulting in atrial-synchronized biventricular pacing or cardiac resynchronization therapy (CRT). The weight of evidence supporting the routine use of CRT in patients with heart failure with ventricular dysynchrony is now quite substantial. More than 4000 patients have been evaluated in randomized controlled trials of CRT, and several thousand additional patients have been assessed in observational studies and in registries. Data from these studies have consistently demonstrated the safety and efficacy of CRT in patients with New York Heart Association class III and IV heart failure. Cardiac resynchronization therapy has been shown to significantly improve LV structure and function, New York Heart Association functional class, exercise tolerance, quality of life, and morbidity and mortality

8. Adornato E, Adornato EMF, Monea P, Pangallo A, Pennisi V: **ICD in cardiac resynchronization therapy: When?** *Policlinico - Sezione Medica (POLICLIN SEZ MED)* /20, OLICLIN.

9. Agacdiken A, Vural A, Ural D, Sahin T, Kozdag G, Kahraman G *et al.*: **Effect of cardiac resynchronization therapy on left ventricular diastolic filling pattern in responder**

and nonresponder patients. *Pacing and clinical electrophysiology - PACE* 2005, 28(7)**:** 654-660.
Abstract: BACKGROUND: The aim of this study was to investigate the short- and long-term effects of cardiac resynchronization therapy (CRT) on left ventricular (LV) diastolic filling pattern and the relation between the diastolic filling pattern and the response to CRT. METHODS: Twenty-three patients with systolic heart failure and complete left bundle-branch block underwent implantation of biventricular pacemaker devices. In order to follow the changes in diastolic function, mitral inflow, pulmonary venous flow, and LV flow propagation (Vp) velocities were measured with pulsed-wave and color M-mode Doppler echocardiography 1 week before and 1 and 6 months after pacemaker implantation. At the 6-month follow-up, patients were divided into two groups according to their response to CRT defined as a relative increase in LV ejection fraction (LVEF) > or =25% versus baseline. RESULTS: After biventricular pacemaker implantation, significant clinical improvement was observed in all patients. Compared to baseline, the ratio of early-to-late peak velocities (E/A) decreased significantly at the 6th month (E/A ratio: from 1.5 +/- 0.9 to 0.8 +/- 0.5 at the 6th month (P = 0.02)). Pulmonary systolic flow to diastolic flow ratio (PVs/PVd) increased with CRT after 6 months (PVs/PVd ratio: from 0.9 +/- 0.4 to 1.3 +/- 0.7 at the 6th month (P = 0.02)). E/Vp ratio decreased significantly at the 1st and 6th month (E/Vp ratio: from 2.7 +/- 0.8 to 2 +/- 0.8 at the 1st (P < 0.002) and to 1.9 +/- 0.7 at the 6th month (P < 0.02)). In responders (n: 17, 74%), E wave and PVra velocity decreased, E-wave deceleration time increased, and E/Vp ratio improved significantly, whereas in nonresponders, changes in LV diastolic parameters remained insignificant. However, diastolic filling pattern improved significantly at the 1st and 6th month of CRT in both responders and nonresponders. CONCLUSION: CRT enhances diastolic filling patterns in both responder and nonresponder patients. This may be related to improvement in symptoms even in nonresponders who have a relative increase in LVEF <25%

10. Akyol A, Alper AT, Cakmak N, Hasdemir H, Eksik A, Oguz E *et al*.: **Long-term effects of cardiac resynchronization therapy on heart rate and heart rate variability.** *Tohoku journal of experimental medicine* 2006, 209(4)**:** 337-346.
Abstract: Congestive heart failure is characterized by significant autonomic dysfunction. Development of left bundle branch block in congestive heart failure is a predictor of worse outcome. There are several lines of evidence that cardiac resynchronization therapy (CRT), by biventricular stimulation in patients with severe heart failure and left bundle branch block, improves autonomic functions which can be quantified by measuring heart rate variability. The aim of the present study was to assess the effect of CRT on autonomic functions quantified by heart rate variability and mean heart rate (HR) in patients with advanced heart failure and left bundle branch block in short and long-term follow-up. A total of 35 patients with systolic heart failure and left bundle branch block (mean-age 60 +/- 11 years; 24 male and 11 female; mean left ventricular ejection fraction [EF]: 22.3 +/- 3%) were enrolled. Clinical assessment and echocardiographic examination were performed at baseline and every three months. Continuous electrocardiographic monitorization by 24-hour Holter recordings was performed pre-implantation, 3 months and 2 years after implantation. Mean HR and one of the time-domain parameters of heart rate variability, standard deviation of the R-R intervals (SDNN) were measured. CRT was associated with a decrease in the mean duration of QRS, and an increase in diastolic filling time, the rate with which the left ventricular pressure rises (dP/dt), and left ventricular ejection fraction. Decrease in mean heart rate and increase in SDNN were statistically significant in the third month and second year recordings when compared to baseline recording (p values were < 0.001 for both). In conclusion, CRT with biventricular pacing provides sustained improvement in autonomic function in patients with advanced heart failure and left bundle branch block

11. Al-Khadra AS: **Use of preshaped sheath to plan and facilitate cannulation of the coronary sinus for the implantation of cardiac resynchronization therapy devices: preshaped sheath for implantation of biventricular devices.** *Pacing and clinical*

electrophysiology - PACE 2005, 28(6)**:** 489-492.
Abstract: OBJECTIVES: The aim of the study is to describe a new technique for facilitating the implantation of cardiac resynchronization therapy (CRT) devices. BACKGROUND: CRT, by simultaneous pacing of the right and left ventricles has proven to be a useful treatment for patients with advanced heart failure and left ventricular (LV) systolic dysfunction, who have concomitant LV dyssynchrony. One of the greatest challenges to the wide applications of this therapy has been the technical difficulty encountered with implantation of the left ventricular lead. This is mainly due to the varied anatomy of the coronary venous system, which is further complicated by distortion of the anatomy in patients with advanced heart failure. METHODS: Details of the coronary venous anatomy are initially assessed by cannulating the coronary sinus (CS) using a specialized long preshaped sheath introduced from the femoral approach. Occlusive venography is performed in three views, and then the guide wire or the deflated balloon catheter is left in the CS for guidance. The most suitable equipment for the anatomy is chosen. Then, the operative site is prepped and the CS is approached from above. RESULTS: From November 2003 until December 2004, we have used this approach on all patients presenting for CRT device implantation at Prince Sultan Cardiac Center (n = 25). The CS was cannulated using the preshaped catheter in less than 5 minutes in all cases. After delineation of the anatomy, successful CRT implantation was achieved in all patients. Mean procedure time for the implantation was 110 +/- 18 minutes. Uncomplicated minor CS dissection related to the use of the preshaped sheath was observed in 1 patient without consequences. CONCLUSIONS: The use of preshaped sheath from the femoral approach facilitates planning the successful and safe implantation of CRT systems

12. Al-Khadra AS: **Use of a modified introducer sheath with a side-hole to improve access to left ventricular veins with proximal origin.** *Europace - European pacing, arrhythmias , and cardiac electrophysiology - journal of the working groups on cardiac pacing, arrhythmias , and cardiac cellular electrophysiology of the European Society of Cardiology* 2006, 8(1)**:** 56-59.
Abstract: AIMS: Despite technical advances in tools used to facilitate implantation of cardiac resynchronization therapy (CRT) devices, there are many hurdles related mainly to the variation in the anatomy of the coronary veins. One such difficulty is the presence of a very proximal origin of the lateral or postero-lateral cardiac vein. METHODS AND RESULTS: We describe an alteration of existing left ventricular (LV) lead delivery sheath with the creation of a side-hole 35-50 mm from its tip. This modification is made to provide access to proximal cardiac vein ostia, while maintaining adequate support for the delivery system. The modified introducer sheath was used in the implantation of six CRT systems (four defibrillators and two pacemakers) in patients who had a proximal origin of the lateral or postero-lateral cardiac vein, all of which were successful and without complications. CONCLUSION: In those patients with unusual proximal origin of target LV veins, modifications of the introducer sheath with the creation of a side-hole facilitate the successful implantation of the LV pacing lead. Until this modified sheath is tested, this technique is considered experimental and may carry unknown risks.

13. Al-Khatib SM, Sanders GD, Mark DB, Lee KL, Bardy GH, Bigger JT *et al*.: **Implantable cardioverter defibrillators and cardiac resynchronization therapy in patients with left ventricular dysfunction: randomized trial evidence through 2004.** *American heart journal* 2005, 149(6)**:** 1020-1034.
Abstract: Although many studies have shown that implantable cardioverter defibrillator (ICD) therapy improves the survival of patients with significant left ventricular dysfunction, the magnitude of effectiveness of ICD therapy in clinically defined subgroups remains uncertain. Similarly, although studies have shown an improvement in patients' hemodynamics and quality of life with cardiac resynchronization therapy (CRT), there is a continuing uncertainty about the effect of CRT on patients' survival and the magnitude of improvement in quality of life with this therapy. On August 24, 2004, an ad hoc group of experts representing clinical cardiovascular medicine, biostatistics, economics, and health

policy were joined by representatives of the Food and Drug Administration, Centers for Medicare and Medicaid Services (Baltimore, Md), Agency for Healthcare Research and Quality (Rockville, Md), and the device industry for a 1-day round table to review the available clinical trial evidence on the effect of ICD therapy in the primary prevention of sudden cardiac death and the effect of CRT in patients with congestive heart failure. The meeting was organized by the Duke Clinical Research Institute, Durham, NC, and funded in part by the Agency for Healthcare Research and Quality. This document summarizes the evidence reviewed at that meeting and the discussions of that evidence

14. Albertsen AE, Nielsen JC, Pedersen AK, Hansen PS, Jensen HK, Mortensen PT: **Left ventricular lead performance in cardiac resynchronization therapy: impact of lead localization and complications.** *Pacing and clinical electrophysiology - PACE* 2005, 28(6)**:** 483-488.
Abstract: INTRODUCTION: Cardiac resynchronization therapy (CRT) using left ventricular (LV) pacing from the coronary sinus tributary is increasingly and frequently used in patients with severe congestive heart failure. The present study investigates LV lead performance in different anatomic locations. METHODS: The LV pacing site was defined by bi-plane fluoroscopy. In the left anterior oblique view, the coronary sinus is encircling the mitral ring with the tributaries radiating out like the hands of a watch. Using this clockwise method, Group A had an LV pacing site before 3 o'clock and Group B at or after 3 o'clock. In right anterior oblique view, the LV was divided into three segments: basal, mid-ventricular, and apical. RESULTS: LV lead implantation was successful in all of 120 consecutive patients. Mean follow-up was 16.7 months. Implantation time decreased from mean 190 to 80 minutes during the period (P = 0.01). The mean LV lead stimulation threshold increased initially and stabilized afterwards. The threshold measured at last follow-up was higher than at implantation (2.3 vs 2.7 microJ, P = 0.04). Useful venograms were obtained in 94 patients. No significant difference in thresholds was observed between Groups A and B. Phrenic nerve stimulation was most commonly seen in Group B (8/70 vs 1/24, P = 0.001). CONCLUSION: Implantation of an LV lead for CRT is possible in patients with congestive heart failure and associated with an acceptable low complication rate. LV lead implantation is associated with a learning curve. At mid-term follow-up, LV lead performance is stable and unrelated to the LV implantation site

15. Ammann P, Sticherling C, Kalusche D, Eckstein J, Bernheim A, Schaer B *et al*.: **An electrocardiogram-based algorithm to detect loss of left ventricular capture during cardiac resynchronization therapy.** *Annals of internal medicine* 2005, 142(12 Pt 1)**:** 968-973.
Abstract: BACKGROUND: Loss of left ventricular capture in patients with cardiac resynchronization devices may account for worsening heart failure and can be difficult to diagnose without a programmer. OBJECTIVE: To determine whether distinct morphologic changes on the surface electrocardiogram indicate loss of left ventricular capture. DESIGN: After analysis of the R-S spike ratio in the 12-lead electrocardiogram during right ventricular and biventricular pacing in 10 patients, an algorithm to detect loss of left ventricular capture was developed. SETTING: University hospital. PATIENTS: 54 patients with a cardiac resynchronization device and underlying left bundle-branch block. MEASUREMENTS: Leads V1 and I of a 12-lead electrocardiogram were assessed after biventricular pacing was confirmed and after the device was programmed to right ventricular pacing only (simulating loss of left ventricular capture). RESULTS: The sensitivity of the algorithm to correctly identify loss of left ventricular capture was 94% (95% CI, 88.2% to 97.7%), and the specificity was 93% (CI, 86.3% to 95.8%). The likelihood ratio of a positive test result was 12.8 (CI, 6.443 to 23.310), and the likelihood ratio of a negative test result was 0.06 (CI, 0.024 to 0.137). LIMITATIONS: The algorithm was tested in patients in whom the right ventricular electrode was placed in the apex of the right ventricle only. CONCLUSION: Presence of biventricular capture--the prerequisite for successful cardiac resynchronization therapy--and loss of left ventricular capture can be

accurately detected by an algorithm based on analysis of the R-S ratio on leads V1 and I of the surface electrocardiogram

16. Antz M, Bansch D: **Idiopathic dilated cardiomyopathy-an appraisal in 2005 <Original> Dilatative kardiomyopathie-wohin schlagt das pendel aus?** *Herz (Herz)* /20, HERZ.
Abstract: AB- Patients who present with an impaired left ventricular (LV) function of nonischemic origin (EF <= 35%), should first undergo intensified heart failure therapy with angiotensin-converting enzyme (ACE) inhibitors, beta-blockers and diuretics. If the impairment of LV function persists for 3-9 months despite adequate therapy, the implantation of a defibrillator (ICD) seems to be reasonable for the primary prevention of sudden cardiac death in these patients. If patients present with non-sustained ventricular tachycardias, ICD implantation and treatment with amiodarone are probably equally effective and better than mere heart failure therapy. In patients presenting with an indication for biventricular pacing, a biventricular ICD should be used. (c) Urban & Vogel 2005

17. Aranda JM, Woo GW, Conti JB, Schofield RS, Conti CR, Hill JA: **Use of cardiac resynchronization therapy to optimize beta-blocker therapy in patients with heart failure and prolonged QRS duration.** *American journal of cardiology* 2005, 95(7)**:** 889-891.
Abstract: A retrospective analysis was performed on 52 patients with heart failure to determine the change in beta-blocker therapy after cardiac resynchronization therapy (CRT). After 6 months of CRT, the number of patients receiving beta-blocker therapy increased from 36 to 44, with improved clinical outcomes and larger beta-blocker doses, indicating that these 2 therapies may work together to improve outcomes by allowing the use of larger doses of beta blockers while correcting ventricular dyssynchrony

18. Aranda JM, Woo GW, Schofield RS, Handberg EM, Hill JA, Curtis AB *et al*.: **Management of heart failure after cardiac resynchronization therapy: integrating advanced heart failure treatment with optimal device function.** *Journal of the American College of Cardiology* 2005, 46(12)**:** 2193-2198.
Abstract: Cardiac resynchronization therapy (CRT) is an established adjunctive treatment for patients with systolic heart failure (HF) and ventricular dyssynchrony. The majority of recipients respond to CRT with improvements in quality of life, New York Heart Association functional class, 6-min walk test, and ventricular function. Management of HF after CRT may include up-titration of neurohormonal blockade and an exercise prescription through cardiac rehabilitation to further improve and sustain clinical outcomes. Diagnostic data provided by the CRT device may help to facilitate and optimize treatment. Initial nonresponder rates remain problematic. We suggest a simple step-by-step management and troubleshooting strategy that integrates device function with advanced HF therapy in patients who do not initially respond to CRT. This algorithm represents a new, comprehensive, collaborative approach between the HF and electrophysiology specialists to further improve and sustain outcomes in the field of CRT

19. Aronow WS: **CRT plus ICD in congestive heart failure. Use of cardiac resynchronization therapy and an implantable cardioverter-defibrillator in heart failure patients with abnormal left ventricular dysfunction.** *Geriatrics* 2005, 60(2)**:** 24, 26-24, 28.
Abstract: Cardiac resynchronization therapy (CRT) significantly improves functional status, exercise duration, left ventricular (LV) ejection fraction, death from progressive congestive heart failure (CHF), and hospitalization for CHF in patients with moderate-to-severe CHF, an abnormal LV ejection fraction, and a QRS duration on the electrocardiogram of 120 msec or more. In these patients, CRT reduces all-cause mortality, though not significantly. However, CRT plus. an implantable cardioverter-defibrillator (ICD) significantly reduces all-cause mortality. Compared with placebo, ICD therapy

significantly reduced all-cause mortality by 33% in patients with class II or III CHF, an abnormal LV ejection fraction, and a QRS duration on the electrocardiogram of 120 msec or more

20. Arya A, Haghjoo M, Sadr-Ameli MA: **ICD therapy: What have we learned from the clinical trials?** *Heart Lung and Circulation (HEART LUNG CIRCUL)* /20, HEART.
Abstract: AB- Development of implantable cardioverter defibrillators (ICD) has been a dramatic advancement in the management of patients with life-threatening ventricular arrhythmias. We hereby reviewed the landmark clinical trials on ICD with special emphasis on late-breaking clinical trials and assessed their impact on every-day decision making and patient selection for ICD implantation. (c) 2005 Australasian Society of Cardiac and Thoracic Surgeons and the Cardiac Society of Australia and New Zealand. Published by Elsevier Inc. All rights reserved

21. Arya A, Haghjoo M, Dehghani MR, Alasti M, Alizadeh H, Kazemi B *et al*.: **Effect of cardiac resynchronization therapy on the incidence of ventricular arrhythmias in patients with an implantable cardioverter-defibrillator.** *Heart rhythm - the official journal of the Heart Rhythm Society* 2005, 2(10)**:** 1094-1098.
Abstract: BACKGROUND: Cardiac resynchronization therapy (CRT) reduces mortality in selected patients with heart failure. However, this result may not be entirely related to the beneficial hemodynamic effects of CRT. OBJECTIVES: The purpose of this study was to assess retrospectively the effect of CRT on the incidence of appropriate therapy in patients with an implantable cardioverter-defibrillator (ICD). METHODS: Sixty-five patients (48 men and 17 women; mean age 58 +/- 13 years) with an ICD (31 biventricular, 34 dual-chamber) were included in the study. Clinical, ECG, and ICD stored data and electrograms were collected. RESULTS: Biventricular and dual-chamber ICDs were implanted in 31 and 34 patients, respectively, who had either ischemic (n = 36) or dilated cardiomyopathy (n = 29). Thirty-two (49%) patients received > or =1 appropriate ICD therapy during follow-up of 11 +/- 8 months. Thirty-five percent and 62% of patients with biventricular (n = 11) and dual-chamber ICDs (n = 21), respectively, received appropriate ICD therapy during the follow-up period (odds ratio = 0.340, P = .048). Stratifying the patients according to underlying heart disease and ejection fraction resulted in an adjusted odds ratio = 0.239 (P = .029). Comparing the rate of > or =1 appropriate ICD therapy between the two groups by Kaplan-Meier analysis and the log rank test resulted in P = .027. CONCLUSION: In this retrospective analysis, biventricular pacing was associated with a decreased incidence of sustained ventricular arrhythmias requiring ICD therapy. The antiarrhythmic effect of biventricular pacing could contribute to the reduction in mortality reported in recent large-scale clinical trials on CRT. However, further prospective studies are warranted to clarify this issue

22. Auricchio A: **[Cardiac resynchronization therapy: are all questions answered?] <Original> Kardiale Resynchronisationstherapie: Sind alle Fragen beantwortet?** *Herzschrittmachertherapie & Elektrophysiologie* 2005, 16(1)**:** 1-2.

23. Auricchio A, Spinelli JC, Kramer AP: **Dynamically optimized multisite cardiac resynchronization device.**
Abstract: A cardiac rhythm management device in which amplitudes of electrograms from one or more cardiac sites are measured in order to ascertain the extent of hypertrophy. The device may then pace the heart by delivering pacing therapy in a manner that unloads the hypertrophied myocardium to effect reversal of undesirable remodeling

24. Auricchio A: **Cardiac resynchronization therapy: does varying the pacing site or combination of sites improve cardiac function?** *Nature clinical practice Cardiovascular medicine* 2005, 2(6)**:** 288-289.

25. Auricchio A, Fantoni C: **Cardiac resynchronization therapy in heart failure.** *Italian heart journal - official journal of the Italian Federation of Cardiology* 2005, 6(3)**:** 256-260.
Abstract: Cardiac resynchronization therapy (CRT) is a new therapeutic approach for a selected group of patients with symptomatic heart failure (NYHA functional class III-IV) despite optimal medical therapy, due to dilated cardiomyopathy of any etiology (left ventricular ejection fraction < or = 35% and left ventricular end-diastolic diameter > or = 55 mm), who present with electromechanical dyssynchrony (QRS > or = 130 ms). Safety and effectiveness of CRT have been demonstrated by several clinical trials, with patients achieving significant improvement in both clinical symptoms as well as functional status and exercise capacity. Furthermore, CRT has reduced morbidity of heart failure patients, while its impact in improving survival still remains to be clarified. Whether or not heart failure patients candidate to CRT should receive a defibrillator back-up remains debatable, although growing evidence is pointing to extensive use of a defibrillator in such a population

26. az-Infante E, Mont L, Leal J, Garcia-Bolao I, Fernandez-Lozano I, Hernandez-Madrid A *et al.*: **Predictors of lack of response to resynchronization therapy.** *American journal of cardiology* 2005, 95(12)**:** 1436-1440.
Abstract: About 30% of patients treated with cardiac resynchronization therapy (CRT) do not respond to treatment. The aim of this study was to identify clinical predictors of lack of improvement in patients receiving CRT. From 197 consecutive patients scheduled to receive CRT, 143 fulfilled the inclusion criteria. Mean age was 68 +/- 7 years and 79% were men. Heart failure was due to ischemic heart disease in 49 patients (34%). Mean QRS duration was 165 +/- 26 ms, and left ventricular ejection fraction was 27 +/- 7%. Nonresponder patients were defined as those who died of heart failure, underwent heart transplantation, or did not increase the distance walked in 6 minutes >10%. At 6-month follow-up, there were 28 nonresponders (20%). Among nonresponders, 2 patients received a heart transplantation and 9 patients died of heart failure. In logistic regression analysis, independent predictors of lack of response to CRT were ischemic heart disease (odds ratio [OR] 2.9, 95% confidence interval [CI] 1.2 to 7; p = 0.023), severe mitral regurgitation (OR 3.5, 95% CI 1.3 to 9; p = 0.014), and left ventricular end-diastolic diameter > or =75 mm (OR 3.1, 95% CI 1.1 to 8; p = 0.026). Patients with these 3 predictors had a probability response of 27%

27. Azizi M, Castel MA, Behrens S, Rodiger W, Nagele H: **Experience with coronary sinus lead implantations for cardiac resynchronization therapy in 244 patients.** *Herzschrittmachertherapie & Elektrophysiologie* 2006, 17(1)**:** 13-18.
Abstract: INTRODUCTION: Cardiac resynchronization therapy (CRT) using coronary sinus (CS) leads is a new method for the therapy of congestive heart failure (CHF). Because the intervention is more complex than regular pacemaker implantations, information on the feasibility and side effects of this method are of interest. METHODS: From 1999 to June 2005, CRT implantations were attempted in 244 patients (pts; mean age 64+/-12 years, range 14-90 years), 82% were male, 44% had coronary artery disease, 29% were in atrial fibrillation, 71 had preexisting pacemakers. RESULTS: In 97% of the pts the intervention was successful (27% of the systems with defibrillation capabilities). In 285 interventions, 255 CS leads were positioned according to CS vein anatomy in 130 posterolateral, 97 anterolateral and 28 anterior side branches (16 patients received 2 CS leads). Over-the-wire leads were used in 88%, 71% were additionally preshaped. We observed no mortality but 37 complications (12.5%): CS dissection in 9, CS perforation in 1, ventricular fibrillation in 4, asystole in 5, pulmonary edema in 1, pneumothorax in 2, need for early CS lead revision in 19 (dislodgement n=7, phrenic nerve stimulation n=12) and infection with explantation in 2 cases. An improvement in NYHA functional class was found in 88% of pts (only 55% if anterior lead position). CONCLUSION: Perioperative complications during CS lead implantation occur in 10-15% of cases. Most patients responded well to CRT. Patients should be informed about the possible need for a

reoperation. During implantation, immediate defibrillation and stimulation capabilities must be available. Anterior lead positions should be avoided

28. Badhwar N, O'Connell JW, DeMarco T, Kumar UN, Lee BK, Schreck C *et al*.: **Novel scintigraphic parameters to assess left ventricular dyssynchrony in patients requiring cardiac resynchronization.**

29. Badhwar N, Lee BK, Kumar UN, DeMarco T, O'Connell JW, Schreck C *et al*.: **Utility of equilibrium radionuclide angiograms to guide coronary sinus lead placement in heart failure patients requiring cardiac resynchronization therapy.**

30. Balt JC, Dekker P, De Voogt WG: **A patient with dizziness, tachycardia and a DDDR pacemaker.** *Netherlands Heart Journal (NETH HEART J)* /20, NETH.
Abstract: AB- An 84-year-old female patient presented to the coronary care unit with dizziness. A DDD-R minute ventilation sensor pacemaker had been implanted eight years previously. The ECG showed an atrial and ventricular paced rhythm of 140 beats/min. After disconnecting the patient from the cardiac monitor the pacemaker rate dropped gradually to 90 beats/min. The cardiac rhythm monitoring system applies low-amplitude electrical pulses in order to measure respiration rate by transthoracic impedance (TTI) measurement. The minute ventilation pacemaker sensor is driven by the same TTI measurement for rate response. Inappropriate interference between these two systems caused a sensor-driven high pacemaker rate. The dizziness was not related to the sensor-driven high rate

31. Banz K: **Cardiac resynchronization therapy (CRT) in heart failure--a model to assess the economic value of this new medical technology.** *Value in health - the journal of the International Society for Pharmacoeconomics and Outcomes Research* 2005, 8(2)**:** 128-139.
Abstract: OBJECTIVES: This article describes the framework of a comprehensive European model developed to assess clinical and economic outcomes of cardiac resynchronization therapy (CRT) versus optimal pharmacological therapy (OPT) alone in patients with heart failure. METHODS: The model structure is based on information obtained from the literature, expert opinion, and a European CRT Steering Committee. The decision-analysis tool allows a consideration of direct medical and indirect costs, and computes outcomes for distinctive periods of time up to 5 years. Qualitative data can also be entered for cost-utility analysis. Model input data for a preliminary economic appraisal of the economic value of CRT in Germany were obtained from clinical trials, experts, health statistics, and medical tariff lists. RESULTS: The model offers comprehensive analysis capabilities and high flexibility so that it can easily be adapted to any European country or special setting. The illustrative analysis for Germany indicates that CRT is a cost-effective intervention. Although CRT is associated with average direct medical net costs of Euro 5880 per patient, this finding means that 22% of its upfront implantation cost is recouped already within 1 year because of significantly decreased hospitalizations. With 36,600 Euros the incremental cost per quality-adjusted life-year (QALY) gained is below the euro equivalent (41,300 Euros, 1 Euro = US1.21 dollars) of the commonly used threshold level of US50,000 dollars considered to represent cost-effectiveness. The sensitivity analysis showed these preliminary results to be fairly robust towards changes in key assumptions. CONCLUSIONS: The European CRT model is an important tool to assess the economic value of CRT in patients with moderate to severe heart failure. In the light of the planned introduction of Diagnosis Related Group (DRG) based reimbursement in various European countries, the economic data generated by the model can play an important role in the decision-making process

32. Barold S Serge, Herweg B, Giudici M: **Electrocardiographic follow-up of biventricular pacemakers.** *Annals of noninvasive electrocardiology - the official journal of the International Society for Holter and Noninvasive Electrocardiology, Inc* 2005, 10(2)**:** 231-

255.
Abstract: Multisite pacing for the treatment of heart failure has added a new dimension to the electrocardiographic evaluation of device function. During left ventricular (LV) pacing from the appropriate site in the coronary venous system, a correctly positioned lead V1 registers a right bundle branch block pattern with few exceptions. During biventricular stimulation associated with right ventricular (RV) apical pacing, the QRS is often positive in lead V1. The frontal plane QRS axis is usually in the right superior quadrant and occasionally in the left superior quadrant. Barring incorrect placement of lead V1 (too high on the chest), lack of LV capture, LV lead displacement or marked latency (exit block or delay from the stimulation site), ventricular fusion with the spontaneous QRS complex, a negative QRS complex in lead V1 during biventricular pacing involving the RV apex probably reflects different activation of an heterogeneous biventricular substrate (ischemia, scar, His-Purkinje participation in view of the varying patterns of LV activation in spontaneous left bundle branch block) and does not necessarily indicate a poor (electrical or mechanical) contribution from LV stimulation. In this situation, it is imperative to rule out the presence of coronary venous pacing via the middle cardiac vein or even unintended placement of two leads in the RV. During biventricular pacing with the RV lead in the outflow tract, the paced QRS in lead V1 is often negative and the frontal plane paced QRS axis is often directed to the right inferior quadrant (right axis deviation). In patients with sinus rhythm and a relatively short PR interval, ventricular fusion with competing native conduction during biventricular pacing may cause misinterpretation of the ECG because narrowing of the paced QRS complex simulates appropriate biventricular capture. This represents a common pitfall in device follow-up. Elimination of ventricular fusion by shortening the AV delay, is often associated with clinical improvement. Anodal stimulation may complicate threshold testing and should not be misinterpreted as pacemaker malfunction. One must be cognizant of the various disturbances that can disrupt 1:1 atrial tracking and cause loss of ventricular resynchronization. (1) Upper rate response. The upper rate response of biventricular pacemakers differs from the traditional Wenckebach upper rate response of conventional antibradycardia pacemakers because heart failure patients generally do not have sinus bradycardia or AV junctional conduction delay. The programmed upper rate should be sufficiently fast to avoid loss of resynchronization in situations associated with sinus tachycardia. (2) Below the programmed upper rate. This may be caused by a variety of events (especially ventricular premature complexes and favored by the presence of first-degree AV block) that alter the timing of sensed and paced events. In such cases, atrial events become trapped into the postventricular atrial refractory period at atrial rates below the programmed upper rate in the presence of spontaneous AV conduction. Algorithms are available to restore resynchronization by automatic temporary abbreviation of the postventricular atrial refractory period

33. Barold S Serge, Herweg B: **Mysterious loss of resynchronization during biventricular pacing.** *Pacing and clinical electrophysiology - PACE* 2005, 28(6)**:** 571-572.

34. Barold S Serge, Herweg B: **Upper rate response of biventricular pacing devices.** *Journal of interventional cardiac electrophysiology - an international journal of arrhythmias and pacing* 2005, 12(2)**:** 129-136.

35. Barold S Serge(Reprint), Stroobandt R, X: **Harmful effects of long-term right ventricular pacing.**

36. Barold SS, Herweg B: **Alternating preventricular and postventricular atrial far-field sensing by a dual chamber cardioverter defibrillator.** *PACE - Pacing and Clinical Electrophysiology (PACE PACING CLIN ELECTROPHYSIOL)* /20, ACE.

37. Barold SS, Herweg B: **Phantom crosstalk.** *PACE - Pacing and Clinical Electrophysiology (PACE PACING CLIN ELECTROPHYSIOL)* /20, ACE.

38. Bauer Peter R, Arand P, Warner RA: **Using simultaneous electrocardiographic and acoustic data to evaluate and monitor patients undergoing cardiac resynchronization therapy.**

39. Bax JJ, Abraham T, Barold S Serge, Breithardt OA, Fung Jeffrey WH, Garrigue S *et al.*: **Cardiac resynchronization therapy - Part 2 - Issues during and after device.**
Abstract: Encouraged by the clinical success of cardiac resynchronization therapy (CRT), the implantation rate has increased exponentially, although several limitations and unresolved issues of CRT have been identified. This review concerns issues that are encountered during implantation of CRT devices, including the role of electroanatomical mapping, whether CRT implantation should be accompanied by simultaneous atrioventricular nodal ablation in patients with atrial fibrillation, procedural complications, and when to consider surgical left ventricular lead positioning. Furthermore, (echocardiographic) CRT optimization and assessment of CRT benefits after implantation are highlighted. Also, controversial issues such as the potential value of CRT in patients with mild heart failure or narrow QRS complex are addressed. Finally, open questions concerning when to combine CRT with implantable cardioverter-defibritlator therapy and the cost-effectiveness of CRT are discussed

40. Bax JJ, Schalij MJ: **How to predict response to cardiac resynchronization therapy?** *European heart journal* 2005, 26(11)**:** 1054-1055.

41. Bax JJ, Abraham T, Barold S Serge, Breithardt OA, Fung Jeffrey WH, Garrigue S *et al.*: **Cardiac resynchronization therapy: Part 1--issues before device implantation.** *Journal of the American College of Cardiology* 2005, 46(12)**:** 2153-2167.
Abstract: Cardiac resynchronization therapy (CRT) has been used extensively over the last years in the therapeutic management of patients with end-stage heart failure. Data from 4,017 patients have been published in eight large, randomized trials on CRT. Improvement in clinical end points (symptoms, exercise capacity, quality of life) and echocardiographic end points (systolic function, left ventricular size, mitral regurgitation) have been reported after CRT, with a reduction in hospitalizations for decompensated heart failure and an improvement in survival. However, individual results vary, and 20% to 30% of patients do not respond to CRT. At present, the selection criteria include severe heart failure (New York Heart Association functional class III or IV), left ventricular ejection fraction <35%, and wide QRS complex (>120 ms). Assessment of inter- and particularly intraventricular dyssynchrony as provided by echocardiography (predominantly tissue Doppler imaging techniques) may allow improved identification of potential responders to CRT. In this review a summary of the clinical and echocardiographic results of the large, randomized trials is provided, followed by an extensive overview on the currently available echocardiographic techniques for assessment of LV dyssynchrony. In addition, the value of LV scar tissue and venous anatomy for the selection of potential candidates for CRT are discussed

42. Bax JJ, Abraham T, Barold S Serge, Breithardt OA, Fung Jeffrey WH, Garrigue S *et al.*: **Cardiac resynchronization therapy: Part 2--issues during and after device implantation and unresolved questions.** *Journal of the American College of Cardiology* 2005, 46(12)**:** 2168-2182.
Abstract: Encouraged by the clinical success of cardiac resynchronization therapy (CRT), the implantation rate has increased exponentially, although several limitations and unresolved issues of CRT have been identified. This review concerns issues that are encountered during implantation of CRT devices, including the role of electroanatomical mapping, whether CRT implantation should be accompanied by simultaneous atrioventricular nodal ablation in patients with atrial fibrillation, procedural complications, and when to consider surgical left ventricular lead positioning. Furthermore, (echocardiographic) CRT optimization and assessment of CRT benefits after implantation are highlighted. Also, controversial issues such as the potential value of CRT in patients

with mild heart failure or narrow QRS complex are addressed. Finally, open questions concerning when to combine CRT with implantable cardioverter-defibrillator therapy and the cost-effectiveness of CRT are discussed

43. Belalcazar A, Patterson R: **Monitoring lung edema using the pacemaker pulse and skin electrodes.** *Physiological measurement* 2005, 26(2)**:** S153-S163.
Abstract: Previous clinical studies have shown that impedance measurements using right ventricular (RV) leads can monitor congestion due to heart failure. We previously reported on a three-fold advantage of bipolar left ventricular (LV) leads, which are near the lung, over RV leads in detecting pulmonary edema with impedance. A combined system of internal and external electrodes is now investigated using computer models, for use with conventional cardiac resynchronization (CRT) systems with unipolar LV leads. The system uses the normal LV pacing pulse as current source, and the resultant voltage at two skin electrodes to obtain a lung edema impedance (Z) measurement. Using gated MRIs, thoracic computer models of 3.8 million control volumes were constructed. Changes of Z with edema were simulated with a conventional totally implanted system, as well as with combined implanted-external systems. Right atrial (RA), RV, RV defibrillator coil and LV leads were used. Per cent Z responses to edema were compared. The all implanted responses were RA: 11.8%, RV: 8.6%, RVcoil: 11.3%, LV: 23.8%. The combined system responses were LV-ext: 21.45%, RA-ext: 10.13%, LV-arm leg: 26.08%. The computer models suggest that combined internal-external systems can be as sensitive as the totally implanted ones. Lung edema may be monitored at follow up or home for LV paced patients with only two external electrodes. Using very low impedance configurations optimized by computer can greatly maximize the response, with a cost of poor stability

44. Belalleazar Andres R, Patterson R: **Monitoring lung edema using the pacemaker pulse and skin electrodes.**
Abstract: Previous clinical studies have shown that impedance measurements using right ventricular (RV) leads can monitor congestion due to heart failure. We previously reported on a three-fold advantage of bipolar left ventricular (LV) leads, which are near the lung, over RV leads in detecting pulmonary edema with impedance. A combined system of internal and external electrodes is now investigated using computer models, for use with conventional cardiac resynchronization (CRT) systems with unipolar LV leads. The system uses the normal LV pacing pulse as current source, and the resultant voltage at two skin electrodes to obtain a lung edema impedance (Z) measurement. Using gated MRIs, thoracic computer models of 3.8 million control volumes were constructed. Changes of Z with edema were simulated with a conventional totally implanted system, as well as with combined implanted-external systems. Right atrial (RA), RV, RV defibrillator coil and LV leads were used. Per cent Z responses to edema were compared. The all implanted responses were RA: 11.8%, RV: 8.6%, RVcoil: 11.3%, LV: 23.8%. The combined system responses were LV-ext: 21.45%, RA-ext: 10.13%, LV-arm leg: 26.08%. The computer models suggest that combined internal-external systems can be as sensitive as the totally implanted ones. Lung edema may be monitored at follow up or home for LV paced patients with only two external electrodes. Using very low impedance configurations optimized by computer can greatly maximize the response, with a cost of poor stability

45. Berberian G, Quinn TA, Kanter JP, Curtis LJ, Cabreriza SE, Weinberg AD *et al*.: **Optimized biventricular pacing in atrioventricular block after cardiac surgery.** *Annals of thoracic surgery* 2005, 80(3)**:** 870-875.
Abstract: BACKGROUND: Temporary pacing is required after open-heart surgery for treatment of heart block. Atrioventricular delay and ventricular pacing site might be manipulated to increase cardiac output. We hypothesized that by optimizing both atrioventricular delay and ventricular pacing site a 10% improvement in cardiac output would be observed compared with a standard pacing protocol. METHODS: Seven patients in first or third degree heart block after valve replacement surgery had temporary wires sewn to the right atrium, right ventricle, and left ventricle. Cardiac output was measured by

integrating flow velocity from an ultrasonic aortic flow probe. After optimization of atrioventricular delays during atrial synchronous right ventricular pacing, the effects of ventricular pacing site were tested at the optimum atrioventricular delay for 10-second intervals. RESULTS: Biventricular pacing was beneficial in all patients with a mean increase of 22% in cardiac index over right ventricular pacing (1.95 L/min/m2 +/- 0.27 standard error of the mean (SEM) to 2.38 L/min/m2 +/- 0.27 SEM, p = 0.0012) and 14% over left ventricular pacing (2.08 L/min/m2 +/- 0.22 SEM to 2.38 L/min/m2 +/- 0.27 SEM, p = 0.0133). Comparing optimized with standard pacing for 30-second intervals yielded a mean increase of 10% in cardiac index over three respiratory cycles (2.87 L/min/m2 +/- 0.33 SEM to 2.60 L/min/m2 +/- 0.37 SEM, p = 0.009) and 17% at the corresponding end-expiratory beats (2.76 L/min/m2 +/- 0.33 SEM to 2.36 L/min/m2 +/- 0.36 SEM, p = 0.011). CONCLUSIONS: Biventricular pacing at optimum atrioventricular delay improves cardiac output in patients with postoperative heart block by at least 10% compared with standard pacing

46. Berberian G, Kanter JP, Quinn TA, Spotnitz HM: **Optimized perioperative biventricular pacing in setting of right heart failure.** *Europace - European pacing, arrhythmias , and cardiac electrophysiology - journal of the working groups on cardiac pacing, arrhythmias , and cardiac cellular electrophysiology of the European Society of Cardiology* 2005, 7(4)**:** 385-387.
Abstract: AIMS: A 78-year-old female with prior atrioventricular junctional ablation for paroxysmal atrial fibrillation and implantation of DDDR pacemaker underwent repair of severe tricuspid insufficiency. Effects of biventricular pacing were tested with temporary wires at the conclusion of cardiopulmonary bypass. METHODS: An ultrasonic flow probe was placed on the ascending aorta for real time cardiac output measurements. Atrioventricular delay optimization was performed and biventricular pacing was initiated while right-left ventricular delays were varied. RESULTS: There was no advantage of biventricular pacing (optimum right-left ventricular delay of +80 ms) compared with existing DDD. CONCLUSIONS: This study confirms the physiological effects of right-left ventricular delay on cardiac output after cardiopulmonary bypass

47. Berberian G, Quinn TA, Cabreriza SE, Garofalo CA, Barrios DM, Weinberg AD *et al*.: **Load dependence of cardiac output in biventricular pacing: left ventricular volume overload in pigs.** *Journal of thoracic and cardiovascular surgery* 2006, 131(3)**:** 666-670.
Abstract: OBJECTIVE: Previous work from our laboratory has demonstrated that optimization of biventricular pacing is load dependent. Cardiac output was maximized with a ventricular-ventricular delay of +40 milliseconds (right ventricle-first pacing) during right ventricular pressure overload and with a ventricular-ventricular delay of -40 milliseconds (left ventricle-first pacing) during right ventricular volume overload. We hypothesized that a model of left ventricular volume overload would also have specific timing requirements during biventricular pacing for optimization of cardiac output. METHODS: After median sternotomy in 6 anesthetized pigs, complete heart block was induced by ethanol ablation. A conduit was grafted from the left ventricle to the left atrium to produce left ventricular volume overload. An ultrasonic flow probe was placed around the conduit to measure retrograde flow that averaged 50% of cardiac output. During epicardial atrial tracking DDD biventricular pacing, atrioventricular delay was varied between 60 and 270 milliseconds in 30-millisescond increments for 20-second intervals. After determination of optimum atrioventricular delay, ventricular-ventricular delay was varied in 20-millisecond increments from +80 to -80 milliseconds for 20-second intervals. RESULTS: Ventricular-ventricular delays had no significant effect on cardiac output with the graft clamped (control). With the graft unclamped, however, there was a statistically significant (P = .0001 by repeated-measures analysis of variance) trend toward higher cardiac output with right ventricle-first pacing. CONCLUSIONS: Right ventricle-first pacing in swine significantly increased cardiac output during acute left ventricular volume overload, but not during the control state. Understanding load-specific pacing requirements will facilitate the development of perioperative temporary biventricular pacing for acute heart failure

48. Berger RD: **ICD update: New evidence and emerging clinical roles in primary prevention of sudden cardiac death.** *Advanced Studies in Medicine (ADV STUD MED)* /20, ADV.
Abstract: AB- PURPOSE: To review recent major randomized trials of implantable cardioverter-defibrillators (ICDs) and discuss the impact of their results on evolving ICD indications. EPIDEMIOLOGY: Sudden cardiac deaths (SCDs) occur about 6 to 9 x more frequently in patients with heart failure (HF) than in patients without HF, and about 550 000 new HF cases are diagnosed every year. REVIEW SUMMARY: Efficacy of ICDs in patients who have already had life-threatening ventricular arrhythmias is well established. More recent evidence that shows ICD efficacy in primary prevention (ie, patients at high risk of first cardiac arrests, such as patients with prior myocardial infarction [MI] and low left ventricular ejection fraction [LVEF]) has suddenly expanded the potential clinical role of these expensive devices. Most significantly, the Multicenter Automatic Defibrillator Implantation Trial (MADIT)-II showed a 31% reduction in mortality with ICDs in patients with prior MI, LVEF of <=30%, and New York Heart Association (NYHA) Class I-III disease; the Sudden Cardiac Death in Heart Failure Trial (SCD-HeFT) demonstrated a 23% reduction in mortality with ICDs in patients with ischemic or nonischemic cardiomyopathy, LVEF of <=35%, and NYHA Class II or III disease; and the Comparison of Medical Therapy, Pacing, and Defibrillation in Heart Failure (COMPANION) trial showed a 36% reduction in mortality with a device that combined ICD functions with resynchronization in patients with intraventricular conduction delays. TYPE OF AVAILABLE EVIDENCE: Unstructured review of randomized-controlled trials. GRADE OF AVAILABLE EVIDENCE: Good. CONCLUSION: ICDs reduce mortality in patients with cardiomyopathy, NYHA Class II-III disease, and LVEF of <=35% (or Class I with LVEF of <=30%). ICDs with resynchronization functionality reduce mortality in patients with LVEF of <=35%, NYHA Class III-IV disease, and ventricular dyssynchrony. Although ICDs are cost effective relative to other common cardiovascular treatments, the societal costs associated with more widespread use of ICDs warrant development of evidence-based patient risk-stratification methods

49. Berger T, Hanser F, Hintringer F, Poelzl G, Fischer G, Modre R *et al.*: **Effects of cardiac resynchronization therapy on ventricular repolarization in patients with congestive heart failure.** *Journal of cardiovascular electrophysiology* 2005, 16(6)**:** 611-617.
Abstract: INTRODUCTION: Biventricular pacing has been shown to improve the clinical status of patients with congestive heart failure, but little is known about its influence on ventricular repolarization. The aim of our study was to evaluate the effect of biventricular pacing on ECG markers of ventricular repolarization in patients with congestive heart failure. METHODS AND RESULTS: Twenty-five patients with congestive heart failure, sinus rhythm (SR), and complete LBBB (6 females; age 61 +/- 8 years; NYHA class II-III; echocardiographic ejection fraction 21 +/- 5%; QRS > or = 130 ms) underwent permanent biventricular DDDR pacemaker implantation. A high-resolution 65-lead body-surface ECG recording was performed at baseline and during right-, left-, and biventricular pacing, and the total 65-lead root mean square curve of the QRST complex and the interlead QT dispersion were assessed. The QRS duration was increased during right (RV)- and left ventricular (LV) pacing (127 +/- 26% and 117 +/- 40%; P < 0.05), as compared to SR (100%) and biventricular pacing (93 +/- 16%; ns). The QTc interval was increased during RV and LV pacing (112 +/- 12% and 114 +/- 14%; P < 0.05) as compared to SR (100%) or biventricular pacing (99 +/- 12%). There was no effect on JT interval during all pacing modes. The T(peak-end) interval was increased during right (120 +/- 34%; P < 0.01) and LV pacing (113 +/- 29%; P < 0.05) but decreased during biventricular pacing (81 +/- 19%; P < 0.01). A similar effect was found for the T(peak-end) integral and the T(peak) amplitude. QT dispersion was increased during right ventricular (129 +/- 16 ms; P < 0.05) and decreased during biventricular pacing (90 +/- 12 ms; P < 0.01), as compared to SR (114 +/- 22 ms). CONCLUSIONS: Using a high-resolution surface ECG, biventricular pacing resulted in a significant reduction of ECG markers of ventricular dispersion of repolarization

50. Bernheim A, Ammann P, Sticherling C, Burger P, Schaer B, Brunner-La Rocca Hans Peter *et al*.: **Right atrial pacing impairs cardiac function during resynchronization therapy: acute effects of DDD pacing compared to VDD pacing.** *Journal of the American College of Cardiology* 2005, 45(9)**:** 1482-1487.
Abstract: OBJECTIVES: We aimed to compare the hemodynamic effects of right-atrial-paced (DDD) and right-atrial-sensed (VDD) biventricular paced rhythm on cardiac resynchronization therapy (CRT). BACKGROUND: Cardiac resynchronization therapy improves hemodynamics in patients with severe heart failure and left ventricular (LV) dyssynchrony. However, the impact of active right atrial pacing on resynchronization therapy is unknown. METHODS: Seventeen CRT patients were studied 10 months (range: 1 to 46 months) after implantation. At baseline, the programmed atrioventricular delay was optimized by timing LV contraction properly at the end of atrial contraction. In both modes the acute hemodynamic effects were assessed by multiple Doppler echocardiographic parameters. RESULTS: Compared to DDD pacing, VDD pacing resulted in much better improvement of intraventricular dyssynchrony assessed by the septal-to-posterior wall motion delay (VDD 106 +/- 83 ms vs. DDD 145 +/- 95 ms; p = 0.001), whereas the interventricular mechanical delay (difference between onset of pulmonary and aortic outflow) did not differ (VDD 20 +/- 21 ms vs. DDD 18 +/- 17 ms; p = NS). Furthermore, VDD pacing significantly prolonged the rate-corrected LV filling period (VDD 458 +/- 123 ms vs. DDD 371 +/- 94 ms; p = 0.0001) and improved the myocardial performance index (VDD 0.60 +/- 0.18 vs. DDD 0.71 +/- 0.23; p < 0.01). CONCLUSIONS: Our findings suggest that avoidance of right atrial pacing results in a higher degree of LV resynchronization, in a substantial prolongation of the LV filling period, and in an improved myocardial performance. Thus, the VDD mode seems to be superior to the DDD mode in CRT patients

51. Birnie David R, Burnes JE, Ruddy T, Dalipaj M, Nazneen L, Gollob M *et al*.: **Utility of novel Radionuclide angiography image derived synchrony parameters in patients receiving cardiac resynchronization therapy (CRT).**

52. Birnie DH, Tang AS: **The problem of non-response to cardiac resynchronization therapy.** *Current opinion in cardiology* 2006, 21(1)**:** 20-26.
Abstract: PURPOSE OF REVIEW: Cardiac resynchronization therapy improves quality of life, exercise performance, left ventricular ejection fraction, and reduces heart failure hospitalizations and mortality in patients with New York Heart Association class III or IV congestive heart failure and intraventricular conduction delay. A number of key clinical research questions remain, perhaps most importantly the issue of why apparently suitable patients do not respond to cardiac resynchronization therapy. These issues are also relevant to patients who do respond to cardiac resynchronization therapy as potentially their response might be further increased. This article will review the data regarding the frequency of the problem of non-response to cardiac resynchronization therapy and then discuss the postulated reasons and potential solutions. RECENT FINDINGS: Rates of non-response to cardiac resynchronization therapy are often quoted as 20-30%, but a critical analysis of the data would suggest the true non-responder rate can be estimated as perhaps 40-50%. The data indicate that on a population basis non-response is multi-factorial and the extent of mechanical dyssynchrony, left ventricular pacing site and cause of congestive heart failure are likely to be important. Ongoing research is exploring the utility of various techniques for quantifying mechanical dyssynchrony and the potential benefits of targeted left ventricular lead placement and post-implant optimization. SUMMARY: Cardiac resynchronization therapy is a major breakthrough in treatment for advanced congestive heart failure patients. There is substantial rate of non-response to this therapy, however, and research is exploring various ways to increase the response to the technique

53. Bjerregaard P, Gussak I: **Short QT syndrome.** *Annals of Noninvasive Electrocardiology (ANN NONINVASIVE ELECTROCARDIOL)* /20, ANN.
Abstract: AB- Short QT syndrome (SQTS) is an inheritable primary electrical disease of

the heart, discovered in 1999. It is characterized by an abnormally short QT interval (<300 ms) and a propensity to atrial fibrillation and sudden cardiac death (SCD). Like in the case of long QT syndrome there is more than one genetic mutation that can lead to a short QT interval in the ECG and so far two have been identified. Shortening of the effective refractory period combined with increased dispersion of repolarization is the likely substrate for reentry and life threatening tachyarrhythmias. Only 22 people have been classified as having SQTS: 15 from the actual measurement of a short QT interval in their ECG and 7 by history, all having died from SCD. It is very likely that several cases, especially among children, have been overlooked, since the shortness of the QT interval only becomes apparent at heart rates <80 beats/min. The best form of treatment is still not known, but prevention of atrial fibrillation has been accomplished by propafenone, and an implantable cardioverter defibrillator is recommended for prevention of SCD

54. Bleeker GB, Schalij MJ, Molhoek SG, Boersma E, Steendijk P, van der Wall EE *et al.*: **Comparison of effectiveness of cardiac resynchronization therapy in patients <70 versus > or =70 years of age.** *American journal of cardiology* 2005, 96(3)**:** 420-422.
Abstract: In the present study, the effects of cardiac resynchronization therapy (CRT) in elderly patients were evaluated. The study included 170 consecutive patients whose clinical and echocardiographic improvements were evaluated after 6 months of follow-up. Survival was evaluated up to 2 years. The effects of CRT in elderly patients (age > or =70 years) were compared with those in younger patients (age <70 years)

55. Bleeker GB, Schalij MJ, Nihoyannopoulos P, Steendijk P, Molhoek SG, van EL *et al.*: **Left ventricular dyssynchrony predicts right ventricular remodeling after cardiac resynchronization therapy.** *Journal of the American College of Cardiology* 2005, 46(12)**:** 2264-2269.
Abstract: OBJECTIVES: The purpose of this research was to evaluate right ventricular (RV) remodeling after six months of cardiac resynchronization therapy (CRT). BACKGROUND: Cardiac resynchronization therapy is beneficial in patients with end-stage heart failure. The effect of CRT on RV size is currently unknown. Accordingly, the effects of CRT on RV size, severity of tricuspid regurgitation, and pulmonary artery pressure were evaluated. METHODS: Fifty-six consecutive patients with end-stage heart failure (52% ischemic cardiomyopathy), left ventricular (LV) ejection fraction (EF) < or =35%, QRS duration >120 ms, and left bundle branch block were included. Clinical parameters, LV volumes, LVEF, LV dyssynchrony, and RV chamber size were assessed at baseline and after six months of CRT; LV dyssynchrony was assessed using tissue Doppler imaging. RESULTS: Clinical parameters improved significantly; LV dyssynchrony was acutely reduced after CRT and remained unchanged at six-month follow-up. Left ventricular EF improved significantly from 19 +/- 6% to 26 +/- 8% ($p < 0.001$), and LV end-diastolic volume decreased from 257 +/- 98 ml to 227 +/- 86 ml ($p < 0.001$). Right ventricular annulus decreased significantly from 37 +/- 9 mm to 32 +/- 10 mm, RV short-axis from 29 +/- 11 mm to 26 +/- 7 mm, and RV long-axis from 89 +/- 11 mm to 82 +/- 10 mm (all $p < 0.001$). Left ventricular and RV reverse remodeling were only observed in patients with substantial LV dyssynchrony at baseline. Finally, significant reductions in severity of tricuspid regurgitation and pulmonary artery pressure were observed. CONCLUSIONS: Cardiac resynchronization therapy results in significant reverse LV and RV remodeling after six months of CRT in patients with LV dyssynchrony. Moreover, CRT leads to a reduction of the severity of tricuspid regurgitation and a decrease in pulmonary artery pressure

56. Bleeker GB, Schalij MJ, Boersma E, Steendijk P, van der Wall EE, Bax JJ: **Does a gender difference in response to cardiac resynchronization therapy exist?** *Pacing and clinical electrophysiology - PACE* 2005, 28(12)**:** 1271-1275.
Abstract: BACKGROUND: Cardiac resynchronization therapy (CRT) has a beneficial effect on clinical symptoms, exercise capacity, and systolic left ventricular (LV) performance in patients with heart failure. The aim of the current study was to evaluate

whether a gender difference exists in response to CRT. METHODS: Consecutive patients with end-stage heart failure (New York Heart Association, NYHA, class III-IV), LV ejection fraction (LVEF) < or =35%, QRS duration >120 ms, and left bundle branch block configuration underwent CRT. At baseline and 6 months post-CRT, clinical and echocardiographic parameters were evaluated; follow-up was obtained up to 5 years. The effects of CRT were compared between women and men. RESULTS: The study population comprised 137 men and 36 women (mean age 66 +/- 11 years). No differences in baseline characteristics were observed except that nonischemic cardiomyopathy was more frequent in women than men (67% vs 38%, P < 0.05). In all patients, clinical and echocardiographic parameters improved significantly at 6-month follow-up. The magnitude of improvement in different parameters was similar between women and men, e.g., the improvement in NYHA Class was 0.9 +/- 0.6 in women and 1.0 +/- 0.7 in men (NS) and the increase in LVEF was 8 +/- 8% in women as compared to 7 +/- 9% in men (NS). The percentage of individual responders was not different between women and men (76% vs 80%, NS) and 2-year survival was comparable for women and men (84% vs 80%, NS). CONCLUSION: No gender differences were observed in response to CRT and long-term survival after CRT

57. Bleeker GB, Kaandorp Theodorus AM, Lamb HJ, Boersma E, Steendijk P, de RA *et al.*: **Effect of posterolateral scar tissue on clinical and echocardiographic improvement after cardiac resynchronization therapy.** *Circulation* 2006, 113(7)**:** 969-976.
Abstract: BACKGROUND: Currently, one third of patients treated with cardiac resynchronization therapy (CRT) do not respond. Nonresponse to CRT may be explained by the presence of scar tissue in the posterolateral left ventricular (LV) segments, which may result in ineffective LV pacing and inadequate LV resynchronization. In the present study, the relationship between transmural posterolateral scar tissue and response to CRT was evaluated. METHODS AND RESULTS: Forty consecutive patients with end-stage heart failure (NYHA class III/IV), LV ejection fraction < or =35%, QRS duration >120 ms, left bundle-branch block, and chronic coronary artery disease were included. The localization and transmurality of scar tissue were evaluated with contrast-enhanced MRI. Next, LV dyssynchrony was assessed at baseline and immediately after implantation with tissue Doppler imaging. Clinical parameters, LV volumes, and LV ejection fraction were assessed at baseline and at a 6-month follow-up. Fourteen patients (35%) had a transmural (>50% of LV wall thickness) posterolateral scar. In contrast to patients without posterolateral scar tissue, these patients showed a low response rate (14% versus 81%; P<0.05) and did not show improvement in clinical or echocardiographic parameters. In addition, LV dyssynchrony remained unchanged after CRT implantation (84+/-46 versus 78+/-41 ms; P=NS). Patients without posterolateral scar tissue and severe baseline dyssynchrony (> or =65 ms) showed an excellent response rate of 95% compared with patients with a posterolateral scar and/or absent LV dyssynchrony (11%). CONCLUSIONS: CRT does not reduce LV dyssynchrony in patients with transmural scar tissue in the posterolateral LV segments, resulting in clinical and echocardiographic nonresponse to CRT

58. Bleeker GB, Bax JJ, Fung JW-H, van der Wall EE, Zhang Q, Schalij MJ *et al.*: **Clinical versus echocardiographic parameters to assess response to cardiac resynchronization therapy.** *American journal of cardiology* 2006, 97(2)**:** 260-263.
Abstract: Currently, a clear definition of response to cardiac resynchronization therapy (CRT) is still lacking, and clinical and echocardiographic end points are used. It is also unclear whether patients with clinical responses also improve in echocardiographic end points (and vice versa). To better understand and define response to CRT, the relation between improvement in clinical and echocardiographic parameters was evaluated in 144 patients

59. Bleeker GB, Schalij MJ, Holman ER, Steendijk P, van der Wall EE, Bax JJ: **Cardiac resynchronization therapy in patients with systolic left ventricular dysfunction and symptoms of mild heart failure secondary to ischemic or nonischemic**

cardiomyopathy. *American journal of cardiology* 2006, 98(2)**:** 230-235.
Abstract: Cardiac resynchronization therapy (CRT) is beneficial in selected patients with moderate to severe heart failure (New York Heart Association [NYHA] classes III to IV). Patients with mildly symptomatic heart failure (NYHA class II) are currently not eligible for CRT and the potential beneficial effects in these patients have not been well studied. Fifty consecutive patients in NYHA class II heart failure and 50 consecutive patients in NYHA classes III to IV (control group) were prospectively included. All patients had left ventricular (LV) ejection fraction<or=35% and QRS duration>120 ms. The effects of CRT in NYHA class II patients were compared with the results obtained in both groups. The severity of baseline LV dyssynchrony (assessed with color-coded tissue Doppler imaging) was comparable between patients in NYHA class II versus those in NYHA classes III to IV (83+/-49 vs 96+/-51 ms, p=NS); resynchronization was achieved in all patients. NYHA class II patients showed a significant improvement in LV ejection fraction (from 25+/-7% to 33+/-10%, p<0.001) and reduction in LV end-systolic volume (from 168+/-55 to 132+/-51 ml, p<0.001) after CRT, similar to patients in NYHA classes III to IV. In addition, only 8% of NYHA class II patients had progression of heart failure symptoms. In conclusion, CRT had comparable effects in patients in NYHA class II and in NYHA classes III to IV heart failure in terms of LV resynchronization, improvement in LV ejection fraction, and LV reverse remodeling

60. Block M, Adler K, Bromsen J, Schmidt M: **Cardiac resynchronization therapy <Original> Kardiale resynchronisationstherapie.** *MMW-Fortschritte der Medizin (MMW-FORTSCHR MED)* /20, MMW-FORTSCHR.
Abstract: AB- Severe cardiac insufficiency with a clearly diminished contraction of the left ventricle is often accompanied by a pronounced left bundle branch block in the EKG. The early and late activated sides of the ventricular walls contract asynchronously, further decreasing the cardiac output. Resynchronization can be achieved through a biventricular pacemaker, which simultaneously stimulates the early and late sides of the ventricular walls. In addition to the electrode usually placed in the tip of the right ventricle, a second electrode is placed on the lateral wall of the left ventricle. This normally leads to an immediate small increase in the blood pressure and to an increased functional capacity. For patients with asynchrony of the left ventricle, an improvement of the cardiac insufficiency by approximately a half of an NYHA class and a decrease in the yearly mortality by 4% has been documented

61. Block M, Bromsen J: **Effect of CRT on morbidity and mortality <Original> Effekt von crt auf morbiditat und mortalitat.** *Herzschrittmachertherapie und Elektrophysiologie (HERZSCHRITTMACHERTHER ELEKTROPHYSIOL)* /20, HERZSCHRITTMACHERTHER.
Abstract: AB- Patients with chronic heart failure who show a left ventricular ejection fraction <=35% and remain in NYHA class III or IV despite optimal pharmacologic treatment show less morbidity and mortality on cardiac resynchronization therapy (CRT) if the left ventricle shows asynchrony. Although only one study has shown a significant reduction of mortality about 4% less deaths per year in the first two years can be resumed. Procedure related mortality is less than 1%. By improving on average one NYHA class 10-20% less patients experience hospitalization due to heart failure in the first two years after implantation of a CRT device. Patients who are hospitalized despite CRT have on average a hospital stay below 5 days. At least 10% of patients are currently suffering surgical revisions due to infections, dislocations and high pacings thresholds of the left ventricular lead. If costs saved by less hospitalization can finance costs of CRT or even exceed the costs of CRT remains unknown. (c) Steinkopff Verlag 2005

62. Block M, Adler K, Bromsen J, Schmidt M: **[Cardiac resynchronization therapy] <Original> Geordnete Erregung fur eine okonomischere Herzarbeit.** *MMW Fortschritte der Medizin* 2005, 147(35-36)**:** 30-33.
Abstract: Severe cardiac insufficiency with a clearly diminished contraction of the left

ventricle is often accompanied by a pronounced left bundle branch block in the EKG. The early and late activated sides of the ventricular walls contract asynchronously, further decreasing the cardiac output. Resynchronization can be achieved through a biventricular pacemaker, which simultaneously stimulates the early and late sides of the ventricular walls. In addition to the electrode usually placed in the tip of the right ventricle, a second electrode is placed on the lateral wall of the left ventricle. This normally leads to an immediate small increase in the blood pressure and to an increased functional capacity. For patients with asynchrony of the left ventricle, an improvement of the cardiac insufficiency by approximately a half of an NYHA class and a decrease in the yearly mortality by 4% has been documented

63. Block M, Bromsen J: **[Effect of CRT on morbidity and mortality] <Original> Effekt von CRT auf Morbiditat und Mortalitat.** *Herzschrittmachertherapie & Elektrophysiologie* 2005, 16(1)**:** 32-37.
Abstract: Patients with chronic heart failure who show a left ventricular ejection fraction < or =35% and remain in NYHA class III or IV despite optimal pharmacologic treatment show less morbidity and mortality on cardiac resynchronization therapy (CRT) if the left ventricle shows asynchrony. Although only one study has shown a significant reduction of mortality about 4% less deaths per year in the first two years can be resumed. Procedure related mortality is less than 1%. By improving on average one NYHA class 10-20% less patients experience hospitalization due to heart failure in the first two years after implantation of a CRT device. Patients who are hospitalized despite CRT have on average a hospital stay below 5 days. At least 10% of patients are currently suffering surgical revisions due to infections, dislocations and high pacing thresholds of the left ventricular lead. If costs saved by less hospitalization can finance costs of CRT or even exceed the costs of CRT remains unknown

64. Bocker D, Gradaus R: **[Cardiac resynchronization therapy and arrhythmias] <Original> Kardiale Resynchronisationstherapie und Arrhythmien.** *Herzschrittmachertherapie & Elektrophysiologie* 2005, 16(1)**:** 28-31.
Abstract: Cardiac resynchronization therapy (CRT) is now considered an established therapy for patients with chronic heart failure in the presence of a wide QRS complex.Though proarrhythmic effects have been described in a few cases, CRT did not increase the frequency of ventricular tachyarrhythmias in prospective studies. In patients on CRT therapy, persistent atrial fibrillation sometimes converts back to sinus rhythm, possibly dependent on the duration of atrial fibrillation

65. Bordachar P, Lafitte S, Reuter S, Serri K, Garrigue S, Laborderie J *et al*.: **Echocardiographic assessment during exercise of heart failure patients with cardiac resynchronization therapy.** *American journal of cardiology* 2006, 97(11)**:** 1622-1625.
Abstract: This prospective echocardiographic study investigated the respective impacts of left ventricular (LV) pacing and simultaneous and sequential biventricular pacing (BVP) on ventricular dyssynchrony during exercise in 23 patients with compensated heart failure and ventricular conduction delays. During exercise, LV pacing and BVP significantly ($p < 0.05$) improved mitral regurgitation and LV dyssynchrony compared with spontaneous activation. LV segmental electromechanical delays were significantly prolonged during LV pacing, leading to increased systolic time ($p < 0.05$), decreased LV filling time ($p < 0.05$), and decreased stroke volume ($p < 0.05$) compared with BVP. After optimization of the interventricular delay with sequential BVP, additional benefit was obtained during exercise in terms of stroke volume and mitral regurgitation ($p < 0.05$). The optimal interventricular delay was different at rest and during exercise in 57% of the patients. Changes from at rest to exercise in LV dyssynchrony were correlated with changes in stroke volume ($r = -0.61$, $p < 0.01$) and changes in mitral regurgitation ($r = 0.60$, $p < 0.01$)

66. Borges AC, Knebel F, Eddicks S, Bondke H-J, Baumann G: **Echocardiographic evaluation to select patients for cardiac resynchronization therapy**

<Original> Echokardiographische methoden zur selektion fur die kardiale resynchronisationstherapie: Sind tissue doppler, stra. *Herzschrittmachertherapie und Elektrophysiologie (HERZSCHRITTMACHERTHER ELEKTROPHYSIOL)* /20, HERZSCHRITTMACHERTHER.
Abstract: AB- Wide QRS complex and asynchronous myocardial contraction in heart failure are associated with poor prognosis. Resynchronization can be achieved by biventricular pacing (BVP), which leads to hemodynamic and clinical improvement and reverse remodeling, and may improve survival. However, there is a substantial subset of patients with wide QRS complexes in the electrocardiogram who does not improve despite BVP, and there are findings which suggest that resynchronization therapy may be also beneficial for heart failure patients with normal QRS duration. QRS width predicts the benefit of BVP only with limitation and only correlates weakly with echocardiographically determined myocardial asynchrony. Determination of asynchrony by tissue Doppler echocardiography seems to be the best predictor for improvement after BVP, although no consensus on the optimal method to assess asynchrony has yet been achieved. To date, most studies evaluating tissue Doppler echo in BVP were performed retrospectively and only one prospective study with patient selection for BVP according to echocardiography and electrocardiography criteria of asynchrony has been published. These new echocardiographic tools will help to prospectively select patients for BVP, help to guide implantation and to optimize device programming

67. Borges AC, Knebel F, Eddicks S, Bondke H-J, Baumann G: **[Echocardiographic evaluation to select patients for cardiac resynchronization therapy] <Original> Echokardiographische Methoden zur Selektion fur die kardiale Resynchronisationstherapie -- Sind Tissue Doppler, Strain- und Strainrate-Imaging und 3D-Echokardiographie die ultimativen Methoden?** *Herzschrittmachertherapie & Elektrophysiologie* 2006, 17 Suppl 1 I63-I72.
Abstract: Wide QRS complex and asynchronous myocardial contraction in heart failure are associated with poor prognosis. Resynchronization can be achieved by biventricular pacing (BVP), which leads to hemodynamic and clinical improvement and reverse remodeling, and may improve survival. However, there is a substantial subset of patients with wide QRS complexes in the electrocardiogram who does not improve despite BVP, and there are findings which suggest that resynchronization therapy may be also beneficial for heart failure patients with normal QRS duration. QRS width predicts the benefit of BVP only with limitation and only correlates weakly with echocardiographically determined myocardial asynchrony. Determination of asynchrony by tissue Doppler echocardiography seems to be the best predictor for improvement after BVP, although no consensus on the optimal method to assess asynchrony has yet been achieved. To date, most studies evaluating tissue Doppler echo in BVP were performed retrospectively and only one prospective study with patient selection for BVP according to echocardiography and electrocardiography criteria of asynchrony has been published. These new echocardiographic tools will help to prospectively select patients for BVP, help to guide implantation and to optimize device programming

68. Boriani G, Fallani F, Martignani C, Biffi M, Saporito D, Greco C *et al.*: **Cardiac resynchronization therapy: effects on left and right ventricular ejection fraction during exercise.** *Pacing and clinical electrophysiology - PACE* 2005, 28 Suppl 1 S11-S14.
Abstract: In patients with heart failure and wide QRS complex, cardiac resynchronization therapy (CRT) is associated with improvement of symptoms and cardiac function. This study examined the effects of a 3-month period of CRT on left ventricular (LV) and right ventricular (RV) ejection fraction (EF) and on LV volumes, both at rest and during exercise. A CRT system was implanted in 15 patients with severe heart failure and wide QRS. Before implant and 3 months later, all patients underwent assessment of cardiac performance with equilibrium Tc(99) radionuclide angiography with imaging in the best septal left anterior oblique view. Exercise was performed on a bicycle ergometer. At 3 months, a significant improvement in New York Heart Association functional class was

observed, and radionuclide angiography showed a significant decrease in LV volumes and a significant increase in LVEF at rest, as well as a significant increase in LVEF during exercise. The remodeling processes associated with CRT did not appear to include RV function, since RVEF did not improve, and changes in RVEF did not correlate with changes in LVEF, neither at rest nor during exercise

69. Boriani G, Biffi M, Martignani C, Ziacchi M, Saporito D, Grigioni F *et al*.: **Electrocardiographic remodeling during cardiac resynchronization therapy.** *International journal of cardiology* 2006, 108(2)**:** 165-170.
Abstract: BACKGROUND: More information is required on the relationship between electrical and structural reverse remodeling in patients treated with cardiac resynchronization therapy. METHODS: QRS and JT intervals were investigated during different pacing modes before and 3 months after implantation of a device for biventricular (BiV) pacing in 20 patients with severe drug-refractory heart failure (with left ventricular ejection fraction < 40% and QRS > 120 ms); structural remodeling was evaluated by echocardiography. RESULTS: QRS interval was significantly shortened by BiV pacing both acutely (p=0.002) and at 3 months (p=0.007). No significant change was found in the JT interval. The extent of QRS shortening obtained by BiV pacing showed moderate correlations with the reduction of end-systolic and end-diastolic volumes (r=0.53, p=0.016 and r=0.45, p=0.045, respectively) as well as with increase of left ventricular ejection fraction (r=0.49, p=0.028) at 3 months. The widening of QRS observed during right ventricular (RV) pacing was greater after 3 months of BiV pacing (with respect to acute assessments), suggesting accentuation of pacing-induced electrical dyssynchrony after a period of pacing-induced resynchronization. CONCLUSION: The extent of QRS shortening induced by BiV pacing appears to correlate with the reverse structural remodeling (in terms of reduction in end-systolic volume). The acute changes and the remodeling process occurring at mid-term in the overall population of CRT-treated patients do not appear to involve the JT interval. A period of pacing-induced resynchronization appears to accentuate the potential for RV pacing-driven electrical dyssynchrony

70. Boriani G, Saporito D, Biffi M, Martignani C, Valzania C, Diemberger I *et al*.: **Acute and chronic haemodynamic effects of biventricular pacing and of switching to different pacing modalities in heart failure patients.** *International journal of cardiology* 2006, 110(3)**:** 318-323.
Abstract: BACKGROUND: In patients with severe heart failure, sinus rhythm and wide QRS complex biventricular (BiV) pacing leads to clinical and haemodynamic improvement, but the immediate reversibility of these changes is not known. METHODS: We assessed the acute and medium-term (3-month) haemodynamic effects of BiV pacing and of switching to other pacing modalities in 21 patients with severe heart failure, sinus rhythm and QRS>or=130 ms. Haemodynamic studies were performed: 1) at the time of implantation of a BiV pacing device, during AAI pacing, atrial synchronous right ventricular (RV) pacing, atrial synchronous left ventricular (LV) pacing and atrial synchronous BiV pacing (all at 100 bpm); 2) after 3 months of continuous BiV pacing--with evaluations being made by switching to RV and the other pacing modalities. RESULTS: At both the acute and medium-term evaluations, BiV pacing provided the greatest improvement in cardiac index. Switching from BiV to RV pacing led to a more marked decrease in the cardiac index at 3 months. No strict correlation was evident between acute and medium-term effects of BiV pacing on cardiac index. CONCLUSION: Cardiac resynchronization by BiV pacing provides acute/medium-term improvements in cardiac index. Sudden, medium-term failure of LV stimulation can lead to an even more pronounced haemodynamic derangement than that inducible by RV pacing at baseline. Acute haemodynamic evaluations do not seem to provide a powerful way for identifying medium-term responders

71. Boriani G, Muller CP, Seidl KH, Grove R, Vogt J, Danschel W *et al*.: **Randomized comparison of simultaneous biventricular stimulation versus optimized**

interventricular delay in cardiac resynchronization therapy. The Resynchronization for the HemodYnamic Treatment for Heart Failure Management II implantable cardioverter defibrillator (RHYTHM II ICD) study. *American heart journal* 2006, 151(5)**:** 1050-1058.
Abstract: BACKGROUND: The clinical value of interventricular (V-V) delay optimization in patients with chronic congestive heart failure (CHF) undergoing implantation of a device for cardiac resynchronization therapy (CRT) has not been clearly demonstrated. METHODS: RHYTHM II was a single-blind randomized trial including 121 recipients of a device for CRT with cardioverter/defibrillator capabilities (CRT-D) randomly assigned in a 1:3 ratio to simultaneous (n = 30) versus optimized (OPT) (n = 91) biventricular pacing. V-V delay was optimized by echocardiography. The study end points were (1) freedom from CRT-D system-related complications and (2) changes between preimplant and 6 months of follow-up in (a) New York Heart Association CHF functional class, (b) distance covered during a 6-minute hall walk, and (c) quality of life (QOL). RESULTS: In the OPT group, the V-V delay ranged from 0 to 80 milliseconds, with 28.4% of patients stimulated at an OPT V-V delay of 0 milliseconds. The overall 6-month survival free of adverse events requiring invasive interventions was 81.8%. In the whole cohort, 6 months of CRT-D was associated with a significant decrease in New York Heart Association class, increase in the distance covered during the 6-minute hall walk, and improvement in QOL (each P < .0001). The effects of CRT-D on these end points were similar in both study groups. CONCLUSIONS: Cardioverter-defibrillator capabilities was associated with a significant alleviation of CHF symptoms, increase in functional capacity, and improvement in QOL. The optimization of the V-V delay conferred no additional benefit compared with simultaneous biventricular stimulation

72. Boriani G, Regoli F, Saporito D, Martignani C, Toselli T, Biffi M *et al*.: **Neurohormones and inflammatory mediators in patients with heart failure undergoing cardiac resynchronization therapy: time courses and prediction of response.** *Peptides* 2006, 27(7)**:** 1776-1786.
Abstract: Despite interest in neurohormonal activation as a determinant of prognosis in chronic heart failure (CHF) and as a target for pharmacological treatments, data are lacking on the time-related effects of electrical cardiac resynchronization therapy (CRT) on a broad spectrum of neurohormones and cytokines. The aim of this study was to assess time-courses and extents of changes within the neurohormonal profile of CHF patients treated with CRT. We performed a prospective follow-up study in 32 patients with NYHA class III-IV CHF to investigate the effects of CRT on a broad panel of neurohormones proposed for characterization of CHF patients. Levels of atrial and brain natriuretic peptides (ANP, BNP), epinephrine, norepinephrine, aldosterone, plasma renin activity, IL-6, TNF, soluble receptors sTNFR1 and 2, and chromogranin A were assessed before implantation and after 3 months of CRT; when feasible, measurements were also performed at 1 week, 1 month and 12 months (clinical evaluation, echocardiography and ECG were also performed at each time-point). The results showed that at 3 months improvement in NYHA class and echographically assessed left ventricular (LV) reverse structural remodeling were accompanied by significant reductions versus baseline in ANP and BNP, but not in other neurohormones. Moreover a baseline ANP concentration < or = 150 pg/ml was a good predictor of response to CRT in terms of NYHA class reduction and reverse LV remodeling. In conclusion 3 months of CRT significantly reduce natriuretic peptides concentrations, while values of other neurohormones and inflammatory cytokines are relatively unvaried. A baseline ANP concentration < or = 150 pg/ml might be a clinically useful predictor of medium-term response to CRT

73. Bornzin GA, Kroll MW: **System and methods for preventing, detecting, and terminating pacemaker mediated tachycardia in biventricular implantable cardiac stimulation device.**
Abstract: Various techniques are described for preventing pacemaker mediated tachycardia (PMT) within biventricular pacing systems and for detecting and terminating PMT should

it nevertheless arise. In a first prevention technique, refractory periods applied to the atrial channel are synchronized to begin with a second of a pair of ventricular pacing pulses to more effectively prevent T-wave oversensing on the atrial channel. In a second prevention technique, the sensitivity of the atrial channel is reduced during T-waves also to prevent T-wave oversensing. In a third prevention technique, template matching is performed on the ventricular channels to prevent T-wave oversensing. In a fourth prevention technique, T-wave detection windows are applied to both the ventricular and atrial channels subsequent to any paced or sensed events. In a first detection technique, PMT is detected based upon a degree of variation within V-pulse to P-wave pacing intervals. In a second detection technique, PMT is detected based upon a degree variation within ventricular pacing intervals. In either case, if the degree of variation is too low, indicative of PMT, ventricular refractory periods are expanded to terminate the PMT

74. Bortone A, Macia J, Leclercq F, Pasquie J: **Monomorphic ventricular tachycardia induced by cardiac resynchronization therapy in patient with severe nonischemic dilated cardiomyopathy.** *Pacing and clinical electrophysiology - PACE* 2006, 29(3)**:** 327-330.
Abstract: We report the case of a patient with severe nonischemic dilated cardiomyopathy in whom cardiac resynchronization therapy (CRT) was the source of incessant, drug-resistant, monomorphic ventricular tachycardia (VT). VT recurrences were only resolutive with inactivation of CRT and reactivation of CRT reproduced VT occurrence. The possible pathophysiology of the VT and the potential ventricular proarrhythmic risk related to CRT are discussed. This report points out clearly that CRT can induce ventricular arrhythmias and suggests the need for CRT systematically associated with a defibrillation system

75. Bosen DM, Ailing E: **Back on the beat: Cardiac resynchronization therapy.** *Nursing* 2006, 36(3)**:** 64cc1-64cc4.
Abstract: Find out how this therapy helps patients with heart failure made worse by conduction disturbances

76. Brandt RR, Reiner C, Arnold R, Sperzel J, Pitschner HF, Hamm CW: **Contractile response and mitral regurgitation after temporary interruption of long-term cardiac resynchronization therapy.** *European heart journal* 2006, 27(2)**:** 187-192.
Abstract: AIMS: Cardiac resynchronization therapy (CRT) utilizing biventricular pacing (BVP) is a promising treatment modality for symptomatic patients with chronic left ventricular (LV) systolic dysfunction and intraventricular conduction delay. Clinical studies have shown short-term improvement in contractile function and mid-term improvement in clinical status with CRT. The objective of this study was to evaluate the haemodynamic consequences of temporary interruption of CRT after long-term stimulation. METHODS AND RESULTS: Twenty patients (16 men, 4 women) with LV dysfunction and New York Heart Association class III or IV heart failure, despite optimal medical therapy and a QRS interval of at least 120 ms, received a transvenous BVP system at the age of 66 (interquartile range, 61-69). Patients were studied after a median duration of 427 days (interquartile range, 281-563) of continuous CRT and again 72 h after cessation of BVP. Withdrawal of CRT resulted in a significant decline in maximal rate of LV systolic pressure rise from 711 mmHg/s (interquartile range, 640-816) to 442 mmHg/s (interquartile range, 389-582) (P=0.0001) and increases in mitral effective regurgitant orifice area from 4.8 mm(2) (interquartile range, 0.0-7.8) to 9.1 mm(2) (interquartile range, 5.7-13.3) (P=0.0001), mitral regurgitant volume from 7.8 mL (interquartile range, 0.0-11.5) to 16.0 mL (interquartile range, 10.7-20.8) (P=0.0001) and fraction from 13.8% (interquartile range, 0.0-19.2) to 27.7% (interquartile range, 14.6-34.0) (P=0.0002) determined by Doppler echocardiography. CONCLUSION: Cessation of long-term BVP leads to a decline in LV systolic performance and an increase in functional mitral regurgitation. These results indicate a sustained benefit of long-term CRT and support the notion to maintain CRT indefinitely

77. Braun MU, Schnabel A, Rauwolf T, Schulze M, Strasser RH: **Impedance cardiography as a noninvasive technique for atrioventricular interval optimization in cardiac resynchronization therapy.** *Journal of interventional cardiac electrophysiology - an international journal of arrhythmias and pacing* 2005, 13(3)**:** 223-229.
Abstract: INTRODUCTION: Impedance cardiography (IC) and Doppler echocardiography (DE) are two noninvasive methods to evaluate hemodynamics in patients with dual-chamber pacemakers. The aim of the present study was to compare both techniques in respect to their ability of AV-interval optimization in cardiac resynchronization therapy (CRT) based on cardiac output (CO) measurements.METHODS AND RESULTS: Twenty-four patients (64 +/- 8 years) with congestive heart failure (EF<35%; NYHA III-IV) and LBBB (>150 ms) were evaluated at baseline and 1 month after implantation of a CRT-D. The optimal AV interval was defined by IC and subsequently by transaortic flow DE as the interval corresponding to the highest CO measured at different AV intervals, varying from 60 to 200 ms (with 20 ms increments). For standardization and comparison of both techniques, a fixed atriobiventricular pacing rate of 90 beats/min was used. Absolute values of COmax were higher by IC (5.8+/-0.9 l/min) as compared to DE (4.6 +/- 0.9 l/min, p < 0.01). The optimal AV interval as determined by IC varied interindividually from 80-180 ms (mean: 121+/-18 ms). In DE, the range was also 80-180 ms with the mean optimal AV interval of 128+/-23 ms. Thus, there was a strong correlation for AV-interval optimization in CRT between both methods (r=0.74; p<0.001).CONCLUSION: In CRT, AV-interval optimization based on CO values determined by IC correlates closely to those measured by transaortic flow DE. Impedance cardiography as an easy and cost-effective technique for AV-interval optimization is a promising alternative for routine management of heart failure patients on a beat-to-beat analysis during CRT follow-up

78. Braunschweig F, Mortensen PT, Gras D, Reiser W, Lawo T, Mansour H *et al*.: **Monitoring of physical activity and heart rate variability in patients with chronic heart failure using cardiac resynchronization devices.** *American journal of cardiology* 2005, 95(9)**:** 1104-1107.
Abstract: Cardiac resynchronization therapy (CRT) devices not only deliver effective treatment but may also serve as valuable diagnostic tools in heart failure management. In the present study, the minutes of daily physical activity and heart rate variability, measured by sensors incorporated into such a device, reflected the effects of CRT and were related to New York Heart Association functional class

79. Breithardt O-A, Sinha AM: **Improved identification of suitable patients for cardiac resynchronization therapy by transthoracic echocardiography <Original> Verbesserte identifizierung geeigneter kandidaten fur die kardiale resynchronisationstherapie mittels transthorakaler echokardiographie.** *Herzschrittmachertherapie und Elektrophysiologie (HERZSCHRITTMACHERTHER ELEKTROPHYSIOL)* /20, HERZSCHRITTMACHERTHER.
Abstract: AB- Transthoracic echocardiography provides numerous options for the evaluation and quantification of contractile cardiac asynchrony in patients with advanced heart failure. Important information on the presence of asynchrony can be obtained already during a standard routine examination with conventional techniques (2D, M-mode and Doppler). Newer techniques such as tissue Doppler imaging and real-time 3D-echocardiography enable us to better quantify the degree of asynchrony. The following article describes the echocardiographic features of asynchrony and algorithms for the improved identification of suitable patients for cardiac resynchronization therapy. (c) Steinkopff Verlag 2005

80. Breithardt O-A, Sinha AM: **[Improved identification of suitable patients for cardiac resynchronization therapy by transthoracic echocardiography] <Original> Verbesserte Identifizierung geeigneter Kandidaten fur die kardiale Resynchronisationstherapie mittels transthorakaler Echokardiographie.** *Herzschrittmachertherapie & Elektrophysiologie* 2005, 16(1)**:** 10-19.

Abstract: Transthoracic echocardiography provides numerous options for the evaluation and quantification of contractile cardiac asynchrony in patients with advanced heart failure. Important information on the presence of asynchrony can be obtained already during a standard routine examination with conventional techniques (2D, M-mode and Doppler). Newer techniques such as tissue Doppler imaging and real-time 3D-echocardiography enable us to better quantify the degree of asynchrony. The following article describes the echocardiographic features of asynchrony and algorithms for the improved identification of suitable patients for cardiac resynchronization therapy

81. Breithardt O, Breithardt G: **Quest for the best candidate: how much imaging do we need before prescribing cardiac resynchronization therapy?** *Circulation* 2006, 113(7) **:** 926-928.

82. Brignole M, Gammage M, Puggioni E, Alboni P, Raviele A, Sutton R *et al*.: **Comparative assessment of right, left, and biventricular pacing in patients with permanent atrial fibrillation.** *European heart journal* 2005, 26(7)**:** 712-722.
Abstract: AIMS: Left ventricular (LV) and biventricular (BiV) pacing are potentially superior to right ventricular (RV) apical pacing in patients undergoing atrioventricular (AV) junction ablation and pacing for permanent atrial fibrillation. METHODS AND RESULTS: Prospective randomized, single-blind, 3-month crossover comparison between RV and LV pacing (phase 1) and between RV and BiV pacing (phase 2) performed in 56 patients (70+/-8 years, 34 males) affected by severely symptomatic permanent atrial fibrillation, uncontrolled ventricular rate, or heart failure. Primary endpoints were quality of life and exercise capacity. Compared with RV pacing, the Minnesota Living with Heart Failure Questionnaire (LHFQ) score improved by 2 and 10% with LV and BiV pacing, respectively, the effort dyspnoea item of the Specific Symptom Scale (SSS) changed by 0 and 2%, the Karolinska score by 6 and 14% ($P<0.05$ for BiV), the New York Heart Association (NYHA) class by 5 and 11% ($P<0.05$ for BiV), the 6-min walked distance by 12 (+4%) and 4 m (+1%), and the ejection fraction by 5 and 5% ($P<0.05$ for both). BiV pacing but not LV pacing was slightly better than RV pacing in the subgroup of patients with preserved systolic function and absence of native left bundle branch block. Compared with pre-ablation measures, the Minnesota LHFQ score improved by 37, 39, and 49% during RV, LV, and BiV pacing, respectively, the effort dyspnoea item of the SSS by 25, 25, and 39%, the Karolinska score by 39, 42, and 54%, the NYHA class by 21, 25, and 30%, the 6-min walking distance by 35 (12%), 47 (16%), and 51 m (19%) and the ejection fraction by 5, 10, and 10% (all differences $P<0.05$). CONCLUSIONS: Rhythm regularization achieved with AV-junction ablation improved quality of life and exercise capacity with all modes of pacing. LV and BiV pacing provided modest or no additional favourable effect compared with RV pacing

83. Bristow MR, Yong P, Saxon LA, Jaski B, Boehmer J, Galle E *et al*.: **Do multiple comorbidities diminish the ability of CRT to reduce mortality and hospitalization?**

84. Bristow MR, Saxton L, DeMarco T, Boehmer J, Galle E, Yong P *et al*.: **What does an ICD add to CRT in advanced heart failure patients? An analysis of major clinical endpoints in the CRT vs. CRT-D groups in the COMPANION trial.**

85. Brizzio ME, Navia JL, Atik FA, Martin D, Gillinov AM, Gonzalez-Stawinski G, V *et al*.: **Combined minimally invasive pulmonary vein isolation, left atrial appendage excision and cardiac resynchronization therapy for heart failure: case report.** *heart surgery forum* 2005, 8(4)**:** E249-E252.
Abstract: A 76-year-old male with ischemic cardiomyopathy presented with heart failure symptoms in the absence of angina. Several hospitalizations were required due to heart failure exacerbation and paroxysmal atrial fibrillation. Electrocardiography and tissue synchronization imaging confirmed ventricular dyssynchrony, requiring biventricular pacing. After a failed attempt of percutaneous placement of the left ventricular lead, a

novel minimally invasive approach was indicated. It consisted of left ventricular epicardial lead placement, microwave pulmonary vein isolation, and left atrial appendage excision through bilateral minithoracotomies. The postoperative recovery was unremarkable, with reestablishment of the ventricular synchrony and regular rhythm

86. Bruce GK, Friedman PA: **Device-based therapies for atrial fibrillation.** *Current Treatment Options in Cardiovascular Medicine (CURR TREAT OPTIONS CARDIOVASC MED)* /20, CURR.
Abstract: AB- Ablation of the atrioventricular conduction system and pacemaker implantation is the preferred procedure for patients with atrial fibrillation (AF) in whom a rate control strategy has been selected but in whom rate-controlling medications are intolerable or ineffective. Selection of standard right ventricular (RV) pacing versus biventricular pacing is individualized, based on the degree and etiology of left ventricular dysfunction. Atrial-based pacing is clearly preferable to ventricular-based pacing in patients with sick sinus syndrome, because it leads to a reduction in the development of AF. Emerging evidence indicates that excess RV pacing is deleterious, increasing AF, heart failure, and possibly mortality. Therefore, physiologic pacing with minimization of RV pacing is desirable. Atrial pacing algorithms that increase the frequency of atrial pacing have shown modest efficacy in the prevention of AF. Use of atrial pacing algorithms is reasonable for patients with a history of AF and standard bradycardia indications for permanent pacing in whom maintenance of sinus rhythm is desirable. Studies assessing novel and multiple site atrial pacing therapies have mixed results, without compelling evidence of clinically important benefit. The exceptions are biatrial and right atrial overdrive pacing immediately after cardiac surgery. Several studies have shown effective suppression of postoperative AF with their use. Device therapy (eg, atrial antitachycardia pacing and defibrillation) for the termination of AF is effective in reducing arrhythmia burden. However, improvement in clinically relevant end points is not established and indications are not clearly defined. If a patient lacks an indication for an implantable cardioverter-defibrillator, we do not offer atrial defibrillation as a treatment option. Atrial arrhythmias may be better prevented by programming to avoid ventricular pacing than by specific atrial interventions. Copyright (c) 2005 by Current Science Inc

87. Brugemann J, van G, I, van der MJ, Zijlstra F: **[Cardiological (pharmaco)therapy and dental practice]**
<Original> Cardiologie en tandheelkunde. *Nederlands tijdschrift voor tandheelkunde* 2006, 113(2)**:** 75-81.
Abstract: In recent years much progress has been made in the treatment of acute coronary syndromes, heart failure and cardiac rhythm disturbances. Polypharmacy including two antiplatelet drugs (aspirin and clopidogrel) is common in many patients after a percutaneous coronary intervention using a 'stent'. Discontinuation of these drugs for invasive dental treatment may result in coronary rethrombosis. However, in many patients with coronary artery disease, a temporal pause in the use of aspirin appears safe and may decrease the risk of bleeding after a dental procedure. An increasing number of patients with heart failure and/or life threatening rhythm disturbances receive an implantable cardioverter defibrillator (ICD). Such a device, equipped with a left ventricular lead, also stimulates the left ventricle in case of delayed electrical conduction (e.g. a left bundle branch block). This so called cardiac resynchronization therapy decreases morbidity and mortality in selected patients. ICDs are safe in the dental office even in case of discharge. In patients with prosthetic heart valves, endocarditis prophylaxis according to the current guidelines is recommended before invasive dental treatment. Dentists are advised to contact the Dutch Thrombosis Service to discuss the dose of oral ancicoagulants and the required INR value. In case of urgent and/or extended dental procedures, admittence to a hospital must be considered to secure optimal therapy

88. Bulava A, Lukl J, Skvarilova M, Marek D: **Dramatically improved left ventricular function after biventricular pacemaker implantation--a case report.** *European journal*

of heart failure - journal of the Working Group on Heart Failure of the European Society of Cardiology 2005, 7(2)**:** 231-233.
Abstract: A case study of a patient suffering from severe chronic congestive heart failure resulting from ischemic cardiomyopathy in whom a biventricular (BiV) pacing system was implanted is reported. After a 1-year follow-up, left ventricular (LV) ejection fraction improved dramatically from an initial 15% to 60%, left ventricular end-diastolic diameter decreased, as did left atrial dimension. Tissue Doppler data and acute hemodynamic measurements taken during the biventricular pacemaker implantation procedure are presented. The case represents an exceptional example of left ventricular reverse remodeling with practically normalized left ventricular function after 1 year of synchronized pacing

89. Bulmer BJ: **VDD pacing in dogs: When, why and how to perform single-lead atrial synchronous, ventricular inhibited (VDD) pacing.** *Journal of Veterinary Cardiology (J VET CARDIOL)* /20, J.
Abstract: AB- Symptomatic, high-grade atrioventricular (AV) block remains one of the most common indications for artificial pacemaker implantation in dogs. The ideal artificial pacemaker would use the His-Purkinje system, maintain rate-responsiveness (RR), and preserve AV synchrony. Although we do not have commercially available pacing systems that accomplish all of these goals, recent advances in the development of single-lead physiologic pacemaker systems now enable maintenance of RR and AV synchrony in dogs with high grade atrioventricular block. This report outlines the indications for implantation of a single-lead atrial synchronous, ventricular inhibited (VDD) pacemaker system. The technique used for lead placement and the initial pacemaker programming required are detailed. (c) 2006 Elsevier B.V. All rights reserved

90. Burri H, Sunthorn H, Somsen A, Zaza S, Fleury E, Shah D *et al*.: **Optimizing sequential biventricular pacing using radionuclide ventriculography.** *Heart rhythm - the official journal of the Heart Rhythm Society* 2005, 2(9) **:** 960-965.
Abstract: BACKGROUND: Biventricular pacemakers are usually programmed with the default setting of synchronous biventricular pacing, although the ventricles may be paced sequentially. Whether this parameter is important for optimizing resynchronization therapy is not clear. OBJECTIVES: The purpose of this study was to investigate whether sequential pacing acutely improves left ventricular ejection fraction (LVEF) and dyssynchrony and to assess the feasibility of nuclear ventriculography for device optimization. METHODS: Twenty-seven patients implanted with a biventricular pacemaker or implantable cardioverter-defibrillator for heart failure were studied. LVEF was measured using planar radionuclide ventriculography during simultaneous biventricular pacing and during sequential pacing at four different interventricular intervals ranging from LV-40 (preexciting the left ventricle by 40 ms) to LV+40 (preexciting the right ventricle). Interventricular and intraventricular dyssynchrony were analyzed by phase analysis at each setting. RESULTS: There was great heterogeneity in individual response to VV interval programming. Twenty-four of 27 patients (89%) had significant changes (both favorable and unfavorable) in LVEF at different interventricular delays, with variations of up to 10% in absolute terms. Simultaneous biventricular pacing yielded maximal LVEF in 9 of 27 patients (33%), with a relative increase in LVEF of 18 +/- 14% by optimized sequential pacing in the remaining patients. Interventricular dyssynchrony varied significantly, with least dyssynchrony at the LV-20 setting (P = .024). There were no significant differences in intraventricular dyssynchrony at the different settings. CONCLUSION: Programming VV intervals has considerable impact on LVEF. However, there is a great degree of variation between patients in response to these settings, requiring individual assessment for device optimization

91. Burri H: **Cardiac-resynchronization therapy in heart failure.** *New England journal of medicine* 2005, 353(2)**:** 205-206.

92. Burri H, Lerch R: **Visualization of cardiac resynchronization using real-time three-dimensional echocardiography.** *Heart rhythm - the official journal of the Heart Rhythm Society* 2005, 2(4)**:** 447-448.

93. Burri H, Lerch R: **Echocardiography and patient selection for cardiac resynchronization therapy: a critical appraisal.** *Heart rhythm - the official journal of the Heart Rhythm Society* 2006, 3(4)**:** 474-479.
Abstract: Echocardiography has been the focus of growing interest for improving patient selection for cardiac resynchronization therapy in order to reduce the number of nonresponders. Various techniques have been described for assessing dyssynchrony, using standard echocardiography (pulsed-wave Doppler and M-mode echocardiography), tissue Doppler imaging, and other imaging modes such as three-dimensional echocardiography. This article provides an overview of the technical and practical aspects of these different techniques and discusses the current evidence for optimizing patient selection by echocardiography

94. Butter C: **Effect of cardiac resynchronization therapy (CRT) on exercise tolerance, functional capacity and quality of life in patients with congestive heart failure <Original> Effekt der cardialen resynchronisationstherapie (Crt) Auf die belastbarkeit und lebensqualitat bei herzinsuffizienzpatienten.**
Herzschrittmachertherapie und Elektrophysiologie (HERZSCHRITTMACHERTHER ELEKTROPHYSIOL) /20, HERZSCHRITTMACHERTHER.
Abstract: AB- This review article summarizes the effect of cardiac resynchronization therapy (CRT) on exercise tolerance, functional capacity and quality of life, as it has been shown in previous randomized controlled trials. Based on these data we carefully have to reconsider the initial goals of this therapy. An early prophylactic implantation is not justified today. Especially patient selection has to be performed with more care in the future using new methods for detection of cardiac asynchrony to avoid a mismatch between implant numbers and real functional benefit. (c) Steinkopff Verlag 2005

95. Butter C: **[Effect of cardiac resynchronization therapy (CRT) on exercise tolerance, functional capacity and quality of life in patients with congestive heart failure] <Original> Effekt der Cardialen Resynchronisationstherapie (CRT) auf die Belastbarkeit und Lebensqualitat bei Herzinsuffizienzpatienten.**
Herzschrittmachertherapie & Elektrophysiologie 2005, 16(1)**:** 20-27.
Abstract: This review article summarizes the effect of cardiac resynchronization therapy (CRT) on exercise tolerance, functional capacity and quality of life, as it has been shown in previous randomized controlled trials. Based on these data we carefully have to reconsider the initial goals of this therapy. An early prophylactic implantation is not justified today. Especially patient selection has to be performed with more care in the future using new methods for detection of cardiac asynchrony to avoid a mismatch between implant numbers and real functional benefit

96. Calvert MJ, Freemantle N, Yao G, Cleland JGF, Billingham L, Daubert J-C *et al*.: **FASTTRACK Cost-effectiveness of cardiac resynchronization therapy: Results from the CARE-HF trial.** *European Heart Journal (EUR HEART J)* /20, EUR.
Abstract: AB- Aims: Whilst the CArdiac REsynchronization in Heart Failure (CARE-HF) trial has shown that cardiac resynchronization therapy (CRT) leads to reduced morbidity and mortality, the cost-effectiveness of this therapy remains uncertain. The aim of this study was to evaluate the incremental cost per quality adjusted life year (QALY) gained and incremental cost per life year gained of CRT plus medical therapy compared to medical therapy alone. Methods and results: This prospective analysis based on intention to treat data from all patients enrolled in the CARE-HF trial at 82 clinical centres in 12 European countries. A total of 813 patients with New York Heart Association class III or IV heart failure due to left ventricular systolic dysfunction and cardiac dyssynchrony were randomized to CRT plus medical therapy (n = 409) vs. medical therapy alone (n = 404).

During a mean follow-up of 29.4 months CRT was associated with increased costs ((euro)4316, 95% CI: 1327-7485), survival (0.10 years, 95% CI: -0.01-0.21), and QALYs (0.22, 95% CI: 0.13-0.32). The incremental cost-effectiveness ratio was (euro)19 319 per QALY gained (95% CI: 5482-45 402) and (euro)43 596 per life-year gained (95% CI: -146 236-223 849). These results were sensitive to the costs of the device, procedure, and hospitalization. Conclusion: Treatment with CRT appears cost-effective at the notional willingness to pay threshold of (euro)29 400 (Pound Sterling20 000) per QALY gained. (c) The European Society of Cardiology 2005. All rights reserved

97. Calvert M, Freemantle N, Cleland John GF: **Cardiac resynchronization therapy in heart failure.** *Annals of internal medicine* 2005, 142(4)**:** 305-307.

98. Calvert MJ, Freemantle N, Yao G, Cleland John GF, Billingham L, Daubert J *et al*.: **Cost-effectiveness of cardiac resynchronization therapy: results from the CARE-HF trial.** *European heart journal* 2005, 26(24)**:** 2681-2688.
Abstract: AIMS: Whilst the CArdiac REsynchronization in Heart Failure (CARE-HF) trial has shown that cardiac resynchronization therapy (CRT) leads to reduced morbidity and mortality, the cost-effectiveness of this therapy remains uncertain. The aim of this study was to evaluate the incremental cost per quality adjusted life year (QALY) gained and incremental cost per life year gained of CRT plus medical therapy compared to medical therapy alone. METHODS AND RESULTS: This prospective analysis based on intention to treat data from all patients enrolled in the CARE-HF trial at 82 clinical centres in 12 European countries. A total of 813 patients with New York Heart Association class III or IV heart failure due to left ventricular systolic dysfunction and cardiac dyssynchrony were randomized to CRT plus medical therapy (n = 409) vs. medical therapy alone (n = 404). During a mean follow-up of 29.4 months CRT was associated with increased costs (4316, 95% CI: 1327-7485), survival (0.10 years, 95% CI: -0.01-0.21), and QALYs (0.22, 95% CI: 0.13-0.32). The incremental cost-effectiveness ratio was 19 319 per QALY gained (95% CI: 5482-45 402) and 43 596 per life-year gained (95% CI: -146 236-223 849). These results were sensitive to the costs of the device, procedure, and hospitalization. CONCLUSION: Treatment with CRT appears cost-effective at the notional willingness to pay threshold of 29 400 (20,000 pounds sterlings) per QALY gained

99. Campos Vieira ML, Maddukuri PV, Phang RS, Pandian NG, Mathias J, Ramires JAF: **Mechanism of cardiac resynchronization therapy by real-time three-dimensional echocardiography in patients with heart failure.** *Arquivos Brasileiros de Cardiologia (ARQ BRAS CARDIOL)* /20, ARQ.
Abstract: AB- We report the case of a 66-year-old man with heart failure NYHA class IV treated with biventricular pacing for cardiac resynchronization. The patient was evaluated by real-time three-dimensional transthoracic echocardiography before and 48 hours after pacemaker implantation. The use of three-dimensional echocardiography contributed to understanding the underlying mechanism involved in cardiac resynchronization therapy by demonstrating enhanced synchrony of myocardial segments, which resulted in the patient's clinical improvement

100. Cannesson Maxime R, Suffoletto MS, Dohi K, Saba S, Gorcsan J: **Which tissue Doppler approach is superior to quantity dyssynchrony and predict response to cardiac resynchronization therapy?**

101. Cannom DS: **Prevention of sudden cardiac death.** *Journal of cardiovascular electrophysiology* 2005, 16 Suppl 1 S21-S24.
Abstract: Although the annual incidence of sudden cardiac death (SCD) is dropping in the United States, therapies for the patient who has survived a SCD episode or is at high risk of developing SCD in the future are now well established. The implantable cardioverter defibrillator (ICD) has emerged from a series of well done randomized clinical trials of the 1990s as providing a survival benefit in carefully defined patient groups with low ejection

fraction of any cause. Patients with either an ischemic or idiopathic dilated cardiomyopathy and an EF <or=35% show a significant survival benefit with the ICD and maximal medical therapy. Many challenging patients (e.g., those with long QT syndrome or Brugada syndrome) who have a reasonably high incidence of sudden death have not been the subject of clinical trials involving the ICD and therapy depends on risk stratification that is currently not completely agreed upon. An exciting research frontier of the future will be those that attempt to integrate the appropriate role of the ICD with the ability of chronic resynchronization therapy to enhance left ventricular function in the damaged ventricle

102. Cannom DS, Mower M: **Relationship of the implantable cardioverter defibrillator and chronic resynchronization therapy: the perfect marriage?** *Annals of noninvasive electrocardiology - the official journal of the International Society for Holter and Noninvasive Electrocardiology, Inc* 2005, 10(4 Suppl)**:** 24-33.
Abstract: BACKGROUND: The two major modes of death in the patient with a reduced ejection fraction (EF) are death due to heart failure and death due to lethal arrhythmia, essentially the two sides of the same coin. Over the last 20 years, two therapies-cardiac resynchronization therapy (CRT) and the implantable cardioverter defibrillator (ICD)-have been developed and tested in clinical trials. They are now, in conjunction with appropriate medical therapy, the mainstays of therapy for these two commonly encountered clinical problems. METHOD AND RESULTS: Both of these therapies were conceived and patented by two Baltimore cardiologists, Michel Mirowski and Morton Mower (Table I). The path to everyday acceptance of both therapies was remarkably similar. The concept and early success of both devices was accomplished but the proof of concept depended on a series of carefully designed randomized clinical trials that showed that both the CRT and ICD devices saved lives in the low EF population, especially when used together. These trials overcame substantial skepticism on behalf of elements of the cardiology and electrophysiology establishment. CONCLUSION: We are now at a crossroads in the further extension of either therapy. The majority of the indications for either device alone or in combination are established. In the next few years, assuming the continued commitment on the part of regulatory agencies to fully embrace evidence-based medicine, we will see indications extended but only by the careful clinical trials that became the bedrock of their initial acceptance

103. Capasso F, Giunta A, Stabile G, Turco P, La R, V, Grimaldi G *et al.*: **Left ventricular functional recovery during cardiac resynchronization therapy: predictive role of asynchrony measured by strain rate analysis.** *Pacing and clinical electrophysiology - PACE* 2005, 28 Suppl 1 S1-S4.
Abstract: Cardiac resynchronization therapy (CRT) improves myocardial performance in patients with heart failure (HF) and left bundle-branch block (LBBB). Tissue Doppler echocardiography (TDE) has already been used to guide the selection of candidates for CRT. The objective of this study is to correlate the effects of CRT on left ventricular (LV) systolic function with wall motion synchrony assessed by TDE. High frame TDE data were obtained in 15 patients (mean age = 68.9 years, 11 men) with LBBB (QRS = 163 +/- 13 ms) to derive temporal intraventricular horizontal asynchrony indexes, expressed as the time difference at the onset of shortening between the septum and the lateral (S-L) and antero-inferior (A-I) walls, and measure the amount of delayed longitudinal contraction (DLC) within the LV. All measurements were made at baseline, 24 hours after implantation, and at 1 year of follow-up. The results show that LV ejection fraction (EF) increased from 25 +/- 6.2% at baseline to 36.9 +/- 7.9% at 1 year, and was strongly related to DLC, expressed either by time duration (DLCd, r =-0.51; P < 0.0001) or percent of the basal segments (%DLC, r =-0.50; P < 0.001). New York Heart Association functional class, which decreased from 3.6 +/- 0.5 to 2.3 +/- 0.8, was correlated with %DLC (r = 0.50) and DLCd (r = 0.48, P < 0.001). Weaker correlations were found between LVEF and S-Li (r =-0.40) and between NYHA and S-Li (r = 0.40). It is concluded that DLC was the best among intraventricular asynchrony indexes in predicting increases in LVEF after CRT. DLC may be useful to identify responders to CRT

104. Cappola TP, Harsch MR, Jessup M, Abraham WT, Young JB, Petersen-Stejskal S *et al*.: **Predictors of remodeling in the CRT era: influence of mitral regurgitation, BNP, and gender.** *Journal of cardiac failure* 2006, 12(3)**:** 182-188.
Abstract: BACKGROUND: We analyzed quantitative echocardiographic data from a large heart failure cohort receiving medical and cardiac resynchronization therapy (CRT) to determine baseline predictors of progressive left ventricular (LV) enlargement. METHODS AND RESULTS: Quantitative echocardiograms were obtained at baseline and after 6 months in 776 outpatients with chronic heart failure who participated in MIRACLE (Multicenter InSync Randomized Clinical Evaluation) and MIRACLE-ICD (Multicenter InSync ICD Randomized Clinical Evaluation). We used multivariable regression to determine clinical, therapeutic, and echocardiographic characteristics that predicted a subsequent change in left ventricular end-diastolic volume (LVEDV). Over 6 months, LVEDV increased in 308 (40%) and decreased in 468 (60%) patients. Baseline mitral regurgitation and levels of plasma brain natriuretic peptide (BNP) independently predicted LV enlargement, whereas CRT predicted a decrease in LVEDV (all $P < .01$). In all models tested, male gender was an independent risk factor for progressive LV enlargement ($P < .0001$). CONCLUSION: Men show more prominent LV dilation than women in chronic heart failure despite medical and device therapy. Rates of LV remodeling are influenced further by mitral regurgitation, plasma BNP, and CRT. Future studies should take these clinical factors into account when determining the influence of genetic factors and novel therapies on ventricular remodeling in chronic heart failure

105. Carbajal EV, Huang GW, Hu B, Calvert M, Freemantle N, Cleland JGF *et al*.: **Cardiac resynchronization therapy in heart failure [1] (multiple letters).** *Annals of Internal Medicine (ANN INTERN MED)* /20, ANN.

106. Carbajal E, V, Huang GW, Hu B: **Cardiac resynchronization therapy in heart failure.** *Annals of internal medicine* 2005, 142(4)**:** 305-308.

107. CARE-HF I: **Cost-effectiveness of cardiac resynchronization therapy: results from the CARE-HF trial.**
Abstract: Aims Whilst the CArdiac REsynchronization in Heart Failure (CARE-HF) trial has shown that cardiac resynchronization therapy (CRT) leads to reduced morbidity and mortality, the cost-effectiveness of this therapy remains uncertain. The aim of this study was to evaluate the incremental cost per quality adjusted life year (QALY) gained and incremental cost per life year gained of CRT plus medical therapy compared to medical therapy alone.Methods and results This prospective analysis based on intention to treat data from all patients enrolled in the CARE-HF trial at 82 clinical centres in 12 European countries. A total of 813 patients with New York Heart Association class III or IV heart failure due to left ventricular systolic dysfunction and cardiac dyssynchrony were randomized to CRT plus medical therapy (n=409) vs. medical therapy alone (n=404). During a mean follow-up of 29.4 months CRT was associated with increased costs (EURO4316, 95% CI: 1327-7485), survival (0.10 years, 95% CI: -0.01-0.21), and QALYs (0.22, 95% CI: 0.13-0.32). The incremental cost-effectiveness ratio was e19 319 per QALY gained (95% CI: 5482-45 402) and e43 596 per life-year gained (95% CI: -146 236-223 849). These results were sensitive to the costs of the device, procedure, and hospitalization.Conclusion Treatment with CRT appears cost-effective at the notional willingness to pay threshold of EURO29 400 (20 pound 000) per QALY gained

108. Care-Hf S, I: **The effect of cardiac resynchronization on morbidity and mortality in heart failure.**
Abstract: BackgroundCardiac resynchronization reduces symptoms and improves left ventricular function in many patients with heart failure due to left ventricular systolic dysfunction and cardiac dyssynchrony. We evaluated its effects on morbidity and mortality.MethodsPatients with New York Heart Association class III or IV heart failure due to left ventricular systolic dysfunction and cardiac dyssynchrony who were receiving

standard pharmacologic therapy were randomly assigned to receive medical therapy alone or with cardiac resynchronization. The primary end point was the time to death from any cause or an unplanned hospitalization for a major cardiovascular event. The principal secondary end point was death from any cause.ResultsA total of 813 patients were enrolled and followed for a mean of 29.4 months. The primary end point was reached by 159 patients in the cardiac-resynchronization group, as compared with 224 patients in the medical-therapy group (39 percent vs. 55 percent; hazard ratio, 0.63; 95 percent confidence interval, 0.51 to 0.77; P<0.001). There were 82 deaths in the cardiac-resynchronization group, as compared with 120 in the medical-therapy group (20 percent vs. 30 percent; hazard ratio 0.64; 95 percent confidence interval, 0.48 to 0.85; P<0.002). As compared with medical therapy, cardiac resynchronization reduced the interventricular mechanical delay, the end-systolic volume index, and the area of the mitral regurgitant jet; increased the left ventricular ejection fraction; and improved symptoms and the quality of life (P<0.01 for all comparisons).ConclusionsIn patients with heart failure and cardiac dyssynchrony, cardiac resynchronization improves symptoms and the quality of life and reduces complications and the risk of death. These benefits are in addition to those afforded by standard pharmacologic therapy. The implantation of a cardiac-resynchronization device should routinely be considered in such patients

109. Caro JJ, Guo S, Ward A, Chalil S, Malik F, Leyva F: **Modelling the economic and health consequences of cardiac resynchronization therapy in the UK.** *Current medical research and opinion* 2006, 22(6)**:** 1171-1179.
Abstract: OBJECTIVE: Clinical evidence supports the use of cardiac resynchronization therapy (CRT) in advanced heart failure, but its cost-effectiveness is still unclear. This analysis assessed the economic and health consequences in the UK of implanting a CRT in patients with NYHA class III-IV heart failure. METHODS: A discrete event simulation of heart failure was used to compare the course over 5 years of 1000 identical pairs of patients -- one receiving both CRT and optimum pharmacologic treatment (OPT), the other OPT alone. All inputs were obtained from the data collected in the CArdiac REsynchronization in Heart Failure (CARE-HF) trial and a hospital in the UK. Direct medical costs (in 2004 pound) from the perspective of the National Health Service were considered. Both costs and benefits were discounted at 3.5%. Sensitivity analyses addressed all model inputs and multivariate analyses were performed by varying key parameters simultaneously. RESULTS: The model predicted 471 deaths and 2263 hospitalizations over 5 years with OPT alone and 348 deaths and 1764 hospitalizations with CRT, equivalent to a 26% reduction in mortality and 22% in hospitalizations, at a discounted cost of pound 11,423 per patient with CRT vs. pound 4,900 with OPT alone quality-adjusted survival by 0.43 QALYs per patient, resulting in an incremental cost-effectiveness ratio of pound 15,247 per QALY gained (range: pound 12,531- pound 23,184). Sensitivity analyses revealed that this outcome was most sensitive to time horizon and cost of implantation. C ONCLUSION: Based on these 5-year analyses, CRT is expected to yield substantial health benefits at a reasonable cost

110. Carson P, Anand I, O'Connor C, Jaski B, Steinberg J, Lwin A *et al.*: **Mode of death in advanced heart failure: the Comparison of Medical, Pacing, and Defibrillation Therapies in Heart Failure (COMPANION) trial.** *Journal of the American College of Cardiology* 2005, 46(12)**:** 2329-2334.
Abstract: OBJECTIVES: The aim of this study was to evaluate the mode of death in patients with advanced chronic heart failure (HF) and intraventricular conduction delay treated with optimal pharmacologic therapy (OPT) alone or OPT with biventricular pacing to provide cardiac resynchronization therapy (CRT) or CRT + an implantable defibrillator (CRT-D). BACKGROUND: Limited data are available on mode of death in advanced HF. No data have existed on mode of death in these patients who also have an intraventricular

conduction delay and are treated with CRT or CRT-D. METHODS: Using prespecified definitions and source materials, seven cardiologists assessed mode of death among the 313 deaths that occurred in the Comparison of Medical, Pacing, and Defibrillation Therapies in Heart Failure (COMPANION) trial. RESULTS: A primary cardiac cause was present in 78% of deaths. Pump failure (44.4%) was the most common mode of death followed by sudden cardiac death (SCD) (26.5%). Compared with OPT, CRT-D significantly reduced the number of cardiac deaths (38%, p = 0.006), whereas CRT alone was associated with a non-significant 14.5% reduction (p = 0.33). Both CRT and CRT-D tended to reduce pump failure deaths (29%, p = 0.11 and 27%, p = 0.14, respectively). The CRT-D significantly reduced SCD (56%, p = 0.02), but CRT alone did not. CONCLUSIONS: Pump failure deaths are the predominant mode of death in patients with advanced HF and are modestly reduced by both CRT and CRT-D. Only CRT-D reduced SCD and thus produced a favorable effect on cardiac mortality

111. Cesario DA, Dec GW: **Implantable Cardioverter- Defibrillator Therapy in Clinical Practice.** *Journal of the American College of Cardiology (J AM COLL CARDIOL)* /20, J.
Abstract: AB- Pharmacologic treatment of heart failure has led to dramatic improvements in survival and quality of life. Nonetheless, heart failure often progresses despite treatment with diuretics, angiotensin-converting enzyme inhibitors, beta-adrenergic blockers, aldosterone antagonists, and digoxin. Further, despite a steady decline in the risk of death from pump failure, many patients remain at high risk for sudden cardiac death. The annual incidence of sudden cardiac death in the U.S. alone has been estimated at 184,000 to over 400,000 cases. During the past decade, substantial advances have been made in the use of device-based therapy for this population. The role of the implantable cardioverter-defibrillator (ICD) continues to evolve in routine heart failure management. The current status of ICD therapy in the treatment of heart failure patients based on randomized clinical trial results and published practice guidelines is summarized in this review. (c) 2006 American College of Cardiology Foundation

112. Chalil SB, Muhyaldeen S, Smith RE, Jordan P, Gibbs CR, Leyva F: **Delayed gadolinium enhancement magnetic resonance imaging is superior to ORS duration and echocardiographic measures of cardiac dyssynchrony in predicting benefit from cardiac resynchronization therapy.**

113. Chauvin M: **[The best of cardiac pacing in 2004] <Original> L'essentiel de 2004 en stimulation cardiaque.** *Archives des maladies du coeur et des vaisseaux* 2005, 98 Spec No 1 63-67.
Abstract: The year 2004 saw the publication of the results of the COMPANION and PAVE studies concerning cardiac pacing. The former underlined, if it was still necessary, the direct relationship between pacing and rhythmology in terms of sudden death due to rhythm disturbances in cardiac failure. COMPANION attempted to discover whether, in severe cardiac failure with intraventricular conduction defects, the addition of multisite pacing either with or without defibrillation is liable to alter the combined risk of death and hospital episodes compared with optimal drug therapy alone. This study confirmed the advantages of resynchronisation pacing already observed in MUSTIC, MIRACLE, InSync and CONTAK CD: retarded progression of cardiac failure, reduction in the number of hospitalisations and functional improvement. Adding defibrillation to anti-bradycardial resynchronisation pacing improved the survival, but only slightly so. On the other hand, the size of the subgroups did not allow any conclusions to be drawn about function and aetiology of cardiac failure, whether ischaemic or not. The PAVE study allowed comparison between biventricular pacing and right ventricular pacing alone in patients in NYHA class II or III, with atrial fibrillation for more than one month and having undergone elective ablation of the nodo-Hissian pathway. The results gave confirmation of the harmful effects of pacing at the apex of the right ventricle in pacing-dependent patients. On the technological front, there was confirmation that probes designed for left ventricular stimulation are stable and increasingly easy to use thanks to a new configuration and the

use of bipolar. Finally, telecardiology has started to proliferate and evaluation of its applications is under way, even though its clinical use is confirmed on a daily basis

114. Chierchia G, Geelen P, Rivero-Ayerza M, Brugada P: **Double wire technique to catheterize sharply angulated coronary sinus branches in cardiac resynchronization therapy.** *Pacing and clinical electrophysiology - PACE* 2005, 28(2)**:** 168-170.
Abstract: Placing a pacing lead for left ventricular pacing through the coronary sinus can be hampered by anatomic obstacles. In this case report we describe a technique that can overcome the problem of sharply angulated coronary sinus branches by using simultaneously two guidewires in the target vessel

115. Chinchoy E: **Method and apparatus for optimizing cardiac resynchronization therapy based on left ventricular acceleration.**
Abstract: A system and method for monitoring left ventricular cardiac contractility and for optimizing a cardiac therapy based on left ventricular lateral wall acceleration (LVA) are provided. The system includes an implantable or external cardiac stimulation device in association with a set of leads including a left ventricular epicardial or coronary sinus lead equipped with an acceleration sensor. The device receives and processes acceleration sensor signals to determine a signal characteristic indicative of LVA during isovolumic contraction. A therapy optimization method evaluates the LVA during varying therapy settings and selects the setting(s) that correspond to a maximum LVA during isovolumic contraction. In one embodiment, the optimal inter-ventricular pacing interval for use in cardiac resynchronization therapy is determined as the interval corresponding to the highest amplitude of the first LVA peak during isovolumic contraction

116. Chinchoy E: **Method and apparatus for optimizing cardiac resynchronization therapy.**
Abstract: A method and apparatus for optimizing cardiac resynchronization therapy are provided. An iterative optimization procedure is performed to test the systolic hemodynamic effects of varying A-V-V timing schemes. The hemodynamic effect is assessed based on a surrogate of stroke volume. The stroke volume surrogate is derived from a sensor signal proportional to the blood pressure in the aorta or a major artery. The A-V-V timing scheme corresponding to the greatest stroke volume, as indicated by the stroke volume surrogate, is identified and automatically programmed to maintain optimal A-V-V settings acutely and chronically

117. Chudzik M, Piestrzeniewicz K, Wranicz JK, Oszczygiel s, Klimczak A, Goch JH *et al.*: **Bifocal right ventricular pacing as an alternative treatment for patients with ventricular asynchrony and unsuccessful left ventricular implantation of cardiac resynchronization system**
<Original> Stymulacja dwupunktowa prawej komory jako alternatywna metoda leczenia pacjentow z asynchronia lewokomorowa po nieudanej implantacji elektrody lewokomorowej ukl(Stroke)Adu resynchronizujacego. *Folia Cardiologica (FOLIA CARDIOL)* /20, FOLIA.
Abstract: AB- Background: Biventricular pacing has demonstrated benefit for patients with congestive heart failure although in 5-15% unsuccessful left ventricular lead implantation is reported. Alternative for failed transvenous left ventricular implantation is epicardiac approach with thoracotomy. Unfortunately this method is associated with very serious complications. Additionally this method increases the costs of the procedures and is available in cardiosurgery units only. It is reported that bifocal pacing in right ventricle might be alternative for unsuccessful left ventricular lead (LVlead) implantation. The aim of the study was clinical and hemodynamic assessment, during 3 month follow up (3mFU) of patients in which bifocal pacing (BiF) in right ventricle was used, for a standard transvenous BiV procedures proved to be ineffective or unsatisfactory. Material and methods: The eight patients with mean age 65 +/- 9, in NYHA IV, with LVEF = = 22%, mean QRS duration = 180 ms with failed LVlead implantation were included to the study. In all patients leads in right atrium appendage and to the apex and outflow tract of the right

ventricle were implanted and connected to the Stratos LV pacemaker (PM). Results: In patients after BiF implantation significant increase in 6 minute walking test was reported. There was no significant difference in QRS duration after procedure. Significant reduction in intraventricular mechanical delay, left ventricular systolic diameter and increase in EF, cardiac output and cardiac index in patients with BiF in ECHO study was assessed. Conclusion: Bifocal pacing in right ventricle might be alternative method for patients with unsecceful LVlead implantation. Copyright (c) 2005 Via Medica

118. Chugh A, Scharf C, Hall B, Cheung P, Good E, Horwood L *et al*.: **Prevalence and management of inappropriate detection and therapies in patients with first-generation biventricular pacemaker-defibrillators.** *Pacing and clinical electrophysiology - PACE* 2005, 28(1)**:** 44-50.
Abstract: BACKGROUND: Tachycardia detection in first-generation biventricular pacemaker-implantable cardioverter defibrillators (BiV ICD) occurs through both the right ventricular (RV) and left ventricular (LV) leads, creating the potential for inappropriate detection and therapies. Little is known regarding the prevalence and management of patients with BiV ICDs and inappropriate detection. METHODS AND RESULTS: A transvenous, first-generation BiV ICD was implanted in 77 consecutive patients (age 61 +/- 11 years) for drug-refractory heart failure. The mean New York Heart Association class, QRS duration, and ejection fraction were 3.1 +/- 0.4, 168 +/- 24 ms, and 0.19 +/- 0.07, respectively. Among the 77 patients, 17 (22%) experienced inappropriate detection at a mean of 154 +/- 140 days after implantation. Fifteen of the 17 patients (88%) experienced inappropriate ICD therapy. In 16 of the 17 (94%) patients, the cause of inappropriate detection was double counting during sinus (8) or atrial rhythm (3), and nonsustained ventricular tachycardia (5). Despite reprogramming of the ICD, 9 patients (53%) required an additional procedure because of inappropriate therapies, including an upgrade to a dedicated BiV ICD (5), revision of the LV lead (2), ablation of the atrioventricular junction (1), and repeat defibrillation threshold testing (2). CONCLUSIONS: Inappropriate detection in patients with a first-generation BiV ICD is common and often results in inappropriate ICD therapy. The most common mechanism of inappropriate detection is double counting that often creates the need for additional procedures. Although devices in which tachycardia detection occurs only through the RV lead now are available, close follow-up of the many patients who received a first-generation BiV ICD is necessary

119. Cleland John GF: **Cardiac resynchronisation in heart failure (CARE HF).**

120. Cleland John GF, Coletta AP, Lammiman M, Witte KK, Loh H, Nasir M *et al*.: **Clinical trials update from the European Society of Cardiology meeting 2005: CARE-HF extension study, ESSENTIAL, CIBIS-III, S-ICD, ISSUE-2, STRIDE-2, SOFA, IMAGINE, PREAMI, SIRIUS-II and ACTIVE.** *European journal of heart failure - journal of the Working Group on Heart Failure of the European Society of Cardiology* 2005, 7(6)**:** 1070-1075.
Abstract: This article provides information and a commentary on trials presented at the European Society of Cardiology meeting held in September 2005, relevant to the pathophysiology, prevention and treatment of heart failure. All reports should be considered as preliminary data, as analyses may change in the final publication. In the CARE-HF extension study, the benefits of cardiac resynchronisation therapy (CRT) observed in the original study were maintained over an increased follow-up period. A study of oral enoximone (25-50 mg t.i.d.) in advanced heart failure (ESSENTIAL) showed limited benefit compared to placebo. The CIBIS-III study showed that heart failure therapy could be safely initiated with bisoprolol followed by the addition of enalapril. A subcutaneous ICD system (S-ICD) showed potential as an alternative to a transvenous ICD. In the ISSUE-2 study, an implantable loop recorder was used to guide therapy in patients with recurrent syncope. The selective endothelin antagonist sitaxsentan improved 6-MWT and functional class in patients with pulmonary arterial hypertension in the STRIDE-2 study. In SOFA, fish oil had no beneficial effect on the incidence of life-threatening

arrhythmias in patients with an ICD. In IMAGINE, quinapril showed no benefit when administered to patients following CABG. Perindopril reduced cardiac remodelling in post-MI patients with normal LV function in PREAMI. SIRIUS-II showed encouraging results for the use of intravenous ularitide in symptomatic decompensated chronic heart failure. The ACTIVE W study of warfarin versus aspirin plus clopidogrel in atrial fibrillation has been stopped due to superiority of warfarin

121. Cleland John GF, Daubert J, Erdmann E, Freemantle N, Gras D, Kappenberger L *et al*.: **The effect of cardiac resynchronization on morbidity and mortality in heart failure.** *New England journal of medicine* 2005, 352(15)**:** 1539-1549.
Abstract: BACKGROUND: Cardiac resynchronization reduces symptoms and improves left ventricular function in many patients with heart failure due to left ventricular systolic dysfunction and cardiac dyssynchrony. We evaluated its effects on morbidity and mortality. METHODS: Patients with New York Heart Association class III or IV heart failure due to left ventricular systolic dysfunction and cardiac dyssynchrony who were receiving standard pharmacologic therapy were randomly assigned to receive medical therapy alone or with cardiac resynchronization. The primary end point was the time to death from any cause or an unplanned hospitalization for a major cardiovascular event. The principal secondary end point was death from any cause. RESULTS: A total of 813 patients were enrolled and followed for a mean of 29.4 months. The primary end point was reached by 159 patients in the cardiac-resynchronization group, as compared with 224 patients in the medical-therapy group (39 percent vs. 55 percent; hazard ratio, 0.63; 95 percent confidence interval, 0.51 to 0.77; P<0.001). There were 82 deaths in the cardiac-resynchronization group, as compared with 120 in the medical-therapy group (20 percent vs. 30 percent; hazard ratio 0.64; 95 percent confidence interval, 0.48 to 0.85; P<0.002). As compared with medical therapy, cardiac resynchronization reduced the interventricular mechanical delay, the end-systolic volume index, and the area of the mitral regurgitant jet; increased the left ventricular ejection fraction; and improved symptoms and the quality of life (P<0.01 for all comparisons). CONCLUSIONS: In patients with heart failure and cardiac dyssynchrony, cardiac resynchronization improves symptoms and the quality of life and reduces complications and the risk of death. These benefits are in addition to those afforded by standard pharmacologic therapy. The implantation of a cardiac-resynchronization device should routinely be considered in such patients. Copyright 2005 Massachusetts Medical Society

122. Cleland John GF, Goode K, Khaleva O, Khan N: **How many patients need cardiac resynchronization therapy?** *European heart journal* 2006, 27(3)**:** 251-252.

123. Cleland John GF, Daubert J, Erdmann E, Freemantle N, Gras D, Kappenberger L *et al*.: **Longer-term effects of cardiac resynchronization therapy on mortality in heart failure [the CArdiac REsynchronization-Heart Failure (CARE-HF) trial extension phase].** *European heart journal* 2006, 27(16)**:** 1928-1932.
Abstract: AIMS: The CArdiac REsynchronization-Heart Failure study randomized patients with left ventricular ejection fraction </=35%, markers of cardiac dyssynchrony, and persistent moderate or severe symptoms of heart failure despite pharmacological therapy, to implantation of a cardiac resynchronization therapy (CRT) device or not. The main study observed substantial benefits on morbidity and mortality during a mean follow-up of 29.4 months [median 29.6, interquartile range (IQR) 23.6-34.6]. Prior to study closure, an extension phase lasting a further 8 months (allowing time for data analysis and presentation) was declared during which cross-over was discouraged. METHODS AND RESULTS: This was an extension of the already reported open-label randomized trial described above. The primary outcome of the extension phase was all-cause mortality from the time of randomization to completion of the extension phase. The secondary outcome was mode of death. The mean follow-up was 37.4 months (median 37.6, IQR 31.5-42.5, range 26.1-52.6 months). There were 154 deaths (38.1%) in 404 patients assigned to medical therapy and 101 deaths (24.7%) in 409 patients assigned to CRT (hazard ratio

0.60, 95% CI 0.47-0.77, P<0.0001) without evidence of heterogeneity in pre-specified subgroups. A reduction in the risk of death due to heart failure (64 vs. 38 deaths; hazard ratio 0.55, 95% CI 0.37-0.82, P=0.003) and sudden death was observed (55 vs. 32; hazard ratio 0.54, 95% CI 0.35-0.84, P=0.005). CONCLUSION: The benefits of CRT observed in the main trial persist or increase with longer follow-up. Reduction in mortality was due to fewer deaths both from worsening heart failure and from sudden death

124. Coleman DB, DeBarr DM, Morales DL, Spotnitz HM: **Pacemaker lead thrombosis treated with atrial thrombectomy and biventricular pacemaker and defibrillator insertion.** *Annals of Thoracic Surgery (ANN THORAC SURG)* /20, ANN.
Abstract: AB- Right atrial thrombosis and pulmonary embolism are infrequent complications of pacemaker insertion. We report a patient with a large mobile thrombus on an endocardial DDD pacing lead and probable pulmonary embolism. We believe that this is the first case of pacemaker lead thrombosis in which treatment included insertion of an epicardial biventricular pacemaker and an implantable cardioverter-defibrillator. (c) 2004 by The Society of Thoracic Surgeons

125. Conley VL, Gilkerson JO, Perschbacher DL: **Pacemaker passive measurement testing system and method.**
Abstract: A system and method for passively testing a cardiac pacemaker in which sensing signal amplitudes and lead impedance values are measured and stored while the pacemaker is functioning in its programmed mode. The amplitude and impedance data may be gotten and stored periodically at regular intervals to generate a historical record for diagnostic purposes. Sensing signal amplitudes may also be measured and stored from a sensing channel which is currently not programmed to be active as long as the pacemaker is physically configured to support the sensing channel. Such data can be useful in evaluating whether a switch in the pacemaker's operating mode is desirable

126. Corsello A: **Review: cardiac resynchronization therapy reduces mortality and hospitalization for heart failure.** *ACP journal club* 2005, 142(2)**:** 35.

127. Cowburn PJ, Patel H, Pipes RR, Parker JD: **Contrast nephropathy post cardiac resynchronization therapy: an under-recognized complication with important morbidity.** *European journal of heart failure - journal of the Working Group on Heart Failure of the European Society of Cardiology* 2005, 7(5)**:** 899-903.
Abstract: OBJECTIVES: The aim of the study was to define the incidence of contrast nephropathy in patients undergoing cardiac resynchronization therapy (CRT). BACKGROUND: CRT is a promising new treatment for advanced heart failure. It is a technically demanding procedure with a recognized failure/complication rate. Contrast nephropathy is a well-recognized complication of coronary angiography/intervention, but has not been described following CRT. METHODS: We performed a retrospective chart review of patients who had undergone CRT at Mount Sinai Hospital, a tertiary referral center for heart failure management, to define the incidence of contrast nephropathy in patients undergoing CRT. Contrast nephropathy was defined as the occurrence of a 25% or greater increase in serum creatinine within 48 h after contrast administration. RESULTS: Sixty-eight patients underwent a total of seventy-three procedures between October 1st 2000 and December 31st 2003. Ten patients (14%) developed contrast nephropathy. Three of these patients (4%) required hemofiltration and one died. Patients with creatinine > or = 200 micromol/l (2.26 mg/dl) were more likely to develop contrast nephropathy than those with creatinine < 200 micromol/l (6/14 patients [43%] v 4/59 patients [7%], p<0.01). The mean length of hospital stay post-procedure in patients developing contrast nephropathy was 19+/-18 (SD) days versus 4+/-5 days for those patients with stable renal function (p<0.01). CONCLUSIONS: Contrast nephropathy is a frequent, but under-recognized complication of CRT with important morbidity/mortality. The extended hospital stay associated with contrast nephropathy has important clinical and health care implications. Patients and physicians need to be aware of this potential risk

128. Cowburn PJ, Parker JD, Cameron DA, Harris L: **Cardiac resynchronization therapy: retiming the failing right ventricle.** *Journal of cardiovascular electrophysiology* 2005, 16(4)**:** 439-443.
Abstract: Cardiac resynchronization therapy (CRT) improves symptoms, reduces hospitalization, and may decrease mortality in patients with moderate/severe heart failure and left bundle branch block. Whether CRT may have a role in the management of patients with adult congenital heart disease and a failing right (systemic) ventricle is unknown. We report the case of an adult patient with transposition of the great arteries and previous Mustard's repair, who successfully underwent CRT using a hybrid transvenous/epicardial approach. Exercise tolerance improved, right ventricular (systemic) ejection fraction improved, diuretic requirements reduced, and renal function improved. CRT may offer a new therapeutic option for this patient population

129. Cowburn PJ, Patel H, Jolliffe RE, Wald RW, Parker JD: **Cardiac resynchronization therapy: an option for inotrope-supported patients with end-stage heart failure?** *European journal of heart failure - journal of the Working Group on Heart Failure of the European Society of Cardiology* 2005, 7(2)**:** 215-217.
Abstract: BACKGROUND: Patients with refractory heart failure requiring inotropic support have a very poor prognosis. Cardiac resynchronization therapy (CRT) offers symptomatic and possibly a survival benefit for patients with stable chronic heart failure (CHF) and a prolonged QRS, but its role in the management of end-stage heart failure requiring inotropic support has not been evaluated. METHODS: We performed a retrospective observational study of patients undergoing CRT at our institution. RESULTS: We identified 10 patients who required inotropic support for refractory CHF and who underwent CRT while on intravenous inotropic agents. Patients had been in hospital for 30+/-29 days and had received inotropic support for 11+/-6 days prior to CRT. All patients were weaned from inotropic support (2+/-2 days post-CRT) and all patients survived to hospital discharge (12+/-13 days post-CRT). Furosemide dose fell from 160+/-38 mg on admission to 108+/-53 mg on discharge ($p<0.01$). Serum creatinine fell from 192+/-34 micromol/l prior to CRT to 160+/-37 micromol/l on discharge ($p<0.05$). Serum sodium was 131+/-4 mmol/l prior to CRT and remained low at 132+/-5 mmol/l on discharge. At short-term follow up (mean 47 days), all patients were alive; mean furosemide dose was 130+/-53 mg ($p=0.056$ versus pre-CRT). Serum creatinine was 157+/-36 micromol/l and serum sodium had increased to 138+/-6 mmol/l ($p<0.05$ and $p<0.01$, respectively, versus pre-CRT). CONCLUSION: CRT may offer a new therapeutic option for inotrope-supported CHF patients with a prolonged QRS

130. Cuesta JM, Farin t, Rodilla IG, Salesa R, de Berrazueta JR: **Aspergillus fumigatus endocarditis in a patient with a biventricular pacemaker**
<Original> Endocarditis por aspergillus fumigatus en un marcapasos bicameral.
Revista Espanola de Cardiologia (REV ESP CARDIOL) /20, REV.
Abstract: AB- Aspergillus fumigatus endocarditis is one of the rarest and severest complications in cardiological patients. We describe a patient with an intracardial pacemaker who was diagnosed as having Aspergillus fumigatus endocarditis. Postmortem examination showed a large, Aspergillus-infected thrombus encased in the right ventricle, pulmonary trunk and main pulmonary branches

131. Cuesta JM, Farinas MC, Rodilla IG, Salesa R, de Berrazueta JR: **[Aspergillus fumigatus endocarditis in a patient with a biventricular pacemaker]**
<Original> Endocarditis por Aspergillus fumigatus en un marcapasos bicameral.
Revista espanola de cardiologia 2005, 58(5)**:** 596-597.
Abstract: Aspergillus fumigatus endocarditis is one of the rarest and severest complications in cardiological patients. We describe a patient with an intracardial pacemaker who was diagnosed as having Aspergillus fumigatus endocarditis. Postmortem examination showed a large, Aspergillus-infected thrombus encased in the right ventricle, pulmonary trunk and main pulmonary branches

132. Curtis AB: **Cardiac resynchronization therapy 101: if it's not late, pacing it early won't help.** *Journal of the American College of Cardiology* 2005, 45(1)**:** 70-71.

133. Czuriga I: **[Chronic heart failure--the epidemic of the 21st century] <Original> Kronikus szivelegtelenseg--a 21. szazad epidemiaja.** *Orvosi hetilap* 2005, 146(20 Suppl 2)**:** 1075-1087.
Abstract: Heart failure represents a major public health problem in the industrialized countries and despite of optimal medical treatment its mortality remains high. The history of its management reflects growth and changes in our understanding of its pathophysiology. In the past, pharmacological treatment of heart failure was aimed only at relieving edema and improving hemodynamics. Today, however, a major aim of treatment is to antagonize the sympathetic nervous system and renin-angiotensin-aldosterone system, to avert harmful effects of neurohormonal activation on the myocardium and peripheral vessels. Currently, the major pharmacological treatments for heart failure are diuretics, ACE inhibitors, beta-blockers and (in NYHA classes III-IV) aldosterone antagonists. Some patients may also require specific treatment with additional drugs (e.g. anti-arrhythmia agents, anticoagulants, or vasodilators) or procedures such as coronary revascularization, or implantable devices such as pacemakers and implantable cardioverter defibrillators, or resynchronization devices. Patients with end-stage heart failure may require cardiac transplantation or ventricular assist devices. This review is summarized the recent practical drug therapy of heart failure and the results of the newer clinical trial

134. D'Ascia C, Cittadini A, Monti MG, Riccio G, Sacca L: **Effects of biventricular pacing on interstitial remodelling, tumor necrosis factor-alpha expression, and apoptotic death in failing human myocardium.** *European heart journal* 2006, 27(2)**:** 201-206.
Abstract: AIMS: Recent data from the COMPANION trial have documented that cardiac resynchronization therapy (CRT) with biventricular (BiV) pacing reduces mortality and hospitalization in patients with advanced CHF, but little is known regarding the cellular and molecular mechanisms of CRT. Our aim is to evaluate interstitial remodelling, tumor necrosis factor-alpha (TNF-alpha) expression, and apoptosis in patients with advanced CHF treated with CRT. METHODS AND RESULTS: We performed endomyocardial biopsies in 10 patients, aged 62, with dilated cardiomyopathy before and 6 months after the implantation of a BiV pacing device. Clinical status and left ventricular (LV) architecture and function were assessed as well as myocardial histology, TNF-alpha expression, and apoptotic index. CRT improved clinical status, as shown by a significant reduction of the Minnesota living with heart failure questionnaire (MLHFQ) score (from 53 to 40) and 6-min walked distance (from 290 to 330 m) (all $P<0.05$ vs. baseline). This was associated with reverse LV remodelling substantiated by significant reductions of LV volumes and end-systolic circumferential wall stress. Examination of myocardial tissue revealed a significant decrease of collagen volume fraction (CVF) (from 25.16 to 18.0%), TNF-alpha expression (from 9.5 to 3.6 pixel x 10(3)), and apoptotic index (from 2030 to 1408 apoptotic nuclei/10(6)), with increased capillary density (from 1801 to 2011 capillary/mm(2)) after 6 months of CRT (all $P<0.05$ vs. baseline). Moreover, changes in TNF-alpha expression were positively correlated with both CVF and end-systolic circumferential wall stress ($r=0.80$ and 0.70, respectively). CONCLUSION: We provide the first evidence that CRT reduces interstitial remodelling, TNF-alpha expression, and apoptosis. The data may explain the beneficial effects of CRT on CHF progression and survival

135. D'Ivernois C, Pi S, Hero M: **Cardiac resynchronization therapy using a VDD lead.** *Pacing and clinical electrophysiology - PACE* 2005, 28(11)**:** 1240-1242.
Abstract: In heart failure patients with normal sinus node function, cardiac resynchronization therapy can be achieved with only two leads, one VDD type, and one left ventricular. This reduces the number of venous punctures, implanted leads, and possibly operation and fluoroscopic times and complication rates. We present two cases and discuss the advantages and limits of such a procedure

136. Da CA, Thevenin J, Roche F, Faure E, Romeyer-Bouchard C, Messier M *et al.*: **Prospective validation of stress echocardiography as an identifier of cardiac resynchronization therapy responders.** *Heart rhythm - the official journal of the Heart Rhythm Society* 2006, 3(4)**:** 406-413.
Abstract: BACKGROUND: Cardiac resynchronization therapy (CRT) provides benefit for congestive heart failure (CHF), but predictors of the clinical response are debated. OBJECTIVE: The aim of this prospective study was to assess the predictive role of dobutamine stress echocardiography (DSE) in identifying a suitable candidate for CRT. METHODS: From March 2001 to December 2003, 71 CHF patients were prospectively enrolled on the basis of four criteria: New York Heart Association (NYHA) class III and IV; QRS > or =150 ms with a left bundle branch block pattern, and left ventricular ejection fraction (LVEF) < or =35% under optimal medical treatment. The combined endpoints were hospital readmission for class IV CHF, heart transplant (HT), and CHF-related death. RESULTS: The 67 patients completing the study presented with the following characteristics: age (70 +/- 10 years; 11 women); etiology (idiopathic in 44, ischemic in 23); NYHA class (40 in class III and 27 in class IV); LVEF 26% (+/-5%); QRS duration (190 +/- 28 ms); 6-minute walk test 330 m (+/-108); peak oxygen uptake 10.7 (+/-3.3 mL/kg/min); mitral insufficiency in 42 (> or =III grade); interventricular (IV) delay (62 +/- 21 ms); and intraventricular dyssynchrony in 30 patients. Over the follow-up period of 12.1 +/- 8.7 months, 20 (29.9%) of 67 patients presented with at least one hemodynamic event: hospitalization for CHF in 19 (28%) of 67, HT in 2 (3%) of 67, and CHF death in 7 (10%) 67. Univariate analysis identified NYHA class (P = .03), LVEF (P = .015), IV dyssynchrony before (P = .038) and after CRT (P = .0035), IV delay after CRT (P = .002), 6-minute walk distance (P = .01), and DSE Res+ (P = .008) as significant predictors of clinical events. A receiver operating curve established a cut-off value of 1.25 for the DSE responders (Res+: 34 patients at 10 microg/kg/min infusion rates), and the improvement at the 10 microg/kg/min level was 41% +/- 7% in Res+ and 29% +/- 8% in nonresponders (P<.0001). With a cut-off value of 1.25-fold the LVEF increase, the DSE test exhibits 70% sensitivity, 61.7% specificity, 43.8% positive predictive value, and 82.9% negative predictive value. Cox analysis identified IV dyssynchrony before CRT (P = .01) and DSE Res+ (P = .003) as independent predictive factors. CONCLUSIONS: Independent predictive factors of severe hemodynamic clinical outcome in patients with CRT are IV dyssynchrony and DSE

137. Daubert JC, Leclercq C, Mabo P: **There is plenty of room for cardiac resynchronization therapy devices without back-up defibrillators in the electrical treatment of heart failure.** *Journal of the American College of Cardiology* 2005, 46(12)**:** 2204-2207.
Abstract: Patients with chronic heart failure might benefit from electrical therapy with a view to resynchronize the heart and improve its mechanical performance by cardiac resynchronization therapy (CRT) or to prevent the risk of sudden death by automatic defibrillation. These two therapies can be applied separately or with a combined device, the biventricular implantable cardioverter-defibrillator (CRT-D). There is currently no strong scientific evidence indicating that a CRT-D must be offered to all candidates for CRT. Plain common sense should limit the prescription of these costly devices for patients in need of secondary prevention or for younger patients without major comorbidities. The preferential choice of CRT pacemakers in the remainder of patients is currently a logical one

138. Davis DR, Krahn AD, Tang Anthony SL, Lemery R, Green MS, Gollob M *et al.*: **Long-term outcome of cardiac resynchronization therapy in patients with severe congestive heart failure.** *Canadian journal of cardiology* 2005, 21(5)**:** 413-417.
Abstract: BACKGROUND: Cardiac resynchronization therapy (CRT) has recently been shown to be an effective short-term therapy for patients with drug-refractory heart failure and intraventricular conduction delay. Little is known about the long-term effects of this therapy. OBJECTIVES: To determine the long-term outcome of all consecutive patients who underwent CRT at two Canadian centres, and to determine what baseline variables

predict a response to CRT. RESULTS AND CONCLUSIONS: The present study comprised a total of 85 patients (mean age 66+/-9 years; 88% male) with New York Heart Association class II (4%), class III (84%) or class IV (12%) heart failure. All patients fulfilled the standard CRT indications with a QRS duration of 168+/-22 ms and a nuclear gated ejection fraction (EF) of 21+/-6%. Eighteen of the 85 patients were implanted with a combination automatic implantable cardioverter-defibrillator and CRT device. Within a mean clinical follow-up of 3.0+/-1.0 years, 26 of the 85 patients died, and eight patients underwent cardiac transplantation, with four transplant-related deaths (mean survival 3.53+/-0.26 years). Ten patients died of sudden cardiac death, eight patients died of progressive heart failure and eight patients died of noncardiac causes. None of the baseline factors (age, sex, EF, etiology, New York Heart Association class, QRS duration or implantable cardioverter-defibrillator) or indexes of CRT (change in EF or QRS duration) were predictive of a poor outcome. There was a clear trend for patients with a greater left ventricular EF gain to have a better outcome (P=0.1). The present observational data represent one of the longest follow-up databases of patients undergoing CRT. The significant morbidity and mortality found after CRT highlight the severity of the underlying cardiac pathology and concurrent illnesses

139. Day JD, Curtis AB, Epstein AE, Goldschlager NF, Olshansky B, Reynolds DW *et al.*: **Addendum to the clinical competency statement: training pathways for implantation of cardioverter defibrillators and cardiac resynchronization devices.** *Heart rhythm - the official journal of the Heart Rhythm Society* 2005, 2(10)**:** 1161-1163.

140. De Cock CC, Van Campen Linda MC, Jessurun ER, Allaart CA, Vos DS, Visser CA: **Long-term follow-up of patients with refractory heart failure and myocardial ischemia treated with cardiac resynchronization therapy.** *Pacing and clinical electrophysiology - PACE* 2005, 28 Suppl 1 S8-S10.
Abstract: Studies in patients without coronary artery disease have shown the restoration of glucose metabolism by cardiac resynchronization therapy (CRT) without changes in myocardial perfusion. We report on the long-term outcome of CRT in 24 patients with severe heart failure (HF) and advanced coronary artery disease not amenable for revascularization. All patients had documented myocardial ischemia on stress (99)Tc-sestamibi single-photon emission computed tomography, and all underwent successful implantations of CRT systems. The mean left ventricular ejection fraction was 21%+/- 4%, 19 patients (79%) had anginal complaints and 20 (83%) had diffuse three-vessel disease. During a follow-up of 13 +/- 0.7 months, two patients died suddenly and one died of progressive HF. Among survivors, functional capacity decreased from New York Heart Association class 3.2 +/- 1.4 to 2.1 +/- 1.0 ($P < 0.01$), and the Minnesota questionnaire quality-of-life scores decreased from 43 +/- 15 to 28 +/- 13 ($P < 0.01$). Despite an increase from 264 +/- 104 to 385 +/- 121 m in distance walked in 6 minutes ($P < 0.01$), the number of anginal attacks/week remained unchanged (4.7 +/- 0.7 to 4.5 +/- 0.6). Patients with advanced HF, stable angina, and documented myocardial ischemia may undergo safe and successful implantations of CRT systems

141. De Lurgio DB, Foster E, Higginbotham MB, Larntz K, Saxon LA: **A comparison of cardiac resynchronization by sequential biventricular pacing and left ventricular pacing to simultaneous biventricular pacing: rationale and design of the DECREASE-HF clinical trial.** *Journal of cardiac failure* 2005, 11(3)**:** 233-239.
Abstract: BACKGROUND: The first generation of cardiac resynchronization therapy (CRT) devices approved for the treatment of heart failure used simultaneous biventricular (BiV) pacing to achieve ventricular resynchronization. Left ventricular pacing alone and sequential BiV pacing also show promise as alternative ways to deliver CRT, but have not been studied together in a large randomized trial. METHODS: The Device Evaluation of CONTAK RENEWAL 2 and EASYTRAK 2: Assessment of Safety and Effectiveness in Heart Failure (DECREASE-HF) Trial is a randomized, double-blind, 3-arm study of patients in New York Heart Association Class III or IV with an ejection fraction of 35% or

less and a QRS duration > or =150 ms. Patients are randomized to receive either left ventricular pacing, simultaneous BiV pacing, or sequential BiV pacing. CONCLUSION: The study uses a novel composite endpoint that combines peak oxygen consumption and left ventricular end systolic dimension, thus combining a measure of symptomatic improvement (peak oxygen consumption) with a physiologic measure of ventricular reverse remodeling (left ventricular end systolic dimension) into a single composite score. Additionally, the safety and effectiveness of the CONTAK RENEWAL 2/4/4HE/EASYTRAK 2 system will be evaluated using: heart failure-related adverse events; system-related complications; left ventricular lead-related complications; detection time of induced ventricular fibrillation; and left ventricular lead performance (pacing threshold, pacing impedance, and R-wave amplitude)

142. De Souza FSO, Mortati NL, Braile DM, Vieira RW, Rojas SO, Rabelo AC *et al.*: **Technical aspects of coronary sinus catheterization based on the atrial component of the intracavitary electrogram and radiological anatomy during the implantation procedure of a biventricular pacemaker.** *Arquivos Brasileiros de Cardiologia (ARQ BRAS CARDIOL)* /20, ARQ.
Abstract: AB- OBJECTIVE: To present a technical proposal based on the experience of 130 implantations using a simplified technique for coronary sinus catheterization, based on the atrial component of the intracavitary electrogram and radiological anatomy. METHODS: From October, 2001 to October, 2004, 130 biventricular pacemaker implantations were performed, using radiological anatomy and observation of the intracavitary electrogram, focusing on the atrial component. RESULTS: The implantation of the system using left ventricular pacing via coronary sinus was not possible in 8 patients. Difficulties on the cannulation of the coronary ostium were felt in 12 patients and difficulties of lead advancement through the coronary sinus were felt in 15 patients. The mean time of radioscopy utilization was 18.69 min. CONCLUSION: The implantation technique, using the atrial component morphology of the intracavitary electrogram and radiological anatomy showed to be workless, safe and effective for the cannulation of the coronary sinus ostium requesting reduced time of radioscopy

143. De ME, Gallo P, Damiano M, Scognamiglio G, De SC, Nilo S *et al.*: **Predictive parameters of left ventricular reverse remodeling in response to cardiac resynchronization therapy in patients with severe congestive heart failure.** *Italian heart journal - official journal of the Italian Federation of Cardiology* 2005, 6(9)**:** 734-739.
Abstract: BACKGROUND: Cardiac resynchronization therapy (CRT) is useful for the treatment of severe congestive heart failure. Unfortunately up to 30% of patients could be non-responders. The aim of our study was to find parameters to predict responsiveness to CRT. METHODS: Fifteen patients (9 males, 6 females, mean age 67.3 +/- 7.8 years, range 52-83 years) with dilated cardiomyopathy, NYHA functional class III-IV, left ventricular (LV) ejection fraction < 35% and QRS > or = 110 ms, underwent CRT. All the patients had echocardiographic evidence of systolic dys-synchrony. RESULTS: One patient died of electromechanical dissociation. The remaining 14 patients maintained biventricular stimulation at 6 months; mean QRS width decreased from 156 to 132 ms ($p < 0.001$). Ten patients (71%) were considered responders because of a reduction in LV end-systolic volume > 15%. In non-responders (4 patients, 29%) LV end-systolic volume was stable in 3 patients and increased in 1. LV ejection fraction significantly increased only in responders ($p < 0.001$). Responders had more severe pre-pacing dyssynchrony than non-responders ($p < 0.001$). Inter- ($p = 0.002$) and intraventricular dyssynchrony ($p = 0.003$) did significantly reduce after CRT only in responders. On multiple regression analysis there were two independent predictors of reverse remodeling after pacing: the baseline mitral QS-tricuspid QS (QSm-QSt) time ($B = -1.7$, $p = 0.005$) and the intraventricular dyssynchrony index ($B = -1.55$, $p = 0.007$). Pre-implant QSm-QSt of 38 ms correctly identified the two groups: responders had a value > 38 ms and non-responders < 38 ms. The pre-implant intraventricular dyssynchrony index of 28 ms was the cut-off value: responders had an index > 28 ms, non-responders < 28 ms. CONCLUSIONS: In the

literature a tissue Doppler imaging index of intraventricular dyssynchrony evaluated before implantation is used to select responders to CRT. In our work we studied interventricular and intraventricular dyssynchrony, and both the QSm-QSt time and the standard deviation of the 12 LV segment QS time were correctly able to identify responders

144. De MG, Messano L, Santamaria M, Parisi Q, Dello RA, Pelargonio G *et al*.: **A randomized evaluation of different approaches to coronary sinus venography during biventricular pacemaker implants.** *Europace - European pacing, arrhythmias , and cardiac electrophysiology - journal of the working groups on cardiac pacing, arrhythmias , and cardiac cellular electrophysiology of the European Society of Cardiology* 2005, 7(1)**:** 73-76.
Abstract: AIM: Biventricular implantation procedures require contrast venography of the coronary sinus. The aim of our study was to evaluate the efficacy and safety of contrast venography obtained by direct manual contrast injection into the guiding catheter, compared with venography obtained after occlusion of the coronary sinus by a Swan-Ganz catheter. METHODS: Eighty-three patients were randomly assigned to direct or occlusive venography technique. The primary endpoint was complication rate. The secondary endpoints were rate of and time required for an adequate venography, total dose of contrast medium and total procedure time. RESULTS: Four dissections of the coronary sinus were observed with the occlusive venography technique group while no complications were observed with the direct venography technique group (p=0.04). Rate of adequate venography was similar in the two groups (p=NS). The time needed for coronary sinus venography and the total dose of contrast medium was significantly lower in the direct venography technique group compared with the alternative (p<0.0001 and p=0.003, respectively); the total procedure time was not significantly different between the two groups (p=NS). CONCLUSIONS: The direct venography technique shows a significantly lower incidence of complications and should be considered to be the first line approach to coronary sinus venography during biventricular pacemaker implantation

145. de SA, Toussaint J, Lavergne T, Ollitrault J, Abergel E, Paziaud O *et al*.: **Determinants of mortality in patients undergoing cardiac resynchronization therapy: baseline clinical, echocardiographic, and angioscintigraphic evaluation prior to resynchronization.** *Pacing and clinical electrophysiology - PACE* 2005, 28(12)**:** 1260-1270.
Abstract: BACKGROUND: In dilated cardiomyopathy (DCM) patients (pts) with cardiac resynchronization therapy (CRT) for ventricular dyssynchrony, long-term predictors of mortality and morbidity remain poorly investigated. METHOD AND RESULTS: We reviewed data of 102 pts, 68 +/- 10 years, NYHA Class II-IV (14 Class II, 67 Class III, 21 Class IV), who benefited from CRT (69 CRT, 33 CRT-ICD). Fifty-two patients had an ischemic DCM, 36 a previously implanted conventional PM/ICD, 29 a permanent atrial fibrillation, and 19 needed dobutamine in the month preceding implant. QRS duration was 187 +/- 35 ms, left ventricular end-diastolic diameter 72 +/- 10 mm, mitral regurgitation severity 1.9 +/- 0.8, echographic aorto-pulmonary electromechanical delay 61.5 +/- 25 ms and septo-lateral left intraventricular delay 86 +/- 56 ms, pulmonary artery pressure (PAP) 43 +/- 11 mmHg, angioscintigraphic left ventricular ejection fraction (EF) 20 +/- 9%, and right ventricular EF 30.5 +/- 14%. Over a mean follow-up of 23 +/- 20 months, 26 pts died (18 heart failures (HFs), 1 arrhythmic storm, 7 noncardiac deaths). Positive univariate predictors of death from any cause were NYHA Class IV (P < 0.001), and need for dobutamine the month preceding CRT (P < 0.008), while use of beta-blocking agents (P < 0.08) and left ventricular EF (P < 0.09) were negative ones. NYHA Class IV was the only independent predictor at multivariate analysis (P < 0.01). Survival at 24 months was 85% in Class II, 80% in Class III, and 37% in Class IV (II vs III, P = ns; III vs IV, P < 0.001). When using a composite endpoint of death from any cause and unplanned rehospitalization for a major cardiovascular event, there were 48 events (14 HF deaths, 3 noncardiac deaths, 26 HF rehospitalizations, 2 paroxysmal atrial fibrillation, 2 sustained ventricular tachycardia, 1 nonfatal pulmonary embolism). Predictors of death from any cause/unplanned rehospitalization for a major cardiovascular event in the follow-up were

NYHA Class IV (P < 0.001), need for dobutamine during the month preceding CRT (P < 0.002), and PAP (<0.02). NYHA Class IV was the only independent predictor at multivariate analysis (P < 0.05). Event-free proportion at 24 months was 70% in Class II, 64% in Class III, and 37% in Class IV (II vs III, P = ns; III vs IV, P < 0.01). When considering determinants of mortality only in NYHA Class IV patients, no variable was significantly correlated to mortality. Need for dobutamine during the last month preceding CRT did not add an adjunctive mortality risk. CONCLUSION: Baseline NYHA Class IV at implantation appears as the most important determinant of a poor clinical outcome in terms of both mortality and morbidity. No predictive criteria seem available for NYHA Class IV patients, in order to discriminate who will die after CRT and who will not. NYHA Class IV strongly influences the clinical outcome, suggesting that, in future studies planned on mortality and rehospitalization as major endpoints, baseline NYHA Class IV should be separately taken into account

146. de VW, van HN, Willems A, Visser J, Chitre Y, Bornzin G *et al*.: **Far-field R-wave reduction with a novel lead design: experimental and human results.** *Pacing and clinical electrophysiology - PACE* 2005, 28(8)**:** 782-788.
Abstract: INTRODUCTION: The purpose of this study was to examine a bipolar screw-in lead (NL), specially designed to reduce unwanted far-field R-wave (FFRW) signal detection in an acute human setting. The results were compared with animal experiments. METHODS: The newly designed lead with a center-to-center distance between the anode and cathode electrodes of 3.23 mm, corresponding to an inter-electrode spacing of 1.1 mm was implanted in nine canines with a follow-up of 6 months. Sensing of P waves, FFRW signals, pacing threshold, and impedance was measured at regular intervals. As a result of the positive outcome with the animal study, an acute human experiment was performed. In patients scheduled for conventional dual chamber pacemaker implantation, the NL was compared to a Tendril Model 1388T bipolar screw-in lead (St. Jude Medical, CRMD, Sylmar, CA). RESULTS: Utilizing a tip-to-ring distance of 1.1 mm, the optimum P wave to FFRW ratio was found in animal experiments. In the acute human tests in 15 patients, the mean P-wave voltage of the 1388T lead of 3.30 +/- 1.54 mV was slightly larger than that of the NL, at 2.55 +/- 1.11 mV, but did not differ significantly (P = 0.13). The FFRW voltage of the 1388T lead was 0.62 +/- 0.37 mV and was significantly greater from that of the NL, at 0.10 +/- 0.08 mV (P < 0.0001). Pacing thresholds and pacing impedances were comparable. CONCLUSION: Animal testing results were reproducible in the acute human test setting. The lead reduced the paced FFRW signal amplitudes significantly, allowing for high atrial sensitivity settings but without sensing the FFRW. A robust P-wave signal could be retained

147. Del Ojo JL, Moya F, Villalba J, Sanz O, Pavon R, Garcia D *et al*.: **Is magnetic resonance imaging safe in cardiac pacemaker recipients?** *Pacing and clinical electrophysiology - PACE* 2005, 28(4)**:** 274-278.
Abstract: Magnetic resonance imaging (MRI) is currently contraindicated in cardiac pacemaker (PM) recipients. The objectives of this prospective study were to (1) reassess the risks of performing an MRI scan in patients with PM, (2) compared the pacing functions before and after the exposure to MRI, and (3) monitor the development of possible adverse effects. Thirteen patients implanted with an Affinity DR model 5330 PMs (St. Jude Medical) connected to a Tendril model 1388 leads (St. Jude Medical) underwent 2.0 T-MRI for a variety of indications. All patients displayed a stable spontaneous rhythm at the time of the MRI scan and were not considered to be PM-dependent. The sensing and pacing functions were analyzed and the impedance of both leads was measured before and after the scan. The MRI scan was performed with all PM programmed in DDD mode. The sensing configuration was bipolar. All patients were monitored utilizing a standard electrocardiographic monitor and direct verbal communication. PM Inhibition, asynchronous pacing, or inappropriately rapid pacing was not observed. No patient reported discomfort, heat, or motion sensation at the PM implant site. There were no significant differences in the sensing, stimulation, AutoCapture threshold, and lead

impedance measurements before and after MRI. The results of this study suggest that performing 2.0 T-MRI scans in patients with Affinity DR model 5330 PM connected to a Tendril model 1388 lead is safe

148. del Rio Carlos L', Kukielka M, Dzwonczyk R, Clymer BD, Howie MB, Billman GE: **Myocardial electrical impedance response to submaximal exercise in dogs with healed infarets.**
Abstract: Introduction: Acute myocardial ischemia during submaximal exercise can induce ventricular fibrillation (VF) in dogs with myocardial infarctions (MI)(1). However, the mechanism that triggers such VF remains unclear. The post-MI heart contains beta-adrenergic receptors (BAR) that can regulate cell volume(2), a determinant of electrotonic coupling (known mechanism of VF3). Hence we tested whether BAR activation during submaximal exercise alters electrotonic coupling between myocardial regions.Methods: Dogs (N=9) with healed MI were instrumented for myocardial electrical impedance (MEI) measurements(4). After recovery, the dogs were subjected to submaximal exercise as follows(1): warm-up (not shown), and 6.4 km/h with grade increased every 3 min (0, 4, 8, 12, and 16%). Analysis: one-way RM ANOVA test with post-hoe Bonferroni t-test vs. 0% ($P < 0.05$).Results: See figure: heart rate (HR, A), and MEI (B). As expected, HR increased (+33.3 +/- 5.2 bpm) with exercise. Interestingly, MEI decreased with the grade of exercise (-9.8 +/- 1.9 Omega @ 16%) and in response to isoproterenol infusion, but not with pacing.Conclusion: These data suggest that beta AR activation during graded exercise modulates electrotonic coupling in the myocardium

149. Delvecchio A, Trivedi HA, Fisher JD, Kim SG, Ferrick KJ, Gross JN *et al*.: **Value of pre-hospital discharge defibrillation testing in recipients of implanted cardioverter defibrillators.** *PACE - Pacing and Clinical Electrophysiology (PACE PACING CLIN ELECTROPHYSIOL)* /20, ACE.
Abstract: AB- Opinions vary regarding the need to perform defibrillation testing prior to hospital discharge in recipients of state-of-the-art cardioverter defibrillators (ICDs). Our protocol is to perform predischarge ICD testing 1 day after implant. This report includes 682 consecutive implants. Adverse observations at testing were grouped into (1) risk of defibrillation failure, (2) surgical complications, (3) sensing/pacing issues or narrow defibrillation margin warranting closer follow-up, or (4) findings correctable by device reprogramming. Among the 682 patients, 63% had single-chamber and 37% dual-chamber or biventricular ICDs. In 48 patients (7%) there were 69 concerns and/or interventions, with overlaps among the four categories, including one failure to defibrillate (0.15%), and six other patients at risk. Surgical complications included 11 hematomas (1.6%), and six lead dysfunctions. Closer follow-up was indicated in 19 patients (2.7%), for high pacing thresholds in seven, sensing issues in seven, and <10 J defibrillation margin in five. Device reprogramming was needed in 31 patients (4.5%), for tachycardia detection and therapy settings in 12, and for pacing/sensing functions in 22 patients. In eight patients ventricular fibrillation could not be induced. There was no morbidity or mortality due to testing. The state-of-the-art ICDs delivering biphasic shocks are remarkably reliable. The routine pre-hospital discharge defibrillation testing of such ICDs may be optional and left to the physicians' discretion

150. Desai AD, Burke MC, Hong TE, Kim S, Salem Y, Yong PG *et al*.: **Predictors of appropriate defibrillator therapy among patients with an implantable defibrillator that delivers cardiac resynchronization therapy.** *Journal of cardiovascular electrophysiology* 2006, 17(5)**:** 486-490.
Abstract: INTRODUCTION: The purpose of this study was to determine predictors of appropriate implantable defibrillator (ICD) therapy among patients with heart failure who are treated with a cardiac resynchronization therapy-defibrillator (CRT-D). METHODS AND RESULTS: Patients enrolled in the Ventak CHF/Contak CD study were treated with a CRT-D device and were required to have NYHA class II-IV CHF, QRS duration > or = 120 msec, and a class I or II indication for an ICD. The study database was retrospectively

analyzed during the 6-month postimplant period to identify predictors of appropriate ICD therapy. Five hundred and one of the 581 patients enrolled in the trial had successful device implantation and were included in this analysis. Patients were mostly male (83%), 66 +/- 11 years old, and had coronary artery disease (69%), a mean left ventricular ejection fraction (EF) = 0.22 +/- 0.07, and NYHA class II (33%), III (58%), or IV (9%) CHF symptoms. During 6 months of follow-up, 73 of 501 (14%) patients received an appropriate ICD therapy. Two independent predictors of appropriate therapy were identified: a history of a spontaneous, sustained ventricular arrhythmia (HR = 2.05; 95% CI = 1.31-3.20; P = 0.002) and NYHA class IV CHF (HR = 1.81; 95% CI = 1.10-2.96; P = 0.019). When patients with NYHA class II were excluded from analysis, a history of a sustained ventricular arrhythmia and the presence of NYHA class IV CHF symptoms remained as independent predictors of appropriate ICD therapy. CONCLUSIONS: In a select population of advanced heart failure patients receiving a CRT-D, NYHA class IV CHF was a powerful independent predictor of appropriate ICD therapy. Approximately one-quarter of the patients with NYHA class IV CHF who received a CRT-D device received an appropriate ICD therapy within 3 months after implant. Additional studies are needed to confirm an association between class IV CHF symptoms and an increased frequency of ICD shocks

151. Di CA, Bongiorni MG, Arena G, Soldati E, Giannola G, Zucchelli G *et al*.: **New-onset ventricular tachycardia after cardiac resynchronization therapy.** *Journal of interventional cardiac electrophysiology - an international journal of arrhythmias and pacing* 2005, 12(3)**:** 231-235.
Abstract: It is well established that coronary artery disease with healed myocardial infarction is the most common backdrop for ventricular tachycardia (VT). Although the clinical benefits of biventricular pacing (BivP) in the treatment of severe heart failure are well documented, exact relation with ventricular arrhythmias remains still unclear.We describe a case of a patient, whitout a previous history of arrhythmic episodes, in which the onset of several episodes of VT presented immediatly after cardiac resynchronization therapy (CRT) and did not occur after BivP discontinuation

152. Di PF, Gasparini G, De PB, Yu Y, Cuesta F, Raviele A: **Hemodynamic effects of atrial septal pacing in cardiac resynchronization therapy patients.** *Journal of cardiovascular electrophysiology* 2005, 16(12)**:** 1273-1278.
Abstract: INTRODUCTION: Spontaneous or pacing-induced interatrial conduction delay may affect the outcome of heart failure patients treated with cardiac resynchronization therapy (CRT). The objective of this study was to evaluate the impact of the atrial pacing site (right atrial appendage, RAA; and low interatrial septum, LIS) during biventricular (BV) pacing on the left ventricular (LV) systolic function in candidates for CRT. METHODS AND RESULTS: Fifteen heart failure patients with left bundle branch block and LV ejection fraction < or =35% were enrolled. Electrodes were placed at the RAA, LIS, right ventricular apex, and LV free wall. A DDD protocol was tested, which consisted of 50 beats in AAI mode from the RAA followed by 50 beats in BV DDD mode with atrial pacing at the RAA (DDD RAA) or at the LIS (DDD LIS) at four AV delays. The average (+/-SD)%LV+dP/dtmax increase during DDD RAA and DDD LIS pacing with respect to baseline was 24 +/- 16% and 21 +/- 15%, respectively (P < 0.01), and average percentage change in aortic pulse pressure during DDD RAA and DDD LIS with respect to baseline (%PP) was 13 +/- 8% and 13 +/- 7% (ns). CONCLUSIONS: Our results show a significant hemodynamic improvement with both DDD RAA and DDD LIS biventricular pacing compared to AAI pacing. However DDD LIS pacing was not superior to DDD RAA pacing in acute hemodynamic responses

153. Dilaveris P, Pantazis A, Giannopoulos G, Synetos A, Gialafos J, Stefanadis C: **Upgrade to biventricular pacing in patients with pacing-induced heart failure: can resynchronization do the trick?** *Europace - European pacing, arrhythmias , and cardiac electrophysiology - journal of the working groups on cardiac pacing, arrhythmias , and*

cardiac cellular electrophysiology of the European Society of Cardiology 2006, 8(5)**:** 352-357.
Abstract: Dyssynchrony imposed on ventricular function by right ventricular (RV) apical pacing may lead in some cases to worsening or appearance of heart failure (HF) symptoms. This is a result of an altered pattern of activation, leading to several histological and functional adjustments of the left ventricle, including inhomogeneous thickening of the ventricular myocardium and myofibrillar disarray, fibrosis, disturbances in ion-handling protein expression, myocardial perfusion defects, alterations in sympathetic tone and mitral regurgitation. Studies of mid- and long-term effects of RV apical pacing on left ventricular (LV) function have demonstrated a progressive decline in ejection fraction and other indices of LV functional competence. Upgrading RV pacing systems to biventricular resynchronization modalities is a theoretically promising option for paced patients with worsening HF. The potentially favourable effect of upgrading on LV functional indices and patient clinical status has been demonstrated in few, non-randomized trials. Apart from the scantiness of existing clinical data, issues concerning technical aspects of the procedure and selection of eligible patients are raised. Is pacing-induced dyssynchrony equivalent to the indigenous dyssynchrony in unpaced patients with HF? What selection criteria should be applied in order to identify potential responders to cardiac resynchronization therapy in this patient population? Answers to these and more questions are still lacking

154. Diller G, Okonko D, Uebing A, Ho SY, Gatzoulis MA: **Cardiac resynchronization therapy for adult congenital heart disease patients with a systemic right ventricle: analysis of feasibility and review of early experience.** *Europace - European pacing, arrhythmias , and cardiac electrophysiology - journal of the working groups on cardiac pacing, arrhythmias , and cardiac cellular electrophysiology of the European Society of Cardiology* 2006, 8(4)**:** 267-272.
Abstract: AIMS: Patients with a systemic right ventricle (RV) frequently develop heart failure and may benefit from cardiac resynchronization therapy (CRT). We aimed to assess the proportion of unselected patients with a systemic RV eligible for CRT and to review available data on the effect of CRT in congenital heart disease patients. METHODS AND RESULTS: Adhering to criteria derived from landmark CRT trials, we determined the eligibility of patients with a systemic RV for CRT. Seventy-five transposition of the great arteries (TGA) patients (age 29.5+/-10.2 years) and 49 patients with congenitally corrected (cc) TGA (age 36.2+/-12.8 years) were studied. Full criteria for CRT were met in 4.0% of the TGA patients and 4.1% of the ccTGA patients. Including New York Heart Association class 2 patients, 9.3% of TGA and 6.1% of ccTGA patients were eligible for CRT. CONCLUSION: Four to 9% of unselected patients with a systemic RV appear to be potential candidates for CRT. Although large clinical studies are currently lacking, available data consistently demonstrate that CRT improves haemodynamics in congenital heart disease patients and warrants further investigation

155. Ding J, Yu Y, Kramer AP, Baumann L: **Method and apparatus for setting pacing parameters in cardiac resynchronization therapy.**
Abstract: A method and apparatus is disclosed for automatically setting the pacing parameters utilized by an implantable cardiac device in delivering cardiac resynchronization therapy. The selection of the pacing parameters is based at least in part upon measurements of intrinsic cardiac conduction parameters. Among the pacing parameters which may be selected in this way is the atrio-ventricular delay interval used in atrial-tracking and AV sequential pacing modes

156. Dohi K, Suffoletto M, Ganz L, Zenati M, Gorcsan J: **Utility of echocardiographic tissue synchronization imaging to redirect left ventricular lead placement for improved cardiac resynchronization therapy.** *Pacing and clinical electrophysiology - PACE* 2005, 28(5)**:** 461-465.
Abstract: An 80-year-old woman with severe symptomatic heart failure (ejection fraction of 13%), and left bundle branch block (QRS duration of 160 ms) underwent cardiac

resynchronization therapy (CRT). She had significant baseline dyssynchrony with a septal to posterior wall delay of 160 ms by echocardiographic tissue synchronization imaging (TSI). Despite exhaustive efforts, a stable posterior-lateral coronary vein lead position could not be achieved with the standard percutaneous approach, resulting in anterior coronary vein lead placement. This resulted in no improvement in the patient's symptoms or ventricular function. Follow-up TSI revealed earlier activation of the anteroseptal site and worsened dyssynchrony with septal to posterior wall delay of now 290 ms. This information prompted surgical revision of the left ventricular (LV) lead position via limited thoracotomy and posterior-lateral epicardial lead implantation. Pacing at the new lead site resulted in a 30% increase in stroke volume and symptomatic improvement. TSI in this case redirected lead position in a clinical nonresponder, resulting in a favorable response to CRT

157. Dohi K, Suffoletto MS, Schwartzman D, Ganz L, Pinsky MR, Gorcsan J: **Utility of echocardiographic radial strain imaging to quantify left ventricular dyssynchrony and predict acute response to cardiac resynchronization therapy.** *American journal of cardiology* 2005, 96(1)**:** 112-116.
Abstract: Echocardiographic strain imaging was used to quantify radial mechanical dyssynchrony in 38 patients who underwent cardiac resynchronization therapy. Dyssynchrony, defined as the time difference of peak radial strain in the septum versus the posterior wall, was significantly greater in patients with acute hemodynamic responses, and changes in radial dyssynchrony correlated with changes in stroke volume. A > or =130-ms difference in septal versus posterior wall peak strain when combined with a favorable left ventricular lead position was strongly predictive of immediate improvement in stroke volume with resynchronization therapy (95% sensitivity, 88% specificity), regardless of electrocardiographic QRS duration

158. Dohi K, Suffoletto M, Murali S, Bazaz R, Gorcsan J: **Benefit of cardiac resynchronization therapy to a patient with a narrow QRS complex and ventricular dyssynchrony identified by tissue synchronization imaging.** *European journal of echocardiography - the journal of the Working Group on Echocardiography of the European Society of Cardiology* 2005, 6(6)**:** 455-460.
Abstract: This report described an 81-year-old woman with severe symptomatic heart failure, reduced ejection fraction, mitral regurgitation, and an electrocardiographic QRS width of 118 ms who had ventricular dyssynchrony identified by echocardiographic tissue synchronization imaging. Because of her severe heart failure symptoms on maximal medical therapy, referral to implant a defibrillator, and mechanical dyssynchrony, she underwent cardiac resynchronization-defibrillator therapy with lateral left ventricular lead placement. This resulted in an immediate 30% increase in stroke volume and 35% decrease in mitral regurgitation. Echocardiographic tissue synchronization imaging may play a role in identifying mechanical dyssynchrony in patients with narrow QRS duration who may potentially benefit from cardiac resynchronization therapy

159. Donal E, Leclercq C, Linde C, Daubert J: **Effects of cardiac resynchronization therapy on disease progression in chronic heart failure.** *European heart journal* 2006, 27(9)**:** 1018-1025.
Abstract: Despite the alleviation of symptoms and longer survival conferred by pharmacological management of chronic congestive heart failure (CHF), this progressive syndrome remains associated with high morbidity and premature death. A new treatment of CHF should ideally alleviate symptoms, improve functional capacity, decrease mortality, and slow or reverse its progression without adding risks for the patient that outweighs the benefits. Growing evidence indicates that devices implanted to resynchronize ventricular contraction are a beneficial adjunct in the treatment of CHF. This review discusses the remodelling process, and its clinical and prognostic significance. We also discuss the impact of CRT, on remodelling and disease progression with a particular focus on patients with asymptomatic or mild heart failure (NYHA Class I-II)

160. Dosdall DJ, Ideker RE: **New technologies of internal defibrillation.** *Journal of interventional cardiac electrophysiology - an international journal of arrhythmias and pacing* 2005, 13 Suppl 1 67-70.
Abstract: This paper reviews recent research seeking to provide more efficient device oriented treatments for atrial and ventricular fibrillation to improve implantable cardioverter defibrillator (ICD) therapy. Investigators have proposed and tested many innovative technologies that may be included in future ICDs. Amongst the most promising technologies are combined cardiac resynchronization therapy and defibrillation, defibrillation coils in the coronary venous system, critical timing of defibrillation shocks, and pacing during ventricular fibrillation and tachycardia. Atrial defibrillation with ICDs is an area of considerable interest, but is not likely to gain widespread application unless acceptable methods of lowering pain associated with defibrillation shocks are implemented

161. Duntley S(Reprint), Stein P, Gleva M, Sowelam S, Nelson L, Markowitz T *et al*.: **Skin temperature changes around sleep onset.**

162. Duray G, Israel CW, Hohnloser SH: **Recent primary prevention implantable cardioverter defibrillator trials.** *Current Opinion in Cardiology (CURR OPIN CARDIOL)* /20, CURR.
Abstract: AB- Purpose of the review: The aim of this article is to summarize the most relevant findings of recently published trials on prophylactic implantable cardioverter defibrillator therapy. Recent findings: A number of important randomized clinical trials on the efficacy of prophylactic implantable cardioverter defibrillator therapy in patients deemed to be at high risk for ventricular tachyarrhythmias have recently reported their results. Patients with chronic ischemic cardiomyopathy, a long history of heart failure, and an ejection fraction of 0.30 or below benefit from preventive device therapy and are thus candidates for prophylactic defibrillator implantation. For this purpose, a single chamber device appears to be appropriate since there have been no prospective studies showing convincing clinical benefit by adding an atrial lead. Prophylactic implantable cardioverter defibrillator therapy should not be used in patients with recent myocardial infarction. There is convincing evidence from one trial that benefit from the defibrillator in coronary patients accrues after a considerable time has elapsed from the most recent infarct, presumably at least 6 months or perhaps longer. Finally, in patients with chronic dilated non-ischemic cardiomyopathy and a left ventricular ejection fraction of 0.35 or below, there is also benefit from prophylactic implantable cardioverter defibrillator therapy. Summary: Taken together, these trials allow an evidence-based approach to primary prevention of sudden cardiac death in patients with both ischemic and non-ischemic cardiomyopathy. (c) 2006 Lippincott Williams & Wilkins

163. Egoavil CA, Ho RT, Greenspon AJ, Pavri BB: **Cardiac resynchronization therapy in patients with right bundle branch block: analysis of pooled data from the MIRACLE and Contak CD trials.** *Heart rhythm - the official journal of the Heart Rhythm Society* 2005, 2(6)**:** 611-615.
Abstract: BACKGROUND: Clinical trials of cardiac resynchronization therapy (CRT) have not included many patients with right bundle branch block (RBBB). OBJECTIVES: We pooled data from two randomized controlled trials of CRT (Multicenter InSync Randomized Clinical Evaluation [MIRACLE] and Contak CD) in order to assess outcomes of patients with RBBB. METHODS: A total of 61 patients with RBBB were identified, 34 of whom were randomized to the CRT group and 27 to the control group. The data from these patients were entered into a new database and analyzed. RESULTS: Baseline demographics were not different between the two groups (mean age 65.5 +/- 11.3 years vs 69.5 +/- 9.6 years; male gender 91% vs 85%; patients with coronary disease 76.5% vs 88%; QRS duration 167 ms vs 164 ms; all P = NS). Outcome variables (New York Heart Association [NYHA] class, 6-minute hall walk distance, peak oxygen consumption (VO2), Minnesota Living with Heart Failure quality-of-life scores, left ventricular ejection fraction, and norepinephrine levels) were analyzed at randomization, 3 months, and 6

months. CONCLUSIONS: (1) With the exception of NYHA class, patients with RBBB as the qualifying wide QRS did not derive significant benefit from CRT in any of the other parameters studied at 3 or 6 months. (2) RBBB patients who received active CRT showed significant improvements in NYHA class by 6 months and trends toward improvement in 6-minute walk distance, quality-of-life scores, and norepinephrine levels. However, control patients also showed significant improvement in NYHA class by 6 months but showed no improvement in objective measurements (VO2, 6-minute walk distance, left ventricular ejection fraction, and norepinephrine levels), consistent with a placebo effect. Analysis of a larger cohort of patients with RBBB undergoing CRT may demonstrate significant benefit, but the current analysis does not support the use of CRT in patients with RBBB

164. Eldadah ZA, Strickberger S Adam: **PAVEing the way for cardiac resynchronization therapy.** *Journal of cardiovascular electrophysiology* 2005, 16(11)**:** 1166-1167.

165. Eldadah ZA, Rosen B, Hay I, Edvardsen T, Jayam V, Dickfeld T *et al*.: **The benefit of upgrading chronically right ventricle-paced heart failure patients to resynchronization therapy demonstrated by strain rate imaging.** *Heart rhythm - the official journal of the Heart Rhythm Society* 2006, 3(4)**:** 435-442.
Abstract: BACKGROUND: RV pacing induces conduction delay (CD), mechanical dyssynchrony, and increased morbidity in patients with HF. CRT improves HF symptoms and survival, but sparse data exist on its direct effect on chronically RV-paced HF patients. OBJECTIVES: To assess the benefit of cardiac resynchronization therapy (CRT) in chronically right ventricle (RV)-paced heart failure (HF) patients. METHODS: We studied 12 consecutive patients with class III HF who had a previously implanted pacemaker or implantable cardioverter-defibrillator. These individuals were chronically RV paced and referred for upgrade to a biventricular device by their primary cardiologists. Tissue Doppler and strain rate imaging (TDI and SRI, respectively) were performed immediately before each upgrade and 4-6 weeks afterward to quantify changes in regional wall motion and synchrony with CRT. RESULTS: CRT significantly reduced the mean QRS duration (205 ms to 156 ms; P<.0001), and it increased the ejection fraction (30.7%+/-5.1% to 35.8%+/-5.1%; P<.01). Left ventricular end-systolic and end-diastolic dimensions were also significantly reduced. Clinically, patients improved by an average of one New York Heart Association (NYHA) functional class after upgrade (P = .006). The parameter exhibiting greatest improvement was the coefficient of variation (CoV: standard deviation/mean) of time to peak systolic strain rate, a marker of ventricular dyssynchrony, which decreased from 34.3%+/-13.0% to 19.0%+/-6.6% (P<.01). Reduction in CoV of time to peak systolic strain rate was maximally seen in the midventricle (38.2%+/-19.6% to 16.5%+/-9.7%; P<.01). CONCLUSIONS: Upgrading chronically RV-paced HF patients to CRT improves global and regional systolic function. TDI and SRI provide compelling evidence that this benefit parallels that seen in HF patients with CD unrelated to RV pacing, which implies that biventricular pacing synchronizes mechanical activation in different myocardial regions in patients upgraded from RV pacing as well

166. Ellenbogen KA, Wood MA, Klein HU: **Why should we care about CARE-HF?** *Journal of the American College of Cardiology* 2005, 46(12)**:** 2199-2203.
Abstract: Previous trials of cardiac resynchronization therapy (CRT) have suggested that this therapy can significantly improve functional class and exercise capacity during short-term follow-up. The impact of this therapy on morbidity and mortality has only recently been reported. The Cardiac Resynchronization-Heart Failure (CARE-HF) study has definitively shown that CRT significantly reduces mortality (36%, p < 0.002) in patients with NYHA functional class III and IV heart failure and ventricular dyssynchrony. This study also shows that CRT reverses ventricular remodeling and improves myocardial performance progressively for at least 18 months. In heart failure patients, the CARE-HF and Comparison of Medical Therapy, Pacing, and Defibrillation in Heart Failure (COMPANION) (the earlier major morbidity/mortality trial) studies together show the unequivocal benefit for CRT therapy and CRT therapy with back-up defibrillation to

significantly reduce mortality and hospitalization compared with optimal medical therapy. Both studies suggest the benefit of adding the implantable cardiac defibrillator to CRT devices, as over one-third of deaths in the CRT-pacemaker arm of both the COMPANION and CARE-HF studies were sudden

167. Ellery S, Pakrashi T, Paul V, Sack S: **Predicting mortality and rehospitalization in heart failure patients with Home Monitoring - The Home CARE pilot study.** *Clinical Research in Cardiology (CLIN RES CARDIOL)* /20, CLIN.
Abstract: AB- The increasing worldwide prevalence of heart failure is associated with numerous and protracted hospital admissions. The multidisciplinary team approach together with telemonitoring aims at reducing the number of rehospitalizations, length of hospital stay, and mortality rates. Novel cardiac resynchonization therapy (CRT) devices have a Home Monitoring capability, offering wireless, everyday transfer of the essential status and therapy data to the attending physician. The transmitted data include potential predictors of death or hospitalization, such as the onset of atrial and ventricular arrhythmias, duration of physical activity, mean heart rates over 24 h and at rest, percentage of CRT delivered, and lead impedances. We present here interim results of the prospective, longitudinal, multicenter Home CARE Phase 0 study, conducted in 123 patients (age: 67 +/- 9 years, 83% male) with clinical indication for CRT. Twenty-nine patients (24%) received a CRT pacemaker, 52 (42%) a prophylactic implantable cardioverter defibrillator (ICD), and 42 (34%) had other ICD indications. All devices have an integrated Home Monitoring feature. In a mean (interim) follow-up period of 3 months (9194 observational days), 11 unplanned rehospitalizations of cardiovascular etiology and 9 deaths occurred. In 70% of the rehospitalization events, the retrospective analysis of transmitted data via Home Monitoring revealed an increase in mean heart rate at rest and in mean heart rate over 24 h within 7 days preceding hospitalization. A decrease in the percentage of CRT was observed in 43% and a reduction in the patients' daily activity in 30% of rehospitalized patients. These interim findings suggest that Home Monitoring data may predict events leading to hospitalization and encourage further research. (c) Steinkopff Verlag 2006

168. Ellery S, Williams L, Frenneaux M: **Role of resynchronisation therapy and implantable cardioverter defibrillators in heart failure.** *Postgraduate medical journal* 2006, 82(963)**:** 16-23.
Abstract: The worldwide prevalence of heart failure is increasing in part because of an aging population. In the developed world, heart failure affects 1%-2% of the general population, accounting for 5% of adult hospital admissions. There is now convincing evidence supporting the beneficial effects of cardiac resynchronisation therapy for the treatment of heart failure. Numerous observational studies, as well as a series of randomised controlled trials, have shown the safety, efficacy, and long term benefits for patients with chronic systolic heart failure who have broad QRS complexes and refractory symptoms despite optimal medical therapy. These studies have consistently found statistically significant improvements in quality of life, New York Heart Association functional class, exercise tolerance, and left ventricular reverse remodelling. Recent evidence suggests that the benefit may at least in part be because of a reduction in mechanical dysynchrony

169. England B, Lee A, Tran T, Faw H, Yang P, Lin A *et al*.: **Magnetic resonance criteria for future trials of cardiac resynchronization therapy.** *Journal of cardiovascular magnetic resonance - official journal of the Society for Cardiovascular Magnetic Resonance* 2005, 7(5)**:** 827-834.
Abstract: Current patient selection criteria for Cardiac Resynchronization Therapy (CRT), an efficacious treatment for heart failure, include no measure of disconjugate cardiac contractility other than prolonged QRS on electrocardiogram. Using cardiac magnetic resonance imaging, we examined the roles of cardiac asymmetry, asynchrony, and circumferential strain in DCC with the principal aim of generating a robust numerical index

for use in future trials of CRT. Standard cardiac magnetic resonance imaging was done on a GE 1.5 Tesla Signa LX MRI clinical scanner (GE Healthcare, Milwaukee, WI, USA) and analyzed by MASS Analysis (MEDIS, Leiden, The Netherlands). The methods were evaluated in eleven patients with advanced heart failure due to ischemic and non-ischemic cardiomyopathy, who did not qualify under current criteria for CRT, five CRT candidates pre-op and eleven normal subjects. Using t-test and standardized differences (SD = sd/diff, Power (N) = number of patients to reach $p < .05$) we determined efficacy. Indices of asymmetry and asynchrony (Ism and Isn, respectively) could be measured with accuracy and provided excellent statistical power when used as surrogate markers to delineate heart failure and CRT patients from control subjects. Asymmetry and asynchrony in heart contraction are both critical components of dilated cardiomyopathy that can be improved by CRT. Magnetic resonance asynchrony is efficacious in screening patients and should now be compared with recently published echocardiography data to improve outcome for this costly but valuable therapy

170. Ennezat P-V, Gal B, Kouakam C, Marquie C, LeTourneau T, Klug D *et al.*: **Cardiac resynchronisation therapy reduces functional mitral regurgitation during dynamic exercise in patients with chronic heart failure: an acute echocardiographic study.** *Heart (British Cardiac Society)* 2006, 92(8)**:** 1091-1095.
Abstract: OBJECTIVES: To assess non-invasively the acute effects of cardiac resynchronisation therapy (CRT) on functional mitral regurgitation (MR) at rest and during dynamic exercise. METHODS: 21 patients with left ventricular (LV) systolic dysfunction and functional MR at rest, treated with CRT, were studied. Each patient performed a symptom-limited maximal exercise with continuous two dimensional Doppler echocardiography twice. The first exercise was performed with CRT; the second exercise was performed without CRT. Mitral regurgitant flow volume (RV), effective regurgitant orifice area (ERO) and LV dP/dt were measured at rest and at peak exercise. RESULTS: CRT mildly reduced resting mitral ERO (mean 8 (SEM 2) v 11 (2) mm(2) without CRT, $p = 0.02$) and RV (13 (3) v 18 (3) ml without CRT, $p = 0.03$). CRT attenuated the spontaneous increase in mitral ERO and RV during exercise (1 (1) v 9 (2) mm(2), $p = 0.004$ and 1 (1) v 8 (2) ml, $p = 0.004$, respectively). CRT also significantly increased exercise-induced changes in LV dP/dt (140 (46) v 479 (112) mm Hg/s, $p < 0.001$). CONCLUSION: Attenuation of functional MR, induced by an increase in LV contractility during dynamic exercise, may contribute to the beneficial clinical outcome of CRT in patients with chronic heart failure and LV asynchrony

171. Epstein AE: **New insights into cardiac resynchronization therapy.** *Clinical cardiology* 2005, 28(11 Suppl 1)**:** I45-I50.
Abstract: Ventricular dyssynchrony plays a central role in the expression and progression of heart failure (HF). An independent risk factor for cardiac mortality, ventricular dyssynchrony is characterized by delay in left ventricular (LV) lateral wall contraction. This leads to decreased pumping efficiency, with resulting fluid retention and impaired exercise tolerance. Cardiac resynchronization therapy (CRT) attempts to improve cardiac efficiency by restoring the normal mechanical relationship between right and left ventricular contraction. Cardiac output increases with resynchronization, while ventricular filling pressure decreases without increasing cardiac oxygen consumption. Cardiac resynchronization therapy can also reverse LV dysfunction and reduce mitral regurgitation in patients with HF. Since 1999, the efficacy of implantable CRT devices has been evaluated in clinical trials enrolling more than 4,000 patients with heart disease. In the CARE-HF trial, CRT reduced the risk of death by 36% relative to standard pharmacologic therapy. Combining CRT with a defibrillator might produce an added benefit. In the COMPANION trial, all-cause mortality in patients randomized to a CRT-defibrillator combination was less than in patients receiving CRT therapy alone. Cardiac resynchronization therapy has also been found to decrease morbidity and improve functional status and quality of life. At the present time, the indications for CRT are limited and include symptomatic HF despite optimal medical therapy, prolonged QRS interval, and

LVEF < or = 35%. However, indications for CRT are still evolving and may be expanded as further studies identify those most likely to benefit

172. Ermis C, Seutter R, Zhu A, X, Benditt LC, VanHeel L, Sakaguchi S *et al*.: **Impact of upgrade to cardiac resynchronization therapy on ventricular arrhythmia frequency in patients with implantable cardioverter-defibrillators.** *Journal of the American College of Cardiology* 2005, 46(12)**:** 2258-2263.
Abstract: OBJECTIVES: This study compared cardiac resynchronization therapy's (CRT) impact on ventricular tachyarrhythmia susceptibility in patients who, due to worsening heart failure (HF) symptoms, underwent a replacement of a conventional implantable cardioverter-defibrillator (ICD) with a CRT-ICD. BACKGROUND: Cardiac resynchronization therapy is an effective addition to conventional treatment of HF in many patients with left ventricular systolic dysfunction. However, whether CRT-induced improvements in HF status also reduce susceptibility to life-threatening arrhythmias is less certain. METHODS: Clinical and ICD electrogram data were evaluated in 18 consecutive ICD patients who underwent an upgrade to CRT-ICD. Pharmacologic HF therapy was not altered during follow-up. The definition of ventricular tachycardia (VT) and ventricular fibrillation (VF) for each patient was as determined by device programming. Statistical comparisons used paired t tests. RESULTS: Findings were recorded during two time periods: 47 +/- 21 months (range 24 to 70 months) before and 14 +/- 2 months (range 9 to 18 months) after CRT upgrade. At time of upgrade, patient age was 69 +/- 11 years and ejection fraction was 21 +/- 8%. Before CRT the frequency of VT, VF, and appropriate ICD shocks was 0.31 +/- 1.23, 0.047 +/- 0.083, and 0.048 +/- 0.085 episodes/month/patient, respectively. After CRT-ICD, VT and VF arrhythmia burdens and frequency of shocks were respectively 0.13 +/- 0.56, 0.001 +/- 0.004, and 0.003 +/- 0.016 episodes/month/patient (p = 0.59, 0.03, and 0.05 vs. pre-CRT). CONCLUSIONS: Arrhythmia frequency and number of appropriate ICD treatments were reduced after upgrade to CRT-ICD for HF treatment. Thus, apart from hemodynamic benefits, CRT may also ameliorate ventricular tachyarrhythmia susceptibility in HF patients

173. Ermis C, Benditt DG: **Cardiac resynchronization pacing without defibrillator capability: is this a viable option?** *Europace - European pacing, arrhythmias , and cardiac electrophysiology - journal of the working groups on cardiac pacing, arrhythmias , and cardiac cellular electrophysiology of the European Society of Cardiology* 2006, 8(7)**:** 499-501.
Abstract: Improved cardiac resynchronization by pacemakers (CRT-P) and implantable defibrillators (CRT-D) benefits cardiac function, reduces heart failure (HF) admissions, and diminishes mortality in patients with severe left ventricular (LV) dysfunction. In terms of mortality benefit, current evidence suggests that CRT-D may be better than CRT-P alone when a broad range of HF patients is considered. However, the differential benefit may be small in certain patients. In individuals with severe and worsening HF due to systolic LV dysfunction, HF complications other than ventricular tachyarrhythmias contribute importantly to both quality-of-life (QoL) and duration of survival; these patients may be served cost-effectively by CRT-P enhancing QoL. A clinical trial evaluating CRT-D vs. CRT-P in terms of QoL and survival in such patients would assist physicians and payers to understand better the relative roles of CRT-P and CRT-D in the care of the sickest HF patients

174. Erol-Yilmaz A, Verberne HJ, Schrama TA, Hrudova J, De Winter RJ, Van Eck-Smit Berthe LF *et al*.: **Cardiac resynchronization induces favorable neurohumoral changes.** *Pacing and clinical electrophysiology - PACE* 2005, 28(4) **:** 304-310.
Abstract: AIM: The aim of this article is to examine whether cardiac resynchronization therapy (CRT) induces improvements in the neurohumoral system. METHODS AND RESULTS: Thirteen patients with HF (left ventricular (LV) ejection fraction <35%) were included. Before and after 6 months of CRT, myocardial (123)I-metaiodobenzylguanidine ((123)I-MIBG) uptake indices, used as an index of neural norepinephrine reuptake and

retention, and brain natriuretic peptide (BNP) levels, used as an index of LV end-diastolic pressure, NYHA classification and echocardiographic indices were assessed. Six months of CRT resulted in significant improvement in (1) NYHA classification and reduction in QRS width (P < 0.001), (2) decrease of LV end-diastolic diameter (P = 0.005), LV end-systolic diameter (P = 0.005), septal to lateral delay (P = 0.01) and mitral regurgitation (MR, P = 0.04), (3) delayed (123)I-MIBG heart/mediastinum ratios improved (P = 0.03) and (123)I-MIBG washout decreased (P = 0.001), and (4) BNP levels decreased (P = 0.001). CONCLUSIONS: Parallel to significant functional improvement and echocardiographic reverse remodeling and resynchronization, our data indicate that CRT induces favorable changes in the neurohumoral system

175. Ertl G, Bauer W: **Cardioverter-defibrillator (ICD) and resynchronization in every patient with cardiac failure**
<Original> Kardioverter-defibrillator (Icd) Und resynchronisationstherapie: Immer bei herzinsuffizienz - contra. *Deutsche Medizinische Wochenschrift (DTSCH MED WOCHENSCHR)* /20, DTSCH.

176. Ertl G, Bauer W: **[Cardioverter-defibrillator (ICD) and resynchronization in every patient with cardiac failure--Against]**
<Original> Kardioverter-Defibrillator (ICD) und Resynchronisationstherapie: immer bei Herzinsuffizienz -- Contra. *Deutsche medizinische Wochenschrift (1946)* 2006, 131(14)**:** 773.

177. Exner D, V: **Long-term effectiveness of cardiac resynchronization therapy: Futile or useful?** *Canadian journal of cardiology* 2005, 21(5)**:** 419-422.

178. Faber L: **Echocardiography-based optimization of cardiac resynchronization therapy in patients with congestive heart failure and conduction disorders.**
Herzschrittmachertherapie & Elektrophysiologie 2006, 17 Suppl 1 I73-I79.
Abstract: Resynchronization of segmental left ventricular mechanics as well as re-coordination of both atrio-ventricular and inter-ventricular contraction are potential mechanisms responsible for the clinical benefit observed in patients with advanced congestive heart failure treated by cardiac resynchronization therapy (CRT). Initially electrical conduction problems, in the majority of cases a left bundle branch block (LBBB), were considered the target for CRT. However, growing experience with CRT in different patient populations including those with milder degrees of conduction disturbance, and improved cardiac imaging utilizing the tissue Doppler approach, have shown the complexity of CRT and the usefulness of sophisticated echocardiographic imaging techniques for therapeutic decision making and optimization of CRT device settings

179. Fang Q, Guo T, Jackson K, Lieberman R: **[Combined cardiac resynchronization and implantable cardioversion defibrillation].** *Zhonghua xin xue guan bing za zhi Chinese journal of cardiovascular diseases* 2005, 33(1)**:** 22-25.
Abstract: OBJECTIVE: To examine the efficacy and safety of implantation of the device with combined cardiac resynchronization therapy (CRT) and implantable cardioversion defibrillation (ICD) capabilities. METHODS: Eleven patients aged 48 - 80 (71.6 +/- 9.5) years, 7 male and 4 female, were included in the study. All patients had either a history of aborted sudden cardiac death, ventricular tachyarrhythmia, or induced ventricular tachycardia during cardiac electrophysiological study, whose left ventricular ejection fractions were 35% or less and QRS durations were 120 or longer. The patients were implanted a Medtronic INSYNC II MARQUIS(TH) 7289. All left ventricular leads were implanted in left lateral or left posterior lateral side-branches of coronary sinus. The procedures were performed in general anesthesia status. The AV interval was optimized guided by ECHO in all the patients in the day after the procedure. RESULTS: All procedures were successfully completed without major complications. The fluoroscopy time was 19 - 73 (44.7 +/- 19.9) min. Atrial lead amplitude, resistance and threshold were

0.5 - 3.5 (2.47 +/- 0.77) mV, 410 - 749 (590 +/- 126) Omega and 0.9 - 3.0 (1.37 +/- 0.71) V respectively. Right ventricular septal lead amplitude, resistance and threshold were 6.8 - 15.8 (11.00 +/- 3.48) mV, 387 - 750 (586 +/- 116) Omega and 0.4 - 1.0 (0.69 +/- 0.21) V respectively. The amplitude, resistance and threshold of left ventricular leads were 1.2 - 25 (15.37 +/- 5.15) mV, 423 - 812 (602 +/- 125) Omega and 0.3 - 5.0 (1.62 +/- 1.59) V respectively. The defibrillation thresholds (DFT) of 20 J were obtained in 3 patients, 6 J in 3 patients, and 15 J, 12 J and 3 J in one patient respectively. One of the 11 patients with failed old device did not obtain successful DFT after lead and device replacement and was defibrillated externally during DFT test. The another one did not obtain successful DFT because of abnormal ST-T changes in ECG. All devices were programmed to maximum of 30 J and discharged from the hospital in 48 hours except the one who failed to obtain DFT. The patients with mitral regurgitation improved after the AV optimization.
CONCLUSIONS: Implantation of device with CRT and ICD features is safe even in aging patients. The long time outcomes of the clinical efficacy of this combined device remain to be observed

180. Fantoni C, Raffa S, Regoli F, Giraldi F, La Rovere MT, Prentice J *et al*.: **Cardiac resynchronization therapy improves heart rate profile and heart rate variability of patients with moderate to severe heart failure.** *Journal of the American College of Cardiology* 2005, 46(10)**:** 1875-1882.
Abstract: OBJECTIVES: This study sought to report long-term changes of cardiac autonomic control by continuous, device-based monitoring of the standard deviation of the averages of intrinsic intervals in the 288 five-min segments of a day (SDANN) and of heart rate (HR) profile in heart failure (HF) patients treated with cardiac resynchronization therapy (CRT). BACKGROUND: Data on long-term changes of time-domain parameters of heart rate variability (HRV) and of HR in highly symptomatic HF patients treated with CRT are lacking. METHODS: Stored data were retrieved for 113 HF patients (New York Heart Association functional class III to IV, left ventricular ejection fraction < or =35%, QRS >120 ms) receiving a CRT device capable of continuous assessment of HRV and HR profile. RESULTS: The CRT induced a reduction of minimum HR (from 63 +/- 9 beats/min to 58 +/- 7 beats/min, $p < 0.001$) and mean HR (from 76 +/- 10 beats/min to 72 +/- 8 beats/min, $p < 0.01$) and an increase of SDANN (from 69 +/- 23 ms to 93 +/- 27 ms, $p < 0.001$) at three-month follow-up, which were consistent with improvement of functional capacity and structural changes. Different kinetics were observed among these parameters. The SDANN reached the plateau before minimum HR, and mean HR was the slowest parameter to change. Suboptimal left ventricular lead position was associated with no significant functional and structural improvement as well as no change or even worsening of HRV. The two-year event-free survival rate was significantly lower (62% vs. 94%, $p < 0.005$) in patients without any SDANN change (Delta change < or =0%) compared with patients who showed an increase in SDANN (Delta change >0%) four weeks after CRT initiation. CONCLUSIONS: Cardiac resynchronization therapy is able to significantly modify the sympathetic-parasympathetic interaction to the heart, as defined by HR profile and HRV. Lack of HRV improvement four weeks after CRT identifies patients at higher risk for major cardiovascular events

181. Faris O, Chen E, Berman M, Moynahan M, Zuckerman B: **A US Food and Drug Administration perspective on cardiac resynchronization and ventricular assist device trials.** *Congestive heart failure (Greenwich , Conn)* 2005, 11(4)**:** 207-211.
Abstract: Cardiac resynchronization therapy and ventricular assist devices are two of the many US Food and Drug Administration-regulated medical device technologies that are intended for patients with heart failure. Cardiac resynchronization therapy devices have been shown to significantly improve the quality and potentially the duration of life for patients with moderate-to-severe congestive heart failure and electrical dyssynchrony. Likewise, ventricular assist devices have benefited patients with end-stage heart failure through both bridge-to-transplant and destination therapy. The pivotal trials that supported the first approvals for these devices, as well as subsequent trials, were shaped by unique

technologic and patient-related concerns. The US Food and Drug Administration has worked to understand these evolving concerns and the role each should play in the design of trials intended to demonstrate the safety and effectiveness of these critical devices

182. Fattore G, Landolina M, Bontempi L, Cacciatore G, Curnis A, Gulizia M *et al.*: **[Economic impact of cardiac resynchronization therapy in patients with heart failure. Available evidence and evaluation of the CRT-Eucomed model for analysis of cost-effectiveness] <Original> L'impatto economico della terapia di resincronizzazione in pazienti con scompenso cardiaco. Evidenze disponibili e valutazione del modello CRT-Eucomed per l'analisi del rapporto costo-efficacia.** *Italian heart journal Supplement - official journal of the Italian Federation of Cardiology* 2005, 6(12)**:** 796-803.
Abstract: Several clinical trials show that cardiac resynchronization therapy (CRT) in patients with moderate-severe heart failure increases survival, improves quality of life and reduces hospital admissions. The high cost of this new technology, incurred by health organizations at the moment of the implant, requires to assess whether its use is economically rational for the Italian Health Service. The paper summarizes evidences of the impact of CRT on the use of hospital resources and on quality of life, and presents a model to calculate incremental costs per quality adjusted life years (QALYs) gained in patients with moderate-severe heart failure treated with optimal medical therapy. The model is based on efficacy data drawn from clinical trials and on other information concerning the Italian context collected and validated by a team of experts from Assobiomedica and the Italian Federation of Cardiology. The model estimates that the incremental cost per QALY gained attributable to CRT is Euro 63,225 if all effects (years of life gained, increased quality of life and reduction of hospital costs) are censored at the end of the first year after the implant and Euro 21,720 if all effects are censored at the end of the third year. Cost-effectiveness of CRT is thus strongly dependent upon the duration of its effects: longer benefits of the therapy compensate initial costs and thus make the technology more cost-effective. In order to get better estimates of the economic profile of CRT it is required to collect more precise data from routine practice on survival, quality of life and hospital resources. The model presented can be easily adapted to take into account new evidence and to calculate cost per QALY gained in regional and local contexts

183. Fauchier L, Poret P, Robin I, de LA, Giraudeau C, Cosnay P *et al.*: **Different criteria of cardiac resynchronization therapy and their prognostic value for worsening heart failure or major arrhythmic events in patients with idiopathic dilated cardiomyopathy.** *American journal of cardiology* 2006, 97(3)**:** 393-399.
Abstract: There are still controversies about pertinent criteria for cardiac resynchronization therapy (CRT) and prophylactic indications for biventricular cardioverter-defibrillators, particularly in idiopathic dilated cardiomyopathy (IDC). This study compared several criteria for resynchronization therapy in IDC among those of several completed trials. In 201 patients with IDC, the relative risk for (1) death from heart failure (HF) or heart transplantation and (2) sudden death or sustained ventricular tachyarrhythmia were calculated separately according to the inclusion criteria of the Multisite Stimulation in Cardiomyopathy (MUSTIC), InSync, Multicenter InSync Randomized Clinical Evaluation (MIRACLE), Pacing Therapies for Congestive Heart Failure (PATH-CHF), Comparison of Medical Therapy, Pacing, and Defibrillation in Heart Failure (COMPANION), and CONTAK studies. The percentage of patients meeting the criteria ranged from 6% for those of MUSTIC to 23% for those of CONTAK. In a follow-up of 51 +/- 42 months, 28 patients died (15 from progressive HF, 13 from sudden death), 20 underwent heart transplantation, and 12 had sustained ventricular tachyarrhythmia. Relative risks of worsening HF ranged from 3.14 (95% confidence interval [CI] 1.41 to 6.99, p = 0.005) for the MIRACLE criteria to 4.63 (95% CI 1.76 to 12.2, p = 0.0019) for the MUSTIC criteria. Only the CONTAK criteria were significantly associated with a risk for major arrhythmic events (2.65, 95% CI 1.19 to 5.95, p = 0.018). Arrhythmic events constituted 16% of all cardiac events for the MUSTIC patients, 11% for InSync patients, 31% for PATH-CHF patients, 36% for MIRACLE patients, 38% for COMPANION patients, and 42% for

CONTAK patients. In conclusion, in IDC, the less restrictive criteria for CRT were associated with the greatest risk for arrhythmic events. In contrast, patients with the MUSTIC criteria for CRT mainly had a risk for worsening HF and may not benefit from biventricular cardioverter-defibrillators

184. Fazelifar AF, Arya A, Haghjoo M, Sadr-Ameli MA: **Familial atrial standstill in association with dilated cardiomyopathy.** *PACE - Pacing and Clinical Electrophysiology (PACE PACING CLIN ELECTROPHYSIOL)* /20, ACE.
Abstract: AB- Atrial standstill is an extremely uncommon arrhythmia that rarely appears to be familial and genetically determined. Atrial standstill has been associated with several conditions including, but not restricted to, congenital heart disease, valvular heart disease, conduction disturbances, Brugada syndrome, myocardial infarction, and amyloidosis. Only a few cases of familial clustering of atrial standstill have been reported so far. This report represents a family with atrial standstill associated with syncope, dilated cardiomyopathy, and sudden cardiac death

185. Feldman AM, de LG, Bristow MR, Saxon LA, De MT, Kass DA *et al*.: **Cost effectiveness of cardiac resynchronization therapy in the Comparison of Medical Therapy, Pacing, and Defibrillation in Heart Failure (COMPANION) trial.** *Journal of the American College of Cardiology* 2005, 46(12)**:** 2311-2321.
Abstract: OBJECTIVES: The analysis goal was to estimate incremental cost-effectiveness ratios (ICERs) for the Comparison of Medical Therapy, Pacing, and Defibrillation in Heart Failure (COMPANION) trial patients who received cardiac resynchronization therapy (CRT) via pacemaker (CRT-P) or pacemaker-defibrillator (CRT-D) in combination with optimal pharmacological therapy (OPT) relative to patients with OPT alone. BACKGROUND: In the COMPANION trial, CRT-P and CRT-D reduced the combined risk of all-cause mortality or first hospitalization among patients with advanced heart failure and intraventricular conduction delays, but the cost effectiveness of the therapy remains unknown. METHODS: In this analysis, intent-to-treat trial data were modeled to estimate the cost effectiveness of CRT-D and CRT-P relative to OPT over a base-case seven-year treatment episode. Exponential survival curves were derived from trial data and adjusted by quality-of-life trial results to yield quality-adjusted life-years (QALYs). For the first two years, follow-up hospitalizations were based on trial data. The model assumed equalized hospitalization rates beyond two years. Initial implantation and follow-up hospitalization costs were estimated using Medicare data. RESULTS: Over two years, follow-up hospitalization costs were reduced by 29% for CRT-D and 37% for CRT-P. Extending the cost-effectiveness analysis to a seven-year base-case time period, the ICER for CRT-P was 19,600 dollars per QALY and the ICER for CRT-D was 43,000 dollars per QALY relative to OPT. CONCLUSIONS: For the COMPANION trial patients, the use of CRT-P and CRT-D was associated with a cost-effectiveness ratio below generally accepted benchmarks for therapeutic interventions of 50,000 dollars per QALY to 100,000 dollars per QALY. This suggests that the clinical benefits of CRT-P and CRT-D can be achieved at a reasonable cost

186. Fernandez L, I, Higgins S, Escudier Villa JM, Niazi I, Toquero J, Yong P *et al*.: **Antitachycardia pacing efficacy significantly improves with cardiac resynchronization therapy**
<Original> La eficacia de la estimulacion antitaquicardia mejora tras la terapia de resincronizacion cardiaca. *Revista Espanola de Cardiologia (REV ESP CARDIOL)* /20, REV.
Abstract: AB- Introduction and objectives. The effect of cardiac resynchronization therapy on antitachycardia pacing still has to be determined. Patients and method. A total of 490 heart failure patients with an indication for an implantable cardioverter-defibrillator participated in the VENTAK CHF/CONTAK CD study, a single-blind, randomized, placebo-controlled study. We compared antitachycardia pacing efficacy in patients with or without cardiac resynchronization therapy. Due to the device design, antitachycardia

pacing was always given simultaneously via both left and right leads (i.e., biventricular antitachycardia pacing). Patients were randomized at the time of implantation, with the pacing mode being programmed accordingly one month later. Results. During follow-up, 32 patients received antitachycardia pacing: 15 with cardiac resynchronization therapy and 17 without. In the 15 patients receiving resynchronization, 221 episodes of tachycardia were treated by antitachycardia pacing. The sinus rhythm conversion rate was 90.5%. In patients not receiving resynchronization, there were 139 episodes of tachycardia and the sinus rhythm conversion rate was 69.1%. The sinus rhythm conversion rate in the cardiac resynchronization therapy group was significantly higher than that in the control group (P<.0001). Moreover, antitachycardia pacing efficacy improved with time in the whole study population. Conclusions. The efficacy of biventricular antitachycardia pacing in heart failure patients is significantly better in those with cardiac resynchronization therapy than in those without

187. Fernandez L, I, Higgins S, Escudier Villa JM, Niazi I, Toquero J, Yong P *et al*.: **[Antitachycardia pacing efficacy significantly improves with cardiac resynchronization therapy]**
<Original> La eficacia de la estimulacion antitaquicardia mejora tras la terapia de resincronizacion cardiaca. *Revista espanola de cardiologia* 2005, 58(10)**:** 1148-1154.
Abstract: INTRODUCTION AND OBJECTIVES: The effect of cardiac resynchronization therapy on antitachycardia pacing still has to be determined. PATIENTS AND METHOD: A total of 490 heart failure patients with an indication for an implantable cardioverter-defibrillator participated in the VENTAK CHF/CONTAK CD study, a single-blind, randomized, placebo-controlled study. We compared antitachycardia pacing efficacy in patients with or without cardiac resynchronization therapy. Due to the device design, antitachycardia pacing was always given simultaneously via both left and right leads (i.e., biventricular antitachycardia pacing). Patients were randomized at the time of implantation, with the pacing mode being programmed accordingly one month later. RESULTS: During follow-up, 32 patients received antitachycardia pacing: 15 with cardiac resynchronization therapy and 17 without. In the 15 patients receiving resynchronization, 221 episodes of tachycardia were treated by antitachycardia pacing. The sinus rhythm conversion rate was 90.5%. In patients not receiving resynchronization, there were 139 episodes of tachycardia and the sinus rhythm conversion rate was 69.1%. The sinus rhythm conversion rate in the cardiac resynchronization therapy group was significantly higher than that in the control group (P<.0001). Moreover, antitachycardia pacing efficacy improved with time in the whole study population. CONCLUSIONS: The efficacy of biventricular antitachycardia pacing in heart failure patients is significantly better in those with cardiac resynchronization therapy than in those without

188. Fish JM, Brugada J, Antzelevitch C: **Potential proarrhythmic effects of biventricular pacing.** *Journal of the American College of Cardiology* 2005, 46(12)**:** 2340-2347.
Abstract: Resynchronization therapy involving right ventricular endocardial and left ventricular epicardial pacing improves cardiac output, quality of life, and New York Heart Association functional class in patients with congestive heart failure. Although a great deal of attention has been directed at showing the mechanical benefits and in fine-tuning the biventricular pacing configuration and protocol, little attention has been focused on the consequences of reversing the direction of activation of the left ventricular wall. Recent basic science and clinical studies have shown a proarrhythmic effect of reversing the direction of activation of the left ventricular wall. Reversal of the normal activation sequence prolongs the QT interval and increases the existing transmural dispersion of repolarization, creating the substrate and trigger for re-entrant arrhythmias under long QT conditions. A number of case reports of R-on-T extrasystoles and ventricular tachyarrhythmia induction as a result of biventricular pacing support this observation, and raise concern that biventricular pacing may be proarrhythmic in select cases, particularly when associated with a prolonged QT interval. Our focus in this review is on current understanding of transmural heterogeneity of repolarization that exists across the left

ventricular wall, how this dispersion of repolarization is amplified as a consequence of reversal of the normal activation sequence, and how these basic experimental findings may apply to patients receiving cardiac resynchronization therapy

189. Fisher JD: **Cardiac resynchronization therapy: On a roll and gaining momentum; but challenges remain.** *PACE - Pacing and Clinical Electrophysiology (PACE PACING CLIN ELECTROPHYSIOL)* /20, ACE.

190. Flachskampf FA, Voigt J: **Echocardiographic methods to select candidates for cardiac resynchronisation therapy.** *Heart (British Cardiac Society)* 2006, 92(3)**:** 424-429.

191. Flevari P, Theodorakis G, Paraskevaidis I, Kolokathis F, Kostopoulou A, Leftheriotis D *et al.*: **Coronary and peripheral blood flow changes following biventricular pacing and their relation to heart failure improvement.** *Europace - European pacing, arrhythmias , and cardiac electrophysiology - journal of the working groups on cardiac pacing, arrhythmias , and cardiac cellular electrophysiology of the European Society of Cardiology* 2006, 8(1)**:** 44-50.
Abstract: AIMS: To study the effect of cardiac resynchronization therapy (CRT) on coronary and peripheral arterial circulation and to assess whether their changes are related to the improvement in patients' functional capacity and prognostically important biochemical markers. METHODS AND RESULTS: Twenty-five patients were studied (New York Heart Association classes III and IV, left ventricular ejection fraction <35%, QRS>120 ms, mean age 66 +/- 2.1 years). Coronary blood flow (CBF), forearm blood flow (FBF), and their reserve were measured by transoesophageal echocardiography (in cm/s) and venous occlusion plethysmography (in mL/100 mL/min) at baseline and following 3 months of CRT. N-terminal-pro-brain natriuretic peptide (Nt-pro-BNP) and serum adhesion molecules, sICAM-1 and sVCAM-1 levels were also assessed. CRT induced a non-significant increase in resting CBF (baseline vs. CRT: 52.1 +/- 5.5 vs. 58.2 +/- 3.6, P: NS), whereas hyperaemic CBF was increased by CRT (baseline vs. CRT: 67.8 +/- 6.8 vs. 79.8 +/- 6.2, $P < 0.05$). Significant increases were observed in resting FBF (baseline vs. CRT: 1.6 +/- 0.2 vs. 2.6 +/- 0.2, $P < 0.05$) and hyperaemic FBF (baseline vs. CRT: 2.1 +/- 0.2 vs. 3.2 +/- 0.3, $P < 0.05$). The per cent difference in hyperaemic FBF was related to the per cent change in Nt-pro-BNP ($r = -0.71$, $P < 0.05$) and the per cent improvement in exercise duration ($r = 0.80$, $P < 0.05$). CONCLUSION: CRT induces favourable changes in coronary and peripheral arterial function. Changes in peripheral blood flow are related to patients' improvement and may be prognostically significant

192. Fonarow GC: **Strategies to improve the use of evidence-based heart failure therapies.** *Reviews in cardiovascular medicine* 2005, 6 Suppl 2 S32-S42.
Abstract: Patients with heart failure (HF) face a very high risk of hospitalizations, arrhythmias, and mortality. Despite compelling scientific evidence that angiotensin-converting enzyme inhibitors, b-blockers, and aldosterone antagonists reduce hospitalizations and mortality in HF patients, these life-prolonging therapies continue to be underutilized. Recently, device therapy for HF, including implantable cardioverter-defibrillators and cardiac resynchronization devices, has also been demonstrated to result in substantial mortality reduction. A number of studies in a variety of clinical settings have documented that a significant proportion of HF patients are not receiving treatment with these guideline-recommended, evidence-based therapies when guided by conventional care. Treatment gaps in providing other components of HF patient care, including patient education, have also been documented. The demonstration that initiation of cardiovascular protective medications before hospital discharge results in a marked increase in treatment rates, improved long-term patient compliance, and better clinical outcomes has led to the revision of national guidelines to endorse this approach as the standard of care. Recent studies demonstrated that hospital-based systems can improve medical care and education of hospitalized HF patients and accelerate use of evidence-based, guideline-recommended therapies by administering them before hospital discharge. HF disease management

programs have also been shown to improve HF treatment, resulting in substantial reduction in hospitalizations and mortality. Further efforts are needed to ensure the implementation of effective strategies and systems that increase the use of evidence-based therapies in the hospital and outpatient settings to reduce the substantial HF morbidity and mortality risk

193. Fox DJ, Fitzpatrick AP, Davidson NC: **Optimisation of cardiac resynchronisation therapy: addressing the problem of "non-responders".** *Heart (British Cardiac Society)* 2005, 91(8)**:** 1000-1002.
Abstract: Cardiac resynchronisation therapy has become firmly established as a treatment for patients with symptomatic heart failure. Several randomised controlled trials and numerous observational studies have demonstrated improvements in exercise capacity and quality of life. Despite these advances it is clear that approximately 25% of patients who meet current criteria for implantation of such a device do not show objective evidence of clinical benefit. Implantation of a CRT device is expensive, time consuming and involves some risk so it is important to accurately identify patients who are likely to respond and to optimise pacing lead placement and device programming to maximise the benefit in these selected patients

194. Fox DJ, Petkar S, Davidson NC, Fitzpatrick AP: **Biventricular pacing in a patient with ventilatory and inotropic dependant heart failure following coronary artery by-pass surgery.** *Europace - European pacing, arrhythmias , and cardiac electrophysiology - journal of the working groups on cardiac pacing, arrhythmias , and cardiac cellular electrophysiology of the European Society of Cardiology* 2005, 7(5)**:** 490-491.
Abstract: Resynchronisation of intra- and interventricular conduction delay by biventricular pacing has become a proven therapy for selected heart failure patients. We present a case of biventricular pacing, used with great success, as a 'bail out' for a patient with refractory congestive heart failure following by-pass surgery

195. Freemantle Nick R, Richardson M, Calvert MJ, Cleland JG, Tavazzi L: **Predictors of response to cardiac resynchronization therapy: Results from the CARE-HF trial.**

196. Freemantle N, Yao G, Calvert MJ, Cleland JGF, Billingham L, Daubert J-C *et al*.: **Cost effectiveness of cardiac resynchronization therapy: Results from the CARE-HF trial: Reply [6].** *European Heart Journal (EUR HEART J)* /20, EUR.

197. Freemantle N, Tharmanathan P, Calvert MJ, Abraham WT, Ghosh J, Cleland JGF: **Cardiac resynchronisation for patients with heart failure due to left ventricular systolic dysfunction -- a systematic review and meta-analysis.** *European journal of heart failure - journal of the Working Group on Heart Failure of the European Society of Cardiology* 2006, 8(4)**:** 433-440.
Abstract: BACKGROUND: Randomised controlled trials generally suggest that cardiac resynchronisation improves outcomes in patients with heart failure due to left ventricular systolic dysfunction and cardiac dyssynchrony. Our objective was to provide a valid synthesis of the effects of CRT on mortality, major morbidity, quality of life and implantation success rates. METHODS: Systematic overview and meta-analysis of randomised trials, both blinded and open, comparing cardiac resynchronisation with control. The primary outcome was all-cause mortality, and secondary outcomes included hospitalisation for worsening heart failure, quality of life and implantation success rates. RESULTS: We identified 8 randomised trials which included 3380 patients and observed a total of 524 deaths. Follow-up ranged from 1 month to a mean of 29.4 months. Most trials were of high quality, with centrally administered randomisation and few patients lost to follow-up. CRT reduced mortality in these trials (odds ratio 0.72, 95% CI 0.59 to 0.88). In addition CRT reduced hospitalisation for worsening heart failure (odds ratio 0.55, 95% CI 0.44 to 0.68) and improved quality of life as measured by the Minnesota Living with Heart Failure Questionnaire (weighted mean difference -7.1, 95% CI -2.9 to -11.4). Implantation success rates in the trials were 87% or greater. CONCLUSION: Cardiac resynchronisation

in patients with heart failure characterised by dyssynchrony substantially reduces all-cause mortality, major morbidity and improves quality of life

198. Frodsham R: **Cardiac resynchronisation therapy for patients with heart failure.** *Nursing standard (Royal College of Nursing (Great Britain) - 1987)* 2005, 19(45)**:** 46-50.
Abstract: Cardiac resynchronisation therapy (CRT) is a non-pharmacological treatment for heart failure. The method 'resynchronises' the contraction of the right and left ventricles, resulting in better cardiac output, thus improving symptoms. This article discusses symptoms, morbidity and mortality of heart failure; potential benefits of CRT to patients' quality of life; and the implications of CRT for nursing practice

199. Frohlig G: **Peculiarities in the follow up of resynchronizing devices <Original> Besonderheiten der nachsorge nach kardialer resynchronisationstherapie.** *Herzschrittmachertherapie und Elektrophysiologie (HERZSCHRITTMACHERTHER ELEKTROPHYSIOL)* /20, HERZSCHRITTMACHERTHER.
Abstract: AB- While resynchronization therapy (CRT) is based on conventional pacemaker- and ICD technology, its main intention is to minimize inter- and intraventricular asynergy and to establish optimal AV timing if sinus rhythm is preserved. The focus of this contribution is a series of conditions which jeopardize the therapeutic goal of CRT and should be recognized and hopefully corrected during follow up of CRT systems. These scenarios include uncertainties about left ventricular capture, double sensing in the ventricles, inhibition of the ventricular output (and loss of resynchronization), atrial and ventricular tachycardia and rate adaptation. Technical issues of following rhythm management devices are only discussed in the context of CRT requirements. (c) Steinkopff Verlag 2005

200. Frohlig G: **[Peculiarities in the follow up of resynchronization therapy] <Original> Besonderheiten der Nachsorge nach kardialer Resynchronisationstherapie.** *Herzschrittmachertherapie & Elektrophysiologie* 2005, 16(1)**:** 44-57.
Abstract: While resynchronization therapy (CRT) is based on conventional pacemaker- and ICD technology, its main intention is to minimize inter- and intraventricular asynergy and to establish optimal AV timing if sinus rhythm is preserved. The focus of this contribution is a series of conditions which jeopardize the therapeutic goal of CRT and should be recognized and hopefully corrected during follow up of CRT systems. These scenarios include uncertainties about left ventricular capture, double sensing in the ventricles, inhibition of the ventricular output (and loss of resynchronization), atrial and ventricular tachycardia and rate adaptation. Technical issues of following rhythm management devices are only discussed in the context of CRT requirements

201. Fumagalli S, Boni N, Padeletti M, Gori F, Boncinelli L, Valoti P *et al.*: **Determinants of thoracic electrical impedance in external electrical cardioversion of atrial fibrillation.** *American journal of cardiology* 2006, 98(1)**:** 82-87.
Abstract: The success of external cardioversion (ECV) of atrial fibrillation depends on generating sufficient transmyocardial current for defibrillation with minimal myocardial injury. Thoracic electrical impedance plays an important role in the relation between the delivered energy and transmyocardial current. This study assessed the determinants of thoracic electrical impedance in ECV of atrial fibrillation. ECV of atrial fibrillation was performed in 80 consecutive patients (mean age 73 +/- 9 years; men 69%; body mass index 26.0 +/- 3.6 kg/m(2)) within 12 months, using biphasic shocks (Multipulse Biowave) delivered through adhesive pads in an anteroposterior position. Thoracic electrical impedance was measured using the first shock. The mean thoracic electrical impedance was 57.7 +/- 12.3 Omega (energy 71 +/- 43 J, current intensity 33 +/- 12 A). Sinus rhythm was immediately restored in 75 patients (94%). Thoracic electrical impedance was greater (60.9 +/- 11.8 vs 51.7 +/- 11.0 Omega, p = 0.001) in patients requiring >1 shock (65%). At multivariate linear regression analysis (R = 0.761, p <0.001), female gender (+9.7 +/- 2.0

Omega, p <0.001), body mass index (+1.5 +/- 0.3 for a 1 kg/m(2) increase, p <0.001), hemoglobin concentration (+1.9 +/- 0.6 for a 1 g/dl increase, p = 0.004), and the presence of chronic heart failure (-5.3 +/- 2.0 Omega, p = 0.009) were independent predictors of thoracic electrical impedance. In conclusion, to increase ECV efficacy and minimize complications, the delivered energy should be adjusted in accordance with the clinical variables that independently affect thoracic electrical impedance and, hence, transmyocardial current

202. Funck RC, Koelsch S, Waldhans S, Prinz H, Grimm W, Moosdorf R *et al*.: **Marked improvement in left ventricular function and significant reverse left ventricular remodeling within 3 months of cardiac resynchronization therapy in patients with dilated cardiomyopathy.** *Pacing and clinical electrophysiology - PACE* 2005, 28 Suppl 1 S5-S7.
Abstract: We monitored reverse left ventricular (LV) remodeling and LV function during the first 6 months of cardiac resynchronization therapy (CRT) in 34 patients (mean age = 55.3 +/- 13.6 years, 28 men) with dilated cardiomyopathy (DCM), left bundle branch block, in stable New York Heart Association class III, and on fixed drug regimen who underwent implantation of CRT systems with or without cardioverter defibrillator back-up. QRS-complex duration was reduced from 169.69 +/- 19.6 ms (SD) to 144.1 +/- 23.4 ms during CRT. Parasternal M-mode and apical 2D-echocardiography was performed before and 3 and 6 months after device implantation. LV enddiastolic (EDD) and endsystolic (ESD) diameters were measured, and biplane LV enddiastolic (EDV), and endsystolic (ESV) volumes and ejection fractions (EF) were calculated using a modified Simpson formula. Significant decreases in LVEDD (P = 0.0064 at 3 months and P = 0.021 at 6 months), LVESD (P = 0.023 at 3 months, and P = 0.003 at 6 months), and LVESV (P = 0.006 resp. P = 0.007), and increases in LVEF (P = 0.003 at 3 months and P < 0.001 at 6 months) were observed. Mean LVEF increased from 23% at baseline to 39% at 6 months. CRT induced prominent reverse LV remodeling and significantly increased LVEF within a few months in patients with DCM

203. Funck RC, Blanc J, Mueller H, Schade-Brittinger C, Bailleul C, Maisch B: **Biventricular stimulation to prevent cardiac desynchronization: rationale, design, and endpoints of the 'Biventricular Pacing for Atrioventricular Block to Prevent Cardiac Desynchronization (BioPace)' study.** *Europace - European pacing, arrhythmias , and cardiac electrophysiology - journal of the working groups on cardiac pacing, arrhythmias , and cardiac cellular electrophysiology of the European Society of Cardiology* 2006, 8(8)**:** 629-635.
Abstract: Despite the deleterious effects of cardiac dyssynchrony and the positive effects of cardiac resynchronization therapy, patients with high-degree atrioventricular block continue to receive desynchronizing right ventricular (RV) pacing systems. Although it is unclear whether the negative effects of RV pacing and left bundle branch block (LBBB) are comparable, and whether they depend on the presence and the degree of structural heart disease, one may hypothesize that RV pacing may have similar effects to LBBB. In the BioPace trial, the long-term effects of RV pacing vs. biventricular pacing will be prospectively compared in 1200 pacemaker patients with high likelihood of mostly paced ventricular events, regardless of whether in sinus rhythm or in atrial fibrillation (AF). After echocardiographic examination of left ventricular (LV) function, patients will be randomly assigned to the implantation of an RV vs. a biventricular pacing system and followed for up to 5 years. Primary study endpoints are survival, quality of life (QoL), and the distance covered in a 6-min hall walk (6-MHW) at 24 months after implantation. Secondary endpoints are QoL and the 6-MHW result at 12 months after implantation, hospitalization rate, LV dimensions, LV ejection fraction, and the development of chronic AF and other adverse events

204. Fung JW-H, Yu C, Chan JY-S, Chan HC-K, Yip GW-K, Zhang Q *et al*.: **Effects of cardiac resynchronization therapy on incidence of atrial fibrillation in patients with poor left**

ventricular systolic function. *American journal of cardiology* 2005, 96(5)**:** 728-731.
Abstract: Although the beneficial role of cardiac resynchronization therapy (CRT) in selected patients with heart failure is well proven, its effect on the incidence of atrial fibrillation (AF) is unclear. The present study compared the incidence of AF in 36 consecutive patients with chronic heart failure receiving CRT with its incidence in controls matched for age, gender, and left ventricular ejection fraction but not receiving CRT. The findings suggest that patients with CRT had a significantly lower incidence of AF than controls. Further studies to establish the role of CRT in preventing AF and its mechanisms are warranted

205. Furugen A, Matsuda N, Kasanuki H: **[Cardiac resynchronization therapy].** *Nippon rinsho Japanese journal of clinical medicine* 2006, 64(5)**:** 941-948.
Abstract: Despite recent advances in pharmacologic treatment for heart failure, the prognosis of patients with chronic heart failure remains poor. One third of patients with chronic heart failure have intraventricular conduction delay. The ventricular mechanical dyssynchrony based on intraventricular conduction delay worsen ventricular systolic dysfunction. Cardiac resynchronization therapy(CRT) through biventricular pacing significantly improves symptoms, exercise tolerance, hemodynamics, hospitalization for heart failure and mortality. However, it is estimated that 30 % of patients do not respond to CRT. A direct assessment of mechanical dyssynchrony with echocardiography seems more important than QRS duration in selecting appropriate patients for CRT

206. Gabor JY, Newman DA, Barnard-Roberts V, Korley V, Mangat I, Dorian P *et al.*: **Improvement in Cheyne-Stokes respiration following cardiac resynchronisation therapy.** *European respiratory journal - official journal of the European Society for Clinical Respiratory Physiology* 2005, 26(1)**:** 95-100.
Abstract: The effect of standard cardiac resynchronisation therapy (CRT) on the severity of Cheyne-Stokes respiration (CSR) in patients with congestive heart failure was studied. It was hypothesised that CRT, through its known beneficial effects on cardiac function, would stabilise the control of breathing and reduce CSR. Twenty-eight patients who were eligible for CRT and receiving optimised medical treatment for congestive heart failure were referred for overnight polysomnography, including monitoring of thoracic and abdominal movements to identify CSR and obstructive sleep apnoea events. Patients underwent repeat polysomnography after 6 months of CRT to re-evaluate sleep quality and sleep-disordered breathing. Twelve of the 28 patients had significant CSR (43%); 10 patients had a successful implantation and underwent repeat polysomnography a mean+/-SD 27+/-7 weeks after continuous biventricular pacing. Six of the 10 patients experienced a significant decrease in CSR severity following CRT, associated with correction of congestive heart failure-related hyperventilation and hypocapnia. Circulation time, oxygen saturation, frequency of obstructive apnoeas and sleep quality did not change. In conclusion, cardiac resynchronisation therapy is associated with a reduction in Cheyne-Stokes respiration, which may contribute to improved clinical outcome in patients treated with cardiac resynchronisation therapy

207. Ganion V, Rhodes M, Stadler RW: **Intrathoracic impedance to monitor heart failure status: a comparison of two methods in a chronic heart failure dog model.** *Congestive heart failure (Greenwich , Conn)* 2005, 11(4)**:** 177-81, 211.
Abstract: In patients with heart failure (HF), a convenient and accurate assessment of HF status could enhance titration of medications and possibly reduce hospitalizations for fluid overload. This study examined the feasibility of monitoring HF status by measuring intrathoracic impedance with either an implantable cardioverter-defibrillator or a pacemaker. Six canines were each instrumented with four devices: two capable of measuring intrathoracic impedance between a right ventricular coil electrode and the device case, one custom pacemaker for inducing HF, and an implantable hemodynamic monitor to measure left ventricular end-diastolic pressure as an assessment of HF status. High-rate ventricular pacing for 3-7 weeks induced HF, followed by a 4-week recovery

period. During high-rate pacing, left ventricular end-diastolic pressure was inversely correlated with impedance measurements from both systems (median r=-0.66; range r=-0.38 to -0.81). During recovery, the inverse correlation between left ventricular end-diastolic pressure and impedance was enhanced (median r=-0.88; range r=-0.58 to -0.95). The two types of impedance measurements were highly correlated (median r=-0.68 during pacing and r=-0.91 during recovery). These results suggest that various methods of measurement of intrathoracic impedance over time could be used to monitor HF status

208. Garcia-Bengochea JB, Fernandez AL, Amaro A, Alvarez J, Mair H, Daebritz S: **Surgical implantation of left ventricular epicardial leads for cardiac resynchronization [3] (multiple letters).** *European Journal of Cardio-thoracic Surgery (EUR J CARDIO-THORAC SURG)* /20, EUR-THORAC.

209. Garcia-Bengochea JB, Fernandez AL, Amaro A, Alvarez J: **Surgical implantation of left ventricular epicardial leads for cardiac resynchronization.** *European journal of cardio-thoracic surgery - official journal of the European Association for Cardio-thoracic Surgery* 2005, 28(1)**:** 184-185.

210. Garcia-Bolao I, Macias A, Lopez B, Gonzalez A, Gavira JJ, Azcarate P *et al*.: **A biomarker of myocardial fibrosis predicts long-term response to cardiac resynchronization therapy.** *Journal of the American College of Cardiology* 2006, 47(11)**:** 2335-2337.

211. Garrigue S(Reprint): **Selection of patients for biventricular pacing <ORIGINAL> Selection des patients a la stimulation biventriculaire.**
Abstract: In heart failure patients with a large QRS width, biventricular pacing has been shown to improve the fonctional status as well as hemodynamic parameters. However, there are non-responders despite of wide QRS complexes (between 15 and 35%). Patients selection might not rely only on electrical parameters. From an electrophysiological concept, clinicians moved toward a more electromechanical analysis, by using non-invasive tools such as Tissue Doppler imaging. Thereby, more than the QRS width, identification of intra-left ventricular asynchrony appears to be a crucial criterion for selecting responders to biventricular pacing. From this fact, several studies have demonstrated the efficacy of biventricular pacing to improve heart failure patients with narrow QRS but with intra-left ventricular asynchrony. Another parameter has been thought to be predominant, i.e. the left ventricular pacing site. If the pacing lead is located within a "slow conduction" area (at this time very difficult to identify during the implant procedure), biventricular pacing will generate a new asynchrony counteracting the beneficial expected. Thus, biventricular pacing appears to be more an electromechanical concept than exclusively electrical for selecting responders. Still, the optimal location of the left ventricular pacing lead remains to be determined. Copyright 2004 Publie par Elsevier SAS

212. Garrigue S: **[Patient selection for biventricular pacing] <Original> Selection des patients a la stimulation biventriculaire.** *Annales de cardiologie et d'angeiologie* 2005, 54(1)**:** 7-11.
Abstract: In heart failure patients with a large QRS width, biventricular pacing has been shown to improve the fonctional status as well as hemodynamic parameters. However, there are non-responders despite of wide QRS complexes (between 15 and 35%). Patients selection might not rely only on electrical parameters. From an electrophysiological concept, clinicians moved toward a more electromechanical analysis, by using non-invasive tools such as Tissue Doppler imaging. Thereby, more than the QRS width, identification of intra-left ventricular asynchrony appears to be a crucial criterion for selecting responders to biventricular pacing. From this fact, several studies have demonstrated the efficacy of biventricular pacing to improve heart failure patients with narrow QRS but with intra-left ventricular asynchrony. Another parameter has been

thought to be predominant, i.e. the left ventricular pacing site. If the pacing lead is located within a "slow conduction" area (at this time very difficult to identify during the implant procedure), biventricular pacing will generate a new asynchrony counteracting the beneficial expected. Thus, biventricular pacing appears to be more an electromechanical concept than exclusively electrical for selecting responders. Still, the optimal location of the left ventricular pacing lead remains to be determined

213. Gasparini Maurizio R, Auricchio A, Regoli F, Galimberti P, Fantoni C, Kawabata M *et al.*: **Importance of atrio-ventricular junction ablation for achieving effective cardiac resynchronization in drug-refractory heart failure patients with permanent atrial fibrillation.**

214. Gasparini Maurizio R, Regoli F, Galimberti P, Ceriotti C, Pini D, Klersy C *et al.*: **Long term results of cardiac resynchronization therapy in refractory heart failure patients: Could superior benefits be achieved in patients with "normal ORS duration"?**

215. Gasparini M, Galimberti P, Regoli F, Ceriotti C, Bonadies M: **Delayed defibrillation testing in patients implanted with biventricular ICD (CRT-D): a reliable and safe approach.** *Journal of cardiovascular electrophysiology* 2005, 16(12)**:** 1279-1283.
Abstract: BACKGROUND: Defibrillation testing (DT) at the end of the implantation of cardiac resynchronization pacemaker with a defibrillator (CRT-D) exposes heart failure (HF) patients to increased procedural risks. However, until now, delayed DT has not been assessed as a possible option in HF patients implanted with CRT-D. OBJECTIVE: Aim of the present study is to assess safety and feasibility of delayed DT in HF patients treated with CRT-D. MATERIAL AND METHODS: Two hundred and eleven consecutive patients (mean age: 65 years, mean NYHA class 3.0, mean EF: 29.3%) underwent CRT-D implantation from October 1999 to December 2004. In the first 17 patients, DT was performed at the end of CRT-D implantation. In the other 194 consecutive patients, DT was performed at 2 months after CRT-D implantation. Outcome of DT, as well as "acute" LV lead dislodgment rate were evaluated in the latter group of 194 patients undergoing a delayed DT. Also, ICD function was assessed through device telemetry analysis at 2 months. RESULTS: At delayed DT, first shock was effective in 187 of 194 patients (96%), ineffective VF interruption at maximum energy occurred only in one patient (0.5%), and acute LV lead dislodgment was 1%. No ICD therapy failure occurred in the 2-month untested period. CONCLUSION: DT performed 2 months after CRT-D implantation is safe and feasible; this is possibly related to the improvement of clinical conditions and hemodynamic status as well as greater lead stability 2 months after CRT-D

216. Gasparini M, Bocchiardo M, Lunati M, Ravazzi PA, Santini M, Zardini M *et al.*: **Comparison of 1-year effects of left ventricular and biventricular pacing in patients with heart failure who have ventricular arrhythmias and left bundle-branch block: the Bi vs Left Ventricular Pacing: an International Pilot Evaluation on Heart Failure Patients with Ventricular Arrhythmias (BELIEVE) multicenter prospective randomized pilot study.** *American heart journal* 2006, 152(1)**:** 155-157.
Abstract: BACKGROUND: Little is known on the chronic effects of left ventricular pacing (LV) in heart failure. METHODS: Seventy-four patients with LBBB, QRS >130 milliseconds, New York Heart Association class (Bradley DJ, Bradley EA, Braughman KL, et al. Cardiac resynchronization and death from progressive heart failure: a meta-analysis of randomized controlled trials. JAMA 2003;289:730-40.) II, LV ejection fraction (LVEF) <35%, and a class I cardioverter/defibrillator indication were implanted with CRT-D devices and were randomized to either LV or biventricular (BiV) pacing. Response (defined as increases of >5 points increase of LVEF and/or > or = 10% 6-minute walking test [6MWT]) between LV and BiV pacing were compared in an attempt to define the number of patients needed to claim noninferiority of LV pacing. In addition, absolute change in LVEF at 12 months in heart failure patients treated with LV pacing was evaluated. The safety of LV pacing was assessed comparing the total number of ventricular

arrhythmia episodes, of hospitilazations, and of deaths between the two pacing modes. RESULTS: The percentage of responders was comparable for both groups (LV = 75%, BiV = 70%, P = .788); based on the 95% CI of the difference between the groups, 1100 patients would be needed to claim noninferiority of LV pacing (with a 5% CI lower limit). LV pacing induced siginificant LVEF increase (5.2%, P = .002). These results remained unchanged after performing adjustment analyses. There were no differences in the numbers of ventricular arrhythmias, hospitalizations, and death events between the 2 pacing modes. CONCLUSIONS: At 12 months, percentage of responders to LV pacing was similar to BIV pacing. Furthermore, LV pacing achieved a significant increase of ejection fraction. LV pacing is both safe and feasible

217. Gasparini M, Reggli F: **Delayed defibrillation testing after CRT-D implant--weighing competing risks.** *Journal of cardiovascular electrophysiology* 2006, 17(4)**:** 457-458.

218. Gassis S, Leon AR: **Cardiac resynchronization therapy: strategies for device programming, troubleshooting and follow-up.** *Journal of interventional cardiac electrophysiology - an international journal of arrhythmias and pacing* 2005, 13(3)**:** 209-222.
Abstract: Cardiac resynchronization therapy (CRT) improves symptoms, exercise performance, ventricular function, and survival in patients with left ventricular dysfunction, prolonged QRS, and drug-refractory moderate to severe CHF. The growing application of CRT has created a large number of patients with complicated devices that need follow-up care from general practitioners, cardiologists, heart failure specialists and electro-physiologists. Optimal care of the CRT patient includes recognition and management of peri-implantation complications, optimal programming of atrio-ventricular and sequential ventricular timing, and troubleshooting device-related problems during long-term follow-up. A basic awareness of fundamental device features, the techniques to maximize the response to CRT, and an understanding of stored device data to track the response to therapy provide clinicians the ability to maximize clinical outcomes in the CHF patient. As evolving technology continues to increase the complexity of device therapies, clinicians must understand these therapies in order to properly treat heart failure patients. This work summarizes many of the issues involving early complications of CRT device implant, the strategies to optimize device function, and suggests a scheme for follow-up care of patients with CRT devices

219. Gassis SA, Delurgio DB, Leon AR: **Progress in cardiovascular disease: technical considerations in cardiac resynchronization therapy.** *Progress in cardiovascular diseases* 2006, 48(4)**:** 239-255.
Abstract: Cardiac resynchronization therapy (CRT) has been shown to improve symptoms, ventricular function, and survival in patients with left ventricular systolic dysfunction and ventricular conduction delay. Patients with moderate to severe drug-refractory heart failure symptoms along with ventricular dyssynchrony, manifested as prolongation of the QRS duration on the surface electrocardiogram, benefit from CRT. Owing to the growing awareness and application of CRT, a large number of patients have been identified as candidates for this therapy, making it necessary for clinicians involved in the care of such patients to be adequately knowledgeable of various aspects of CRT implementation. In particular, clinicians involved in the care of these patients must be aware of the practical considerations in preparing patients for the implantation procedure, careful surveillance for early or late procedure-related complications, and knowledge of the fundamental device features so as to tailor therapeutic and programming techniques to improve long-term response to CRT. This review addresses the technical considerations of the implantation procedure and device function with emphasis on the initial and long-term programming to ensure optimal delivery of CRT

220. Germano JJ, Reynolds M, Essebag V, Josephson ME: **Frequency and causes of implantable cardioverter-defibrillator therapies: is device therapy proarrhythmic?**

American journal of cardiology 2006, 97(8)**:** 1255-1261.
Abstract: Implantable cardioverter-defibrillator (ICD) shocks diminish patients' quality of life, increase health care resource utilization, and may lead to other adverse sequelae. Better understanding of the factors that lead to ICD therapies, and better strategies to avoid unnecessary therapies, are needed to optimize patient outcomes. Data from major randomized clinical trials involving the use of ICDs and cardiac resynchronization therapy-defibrillator devices were reviewed to determine control group mortality rates, control group sudden death rates, and the frequency of appropriate and inappropriate ICD therapies. In all studies that classified deaths, appropriate ICD therapies outnumbered control group sudden cardiac deaths by a factor of 2 to 3. Some of these episodes can be explained by device programming, by the treatment of potentially unsustained tachycardias, and by errors of episode classification. Another underexplored possibility is that device therapy is proarrhythmic. Reasons for frequent therapies and methods to prevent them are discussed, as well as the notion of device proarrhythmia and the potentially detrimental effects of ICD shocks. These issues clearly affect the overall benefit of device therapy and have important implications for patient management and health care delivery

221. Ghanbari H, Hassunizadeh B, Machado C: **Expanding cardiac resynchronization for systolic heart failure to patients with mechanical dyssynchrony and atrial fibrillation.** *Reviews in cardiovascular medicine* 2005, 6(3)**:** 140-151.
Abstract: Despite progress in the management of heart failure (HF) using pharmacotherapy, the mortality and morbidity associated with this condition remain unacceptably high. Cardiac resynchronization therapy (CRT), a left-sided pacing therapy for drug-refractory and highly symptomatic HF patients with ventricular conduction delay, has been shown to improve left ventricular (LV) systolic function, myocardial oxygen consumption, and New York Heart Association functional class and to inhibit or reverse LV chamber dilation and remodeling. Atrial fibrillation is common in patients with HF and is associated with significant worsening of HF and myocardial function. Only recently have trials been designed to specifically study CRT in patients with HF and chronic atrial fibrillation. These studies have shown that CRT with biventricular or univentricular LV pacing in patients with atrial fibrillation corrects mechanical dyssynchrony and results in significant and sustained improvement in functional capacity, LV ejection fraction, quality of life, and QRS duration

222. Ghio Stefano R, Freemantle N, Cleland JFG, Serio A, Magrini G, Scelsi L *et al*.: **Long-term ventricular reverse remodeling with cardiac resynchronization therapy. Results from the CARE-HF trial.**

223. Ghosh J, Freemantle N, Cleland J, Salukhe TV, Francis DP: **Meta-analysis does not show that cardiac resynchronisation reduces all-cause mortality [3] (multiple letters).** *International Journal of Cardiology (INT J CARDIOL)* /20, INT.

224. Ghosh J, Freemantle N, Cleland J: **Meta-analysis does not show that cardiac resynchronisation reduces all-cause mortality.** *International journal of cardiology* 2005, 103(2)**:** 230-231.

225. Gillis AM: **Referring patients for consideration of device treatment of sudden cardiac death and heart failure: Incorporating evidence-based therapies within the Canadian health care system.** *Canadian journal of cardiology* 2005, 21 Suppl A 25-30.
Abstract: The growing use of the implantable cardioverter defibrillator (ICD) in Canada reflects the impact that primary and secondary prevention trials have had in demonstrating the superiority of the ICD over medical therapy in the prevention of sudden cardiac death in high-risk populations. Currently, there are significant regional disparities in ICD implantation in Canada. These disparities may reflect a lack of regional ICD implant and follow-up programs, and capping of funding for ICDs. In addition to increased funding for

ICD systems, more resources are required to perform device implantations and follow patients over the long-term. Potentially eligible patients should be referred to an electrophysiologist for consideration of ICD therapy for the prevention of sudden cardiac death or to an electrophysiologist/ heart failure specialist for the consideration of combination cardiac resynchronization and ICD therapy for the management of refractory heart failure

226. Gimbel JR: **Method and demonstration of direct confirmation of response to cardiac resynchronization therapy via preimplant temporary biventricular pacing and impedance cardiography.** *American journal of cardiology* 2005, 96(6)**:** 874-876.
Abstract: Temporary resynchronization therapy pacing is feasible, and impedance cardiography (ICG) can provide evidence of hemodynamic benefit before permanent pacemaker implantation. During an electrophysiologic study performed before permanent device implantation, a guidewire was placed in a tributary of the coronary sinus to allow pacing of the left ventricle. Temporary pacing was implemented in various modalities, during which time ICG was used to document the hemodynamic consequences of atrial pacing, dual-chamber pacing, and biventricular pacing, with biventricular pacing being hemodynamically most favorable

227. Glick A, Michowitz Y, Keren G, George J: **Neurohormonal and inflammatory markers as predictors of short-term outcome in patients with heart failure and cardiac resynchronization therapy.** *Israel Medical Association journal - IMAJ* 2006, 8(6)**:** 391-395.
Abstract: BACKGROUND: Cardiac resynchronization therapy is a modality with proven morbidity and mortality benefit in advanced systolic heart failure. Nevertheless, not all patients respond favorably to CRT. Natriuretic peptides and inflammatory markers are elevated in congestive heart failure and reflect disease severity. OBJECTIVES: To test whether an early change in neurohormonal and inflammatory markers after implantation can predict the clinical response to CRT. METHODS: The study group included 32 patients with advanced symptomatic systolic heart failure and a prolonged QRS complex who were assigned to undergo CRT. Baseline plasma levels of B-type natriuretic peptide and high sensitivity C-reactive protein were determined in the peripheral venous blood and coronary sinus, Post-implantation levels were determined 2 weeks post-procedure in the PVB. Baseline levels and their change in 2 weeks were correlated with all-cause mortality and hospitalization for congestive heart failure. RESULTS: At baseline, coronary sinus levels of BNP but not hsCRP were significantly elevated compared to the PVB. Compared to baseline levels, BNP and hsCRP decreased significantly within 2 weeks after the implantation (BNP mean difference 229.1 +/- 102.5 pg/ml, 95% confidence interval 24.2-434, P< 0.0001; hsCRP mean difference 5.2 +/- 2.4 mg/dl, 95% CI 0.3-10.1, P= 0.001). During a mean follow-up of 17.7 +/- 8.2 months 6 patients died (18.7%) and 12 (37.5%) were hospitalized due to exacerbation of CHF. Baseline New York Heart Association and CSBNP levels predicted CHF-related hospitalizations. HsCRP levels or their change over 2 weeks did not predict all-cause mortality or hospitalizations. CONCLUSIONS: BNP levels in the CS and peripheral venous blood during biventricular implantation and 2 weeks afterwards predict clinical response and may guide patient management

228. Goette A, Jentsch-Ullrich K, Hammwohner M, Trautmann S, Franke A, Klein HU *et al.*: **Cardiac uptake of progenitor cells in patients with moderate-to-severe left ventricular failure scheduled for cardiac resynchronization therapy.** *Europace - European pacing, arrhythmias , and cardiac electrophysiology - journal of the working groups on cardiac pacing, arrhythmias , and cardiac cellular electrophysiology of the European Society of Cardiology* 2006, 8(3)**:** 157-160.
Abstract: AIMS: Injury to the heart causes haematopoietic and endothelial progenitor cells (PCs) to migrate to the site of damage and to undergo PC differentiation, which may contribute to angiogenesis and myocardial tissue repair. We sought to determine the cardiac uptake of PC in patients with moderate-to-severe congestive heart failure (CHF)

scheduled for cardiac resynchronization therapy. METHODS AND RESULTS: A total of 28 patients was included in the study. Fourteen patients had moderate-to-severe CHF with a mean left ventricular ejection fraction (LVEF) of 20 +/- 9%. The remaining patients had a normal LVEF and served as controls. PCs (CD34(+) and CD34(+)/CD117(+)) were quantified using a fluorescence-activated cell sorter. In CHF patients, PCs were determined from whole blood samples taken from the aorta, the coronary sinus (CS), and the superior vena cava (SVC) during right and left heart catheterization. Cardiac PC uptake was determined as the difference in PC levels between the aorta and the CS. Differences in CD34(+)PC counts (Delta0.11 +/- 0.98 x 10(3) mL(-1)) and relative amount of CD34(+)/CD117(+)PC (Delta0.08 +/- 0.31%) between the aorta and the CS were not significant. PC levels were comparable between the SVC, CS, and aorta. CD34(+) and PC levels did not correlate with New York Heart Association class (r(2) = 0.22), LVEF (r(2) = 0.01), LV diameter (r(2) = 0.05), QRS complex duration (r(2) = 0.1), or maximal O(2) uptake during exercise (r(2) = 0.08). There was no difference between patients with ischaemic cardiomyopathy (ICM) and non-ICM. Systemic PC levels were not different compared with age-matched controls without LV failure (CD34(+): 4.61 +/- 1.83 x 10(3) mL(-1) vs. control: 5.25 +/- 1.67 x 10(3) mL(-1); P = n.s.). CONCLUSION: Moderate-to-severe chronic CHF is not associated with elevated PC levels in the systemic circulation. A measurable cardiac uptake of CD34(+) and CD34(+)/CD117(+)PC cannot be demonstrated by FACS analysis in this cohort of patients

229. Gold MR, Niazi I, Giudici M, Leman RB, Sturdivant LJ, Kim M *et al*.: **Incremental benefit of interventricular delay measurements to predict the acute hemodynamic response to cardiac resynchronization therapy.**

230. Gold MR, Auricchio A, Hummel JD, Giudici MC, Ding J, Tockman B *et al*.: **Comparison of stimulation sites within left ventricular veins on the acute hemodynamic effects of cardiac resynchronization therapy.** *Heart rhythm - the official journal of the Heart Rhythm Society* 2005, 2(4)**:** 376-381.
Abstract: OBJECTIVES: The purpose of this study was to study the acute hemodynamic effect of left ventricular (LV) stimulation sites within a coronary vein. BACKGROUND: Access to LV stimulation sites for resynchronization therapy is achieved using specialized lead systems navigated through a coronary vein. The effects of stimulation in different coronary veins have been evaluated previously, but less is known about stimulation sites within a coronary vein. METHODS: Twenty-four patients (New York Heart Association functional class II-IV, age 59 +/- 10 years, ejection fraction 21 +/- 7%, QRS 166 +/- 30 ms) were enrolled in the study. A novel over-the-wire lead system was used to access an anterior or lateral coronary vein. At each lead location, a randomized stimulation protocol was executed. Hemodynamic responses were evaluated using LV dP/dtmax. RESULTS: The mean time to cannulate the coronary sinus and position the LV lead was 19 +/- 30 minutes and 17 +/- 18 minutes, respectively. Data from stimulation at two sites within a coronary vein were obtained in 19 patients (anterior vein 11; lateral vein 8). Of these patients, 14 (anterior vein 9; lateral vein 5) showed large improvement in dP/dtmax (22%-25% in anterior vein, 37%-40% in lateral vein). Overall, there were no group differences in hemodynamic effects among different stimulation sites within a coronary vein, although significant variability among sites was observed in individuals. CONCLUSIONS: Resynchronization therapy through a coronary vein improves acute hemodynamic function of heart failure patients with LV conduction disorder. There were no significant differences between basal and apical pacing sites for this group

231. Goldberger Z, Lampert R: **Implantable cardioverter-defibrillators: expanding indications and technologies.** *JAMA - the journal of the American Medical Association* 2006, 295(7)**:** 809-818.
Abstract: CONTEXT: Sudden cardiac death (SCD) is a major challenge facing contemporary cardiology. For an increasing number of patients, the current standard of care for the treatment and prevention of SCD is the implantable cardioverter-defibrillator (ICD).

Since its introduction, there have been numerous advances in ICD technology, and indications for its use have expanded greatly in the past year. OBJECTIVE: To highlight the evolving indications for and the numerous advances in ICD technology, with emphasis on primary and secondary prophylaxis of SCD. EVIDENCE ACQUISITION: Electronic literature search of the Pubmed and MEDLINE databases from January 1996 to July 2005, using the Medical Subject Heading implantable defibrillator. Abstracts and titles were reviewed to identify English-language randomized controlled trials that included an ICD group and a non-ICD group and that had end points of all-cause mortality, cardiac death, and/or arrhythmic mortality as the main outcome. A further MEDLINE search was conducted to identify randomized controlled trials of cardiac resynchronization therapy (CRT) with a CRT and a non-CRT group (including both mortality and other end points). Other studies were included that clarify aspects of device function and other relevant issues. A total of 22 trials were identified. EVIDENCE SYNTHESIS: ICD implantation improves survival in patients with a history of life-threatening ventricular arrhythmia. More recent evidence shows that ICD implantation also improves survival as primary prophylaxis against SCD in patients at high risk for ventricular arrhythmias, including those with left ventricular ejection fraction (LVEF) of 35% or less and New York Heart Association class II or III heart failure and those with a history of myocardial infarction and LVEF of 30% or less. Cardiac resynchronization improves symptoms, quality of life, and survival for patients with advanced heart failure and intraventricular conduction delays and ventricular dyssynchrony. CONCLUSIONS: ICDs have been shown to improve survival as both primary and secondary prophylaxis in an expanding population of patients. Ongoing ICD research may continue to delineate groups with survival benefit from ICDs, and the use and indications of these devices in clinical practice will continue to expand

232. Gotze S, Butter C, Fleck E: **[Cardiac resynchronization therapy for heart failure-From experimental pacing to evidence-based therapy.]**
<Original> Kardiale Resynchronisation bei Herzinsuffizienz : Vom experimentellen Pacing zur Evidenz-basierten Therapie. *Clinical research in cardiology - official journal of the German Cardiac Society* 2006, 95 Suppl 4 18-35.
Abstract: Within the last decade, cardiac resynchronization therapy (CRT) has become an evidence-based cornerstone for a subset of patients with chronic heart failure. For those, who suffer from ischemic or non-ischemic cardiomyopathies at NYHA III or IV, have sinus rhythm, a left bundle branch block and a left ventricular ejection fraction below 35%, CRT has evolved as an important treatment option with promising results. Numerous studies have shown that in these patients pacemaker-mediated correction of intra- and interventicular conduction disturbances can improve not only clinical symptoms, exercise tolerance and the frequency of hospitalizations, but even more important the overall mortality. These clinical results are due to several functional aspects. In the failing heart characteristic intra- and interventricular alterations in electrical conduction result in mechanical asynchrony that leads to an abnormal contraction of the left ventricle with delayed activation of the lateral wall, a paradoxical septal movement, a reduced diastolic filling and a mitral regurgitation due to dyssynchrony of papillary muscle activation. It is conceivable that these functional changes have fatal consequences for the failing heart. AV-optimized left- or biventricular stimulation by modern pacemakers can correct the pathological dyssynchrony, thereby improving cardiac function and clinical outcome in these patients. Although tremendous progress in cardiac resynchronization therapy has been made during the last decade, a couple of questions still need to be resolved. Critical issues are the identification of patients, who will predictably benefit from CRT, the value of CRT-pacemakers versus CRT-ICDs, and the usefullness of CRT in patients with atrial fibrillation

233. Gould PA, Mariani JA, Kaye DM: **Biventricular pacing in heart failure: a review.** *Expert review of cardiovascular therapy* 2006, 4(1)**:** 97-109.
Abstract: Biventricular pacing has been an exciting recent advance in the management of drug-refractory heart failure. This new therapy has evolved as much from necessity as

scientific observation, since benefits derived from pharmacotherapy currently appear to have reached their peak. Clinical trials of biventricular pacing are establishing morbidity and mortality benefits in heart failure. New challenges in the use of these pacemakers are now arising. These include the accurate diagnosis of ventricular dyssynchrony and, hence, potential responders to the refinement of implantation of the left ventricular lead to the appropriate dyssynchronous ventricular area and optimization of pacemaker programming. This review gives a general overview of the principles and the current evidence for the use of biventricular pacemakers in the treatment of heart failure. In addition, a discussion of current research and future projects is included

234. Gregoratos G: **Indications and recommendations for pacemaker therapy.** *American family physician* 2005, 71(8)**:** 1563-1570.
Abstract: Each year, pacemaker therapy is prescribed to approximately 900,000 persons worldwide. Current pacemaker devices treat bradyarrhythmias and tachyarrhythmias and, in some cases, are combined with implantable defibrillators. In older patients, devices that maintain synchrony between atria and ventricles are preferred because they maintain the increased contribution of atrial contraction to ventricular filling necessary in this age group. In general, rate-responsive devices are preferred because they more closely simulate the physiologic function of the sinus node. Permanent pacemakers are implanted in adults primarily for the treatment of sinus node dysfunction, acquired atrioventricular block, and certain fascicular blocks. They also are effective in the prevention and treatment of certain tachyarrhythmias and forms of neurocardiogenic syncope. Biventricular pacing (resynchronization therapy) recently has been shown to be an effective treatment for advanced heart failure in patients with major intraventricular conduction effects, predominately left bundle branch block. Many studies have documented that pacemaker therapy can reduce symptoms, improve quality of life and, in certain patient populations, improve survival

235. Gronefeld G, Manegold J, Israel CW, Hohnloser SH: **ICD therapy in coronary artery disease: A reappraisal in 2005.** *Herz (Herz)* /20, HERZ.
Abstract: AB- 25 years after the first coronary artery patient received an implantable cardioverter defibrillator (ICD), many randomized controlled trials on prophylactic ICD therapy have been conducted. Taken together, these trials allow an evidence-based approach to primary prevention of sudden cardiac death in patients after a myocardial infarction. Patients with chronic ischemic cardiomyopathy, a long history of heart failure, and an ejection fraction of <= 0.30 benefit from preventive device therapy and are thus candidates for prophylactic defibrillator implantation. For this purpose, a single-chamber device appears to be appropriate, since there have been no prospective studies showing convincing clinical benefit by adding an atrial lead. For similar patients who have additional intraventricular conduction delays, a biventricular ICD must be considered. However, this decision must be based on individual considerations until more data from prospective trials become available. Prophylactic ICD therapy should not be used in patients with recent myocardial infarction.There is convincing evidence that ICD benefit in coronary patients accrues after a considerable time having elapsed from the most recent infarct, presumably at least 6 months or perhaps longer. (c) Urban & Vogel 2005

236. Guenoun M, Hero M, Roux O, Mainardis M: **Cross-ventricular pacemaker-mediated tachycardia by myopotential induction during biventricular pacing.** *Pacing and clinical electrophysiology - PACE* 2005, 28(6)**:** 585-587.
Abstract: BACKGROUND: Patients in permanent atrial fibrillation treated for heart failure and ventricular asynchrony can be implanted with conventional dual chamber pacemakers (DDD) pacemakers used in the biventricular mode. The left ventricular lead is connected to the atrial channel. CASE REPORT: We report the case of a patient who developed ventriculo-ventricular pacemaker-mediated tachycardia (PMT) induced by myopotential sensing in the atrial channel, inhibiting left ventricular pacing. CONCLUSION: In the absence of specifically designed pacemakers, the use of DDD pacemakers in the

biventricular mode requires certain precautions, such as anti-PMT mode activation, disabling automatic sensitivity, and lengthening the postventricular atrial refractory period (PVARP), or mode switch to DVIR

237. Gula LJ, Ames A, Woodburn A, Matkins J, McCormick M, Bell J *et al.*: **Central venous occlusion is not an obstacle to device upgrade with the assistance of laser extraction.** *PACE - Pacing and Clinical Electrophysiology (PACE PACING CLIN ELECTROPHYSIOL)* /20, ACE.
Abstract: AB- Objective: To assess the efficacy and safety of laser-assisted lead extraction for upgrade of existing pacemakers and defibrillators in patients with central venous obstruction. Background: Implantable cardiac defibrillators and biventricular pacing have become the accepted therapeutic measures for patients with congestive heart failure. Many patients who are candidates for device therapy, however, already have existing right ventricular leads and the presence of central venous obstruction. Upgrade of existing devices in these patients is a dilemma, which is increasingly encountered by device-implanting physicians. Laser-assisted extraction of existing leads can facilitate access for device upgrade and provide an alternative to lead abandonment and contralateral implant. Methods: We review our experience with laser-assisted lead extraction in patients, referred for upgrade of existing devices, who were found to have, or known to have, ipsilateral subclavian vein occlusion. Results: Over the past 3 years, 18 patients (13 men, 5 women; mean age 63.9 +/- 16 years) with subclavian vein occlusion underwent successful laser-assisted lead extraction (total 29 leads) and upgrade of existing leads to defibrillators and/or biventricular systems. Mean implant duration prior to extraction was 70.8 +/- 43.5 (11-192) months. Cannulation of the coronary sinus and placement of a transvenous left ventricular lead were achieved in all 13 patients in whom it was attempted. No complications occurred. Conclusions: Laser-assisted lead extraction is a safe and effective approach, allowing for ipsilateral device upgrade in patients with existing devices and central venous obstruction

238. Gunderson BD, Gillberg JM, Wood MA, Vijayaraman P, Shepard RK, Ellenbogen KA: **Development and testing of an algorithm to detect implantable cardioverter-defibrillator lead failure.** *Heart Rhythm (Heart Rhythm)* /20, HEART.
Abstract: AB- Background: Implantable cardioverter-defibrillator (ICD) lead failures often present as inappropriate shock therapy. An algorithm that can reliably discriminate between ventricular tachyarrhythmias and noise due to lead failure may prevent patient discomfort and anxiety and avoid device-induced proarrhythmia by preventing inappropriate ICD shocks. Objectives: The goal of this analysis was to test an ICD tachycardia detection algorithm that differentiates noise due to lead failure from ventricular tachyarrhythmias. Methods: We tested an algorithm that uses a measure of the ventricular intracardiac electrogram baseline to discriminate the sinus rhythm isoelectric line from the right ventricular coil-can (i.e., far-field) electrogram during oversensing of noise caused by a lead failure. The baseline measure was defined as the product of the sum (mV) and standard deviation (mV) of the voltage samples for a 188-ms window centered on each sensed electrogram. If the minimum baseline measure of the last 12 beats was <0.35 mV-mV, then the detected rhythm was considered noise due to a lead failure. The first ICD-detected episode of lead failure and inappropriate detection from 24 ICD patients with a pace/sense lead failure and all ventricular arrhythmias from 56 ICD patients without a lead failure were selected. The stored data were analyzed to determine the sensitivity and specificity of the algorithm to detect lead failures. Results: The minimum baseline measure for the 24 lead failure episodes (0.28 < 0.34 mV-mV) was smaller than the 135 ventricular tachycardia (40.8 +/- 43.0 mV-mV, P <.0001) and 55 ventricular fibrillation episodes (19.1 +/- 22.8 mV-mV, P <.05). A minimum baseline <0.35 mV-mV threshold had a sensitivity of 83% (20/24) with a 100% (190/190) specificity. Conclusion: A baseline measure of the far-field electrogram had a high sensitivity and specificity to detect lead failure noise compared with ventricular tachycardia or fibrillation.

239. Guo H, Hahn D, Olshansky B: **Erratum: "Temporary biventricular pacing in a patient with subacute myocardial infarction, cardiogenic shock, and third-degree atrio-venticular block" (Heart Rhythm (2005) (112)).** *Heart Rhythm (Heart Rhythm)* /20, HEART.

240. Guo H, Hahn D, Olshansky B: **Temporary biventricular pacing in a patient with subacute myocardial infarction, cardiogenic shock, and third-degree atrioventricular block.** *Heart rhythm - the official journal of the Heart Rhythm Society* 2005, 2(1)**:** 112.

241. Haddad M, Lam K, Hendry P, Mesana T, Davies R: **Left ventricular assist devices for the treamtent of congestive heart failure.** *Current Treatment Options in Cardiovascular Medicine (CURR TREAT OPTIONS CARDIOVASC MED)* /20, CURR.
Abstract: AB- The mainstay of heart failure therapy is aggressive medical management with consideration of resynchronization therapy and automatic implantable cardioverter-defibrillator. This is best done with the support of a multidisciplinary team. Transplantation, when possible, remains the therapy of choice for patients who are refractory to medical therapy. Other options short of left ventricular assist device (LVAD) that should be considered include revascularization, mitral valve repair, and left ventricular remodeling procedures. LVAD therapy as a bridge to transplantation should be considered in patients with heart failure who are clinically deteriorating while on the transplant waiting list. This should be initiated prior to the onset of irreversible end-organ damage. In nontransplant candidates, an LVAD can be considered as an alternative to transplantation (destination therapy). However, cost and the availability of expertise continue to limit this therapy to quaternary care and research institutions. Copyright (c) 2005 by Current Science Inc

242. Han Y, Zang H, Wang D, Jing Q, Wang S, Wang Z: **[Percultaneous coronary intervention combined cardiac resynchronization therapy for refractory heart failure secondary to ischemic cardiomyopathy].** *Zhonghua xin xue guan bing za zhi Chinese journal of cardiovascular diseases* 2005, 33(1)**:** 17-21.
Abstract: OBJECTIVE: To evaluate the efficacy and safety of percultaneous coronary intervention (PCI) combined cardiac resynchronization therapy (CRT) for refractory heart failure secondary to ischemic cardiomyopathy (ICM). METHODS: PCI and CRT were performed in 7 ICM patients confirmed by angiography with NYHA class IV, QRS duration >/= 130 ms in 6 of them, III degrees AVB in 1 patient, fast ventricular heart rate Af in 1 patient, ventricular fibrillation history in 2 patient. All of them had their LVEDD >/= 55 mm, and LVEF </= 0.40 detected by UCG. PCI was performed first in 5 patients, and their follow-up angiography showed no restenosis 6 months after PCI, then CRT was given. CRT was performed first in 2 patients and 2 weeks later PCI was combined. RESULTS: The procedures of PCI and CRT were performed successfully in all patients. Five patients received right atrial and biventricular pacing, one patient with Af received biventricular pacing and atrial-ventricular node radiofrequency ablation at the same procedure, and the another one patient received CRTD. One out of seven patients died of re-AMI 4 months after the combination therapy, and the other 6 patients had been alive 5 - 41 (23.2 +/- 13.8) months during the follow-up period. The heart function of the 7 patients had further improved after PCI and CRT combined therapy compared to that of PCI or CRT only. Their NYHA class decreased from IV to II, 6-minute walking distance increased steadily, and mitral regurgitation reduced and QRS duration shortened significantly. The LVEDD decreased and LVEF increased significantly in 2 patients without ventricular aneurysm, and slight improvement or no change were in the other 5 patients. CONCLUSION: For patients with refractory heart failure secondary to ICM, the combination of PCI and CRT could obviously improve their heart function, quality of life and prognosis, which also very safe in performation

243. Hansky B, Vogt J, Gueldner H, Heintze J, Lamp B, Horstkotte D *et al*.: **Left ventricular pacing and CRT. What CV lead fits into which vein?**

<Original> Linksventrikulare stimulation und crt. Welche elektrode passt zu welcher vene? *Herzschrittmachertherapie und Elektrophysiologie (HERZSCHRITTMACHERTHER ELEKTROPHYSIOL)* /20, HERZSCHRITTMACHERTHER.
Abstract: AB- The experience of 579 patients with left ventricular pacing specific characteristics of various leads and lead types for left ventricular stimulation are reported. After describing the advantages of coronary vein (CV) leads versus epicardial lead usage for left ventricular stimulation, commercially available CV leads are introduced and discussed. Since there is no universally applicable CV lead, the individual optimal lead choice and the sequelae of erroneous lead choice are described in typical clinical examples

244. Harada M, Osaka T, Yokoyama E, Takemoto Y, Ito A, Kodama I: **Biventricular pacing has an advantage over left ventricular epicardial pacing alone to minimize proarrhythmic perturbation of repolarization.** *Journal of cardiovascular electrophysiology* 2006, 17(2)**:** 151-156.
Abstract: INTRODUCTION: Cardiac resynchronization therapy (CRT) by simultaneous biventricular pacing is now widely accepted as a new therapeutic option for patients with severe congestive heart failure (CHF). Recent studies have shown comparable hemodynamic benefits of left ventricular (LV) pacing alone. The clinical usefulness of CRT, however, might be compromised by potential exaggeration of arrhythmogenic substrates through a modification of ventricular repolarization. METHODS AND RESULTS: We compared ECG parameters during sinus rhythm (SR), atrioventricular synchronous pacing at the right ventricular apex (RV(end)P), at LV epicardium (LV(epi)P), and at both sites (BiVP) in acute homodynamic studies of 14 CHF patients scheduled for CRT (QRS duration = 144 +/- 23 msec, LVEF = 27 +/- 10%). The maximum rate of increase in LV pressure (LVdp/dt(max)) was decreased significantly during RV(end)P, whereas it was increased similarly during LV(epi)P and BiVP compared with SR. QTc was increased during RV(end)P (by 10.2%) and LV(epi)P (by 26.1%). QTc dispersion (QTc(max)-QTc(min) in the six precordial leads) was also increased during LV(epi)P (by 66.5%). These parameters were unaffected during BiVP. JTc was unchanged, and the interval from the peak to the end of the T wave (Tc(peak-end)) was increased slightly (by 19.3%) during RV(end)P. Both JTc and Tc(peak-end) were increased dramatically during LV(epi)P (by 18.2% and 55.4%, respectively), but increased only modestly during BiVP (by 6.6% and 15.8%, respectively). CONCLUSIONS: LV(epi)P causes much greater increase in spatial dispersion of ventricular repolarization than BiVP in CHF patients. BiVP may have a substantial advantage over LV(epi)P to minimize the proarrhythmic perturbation of ventricular repolarization in association with CRT

245. Hasan S, Lewis CT: **A new method of temporary epicardial atrioventricular pacing utilizing bipolar pacing leads.** *Annals of thoracic surgery* 2005, 79(4)**:** 1384-1387.
Abstract: PURPOSE: We evaluated a convenient method of temporary atrioventricular pacing utilizing bipolar epicardial pacing leads that offer better sensing and pacing performance. DESCRIPTION: Fifty-one patients undergoing coronary artery bypass grafting had atrial and ventricular bipolar leads implanted. The ventricular leads were inserted onto the front of the right ventricle, and the atrial leads were inserted into the lateral muscular part of the right atrium near the interatrial groove. Sensing values, pacing thresholds, and impedance were measured on all leads on postoperative days 0, 2, and 4, and complications of insertion and removal were noted. EVALUATION: The method was convenient and there were no complications during insertion or removal. The mean pacing threshold increased from 1.1 V to 1.5 V in both the atrial and ventricular leads from day 0 to day 4 (not significant). The mean sensed p wave amplitude decreased from 2.2 mv to 2.0 mv (not significant), and the mean sensed R wave amplitude decreased from 6.2 mv to 4.1 mv ($p = 0.001$) from day 0 to day 4. In spite of this significant drop in the sensed R wave amplitude, this value remained in an acceptable range. There was also a significant decrease in impedance, but overall all values were in an acceptable range assuring safe and effective pacemaker function. Only one atrial lead (2%) and three ventricular leads (6.1%)

failed to pace on day 4. CONCLUSIONS: We conclude that this temporary epicardial pacing method is safe, convenient, and less time consuming. Satisfactory pacing and sensing performance was achieved with low thresholds and minimal complications

246. Hauser RG, Hayes DL, Epstein AE, Cannom DS, Vlay SC, Song SL *et al*.: **Multicenter experience with failed and recalled implantable cardioverter-defibrillator pulse generators.** *Heart rhythm - the official journal of the Heart Rhythm Society* 2006, 3(6)**:** 640-644.
Abstract: BACKGROUND: Despite the widespread and growing use of implantable cardioverter-defibrillators (ICDs), little information is available regarding their performance or the impact of advanced pacing functions on ICD reliability and longevity. OBJECTIVES: The purpose of this study was to examine the performance of contemporary ICD pulse generators that failed or were replaced because of manufacturers recalls. METHODS: ICD data were entered prospectively by nine participating centers. ICD pulse generator failure was defined as removal from service because the device was not functioning according to the manufacturer's specifications. A recalled ICD was a normally functioning pulse generator that was replaced as the result of a recall or advisory. RESULTS: From 1998 to 2005, 1,220 ICDs failed and 135 were recalled and replaced. The average implant time of failed ICDs was 4.4 +/- 1.5 years and of recalled ICDs was 1.7 +/- 0.8 years. The average implant time of single- and dual-chamber ICDs with rate responsive or cardiac resynchronization (CRT-D) pacing capabilities was significantly shorter than the average implant time of single- or dual-chamber devices without these features (P <.001). ICDs that provided rate responsive or CRT-D pacing failed earlier because of battery depletion (P <.001) and were significantly more prone to unexpected electronic or housing failure (9% vs 5%, P = .008) and recalls (25% vs 1%, P <.0001). Major adverse events included death (n = 2), failure to convert ventricular tachyarrhythmias (n = 6), and inappropriate shocks (n = 11). CONCLUSION: Based on our analysis of failed and recalled devices, the performance of contemporary ICDs has been adversely affected by premature battery depletion, electronic failure, and manufacturers' recalls. Additional studies are needed to precisely estimate ICD longevity and to determine the incidence of unexpected ICD failure

247. Hawkins NM, Petrie MC, MacDonald MR, Hogg KJ, McMurray JJ, V: **Selecting patients for cardiac resynchronization therapy: electrical or mechanical dyssynchrony?** *European heart journal* 2006, 27(11)**:** 1270-1281.
Abstract: Cardiac resynchronization therapy (CRT) markedly reduces morbidity and mortality in patients with heart failure and prolonged QRS duration. Landmark trials have included over 4000 patients based on their electrocardiogram. A few small, observational, non-randomized, single centre studies of short duration have suggested that echocardiographic measurement of mechanical dyssynchrony may better identify patients likely to benefit from CRT. We objectively review the meaning and measurement of electrical and mechanical dyssynchrony, the strengths and weaknesses of echocardiographic indices of dyssynchrony, and the controversial issue of predicting response to treatment. We conclude that proposals to alter current guidelines for patient selection, and include echocardiography, are misguided. Echocardiographic assessment will only become credible and applicable to clinical practice once used to select patients for large prospective randomized trials which show an improvement in clinical outcome

248. Hedrich O, Weinstock J, Link M, Homoud M, Estes M: **Device trials in heart failure: a focused summary.** *Reviews in cardiovascular medicine* 2005, 6 Suppl 2 S21-S31.
Abstract: Despite considerable progress in heart failure management with pharmacologic agents, measures to bring about significant improvements in morbidity and mortality are still needed. Cardiac resynchronization therapy (CRT) is a means to enhance myocardial function by stimulating the failing left ventricle at or near the time of right ventricular activation to synchronize ventricular depolarization. Current data from randomized, controlled trials suggest that CRT benefits patients with moderate to severe heart failure

and have shown that this therapy significantly reduces mortality and hospital admissions in this group. In addition to CRT, implantable cardioverter-defibrillators have been evaluated in heart failure patients with significantly reduced left ventricular function and have been shown to reduce mortality from sudden cardiac death. This article summarizes recent device trials and discusses how best to apply their results to clinical practice

249. Heerey A, Lauer M, Alsolaiman F, Czerr J, James K: **Cost effectiveness of biventricular pacemakers in heart failure patients.** *American journal of cardiovascular drugs - drugs, devices, and other interventions* 2006, 6(2)**:** 129-137.
Abstract: BACKGROUND: Biventricular pacemakers have been shown to reduce mortality and hospitalizations in heart failure (HF) patients and are indicated for those with a New York Heart Association functional class of III or IV and a QRS interval of >130 ms. However, these devices currently cost in the region of dollar US 33,500 and require replacement upon battery depletion. Therefore, determination of the cost effectiveness of resynchronization therapy is important, although little data have been published to date on this topic. METHODS AND RESULTS: A cost-utility analysis from the healthcare perspective was performed using HF patients who received a biventricular pacing device in the Cleveland Clinic Foundation. The comparator was a similarly profiled group of patients who did not receive the device but were treated medically. A Markov model was used to investigate the cost effectiveness at 1 and 5 years. Second-order Monte-Carlo simulation was used to determine the variability in results, using probabilistic sensitivity analysis. Medical treatment was dominated by biventricular pacemaker treatment at both 1 and 5 years of follow-up. CONCLUSION: Biventricular device insertion is an economically attractive treatment option for clinically indicated HF patients

250. Heinke M, Surber R, Kuhnert H, Dannberg G, Schwarz G, Figulla HR: **Transoesophageal left ventricular pacing in heart failure patients with permanent right ventricular pacing.** *Europace (Europace)* /20, EUROPACE.
Abstract: AB- Background: Previous studies of biventricular (BV) pacing for treatment of heart failure (HF) patients with left bundle branch block (LBBB) evaluated responders to BV pacing with acute transvenous left ventricular (LV) pacing and arterial pulse pressure (PP). The aim of this study was to assess transoesophageal LV pacing in evaluation of the haemodynamic response with a view to upgrading responders from permanent right ventricular (RV) pacing to BV pacing. Methods and results: Ten HF patients (age 62 +/- 8 years; one female, nine males) in NYHA III, LV ejection fraction 24 +/- 9% and permanent RV pacing by means of an implanted pacemaker or ICD were tested using transoesophageal LV pacing and PP. Permanently RV-paced HF patients were analysed with transoesophageal atrial sensed LV pacing in VAT mode with a different AV delay (n = 6) and with transoesophageal LV pacing in V00 mode during atrial fibrillation (n = 4). In five responders, PP was higher during transoesophageal LV pacing than PP during RV pacing (74 +/- 42 versus 57 +/- 31 mmHg, P = 0.015). Responders were upgraded by means of an LV lead via the coronary sinus in the posterior (n = 1) or posterolateral (n = 4) walls and after attaining a high LV pacing threshold with an epicardial LV lead on the anterior (n = 1) or anterolateral (n = 1) walls. NYHA class improved from 3 to 2 +/- 0.3 (P = 0.003) during 204 +/- 120 days follow-up and cardiac output increased from 4.4 +/- 1.5 to 5.6 +/- 1.7 l/min (P = 0.027) when comparing BV pacing and optimal AV delay with RV pacing. In five nonresponders, PP was not higher during transoesophageal LV pacing than during RV pacing. Conclusion: Transoesophageal LV pacing may be a useful technique to detect responders to BV pacing in permanently RV-paced HF patients. (c) 2005 The European Society of Cardiology. Published by Elsevier Ltd. All rights reserved

251. Heist E Kevin, Fan D, Mela T, rzola-Castaner D, Reddy VY, Mansour M *et al.*: **Radiographic left ventricular-right ventricular interlead distance predicts the acute hemodynamic response to cardiac resynchronization therapy.** *American journal of cardiology* 2005, 96(5)**:** 685-690.
Abstract: Placement of left ventricular (LV) and right ventricular (RV) leads with maximal

interlead separation is frequently sought during cardiac resynchronization therapy (CRT), but few published data are available to support this. This study examined the relation between LV and RV lead separation and the acute effects of CRT on cardiac contractility. A total of 51 consecutive patients who underwent CRT for standard indications with sufficient mitral regurgitation for echocardiographic assessment of contractility (using Doppler profiles of mitral regurgitation as a percentage of change in dP/dt [DeltadP/dt] with CRT on and off), successful transvenous LV lead placement, and postprocedural chest radiography were evaluated. The separation of the LV and RV lead tips (direct interlead distance and horizontal and vertical components) was determined on postprocedural posteroanterior and lateral radiographs. The corrected direct LV-RV interlead distance on the lateral radiograph was correlated with the DeltadP/dt (n = 51, r = 0.43, p = 0.002). The lateral interlead distance in the horizontal plane (r = 0.58, p <0.0001), but not the vertical plane (r = -0.28, p = NS), correlated with the DeltadP/dt. The corrected horizontal interlead distance on the lateral film was greater in acute hemodynamic responders to CRT (DeltadP/dt >25%) compared with nonresponders (14.4 +/- 5.4 vs 9.2 +/- 5.8 cm, p = 0.002). Other LV-RV measures on the posteroanterior and lateral radiographs did not correlate with the DeltadP/dt. Use of these findings may help to guide the sites of LV and RV lead placement to maximize the benefit derived from CRT

252. Heist E Kevin, Taub C, Fan D, rzola-Castaner D, Alabiad CR, Reddy VY *et al*.: **Usefulness of a novel "response score" to predict hemodynamic and clinical outcome from cardiac resynchronization therapy.** *American journal of cardiology* 2006, 97(12)**:** 1732-1736.
Abstract: Cardiac resynchronization therapy (CRT) is an important treatment for patients with congestive heart failure and ventricular dyssynchrony, but response to CRT is highly variable. We assessed whether a scoring system that encompasses a combination of patient selection and procedural variables would improve prediction of CRT response. Thirty-nine patients who underwent CRT with echocardiographic assessment of baseline contractility and left ventricular (LV) dyssynchrony, intraprocedural assessment of LV lead electrical delay, and postprocedural chest radiography were included. Baseline LV dyssynchrony was measured by Doppler tissue velocity imaging as the maximum time difference between peak systolic velocity of anterior, lateral, posterior, and septal walls. The hemodynamic effect of CRT was measured by Doppler analysis of mitral regurgitation as percent change in maximal +dP/dt (DeltadP/dt) with CRT on versus off. Acute responders to CRT were defined as Deltadp/dt >or=25%. Clinical response was measured as a combined end point of hospitalization for heart failure and all-cause mortality. A 4-point response score was generated using variables associated with DeltadP/dt and assigning 1 point for a dorsoventral LV/right ventricular interlead distance>10 cm, 1 point for a LV lead electrical delay>or=50%, 1 point for a baseline maximum +dP/dt <600 mm Hg/s, and 1 point for a maximum time difference>100 ms. In conclusion, there was a significant association between response score (0 to 4 points) and acute hemodynamic response to CRT (p<0.0001). Kaplan-Meier analysis associated a higher response score with improved 12-month event-free survival after CRT implantation (p=0.0019)

253. Heist E Kevin(Reprint), Taub C, Fan D, Alabiad CR, rzola-Castaner D, Mela T *et al*.: **Left ventricular lead placement based on anatomy but not regional mechanical delay predicts the hemodynamic response to cardiac resynchronization therapy.**

254. Helm RH, Leclercq C, Faris OP, Ozturk C, McVeigh E, Lardo AC *et al*.: **Cardiac dyssynchrony analysis using circumferential versus longitudinal strain: implications for assessing cardiac resynchronization.** *Circulation* 2005, 111(21)**:** 2760-2767.
Abstract: BACKGROUND: QRS duration is commonly used to select heart failure patients for cardiac resynchronization therapy (CRT). However, not all patients respond to CRT, and recent data suggest that direct assessments of mechanical dyssynchrony may better predict chronic response. Echo-Doppler methods are being used increasingly, but these principally rely on longitudinal motion (epsilonll). It is unknown whether this analysis

yields qualitative and/or quantitative results similar to those based on motion in the predominant muscle-fiber orientation (circumferential; epsiloncc). METHODS AND RESULTS: Both epsilonll and epsiloncc strains were calculated throughout the left ventricle from 3D MR-tagged images for the full cardiac cycle in dogs with cardiac failure and a left bundle conduction delay. Dyssynchrony was assessed from both temporal and regional strain variance analysis. CRT implemented by either biventricular (BiV) or left ventricular-only (LV) pacing enhanced systolic function similarly and correlated with improved dyssynchrony based on epsiloncc-based metrics. In contrast, longitudinal-based analyses revealed significant resynchronization with BiV but not LV for the overall cycle and correlated poorly with global functional benefit. Furthermore, unlike circumferential analysis, epsilonll-based indexes indicated resynchronization in diastole but much less in systole and had a lower dynamic range and higher intrasubject variance. CONCLUSIONS: Dyssynchrony assessed by longitudinal motion is less sensitive to dyssynchrony, follows different time courses than those from circumferential motion, and may manifest CRT benefit during specific cardiac phases depending on pacing mode. These results highlight potential limitations to epsilonll-based analyses and support further efforts to develop noninvasive synchrony measures based on circumferential deformation

255. Henrikson CA, Brinker JA, Donahue JK: **Temporary placement of a defibrillating lead in the treatment of infection and ventricular tachycardia.** *Heart Rhythm (Heart Rhythm)* /20, HEART.

256. Hernandez MA, Escobar CC, Marin M, I, Bernal ME: **Cardiac resynchronization. Socioeconomic and health care impact. Mortality of procedure. Cost-benefit ratio. Impact on functional class/quality of life. Prognosis and follow-up <Original> Resincronizacion cardiaca. Impacto socioeconomico sanitario. Mortalidad del procedimiento. Relacion coste-beneficio. Impacto en la clase funcional/calidad de vida. Pronostico y seguimiento.** *Investigacion Cardiovascular (INVEST CARDIOVASC)* /20, INVEST.
Abstract: AB- Background: Cardiac resynchronization has been shown to be an effective treatment for patients with NYHA functional class III-IV/IV heart failure, severe impairment of systolic function and bundle branch block. However, the economic benefit of this therapy has not been well studied. Materials and methods: All patients admitted to our hospital between December 2000 and September 2004 with NYHA functional class III-IV/IV heart failure, severe impairment of systolic function and bundle branch block were included in the study. There were two groups. Costs generated in both groups were compared. Group 1: Patients with optimal pharmacologic therapy and resynchronization therapy. Group 2: Patients with optimal pharmacologic therapy only. Cost analysis included hospitalizations, emergency department visits, complementary tests and medical treatment. Results: A total of 164 patients were included in the study (64 in Group 1 and 100 patients in Group 2). Mean follow-up was 15.3 +/- 9.45 months in Group 1 and 15.9 +/- 9.48 months in Group 2. There were not significant differences in baseline characteristics of patients. Hospitalizations produced 71% of costs generated in both groups. The number of hospitalizations per year was 1.55 in group 1 and 3.1 in group 2, p = 0.003. The number of days hospitalized per year was 23.12 versus 40.5, p = 0.004. After calculating costs generated in both groups, we found that 14.6 months of follow-up were required to balance the initial cost of the resynchronization device. Conclusions: Cardiac resynchronization therapy is an effective treatment for patients with severe heart failure

257. Herweg B, Ilercil A, Madramootoo C, Krishnan S, Rinde-Hoffman D, Weston M *et al*.: **Latency during left ventricular pacing from the lateral cardiac veins: a cause of ineffectual biventricular pacing.** *Pacing and clinical electrophysiology - PACE* 2006, 29(6)**:** 574-581.
Abstract: We report three patients with cardiomyopathy and pronounced stimulus to QRS latency during left ventricular (LV) pacing from an epicardial cardiac vein. Delayed LV activation during simultaneous biventricular pacing produced an electrocardiographic

pattern dominated by right ventricular stimulation. Hemodynamic parameters improved immediately after advancing LV stimulation (in one patient) or pacing the LV only (in two patients) coupled with dramatic improvement of heart failure symptoms

258. Higuchi K, Toyama T, Tada H, Naito S, Ohshima S, Kurabayashi M: **Usefulness of biventricular pacing to improve cardiac symptoms, exercise capacity and sympathetic nerve activity in patients with moderate to severe chronic heart failure.** *Circulation journal - official journal of the Japanese Circulation Society* 2006, 70(6)**:** 703-709.
Abstract: BACKGROUND: Although cardiac resynchronization using biventricular pacing (BVP) results in significant clinical improvement in patients with chronic heart failure (CHF), there is no evidence of improvement in sympathetic nerve activity (SNA). METHODS AND RESULTS: Eighteen patients with CHF (dilated cardiomyopathy/ischemic cardiomyopathy =14/4) and left ventricular (LV) ejection fraction <40%, QRS duration >160 ms and dyssynchronous LV wall motion were classified into 2 groups based on the findings of (99m)Tc-methoxyisobutyl isonitrile (MIBI) quantitative gated single-photon emission computed tomography (SPECT) (QGS). Resynchronization was considered to be present when the difference between the QGS frame number for end-systole for the LV septal and lateral walls (dyssynchrony index) disappeared. Group A achieved resynchronization after BVP, but not Group B. In group A, New York Heart Association functional class (p=0.0002), specific activity scale (p=0.0001), total defect score (p<0.05), and the heart/mediastinum ratio of delayed (123)I-metaiodobenzylguanidine imaging (p<0.05) were significantly improved after resynchronization. However, there was no significant change in group B. CONCLUSIONS: Cardiac resynchronization after BVP can improve cardiac symptoms, exercise capacity, and SNA in patients with moderate to severe CHF

259. Hill Michael RS: **System and method for bi-ventricular fusion pacing.**
Abstract: Bi-ventricular cardiac pacing systems and systems for improving cardiac function for heart failure patients that pace and sense in right and left ventricles of the heart and particularly pace in one of the right and left ventricles after an AV delay timed from a preceding atrial event and after a spontaneous depolarization in the other of the right and left ventricles to achieve fusion pacing. An A-RVp delay and an A-LVp delay are each determined from an intrinsic sensed A-RVs delay and an intrinsic A-LVs delay. If the derived A-LVp delay becomes substantially equal to or shorter than the intrinsic A-RVs delay, then the A-RVp delay is decremented to be shorter than the A-LVp delay. Bi-ventricular pacing of the RV and LV is then established closely timed to the intrinsic RV and LV depolarizations

260. Hlatky MA: **Cost effectiveness of cardiac resynchronization therapy.** *Journal of the American College of Cardiology* 2005, 46(12)**:** 2322-2324.

261. Hoijer CJ, Meurling C, Brandt J: **Upgrade to biventricular pacing in patients with conventional pacemakers and heart failure: a double-blind, randomized crossover study.** *Europace - European pacing, arrhythmias , and cardiac electrophysiology - journal of the working groups on cardiac pacing, arrhythmias , and cardiac cellular electrophysiology of the European Society of Cardiology* 2006, 8(1)**:** 51-55.
Abstract: AIMS: To investigate whether patients with previously implanted conventional pacemakers and severe heart failure benefit from an upgrade to a biventricular system. METHODS AND RESULTS: Study inclusion criteria were New York Heart Association (NYHA) classes III and IV, dominant paced rhythm, and no left bundle branch block in the pre-pacing ECG. Ten patients with pacemakers (four VVIR due to slow atrial fibrillation and six DDDR, of which four were due to high-degree atrioventricular block and two to sinus node disease) were upgraded to a biventricular pacing (BVP) system. The median duration of pacing before the upgrade was 5.7 years. Assessments of 6-min walk test, symptom score, brain natriuretic peptide (pro-BNP), and echocardiography were made pre-operatively. After a run-in period of 1 month in BVP following the upgrade, the patients

were randomized to a 2-month period in either BVP or right ventricular pacing (RVP), followed by 2 months in the other mode, in a double-blind crossover fashion. After each period, the pre-operative measurements were repeated. After study completion, patients were asked to select their preferred period. The median 6-min walking distance was significantly longer in BVP (400 m) vs. RVP (315 m), P = 0.02. The symptom score was also significantly better in BVP (P = 0.005). Median pro-BNP was significantly lower in BVP than in RVP, 3,030 vs. 5,064 ng/L (P = 0.005). Six patients demanded an early crossover in RVP but none in BVP (P = 0.015), and all patients except one expressed a preference for BVP. However, echo parameters did not show any significant differences between BVP and RVP. CONCLUSION: Pacemaker patients with heart failure and dominant paced heart rhythm benefit substantially from an upgrade to BVP, in terms of physical performance and symptoms. The upgrade resulted in significantly improved cardiac function as reflected by reduced levels of pro-BNP

262. Hoppe UC, Casares JM, Eiskjaer H, Hagemann A, Cleland John GF, Freemantle N *et al*.: **Effect of cardiac resynchronization on the incidence of atrial fibrillation in patients with severe heart failure.** *Circulation* 2006, 114(1)**:** 18-25.
Abstract: BACKGROUND: Atrial fibrillation/flutter (AF) and heart failure often coexist; however, the effect of cardiac resynchronization therapy (CRT) on the incidence of AF and on the outcome of patients with new-onset AF remains undefined. METHODS AND RESULTS: In the CArdiac REsynchronisation in Heart Failure (CARE-HF) trial, 813 patients with moderate or severe heart failure were randomly assigned to pharmacological therapy alone or with the addition of CRT. The incidence of AF was assessed by adverse event reporting and by ECGs during follow-up, and the impact of new-onset AF on the outcome and efficacy of CRT was evaluated. By the end of the study (mean duration of follow-up 29.4 months), AF had been documented in 66 patients in the CRT group compared with 58 who received medical therapy only (16.1% versus 14.4%; hazard ratio 1.05; 95% confidence interval, 0.73 to 1.50; P=0.79). There was no difference in the time until first onset of AF between groups. Mortality was higher in patients who developed AF, but AF was not a predictor in the multivariable model (hazard ratio 1.17; 95% confidence interval, 0.82 to 1.67; P=0.37). In patients with new-onset AF, CRT significantly reduced the risk for all-cause mortality and all other predefined end points and improved ejection fraction and symptoms (no interaction between AF and CRT; all P>0.2). CONCLUSIONS: Although CRT did not reduce the incidence of AF, CRT improved the outcome regardless of whether AF developed

263. Hori M: **[Recent advances in treatment and the future problems to be solved].** *Nippon rinsho Japanese journal of clinical medicine* 2006, 64(5)**:** 823-825.
Abstract: The goal of the treatment of chronic heart failure is improvement of patient's prognosis and QOL. To achieve this goal, new pharmacological and nonpharmacological approaches have been developed. ACE inhibitor - and beta-blocker-treatment added to the standard therapy has been established to improve the prognosis, and ICD, cardiac resynchronization treatment (CRT) with biventricular pacing and LV assist device also contribute to the advances in the therapeutic progress. However, recent clinical trials for the new drugs which antagonize the endothelin receptors and TNF receptors failed to demonstrate the benefit of these new drugs. Establishment of the therapeutic strategies for treatment of diastolic heart failure is also another problem to be solved

264. Horstkotte D, Piper C, Vogt J, Lamp B, Dorszewski A: **Cardiac resynchronization therapy as an alternative to valve replacement in high-risk patients with a chronically decompensated aortic stenosis?** *Journal of heart valve disease* 2006, 15(2)**:** 203-205.

265. Hsieh M, Yeh K, Satish OS, Wang C: **Permanent pacing using a coronary sinus lead in a patient with univentricular physiology: an extended application of biventricular pacing technology.** *Europace - European pacing, arrhythmias , and cardiac electrophysiology - journal of the working groups on cardiac pacing, arrhythmias , and*

cardiac cellular electrophysiology of the European Society of Cardiology 2006, 8(2)**:** 147-150.
Abstract: In the past, patients requiring permanent pacing with difficult right ventricular (RV) access were usually subjected to epicardial pacing by a surgical approach. This report describes a young patient with univentricular physiology following repeated palliative surgery for complex congenital heart disease. The patient had symptomatic complete heart block and a dual chamber pacemaker with transvenous atrial and ventricular leads was implanted successfully. The ventricle was paced through the posterolateral cardiac vein with a lead specially designed for cardiac resynchronization therapy. This case illustrates an extended application of the recently developed coronary sinus lead in selected patients, when conventional RV endocardial pacing is impossible

266. Hsu C-H, Chang K-C, Pai P-Y, Lo P-H, Lin Y-C: **Cardiac resynchronization therapy in congestive heart failure also provides beneficial effects for rhythm control of atrial fibrillation.** *Mid-Taiwan Journal of Medicine (MID-TAIWAN J MED)* /20, MID-TAIWAN.
Abstract: AB- Two patients with dilated cardiomyopathy and persistent atrial fibrillation (AF) underwent successful electrical cardioversion and atrioventricular (AV) junction ablation, followed by implantation of a cardiac resynchronization therapy (CRT) pacemaker with a biventricular pacing system. The duration of persistent AF was one week in patient one and one year in patient two. The interventions resulted in marked improvement in refractory heart failure as well as rhythm control of AF. Patient one was free of AF at 11-month follow-up, and patient two had had markedly fewer episodes of paroxysmal AF during a follow-up period of 6 months. The anecdotal evidence in our two patients suggests that reduction of atrial size and atrial stretch after CRT and hence the atrial anatomical-electrical remodeling is the underlying mechanism for the improvement of rhythm control of AF

267. Huang H, Shen L, Zhang R, Makedon F, Hettleman B, Pearlman J: **A prediction framework for cardiac resynchronization therapy via 4D cardiac motion analysis.** *Medical image computing and computer -assisted intervention - MICCAI International Conference on Medical Image Computing and Computer -Assisted Intervention* 2005, 8(Pt 1)**:** 704-711.
Abstract: We propose a novel framework to predict pacing sites in the left ventricle (LV) of a heart and its result can be used to assist pacemaker implantation and programming in cardiac resynchronization therapy (CRT), a widely adopted therapy for heart failure patients. In a traditional CRT device deployment, pacing sites are selected without quantitative prediction. That runs the risk of suboptimal benefits. In this work, the spherical harmonic (SPHARM) description is employed to model the ventricular surfaces and a novel SPHARM-based surface correspondence approach is proposed to capture the ventricular wall motion. A hierarchical agglomerative clustering technique is applied to the time series of regional wall thickness to identify candidate pacing sites. Using clinical MRI data in our experiments, we demonstrate that the proposed framework can not only effectively identify suitable pacing sites, but also distinguish patients from normal subjects perfectly to help medical diagnosis and prognosis

268. Hummel JP, Lindner JR, Belcik JT, Ferguson JD, Mangrum JM, Bergin JD *et al*.: **Extent of myocardial viability predicts response to biventricular pacing in ischemic cardiomyopathy.** *Heart rhythm - the official journal of the Heart Rhythm Society* 2005, 2(11)**:** 1211-1217.
Abstract: BACKGROUND: The clinical response to biventricular pacing is unpredictable, especially in patients with ischemic cardiomyopathy. OBJECTIVES: The purpose of this study was to prospectively examine the relationship between the extent of myocardial viability and the response to cardiac resynchronization therapy. METHODS: Twenty-one patients with ischemic left ventricular (LV) dysfunction (left ventricular ejection fraction [LVEF] 21 +/- 5%), New York Heart Association (NYHA) functional class III-IV, and

QRS >120 ms received biventricular devices. Myocardial viability was assessed by myocardial contrast echocardiography, and a perfusion score index (PSI) was calculated from summed segmental perfusion scores. LV performance was assessed by echocardiography on the day after implantation and at 6 months. RESULTS: PSI was closely correlated with acute improvement in LVEF (P = .003, r = 0.65), stroke volume (P = .02, r = 0.54), and end-systolic volume (P = .05, r = -0.49). PSI also correlated with early diastolic LV relaxation (E', P < .05, r = 0.50) and global myocardial performance or Tei index (P = .003, r = 0.63). By multiple linear regression analysis, PSI provided incremental predictive value to the degree of dyssynchrony, measured by tissue Doppler imaging, for predicting improvement in LVEF. At 6 months, PSI remained positively correlated with improvement in ventricular performance and with reduction in LV end-diastolic dimension (P = .003, r = -0.68). PSI also influenced the clinical variables of NYHA class, 6-minute walk distance, quality-of-life score, and number of hospitalizations for heart failure. CONCLUSION: In patients with ischemic cardiomyopathy, the extent of myocardial viability predicts acute and long-term improvement in LV performance, exercise tolerance, and reduction in LV end-diastolic dimension with biventricular pacing

269. Hunt: **ACC/AHA 2005 guideline update for the diagnosis and management of chronic heart failure in the adult - Summary article: A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing committee to update the 2001 guidelines for the evaluation and management of heart failure) (vol 112, pg 1825, 2005).**

270. Hurkmans CW, Scheepers E, Springorum BGF, Uiterwaal H: **Influence of radiotherapy on the latest generation of implantable cardioverter-defibrillators.** *International Journal of Radiation Oncology Biology Physics (INT J RADIAT ONCOL BIOL PHYS)* /20, INT.
Abstract: AB- Purpose: Radiotherapy can influence the functioning of pacemakers and implantable cardioverter-defibrillators (ICDs). ICDs offer the same functionality as pacemakers, but are also able to deliver a high-voltage shock to the heart if needed. Guidelines for radiotherapy treatment of patients with an implanted rhythm device have been published in 1994 by The American Association of Physicists in Medicine, and are based only on experience with pacemakers. Data on the influence of radiotherapy on ICDs are limited. The objective of our study is to determine the influence of radiotherapy on the latest generation of ICDs. Methods and Materials: Eleven modern ICDs have been irradiated in our department. The irradiation was performed with a 6-MV photon beam. The given dose was fractionated up to a cumulative dose of 120 Gy. Two to 5 days passed between consecutive irradiations. Frequency, output, sensing, telemetry, and shock energy were monitored. Results: Sensing interference by ionizing radiation on all ICDs has been demonstrated. For four ICDs, this would have caused the inappropriate delivery of a shock because of interference. At the end of the irradiation sessions, all devices had reached their point of failure. Complete loss of function was observed for four ICDs at dose levels between 0.5 Gy and 1.5 Gy. Conclusions: The effect of radiation therapy on the newest generation of ICDs varies widely. If tachycardia monitoring and therapy are functional (programmed on) during irradiation, the ICD might inappropriately give antitachycardia therapy, often resulting in a shock. Although most ICDs did not fail below 80 Gy, some devices had already failed at doses below 1.5 Gy. Guidelines are formulated for the treatment of patients with an ICD. (c) 2005 Elsevier Inc

271. Iino K, Ohashi H, Tsutsumi Y, Kawai T, Fujii H, Ohnaka M: **Biventricular pacing 18 months after Batista operation.** *Annals of thoracic surgery* 2006, 81(6)**:** 2302-2304.
Abstract: We conducted biventricular pacing in a patient with dilated cardiomyopathy and complete left bundle branch block who had recurrent heart failure and mitral valve regurgitation 18 months after partial left ventriculectomy and mitral valve repair. An epicardial lead was fixed on the left ventricular free wall surgically through a thoracotomy, and the other two leads were implanted transvenously. Biventricular pacing restored

contractile synchrony and led to more efficient left ventricular contraction and reductions in mitral regurgitation. Biventricular pacing may produce beneficial effects for patients with the recurrent intractable heart failure associated with cardiomyopathy and complete left bundle branch block after partial left ventriculectomy

272. Iler MA, Hu T, Ayyagari S, Callahan TD, Civello KC, Thal SG *et al*.: **A wider QRS duration after CRT device implantation independently predicts mortality in patients with heart failure.**

273. Inoue N, Ishikawa T, Sumita S, Nakagawa T, Kobayashi T, Matsushita K *et al*.: **Long-term follow-up of atrioventricular delay optimization in patients with biventricular pacing.** *Circulation journal - official journal of the Japanese Circulation Society* 2005, 69(2)**:** 201-204.
Abstract: BACKGROUND: Atrioventricular (AV) delay optimization may be important in patients with biventricular pacing and the optimal AV delay can be predicted using Doppler echocardiography and the formula: optimal AV delay = AV delay-the interval between the end of A wave and complete closure of the mitral valve when the AV delay is set at slightly prolonged AV delay. METHODS AND RESULTS: In the present study the efficacy of this method was evaluated in 5 patients (67.4+/-8.0 (SD) years old) with biventricular pacing. Cardiac output (CO) and diastolic filling time were measured by Doppler echocardiography. When the AV delay was set at the predicted optimal AV delay -25 ms, the predicted optimal AV delay (133+/-66 ms) and predicted optimal AV delay + 25 ms, the respective CO were 4.5+/-0.9, 5.3+/-1.0, 4.8+/-1.0 L/min ($p<0.05$, ANOVA) and the diastolic filling times were 364 +/-100, 373+/-105, 335+/-84 ms ($p<0.05$, ANOVA). Congestive heart failure improved from New York Heart Association class 3.6+/-0.5 to 1.4+/-0.5 ($p<0.001$). CONCLUSIONS: AV delay optimization is important in patients with biventricular pacing and can be easily achieved by the new method

274. InSync III Clinical Study Investig: **Cardiac resynchronization with sequential biventricular pacing for the treatment of moderate-to-severe heart failure.**
Abstract: OBJECTIVES The InSync III study evaluated sequential cardiac resynchronization therapy (CRT) in patients with moderate-to-severe heart failure and prolonged QRS.BACKGROUND Simultaneous CRT improves hemodynamic and clinical performance in patients with moderate-to-severe heart failure (HF) and a wide QRS. Recent evidence suggests that sequentially stimulating the ventricles might provide additional benefit.METHODS This multicenter, prospective, nonrandomized, six-month trial enrolled a total of 422 patients to determine the effectiveness of sequential CRT in patients with New York Heart Association (NYHA) functional class III or IV HF and a prolonged QRS. The study evaluated: whether patients receiving sequential CRT for six months experienced improvement in 6-min hall walk (6MHW) distance, NYHA functional class, and quality of life (QoL) over control group patients from the reported Multicenter InSync Randomized Clinical Evaluation (MIRACLE) trial; whether sequential CRT increased stroke volume compared to simultaneous CRT; and whether an increase in stroke volume translated into greater clinical improvements compared to patients receiving simultaneous CRT.RESULTS InSync III patients experienced greater improvement in 6MHW, NYHA functional class, and QoL at six months compared to control (all $p < 0.0001$). Optimization of the sequential pacing increased (median 7.3%) stroke volume in 77% of patients. No additional improvement in NYHA functional class or QoL was seen compared to the simultaneous CRT group; however, InSync III patients demonstrated greater exercise capacity.CONCLUSIONS Sequential CRT provided most patients with a modest increase in stroke volume above that achieved during simultaneous CRT. Patients receiving sequential CRT had improved exercise capacity, but no change in functional status or QoL

275. InSync IS, I: **Monitoring of physical activity and heart rate variability in patients with chronic heart failure using cardiac resynchronization devices.**

Abstract: Cardiac resynchronization therapy (CRT) devices not only deliver effective treatment but may also serve as valuable diagnostic tools in heart failure management. In the present study, the minutes of daily physical activity and heart rate variability, measured by sensors incorporated into such a device, reflected the effects of CRT and were related to New York Heart Association functional class. (c) 2005 by Excerpta Medica Inc

276. Ishikawa T: **Cardiac Resynchronization Therapy (CRT) for severe congestive heart failure.** *Respiration and Circulation (RESPIR CIRC)* /20, RESPIR.

277. Islam J, Uretsky BF, Sierpina VS: **Heart Failure Improvement with CoQ10, Hawthorn, and Magnesium in a Patient Scheduled for Cardiac Resynchronization-Defibrillator Therapy: A Case Study.** *Explore (New York , N Y)* 2006, 2(4)**:** 339-341.

278. Ismer B, Korber T, von Knorre GH, Voss W, Burska D, Nienaber CA: **[Left ventricular electromechanical latency period is an additional indicator to upgrade from right to biventricular DDD pacing]**
<Original> Die linksventrikulare elektromechanische Latenzzeit ist ein zusatzlicher Indikator fur ein Upgrading zur biventrikularen Stimulation.
Herzschrittmachertherapie & Elektrophysiologie 2006, 17 Suppl 1 I37-I41.
Abstract: In DDD pacing, the left-ventricular electromechanical latency period defines the duration between premature ventricular stimulation and the prematurely ending left-atrial contribution to left-ventricular filling. It has to be considered in diastolic AV delay optimization. Individual duration of this parameter seemed to reflect the ventricular function. Therefore, we compared the left-ventricular electromechanical latency period due to right ventricular stimulus with the documented ejection fraction of two groups, 33 congestive heart failure patients carrying biventricular systems and 13 right ventricular paced bradycardia patients. A mean latency period of 168+/-26 ms was found in the heart failure patients (ejection fraction: 25+/-5%) which was significantly longer (p=0.0039) compared to the bradycardia patients (ejection fraction: 51+/-12%) with a mean latency of 119+/-13 ms. Thus, an increasing latency period during right ventricular DDD pacing therapy indicates decreasing ejection fraction. A cut-off interval of 135 ms allowed the discrimination of 93% of our patients as having an individual ejection fraction of either up to 35% or above. Thus, the left ventricular electromechanical latency period can be used as an additional parameter indicating the necessity to upgrade from right to biventricular DDD pacing

279. Israel CW, Butter C: **Indication for cardiac resynchronization therapy: Consensus 2005**
<Original> Indikation zur kardialen resynchronisation: Konsensus 2005.
Herzschrittmachertherapie und Elektrophysiologie (HERZSCHRITTMACHERTHER ELEKTROPHYSIOL) /20, HERZSCHRITTMACHERTHER.
Abstract: AB- The indication for cardiac resynchronization therapy (CRT) using biventricular pacing or ICD systems has to be highly differentiated to optimize the proportion of patients who derive significant symptomatic benefit from this therapy, on the one hand, and to avoid this invasive treatment in patients with a low probability of clinical success of CRT, on the other hand. As a consensus in 2005, it can be put forward that there is sufficient evidence for an indication for CRT from clinical studies for the following characteristics: 1) Heart failure in NYHA functional class III or IV (if cardiac recompensation to class III is at least temporarily successful), 2) left ventricular ejection fraction <= 35%, 3) QRS duration > 130 ms, particularly if left bundle branch block is present, 4) sinus rhythm. In addition, available data also suggest an indication for CRT in patients with atrial fibrillation if the other criteria listed above are met. The indication for CRT is unclear in patients with other intraventricular conduction delay (particularly right bundle branch block) while patients with left bundle branch block and a QRS duration of 120-130 ms seem to benefit if echocardiographic criteria demonstrate ventricular dyssynchrony. Since a multiplicity of echocardiographic criteria of ventricular

dyssynchrony exists which is neither standardized nor evaluated in large-scale randomized trials, ventricular dyssynchrony on echocardiography alone cannot be regarded as an established indication for CRT without a QRS complex >= 120 ms. Similarly, whether heart failure in functional state NYHA II should be regarded as a CRT indication is currently being investigated in the randomized RAFT and MADIT-CRT trials

280. Israel CW, Butter C: **[Indication for cardiac resynchronization therapy: Consensus 2005]**
<Original> Indikation zur kardialen Resynchronisation: Konsensus 2005.
Herzschrittmachertherapie & Elektrophysiologie 2006, 17 Suppl 1 I80-I86.
Abstract: The indication for cardiac resynchronization therapy (CRT) using biventricular pacing or ICD systems has to be highly differentiated to optimize the proportion of patients who derive significant symptomatic benefit from this therapy, on the one hand, and to avoid this invasive treatment in patients with a low probability of clinical success of CRT, on the other hand. As a consensus in 2005, it can be put forward that there is sufficient evidence for an indication for CRT from clinical studies for the following characteristics: 1) Heart failure in NYHA functional class III or IV (if cardiac recompensation to class III is at least temporarily successful), 2) left ventricular ejection fraction < or =35%, 3) QRS duration >130 ms, particularly if left bundle branch block is present, 4) sinus rhythm. In addition, available data also suggest an indication for CRT in patients with atrial fibrillation if the other criteria listed above are met. The indication for CRT is unclear in patients with other intraventricular conduction delay (particularly right bundle branch block) while patients with left bundle branch block and a QRS duration of 120-130 ms seem to benefit if echocardiographic criteria demonstrate ventricular dyssynchrony. Since a multiplicity of echocardiographic criteria of ventricular dyssynchrony exists which is neither standardized nor evaluated in large-scale randomized trials, ventricular dyssynchrony on echocardiography alone cannot be regarded as an established indication for CRT without a QRS complex > or =120 ms. Similarly, whether heart failure in functional state NYHA II should be regarded as a CRT indication is currently being investigated in the randomized RAFT and MADIT-CRT trials

281. Israel CW, Hohnloser SH: **Acute severe cardiac decompensation during cardiac resynchronization therapy: what is the cause?** *Pacing and clinical electrophysiology - PACE* 2006, 29(6)**:** 632-636.

282. Iyengar Srinivas R, Abraham WT: **Cardiac resynchronization therapy - A better and longer life for patients with advanced heart failure.**

283. Iyengar S, Abraham WT: **Cardiology patient page. Cardiac resynchronization therapy: a better and longer life for patients with advanced heart failure.** *Circulation* 2005, 112(13)**:** e236-e237.

284. James KB, Militello M, Barbara G, Wilkoff BL: **Biventricular pacing for heart failure patients on inotropic support: a review of 38 consecutive cases.** *Texas Heart Institute journal / from the Texas Heart Institute of St Luke's Episcopal Hospital , Texas Children's Hospital* 2006, 33(1)**:** 19-22.
Abstract: Biventricular pacing (BiV) has documented benefit in New York Heart Association functional class III patients. Whether BiV offers benefit to class IV patients on inotropic therapy is unclear. Retrospective review was performed on 38 consecutive heart failure patients who received BiV while on inotropic support or within 30 days of inotropic administration; the mean age was 63 +/- 13 yrs; 9 were women. Fourteen who received inotropic agents did so in conjunction with coronary artery bypass grafting, or valve or infarct exclusion surgery. Twenty-three patients received inotropic therapy only before BiV Nine other patients received inotropic therapy before BiV and at another point (5 at implant and 4 after BiV); 6 were on inotropic support only at implant. Mean follow-up was 1.2 +/- 0.9 years. There were 14 deaths. Survival estimates at 6 months, 1 year, and 2 years were

74%, 71%, and 61%, respectively. When patients on inotropic therapy before BiV (n=32) were compared with patients never on such therapy before BiV (n=6), there was a survival difference (P <0.0001); all 6 patients not on inotropic therapy before BiV died within the first 2 years. Estimated 6-month and 1-year survival for those on inotropic support before BiV was 84 % and 81 %, compared with 23% and 23% for the other group. Patients who required inotropic agents only before BiV fared better than those requiring inotropic support at other times. Although the patients in this survey were a very high-risk group, a small subset was weaned and had stable short-term survival

285. Jansen Annemieke HM, Bracke F, van Dantzig JM, Meijer A, Korsten Erik HM, Peels KH *et al.*: **Optimization of pulsed wave tissue Doppler to predict left ventricular reverse remodeling after cardiac resynchronization therapy.** *Journal of the American Society of Echocardiography - official publication of the American Society of Echocardiography* 2006, 19(2)**:** 185-191.
Abstract: OBJECTIVE: The optimal use of pulsed wave Doppler tissue imaging (DTI) in predicting left ventricular (LV) reverse remodeling after cardiac resynchronization therapy (CRT) was investigated. METHODS: DTI was performed in 69 patients before and 3 months after CRT. Echocardiographic reverse remodeling was observed in 38 patients. LV dyssynchrony was measured with the time to onset or peak systolic velocity in 2- and 6-basal segment models. RESULTS: The time to onset and either the standard deviation of 6 segments of > 20 ms or a delay of > or = 60 ms between any 2 of 6 segments had a similar predictive accuracy (sensitivity, 97% and 95%, respectively; specificity, 74% and 73%, respectively). The time to peak systolic velocity or evaluating 2 segments was less accurate. CONCLUSIONS: Evaluation of 6 segments is necessary to predict LV reverse remodeling after CRT. The time to onset of systolic velocity is superior to the time to peak velocity

286. Jansen Annemieke HM, Bracke FA, van Dantzig JM, Meijer A, van d, V, Aarnoudse W *et al.*: **Correlation of echo-Doppler optimization of atrioventricular delay in cardiac resynchronization therapy with invasive hemodynamics in patients with heart failure secondary to ischemic or idiopathic dilated cardiomyopathy.** *American journal of cardiology* 2006, 97(4)**:** 552-557.
Abstract: This study investigated the optimal echocardiographic indexes to determine the most hemodynamically appropriate atrioventricular (AV) delay in cardiac resynchronization therapy (CRT) for heart failure. Doppler echocardiographic optimization of AV delay in CRT has not been correlated with invasive hemodynamic indexes. In 30 patients who underwent CRT, invasive left ventricular (LV) pressure measurements with a sensor-tipped pressure guidewire and Doppler echocardiographic examination were performed <24 hours after pacemaker implantation. Invasively, the optimal sensed AV delay was determined by LV dP/dt(max). The Doppler echocardiographic methods evaluated were the velocity-time integral (VTI) of the transmitral flow (EA VTI), diastolic filling time (EA duration), the VTI of the LV outflow tract or aorta (LV VTI), and Ritter's formula. Biventricular pacing with optimized interventricular and AV delay increased LV dP/dt(max) from 777 +/- 149 to 1,010 +/- 163 dynes/s (p<0.0001). The optimal AV delay with the EA VTI method was concordant with LV dP/dt(max) in 29 of 30 patients (r = 0.96), with EA duration in 20 of 30 patients (r= 0.83), with LV VTI in 13 patients (r = 0.54), and with Ritter's formula in none of the patients (r = 0.35). In conclusion, to obtain the optimal acute hemodynamic benefit of CRT, Doppler echocardiography is a reliable tool to optimize the AV delay compared with the invasive LV dP/dt(max). The measurement of the maximal VTI of mitral inflow is the most accurate method

287. Jansen AH, Bracke F, van Dantzig Jm, Post J, van de BH, van GB *et al.*: **Influence of inferoposterolateral scar tissue in cardiac resynchronization therapy.**

288. Jarcho JA: **Resynchronizing ventricular contraction in heart failure.** *New England journal of medicine* 2005, 352(15)**:** 1594-1597.

289. Jarcho JA: **Biventricular pacing.** *New England journal of medicine* 2006, 355(3)**:** 288-294.

290. Jia P, Ramanathan C, Ghanem RN, Ryu K, Varma N, Rudy Y: **Electrocardiographic imaging of cardiac resynchronization therapy in heart failure: observation of variable electrophysiologic responses.** *Heart rhythm - the official journal of the Heart Rhythm Society* 2006, 3(3)**:** 296-310.
Abstract: BACKGROUND: Cardiac resynchronization therapy (CRT) for congestive heart failure patients with delayed left ventricular (LV) conduction is clinically beneficial in approximately 70% of patients. Unresolved issues include patient selection, lead placement, and efficacy of LV pacing alone. Being an electrical approach, detailed electrical information during CRT is critical to resolving these issues. However, electrical data from patients have been limited because of the requirement for invasive mapping. OBJECTIVES: The purpose of this study was to provide observations and insights on the variable electrophysiologic responses of the heart to CRT using electrocardiographic imaging (ECGI). METHODS: ECGI is a novel modality for noninvasive epicardial mapping. ECGI was conducted in eight patients undergoing CRT during native rhythm and various pacing modes. RESULTS: In native rhythm (six patients), ventricular activation was heterogeneous, with latest activation in the lateral LV base in three patients and in the anterolateral, midlateral, or inferior LV in the remainder of patients. Anterior LV was susceptible to block and slow conduction. Right ventricular pacing improved electrical synchrony in two of six patients. LV pacing in three of four patients involved fusion with intrinsic excitation resulting in electrical resynchronization similar to biventricular pacing. Although generally electrical synchrony improved significantly with biventricular pacing, it was not always accompanied by clinical benefit. CONCLUSION: Results suggest that (1) when accompanied by fusion, LV pacing alone can be as effective as biventricular pacing for electrical resynchronization; (2) right ventricular pacing is not effective for resynchronization; and (3) efficacy of CRT depends strongly on the patient-specific electrophysiologic substrate

291. Jondeau G: **[The best of cardiac failure in 2005]**
<Original> L'essentiel de 2005 en insuffisance cardiaque. *Archives des maladies du coeur et des vaisseaux* 2006, 99 Spec No 1(1)**:** 61-69.
Abstract: The year 2005 saw the validation of resynchronisation treatment of cardiac failure with improved mortality in certain symptomatic patients under optimal medical therapy with QRS duration >150 msec. The implantable defibrillator has ousted the last antiarrhythmic drug, amiodarone, on which hopes for a reduction in mortality had been based. The positive inotropic agents have thrown their last reserves into the fight against cardiac failure: the anti-endothelins have not yet been shown to have significant benefits. The year 2005 was also the year of recommendations: European in acute and chronic heart failure, and American. The importance of clinical practice has been emphasised by the role given to registers. Finally, the diseases change: cardiomyopathy of stress is recognised in this stressful era; the importance of polypathology is increasingly understood in the elderly; the importance of renal function has been underlined although the method of its evaluation is less clear. As usual, there have been many advances in 2005, difficult to summarise in just a few lines

292. Joshi S, Steinberg JS, Ashton RC, Balaram S, Fischer A, DeRose JJ: **Follow-up of robotically assisted left ventricular epicardial leads for cardiac resynchronization therapy.** *Journal of the American College of Cardiology* 2005, 46(12)**:** 2358-2359.

293. Jung W, Birkemeyer R: **[Home Monitoring with implantable ICD--a diagnostic innovation?]**
<Original> Home Monitoring mit implantierbaren Defibrillatoren -- ein diagnostischer Fortschritt? *Herzschrittmachertherapie & Elektrophysiologie* 2005, 16(3)**:** 183-190.

Abstract: In recent years the rate of ICD implantation has grown substantially after the results of primary and secondary prevention trails have shown significant improvement in mortality and morbidity. However, the increasing number of patients with ICD indication leaves the implanting centres with large logistic problems, esp. with the number of follow-up visits. To further ensure high quality standard in therapy management new follow up routines have to be considered. Possible help may come with new methods of telecardiology, which are presently being introduced into clinical practice. Those systems differ in the way that they are capable to substitute a routine follow up and/ or deliver continuous diagnostic and device status information. Maybe the most promising solution is Home Monitoring in which the implant sends automatically daily messages with regard to therapy and ICD/CRT status without any cooperation of the patient. Interaction of the physician can be triggered by patient individual event filter. By utilizing this features in combination with event related IEGM Online Data physician are able to guide patients more effectively

294. Kadish A, Mehra M: **Heart failure devices: implantable cardioverter-defibrillators and biventricular pacing therapy.** *Circulation* 2005, 111(24)**:** 3327-3335.

295. Kantharia BK, Patel JA, Nagra BS, Ledley GS: **Electrical storm of monomorphic ventricular tachycardia after a cardiac-resynchronization-therapy-defibrillator upgrade.** *Europace - European pacing, arrhythmias , and cardiac electrophysiology - journal of the working groups on cardiac pacing, arrhythmias , and cardiac cellular electrophysiology of the European Society of Cardiology* 2006, 8(8)**:** 625-628.
Abstract: In patients with significant left ventricular dysfunction and congestive heart failure despite optimal medical therapy, implantation of cardiac resynchronization therapy-defibrillation (CRT-D) devices has been shown to improve symptoms and mortality. In this report, we describe a case of a patient with ischaemic cardiomyopathy who developed incessant ventricular tachycardia (VT) after undergoing an upgrade from an implantable cardioverter defibrillator to a CRT-D device. The patient required multiple anti-arrhythmic agents, removal of the coronary sinus lead, and radiofrequency ablation to control VT. Thus, in rare patients, the CRT devices may potentially cause 'proarrhythmia' with serious consequences

296. Kanzaki Hideaki R, Satomi K, Suyama K, Kurita T, Shimizu W, Aihara N *et al*.: **Upgrade to cardiac resynchronization therapy: Baseline ORS duration predicts benefits in patients with right ventricular pacing and heart failure.**

297. Kapetanakis Stamatis R, Ho E, Turner SP, Kearney MT, Monaghan MJ: **Predicting symptomatic improvement and reverse left ventricular remodelling post cardiac resynchronisation therapy: The emerging role of 3D echo.**

298. Kargul W, Ml s, Pil s: **Implantation of pacemakers and cardioverter-defibrillators <Original> Implantowanie stymulatorow serca i kardiowerterow-defibrylator ow.** *Chirurgia Polska (CHIR POL)* /20, CHIR.
Abstract: AB- Since the implantation of the first cardiac pacemaker in 1958 by Ake Sening and Rune Elmqvist, there has been enormous progress in this field of medicine, including both the range of the equipment and the techniques of implantation. Today, electrotherapy is a rapidly developing field of invasive cardiology. There is a wide range of devices which can be implanted: pacemakers, implanted cardioverter defibrillators (ICD) and CRT - Cardiac Resynchronization Therapy pacemakers for biventricular stimulation. In this paper, a description of the methods of implantation is presented, including a short description of the equipment which can be implanted. Special emphasis was placed on the surgical side of the described procedures as well as the possible complications of permanent cardiac stimulation. An additional section contains information about patients' activity and medical examinations which can be done safely after this kind of operation. Copyright (c) 2005 by Via Medica

299. Karhausen T, Stockburger M, Doehner W, Anker SD: **Questions in cardiac resynchronization therapy: metabolic implications.** *Journal of the American College of Cardiology* 2006, 48(3)**:** 591-592.

300. Kashani A, Barold S Serge: **Significance of QRS complex duration in patients with heart failure.** *Journal of the American College of Cardiology* 2005, 46(12)**:** 2183-2192.
Abstract: Prolongation of QRS (> or =120 ms) occurs in 14% to 47% of heart failure (HF) patients. Left bundle branch block is far more common than right bundle branch block. Left-sided intraventricular conduction delay is associated with more advanced myocardial disease, worse left ventricular (LV) function, poorer prognosis, and a higher all-cause mortality rate compared with narrow QRS complex. It also predisposes heart failure patients to an increased risk of ventricular tachyarrhythmias, but the incidence of cardiac or sudden death remains unclear because of limited observations. A progressive increase in QRS duration worsens the prognosis. No electrocardiographic measure is specific enough to provide subgroup risk categorization for excluding or selecting HF patients for prophylactic implantable cardioverter-defibrillator (ICD) therapy. In ICD patients with HF, a wide underlying QRS complex more than doubles the cardiac mortality compared with a narrow QRS complex. There is a high incidence of an elevated defibrillation threshold at the time of ICD implantation in patients with QRS > or =200 ms. Mechanical LV dyssynchrony potentially treatable by ventricular resynchronization occurs in about 70% of HF patients with left-sided intraventricular conduction delay, a fact that would explain the lack of therapeutic response in about 30% of patients subjected to ventricular resynchronization according to standard criteria relying on QRS duration. The duration of the basal QRS complex does not reliably predict the clinical response to ventricular resynchronization, and QRS narrowing after cardiac resynchronization therapy does not correlate with hemodynamic and clinical improvement. Mechanical LV dyssynchrony is best shown by evolving echocardiographic techniques (predominantly tissue Doppler imaging) currently in the process of standardization

301. Kasravi B, Tobias S, Barnes MJ, Messenger JC: **Coronary sinus lead extraction in the era of cardiac resynchronization therapy: single center experience.** *Pacing and clinical electrophysiology - PACE* 2005, 28(1)**:** 51-53.
Abstract: As the number of coronary sinus (CS) lead implantations for cardiac resynchronization therapy increases so will the need for extraction of these leads. The safety of extraction of leads from the branches of the CS has not been reported. We reviewed our database of patients undergoing pacemaker lead extraction from January 2002 through February 2004 at our institution. Of 149 patients referred for lead extraction, 14 (9%) had a biventricular device. The indications for lead extraction were infection, lead malfunction, and exit block. The duration of CS lead implants ranged between 2 and 43 months (mean 17 months). All 14 CS leads were removed successfully using nonsurgical lead extraction techniques. Three leads that were in place the longest (> or =27 months) were removed via the femoral vein approach due to fibrous attachment of the CS lead body to the other pacemaker leads. The leads were structurally intact and without any significant fibrosis of their tips upon visual inspection. There were no major complications of CS laceration, hypotension, pericardial effusion, or excessive blood loss associated with any of the extraction procedures. CS leads were removed safely, successfully and with relative ease based on our experience in this small cohort of patients

302. Kass DA: **Cardiac resynchronization therapy.** *Journal of cardiovascular electrophysiology* 2005, 16 Suppl 1 S35-S41.
Abstract: Cardiac resynchronization therapy (CRT) is a recently developed approach to treat dilated heart failure with discoordinate contraction. Such dyssynchrony typically stems from electrical delay that then translates into mechanical delay between the septal and lateral walls. Over the past decade, many studies have examined the pathophysiology of cardiac dyssynchrony, tested the effects of cardiac resynchronization on heart function and energetics,tested the chronic efficacy of this therapy to enhance symptoms and reduce

mortality, and better established which patients are most likely to benefit. This brief review discusses these topics

303. Kass DA: **Cardiac resynchronization therapy and cardiac reserve: how you climb a staircase may alter its steepness.** *Circulation* 2006, 113(7)**:** 923-925.

304. Kayano H, Ueda H, Kawamata T, Miyoshi F, Toshida T, Watanabe N *et al*.: **Improved septal contraction and coronary flow velocity after cardiac resynchronization therapy elucidated by strain imaging and pulsed wave Doppler echocardiography.** *Journal of cardiology* 2006, 47(2)**:** 51-61.
Abstract: OBJECTIVES: The effects of cardiac resynchronization therapy (CRT) with various atrioventricular conduction delay settings were investigated on cardiac hemodynamic changes involved in coronary flow velocity using color and pulsed wave Doppler modalities and myocardial regional contractility using a novel echocardiographic technique (strain imaging). METHODS: Seven patients with advanced heart failure (left ventricular ejection fraction < 35%) and left bundle branch block(QRS > or = 140 msec) were treated with CRT. Color and pulsed wave Doppler imaging were performed from the apical four-chamber view to examine the cardiac functions such as stroke volume, cardiac output, mitral regurgitant volume and coronary flow velocity. Strain imaging was performed to quantify the asynchrony of both intraventricular and interventricular time delay between the septum and left ventricular free wall (posterior wall) and to assess the regional contractile function. Wall motion was also evaluated. RESULTS: Intraventricular and interventricular asynchrony were improved from 173 +/- 18 to 60 +/- 6 msec, and 69 +/- 25 to 12 +/- 3 msec, respectively. Stroke volume (55.2 +/- 6.2 to 76.8 +/- 10.8 ml; 39% up), cardiac output (3.9 +/- 0.3 to 5.4 +/- 0.5 I/min; 38% up) and coronary flow velocity (24 +/- 3 to 36 +/- 5 cm/sec; 50% up) were greatly increased and mitral regurgitant volume (59.7 +/- 18.0 to 38.9 +/- 11.3 ml; 35% down)was clearly decreased. Septal wall shortening was greatly increased from 10.2 +/- 2.3% to 17.0 +/- 1.8% and septal wall motion (radial thickening)was also improved simultaneously. Atrioventricular interval settings influenced all above parameters. CONCLUSIONS: CRT improved the cardiac hemodynamics involved in coronary flow significantly due to both resynchronization of inter and intra asynchrony, and improvement of the regional myocardial contraction in patients with severe congestive heart failure and complete left bundle branch block

305. Kaye GC: **Upgrading pacing generators in the era of biventricular pacing.** *Pacing and clinical electrophysiology - PACE* 2006, 29(7)**:** 689-690.

306. Kearney P, Stokoe G, Breithardt G, Longson C, Marco J, Morgan J *et al*.: **Improving patient access to novel medical technologies in Europe.** *European Heart Journal (EUR HEART J)* /20, EUR.
Abstract: AB- The European Society of Cardiology (ESC) organized a one-day workshop with clinicians, health economic experts, and health technology appraisal experts to discuss the equity of patient access to novel medical technologies in Europe. Two index technologies were considered: implantable cardioverter defibrillators (ICDs) and drug-eluting stents (DES). The use of ICDs range from 35 implants/ million population in Portugal to 166 implants/million population in Germany, whereas for implants of DES (as percentage of total stents) it is lowest in Germany at 14% and high in Portugal at 65%. These differences can in part be explained by a lack of structured implementation of guidelines, the direct cost in relation to the overall healthcare budget, and to differences in procedures and models applied by Health Technology Assessment (HTA) agencies in Europe. The workshop participants concluded that physicians need to be involved in a more structured way in HTA and need to become better acquainted with its methods and terminology. Clinical guidelines should be systematically translated, explained, disseminated, updated, and adopted by cardiologists in Europe. Clinically appropriate, consistent and transparent health economic models need to be developed and high-quality international outcome and cost data should be used. A process for funding of a technology

should be developed after a positive recommendation from HTA agencies. Both the ESC and the national cardiac societies should build-up health economic expertise and engage more actively in discussions with stakeholders involved in the provision of healthcare. (c) The European Society of Cardiology 2006. All rights reserved

307. Kerlan JE, Sawhney NS, Waggoner AD, Chawla MK, Garhwal S, Osborn JL *et al.*: **Prospective comparison of echocardiographic atrioventricular delay optimization methods for cardiac resynchronization therapy.** *Heart rhythm - the official journal of the Heart Rhythm Society* 2006, 3(2)**:** 148-154.
Abstract: BACKGROUND: Atrioventricular (AV) delay optimization can be an important determinant of the response to cardiac resynchronization therapy (CRT) in patients with medically refractory heart failure and a ventricular conduction delay. OBJECTIVES: The purpose of this study was to compare two Doppler echocardiographic methods of AV delay optimization after CRT. METHODS: Forty consecutive patients (age 59 +/- 12 years) with severe heart failure, New York Heart Association class 3.1 +/- 0.4, QRS duration 177 +/- 23 ms, and left ventricular ejection fraction 26% +/- 6% referred for CRT were studied using two-dimensional Doppler echocardiography. In each patient, the acute improvement in stroke volume with CRT in response to two methods of AV delay optimization was compared. In the first method, the AV delay that produced the largest increase in the aortic velocity time integral (VTI) derived from continuous-wave Doppler (aortic VTI method) was measured. In the second method, the AV delay that optimized the timing of mitral valve closure to occur simultaneously with the onset of left ventricular systole was calculated from pulsed Doppler mitral waveforms at a short and long AV delay interval (mitral inflow method). RESULTS: The optimized AV delay determined by the aortic VTI method resulted in an increase in aortic VTI of 19% +/- 13% compared with an increase of 12% +/- 12% by the mitral inflow method (P <.001). The optimized AV delay by the aortic VTI method was significantly longer than the optimized AV delay calculated from the mitral inflow method (119 +/- 34 ms vs 95 +/- 24 ms, P <.001). There was no correlation in the AV delay determined by the two methods (r = 0.03). CONCLUSION: AV delay optimization by Doppler echocardiography for patients with severe heart failure treated with a CRT device yields a greater systolic improvement when guided by the aortic VTI method compared with the mitral inflow method

308. Khairy P, Fournier A, Thibault B, Dubuc M, Therien J, Vobecky SJ: **Cardiac resynchronization therapy in congenital heart disease.** *International journal of cardiology* 2006, 109(2)**:** 160-168.
Abstract: While cardiac resynchronization therapy (CRT) is of proven benefit in selected patients with severe ischemic or dilated cardiomyopathy, refractory symptoms, and conduction delay, extrapolation to congenital heart disease is not straightforward. This rapidly expanding patient population commonly suffers from heart failure, particularly in the presence of a single or systemic right ventricle. Surgical repair may also contribute to ventricular asynchrony. In this systematic review, the current state of knowledge regarding CRT in congenital heart disease is presented. Issues specific to congenital heart disease including right bundle branch block, right (pulmonary) ventricular dysfunction, systemic right ventricular dysfunction, and single ventricle dysfunction are explored. Evidence-based CRT applications for each of these particular conditions are reviewed. Initial experience with CRT in the acute postoperative setting and longer-term, including our own, is elaborated. Unlike standard indications based on multiple randomized clinical trials, supporting evidence for CRT in congenital heart disease is limited to case reports, case series, and small experimental crossover studies in the acute postoperative setting. The heterogeneous patient population, technical limitations from patient size, vascular access issues, and unique forms of ventricular asynchrony further obscure the selection of potential beneficiaries. Despite these limitations, experience thus far has been favorable. Quality of current data precludes definitive evidence-based recommendations, but optimistic initial results suggest that research endeavors in this field should be pursued. Multicenter prospective collaborative efforts are to be encouraged

309. Khan Mohammed R, Jais P, Cummings JE, Sanders P, Kautzner J, Hao S *et al*.: **Randomized controlled trial of pulmonary vein antrum isolation vs. AV node ablation with bi-ventricular pacing for treatment of atrial fibrillation in patients with congestive heart failure (PABA CHF).**

310. Kies P, Leclercq C, van der WE, Schalij M, Bax J: **Cardiac resynchronization therapy in patients with persistent and permanent atrial fibrillation: Impact on dimensions and persistence of atrial fibrillation.**

311. Kies P, Leclercq C, Bleeker GB, Crocq C, Molhoek SG, Poulain C *et al*.: **Cardiac resynchronisation therapy in chronic atrial fibrillation: impact on left atrial size and reversal to sinus rhythm.** *Heart (British Cardiac Society)* 2006, 92(4)**:** 490-494.
Abstract: OBJECTIVE: To evaluate the impact of long term cardiac resynchronisation therapy (CRT) on left atrial and left ventricular (LV) reverse remodelling and reversal to sinus rhythm (SR) in patients with heart failure with atrial fibrillation (AF). PATIENTS: 74 consecutive patients (age 68 (8) years; 67 men) with advanced heart failure and AF (20 persistent and 54 permanent) were implanted with a CRT device. MAIN OUTCOME MEASURES: Patients were evaluated clinically (New York Heart Association (NYHA) class, quality of life, six minute walk test) and echocardiographically (LV ejection fraction, LV diameters, and left atrial diameters) before and after six months of CRT. Additionally, restoration of SR was evaluated after six months of CRT. RESULTS: NYHA class, quality of life score, six minute walk test, and LV ejection fraction had improved significantly after six months of CRT. In addition, left atrial and LV end diastolic and end systolic diameters had decreased from 59 (9) to 55 (9) mm, from 72 (10) to 67 (10) mm, and from 61 (11) to 56 (11) mm, respectively (all $p < 0.01$). During implantation 18 of 20 (90%) patients with persistent AF were cardioverted to SR. At follow up 13 of 18 (72%) patients had returned to AF and none had spontaneously reverted to SR; thus, only 5 of 74 (7%) were in SR. CONCLUSION: Six months of CRT resulted in significant clinical benefit with significant left atrial and LV reverse remodelling. Despite these beneficial effects, 93% of patients had not reverted to SR

312. Kies P, Bax JJ, Molhoek SG, Bleeker GB, Boersma E, Steendijk P *et al*.: **Comparison of effectiveness of cardiac resynchronization therapy in patients with versus without diabetes mellitus.** *American journal of cardiology* 2005, 96(1)**:** 108-111.
Abstract: The effect of long-term cardiac resynchronization therapy (CRT) was evaluated in 32 patients with heart failure (HF) and diabetes mellitus (DM) compared with 65 patients with HF and no DM. Clinical parameters were obtained before and after 6 months of CRT. Long-term follow-up was performed <2 years after implantation

313. Kies P, Bax JJ, Molhoek SG, Bleeker GB, Zeppenfeld K, Bootsma M *et al*.: **Effect of cardiac resynchronization therapy on inducibility of ventricular tachyarrhythmias in cardiac arrest survivors with either ischemic or idiopathic dilated cardiomyopathy.** *American journal of cardiology* 2005, 95(9)**:** 1111-1114.
Abstract: We evaluated whether long-term cardiac resynchronization therapy affects the inducibility of ventricular tachyarrhythmias in relation to reverse remodeling in cardiac arrest survivors with either ischemic or idiopathic dilated cardiomyopathy. Clinical, electrophysiologic, and echocardiographic data of 18 patients were obtained before and after 6 months of cardiac resynchronization

314. Kindermann M, Hennen B, Jung J, Geisel J, Bohm M, Frohlig G: **Biventricular versus conventional right ventricular stimulation for patients with standard pacing indication and left ventricular dysfunction: the Homburg Biventricular Pacing Evaluation (HOBIPACE).** *Journal of the American College of Cardiology* 2006, 47(10)**:** 1927-1937.
Abstract: OBJECTIVES: The Homburg Biventricular Pacing Evaluation (HOBIPACE) is the first randomized controlled study that compares the biventricular (BV) pacing approach

with conventional right ventricular (RV) pacing in patients with left ventricular (LV) dysfunction and a standard indication for antibradycardia pacing in the ventricle. BACKGROUND: In patients with LV dysfunction and atrioventricular block, conventional RV pacing may yield a detrimental effect on LV function. METHODS: Thirty patients with standard indication for permanent ventricular pacing and LV dysfunction defined by an LV end-diastolic diameter > or =60 mm and an ejection fraction < or =40% were included. Using a prospective, randomized crossover design, three months of RV pacing were compared with three months of BV pacing with regard to LV function, N-terminal pro-B-type natriuretic peptide (NT-proBNP) serum concentration, exercise capacity, and quality of life. RESULTS: When compared with RV pacing, BV stimulation reduced LV end-diastolic (-9.0%, p = 0.022) and end-systolic volumes (-16.9%, p < 0.001), NT-proBNP level (-31.0%, p < 0.002), and the Minnesota Living with Heart Failure score (-18.9%, p = 0.01). Left ventricular ejection fraction (+22.1%), peak oxygen consumption (+12.0%), oxygen uptake at the ventilatory threshold (+12.5%), and peak circulatory power (+21.0%) were higher (p < 0.0002) with BV pacing. The benefit of BV over RV pacing was similar for patients with (n = 9) and without (n = 21) atrial fibrillation. Right ventricular function was not affected by BV pacing. CONCLUSIONS: In patients with LV dysfunction who need permanent ventricular pacing support, BV stimulation is superior to conventional RV pacing with regard to LV function, quality of life, and maximal as well as submaximal exercise capacity

315. Kirkorian GA, Burri H, Cleland JGF, Daubert J-C, Tavazzi L: **Cardiac-resynchronization therapy in heart failure [1] (multiple letters).** *New England Journal of Medicine (NEW ENGL J MED)* /20, NEW.

316. Kirkorian GA: **Cardiac-resynchronization therapy in heart failure.** *New England journal of medicine* 2005, 353(2)**:** 205-206.

317. Kirsh JA, Stephenson EA, Redington AN: **Recovery of left ventricular systolic function after biventricular resynchronization pacing in a child with repaired tetralogy of fallot and severe biventricular dysfunction.** *Circulation (Circulation)* /20, CIRCULATION.

318. Kirsh JA, Stephenson EA, Redington AN: **Images in cardiovascular medicine. Recovery of left ventricular systolic function after biventricular resynchronization pacing in a child with repaired tetralogy of Fallot and severe biventricular dysfunction.** *Circulation* 2006, 113(14)**:** e691-e692.

319. Kleckner KJ, Betzold RA, Lynn TG: **Atrial tracking recovery to restore cardiac resynchronization therapy in dual chamber tracking modes.**
Abstract: A feature named "atrial tracking recovery" (ATR) provides for restoring delivery of cardiac pacing therapy upon identification of an atrial refractory sense-ventricular sense (AR-VS) pattern of cardiac activity. In one embodiment, such patterns are monitored to determine if they are terminable. Once the AR-VS pattern is identified, the then operative post-ventricular atrial refractory period (PVARP) is shortened to allow sensing of the atrial event, which previously was unable to initiate a sensed atrioventricular (SAV) interval. Subsequent SAV intervals are shortened until an atrial event is sensed so that a ventricular pacing stimulus is delivered after the SAV interval expires. Since the SAV interval is normally programmed to an interval that is shorter than the intrinsic conduction time, ventricular pacing stimulus is provided after the SAV ends, thereby effectively restoring delivery of a ventricular pacing modality such as cardiac resynchronization therapy (CTR)

320. Klein HU: **[Cardioverter-defibrillator (ICD) and resynchronization in every patient with cardiac failure--For]**
<Original> Kardioverter-Defibrillator (ICD) und Resynchronisationstherapie: immer

bei Herzinsuffizienz -- Pro. *Deutsche medizinische Wochenschrift (1946)* 2006, 131(14)**:** 772.

321. Knaapen P, Lammertsma AA, Visser FC, Lindner O, Vogt J, Burchert W: **Enhancement of perfusion reserve by cardiac resynchronization therapy [2] (multiple letters).** *European Heart Journal (EUR HEART J)* /20, EUR.

322. Knaapen P, Lammertsma AA, Visser FC: **Enhancement of perfusion reserve by cardiac resynchronization therapy.** *European heart journal* 2005, 26(14)**:** 1447-1448.

323. Kocovic DZ: **Cardiac resynchronization therapy and other new approaches for the treatment of heart failure in the elderly.** *American journal of geriatric cardiology* 2006, 15(2)**:** 108-113.
Abstract: Approximately 15% to 20% of patients with systolic heart failure have a QRS duration greater than 120 ms, which is most commonly seen as left bundle-branch block (LBBB). In LBBB, the left ventricle is activated through the septum from the right ventricle, resulting in a significant delay between the onset of right (RV) and left ventricular (LV) contraction. In patients with LV dysfunction, ventricular dyssynchrony caused by LBBB places the already failing left ventricle at an additional mechanical disadvantage. Ventricular dyssynchrony appears to have a deleterious impact on the natural history of heart failure, as a wide QRS complex has been associated with increased mortality in patients experiencing heart failure. On the basis of these observations, investigators hypothesized that patients with LV dysfunction and delayed ventricular conduction would benefit from pacing at sites that achieve a more favorable contraction pattern, and correct interatrial and/or interventricular conduction delays to maintain optimal atrial-ventricular (AV) synchrony. Multiple clinical trials of cardiac resynchronization therapy have demonstrated that it is safe and effective, with patients achieving significant improvement in both clinical symptoms as well as multiple measures of functional status and exercise capacity. Moreover, it has reduced measures of morbidity and mortality in several studies. Thus, cardiac resynchronization therapy should be routinely offered to eligible patients experiencing heart failure

324. Koglek W, Brandl J, Oberbichler A, Schmidt K, Grimm G, Butter C: **[Three-dimensional vectorcardiography to predict CRT-responder]**
<Original> Dreidimensionale Vektorkardiographie zur CRT-Responderbestimmung. *Herzschrittmachertherapie & Elektrophysiologie* 2006, 17 Suppl 1 I28-I36.
Abstract: Cardiac resynchronization therapy (CRT) is an accepted treatment for congestive heart failure (NYHA III-IV), but a substantial number of patients show no response to therapy. LBB, QRS width and echocardiographic measurements are parameters for indication, but they are not valid to predict hemodynamic response. A new method based on vector ECG analysis can deliver additional information, such as: parts or areas with late excitation, and with slow or fast depolarization speed. Electrical excitation is a prerequisite for contraction; this leads to the hypothesis that areas with late electrical activation will contract later. Algorithms for analysis of the vector ECG (determination of the vector -- time, area and speed) may help to identify responders and non-responders

325. Kohli S, Elliott P: **Cardiac resynchronization therapy: the procedure and progress so far.** *British journal of hospital medicine (London, England - 2005)* 2005, 66(8)**:** 469-473.

326. Kokolis S, Clark LT, Kokolis R, Kassotis J: **Ventricular Arrhythmias and Sudden Cardiac Death.** *Progress in Cardiovascular Diseases (PROG CARDIOVASC DIS)* /20, ROG.
Abstract: AB- The evaluation of a patient at risk for ventricular arrhythmias and CAD begins with a thorough medical history and the standard ECG, followed by an assessment of LVEF and the presence of ischemia. The SAECG, HRV, microvolt TWA, and invasive EPS should be used in particular subgroups of patients to assist the clinician in risk

stratification for VT, VF, and SCD. Amiodarone is the superior antiarrhythmic agent in reducing the recurrence of VT/VF and subsequent ICD shocks. In addition, amiodarone has been shown to reduce arrhythmic death, but has fallen short in reducing total mortality. At present, patients who have a severely reduced LVEF (<=30%) and a history of MI are at extremely high risk for SCD and require an ICD. Aggressive risk stratification of patients is crucial in reducing the incidence of SCD. Understanding the role of pharmacotherapy and device therapy alike in the treatment of these patients will decrease future arrhythmic events and death. (c) 2006

327. Kolb C, Halbfass P, Zrenner B, Schmitt C: **Paradoxical atrial undersensing due to inappropriate atrial noise reversion of atrial fibrillation in dual-chamber pacemakers.** *Journal of Cardiovascular Electrophysiology (J CARDIOVASC ELECTROPHYSIOL)* /20, J.
Abstract: AB- Paradoxical Atrial Undersensing. Background: Paradoxical atrial undersensing at high atrial sensing levels was described as false atrial noise reversion of dual-chamber pacemakers during atrial fibrillation in a sheep model. It is unknown whether this phenomenon occurs in humans. Methods: In total, 71 patients with implanted dual-chamber pacemakers and atrial fibrillation were tested for the occurrence of paradoxical atrial undersensing. After determination of the sensing threshold of atrial fibrillation (30 seconds of continuous mode switch), the atrial sensing level was stepwise increased. If, after correct mode switch behavior at insensitive levels, loss of mode switch occurred at higher sensing levels and if the pacing mode was consistent with atrial noise reversion, paradoxical atrial undersensing was assumed. Results: Paradoxical atrial undersensing could be provoked in 9 of 71 (13%) patients at a median sensing level of 0.4 (range 0.15-2.0) mV. Six different pacemaker models of five different manufacturers were affected. The occurrence of paradoxical atrial undersensing was significantly associated with the sensing threshold of atrial fibrillation (2.7 +/- 1.5 mV for patients with paradoxical undersensing compared to 1.6 +/- 1.3 mV for those without, P = 0.02). Decreasing the atrial sensing level avoided paradoxical undersensing in 8 of 9 patients while maintaining an adequate safety margin for the detection of atrial fibrillation. Conclusion: Paradoxical atrial undersensing is inherent to all current dual-chamber pacemakers. The incidence is about 13% when using very high atrial sensing levels. Inappropriate atrial noise reversion can be resolved in most of the cases by decreasing atrial sensing levels and knowledge of this phenomenon is important to avoid unwarranted atrial lead revisions

328. Kolb C, Markwardt C, Zrenner B, Schmitt C: **Pacemaker auto-interference by thoracic impedance measurement for the rate response function.** *Pacing and clinical electrophysiology - PACE* 2005, 28(12)**:** 1360-1362.
Abstract: This report describes two cases of pacemaker auto-interference caused by thoracic impedance measurements for the rate response function of a dual chamber pacemaker. Mechanisms of this phenomenon and reprogramming strategies are discussed

329. Komsuoglu B, Vural A, Agacdiken A, Ural D: **Effect of biventricular pacing on left ventricular outflow tract pressure gradient in a patient with hypertrophic cardiomyopathy and normal interventricular conduction.** *Journal of cardiovascular electrophysiology* 2006, 17(2)**:** 207-209.
Abstract: We report a case of hypertrophic obstructive cardiomyopathy (HOCM) that was markedly improved by biventricular pacing. A 55-year-old woman with HOCM presented with palpitation and presyncope. Electrophysiologic study revealed an atrioventricular nodal reentrant tachycardia. After radiofrequency catheter ablation, a Mobitz type II atrioventricular block developed and a permanent pacemaker implantation was decided. Cardiac catheterization showed a left ventricular outflow tract (LVOT) gradient of 130 mmHg. Right dual-chamber and atrial-synchronous left ventricular epicardial pacing failed to reduce the gradient. After biventricular pacing, LVOT gradient decreased to 20 mmHg. Biventricular pacing may be an alternative therapy for patients with HOCM

330. Konstantino Y, Iakobishvili Z, Arad O, Ben-Gal T, Kusniec J, Mazur A *et al*.: **Urgent cardiac resynchronization therapy in patients with decompensated chronic heart failure receiving inotropic therapy. A case series.** *Cardiology* 2006, 106(1)**:** 59-62.
Abstract: BACKGROUND: It remains unknown whether patients with severe decompensated class IV heart failure (HF) receiving intravenous inotropic treatment benefit from cardiac resynchronization therapy (CRT). METHODS: We identified patients who underwent urgent CRT implantation due to decompensated class IV HF necessitating intravenous inotropic therapy. RESULTS: Of 10 patients with chronic ischemic cardiomyopathy (median QRS duration of 170 ms), CRT implantation was associated with symptomatic improvement in 8 patients. The mortality rate was 50% during a median follow-up of 9.5 months, with a median CRT-to-death duration of 6 months. CONCLUSIONS: CRT was feasible among class IV patients receiving inotropic treatment and was associated with clinical improvement. Copyright 2006 S. Karger AG, Basel

331. Kowalski O, Prokopczuk J, Lanarczyk R, Pruszkowska-Skrzep P, Polonski L, Kalarus Z: **Coronary sinus stenting for the stabilization of left ventricular lead during resynchronization therapy.** *Europace (Europace)* /20, EUROPACE.
Abstract: AB- We report on two patients treated with cardiac resynchronization therapy, in whom early (intra-operatively, 64-year-old man) and late (4 months post-operatively, 57-year-old woman) instability of the left ventricular (LV) lead occurred. In order to stabilize the electrodes, stents were deployed in both patients within the coronary sinus, into the space between the lead and the wall of the vein effectively pinning the lead to the wall. During 3 and 5 months of follow-up, the electrodes remained stable and allowed for successful resynchronization in both cases. Stenting within the coronary sinus seems to be a safe method for LV lead stabilization, which can substantially increase the success rate of resynchronization therapy. This new approach, although promising, has to prove its safety and should not be practised routinely until long-term follow-up data are available. (c) 2006 Oxford University Press

332. Kralik MR: **Temporary biventricular pacing of heart after heart surgery.**
Abstract: Apparatus is disclosed for providing a practitioner the ability to switch from one cardiac pacing mode to another cardiac pacing mode when treating a patient suffering from heart failure due to discoordinate ventricular contraction. Also disclosed are methods of providing different modes of cardiac pacing to a cardiac pacing patient using the apparatus

333. Kramer AP, Stahmann J, Kadhiresan VA: **Trending of conduction time for optimization of cardiac resynchronization therapy in cardiac rhythm management system.**
Abstract: A method of optimizing cardiac resynchronization therapy delay over a patient's full range of activity for use in operating an implantable cardiac pacing device and such a device are disclosed. The method includes measuring selected conduction time between selected sites in the heart for a plurality of beats and logging the values on a periodic repeating programmable basis to produce cumulative data and constructing a current template of conduction time in relation to one or more other sensed parameters of interest over a desired range of patient activity levels. The current template is used to derive suggested optimum pacing timing

334. Kramm B: **Ventricular safety pacing in biventricular pacing.**
Abstract: A pacing method and apparatus includes providing an AV interval initiated by occurrence of either an atrial paced or sensed event. A ventricular safety pacing window is defined. In one embodiment, ventricular events are sensed at only one ventricular side and if a ventricular event is sensed during the ventricular safety pacing window, then a commitment is made to delivery of ventricular stimulus only to the one ventricular side of the patient's heart where the ventricular event is sensed. Further, in another embodiment, sensing of ventricular events may occur at both ventricular sides during the ventricular safety pacing window. If a ventricular event is sensed during the ventricular safety pacing window at a first ventricular side, then commitment is made to delivery of ventricular

stimulus to at least the first ventricular side. Further, upon such sensing, modification is provided to reduce the likelihood of sensing ventricular events at the second ventricular side for a predetermined time period following the sensing of the ventricular event at the first side

335. Kranig W, Grove R, Ludorff G, Thale J: **[Cardiac resynchronization therapy (CRT) and anodal stimulation]**
<Original> Kardiale Resynchronisationstherapie (CRT) und anodale Stimulation.
Herzschrittmachertherapie & Elektrophysiologie 2005, 16(4)**:** 278-283.
Abstract: We describe a biventricular stimulation mode to pace both ventricles with a single electrical stimulus between the tip of the left ventricular electrode and the tip of the right ventricular electrode: one ventricle is stimulated cathodal the other anodal

336. Kriebel T, Ruschewski W, Paul T: **Implantation of an "extracardiac" internal cardioverter defibrillator in a 6-month-old infant.** *Zeitschrift fur Kardiologie (Z KARDIOL)* /20, Z.
Abstract: AB- In infants and small children, ICD implantation is a challenge due to technical limitations and a significant number of complications. This report describes ICD implantation in a 6-month-old infant (body weight 5.5 kg). A completely extracardiac defibrillation system was implanted using a transvenous lead subcutaneously in the back below the left scapula as the defibrillation electrode and an active-can device in the right upper abdomen. Defibrillation threshold of implantation was <=10 J. During the follow-up of 3 months, 8 adequate ICD discharges were noted. The technique described seems feasible to facilitate ICD implantation in small infants. (c) Steinkopff Verlag 2005

337. Krishnan K, Avramovitch NA, Kim MH, Trohman RG: **Cardiac resynchronization therapy: a potential option for congenitally corrected transposition of the great vessels.** *Journal of heart and lung transplantation - the official publication of the International Society for Heart Transplantation* 2005, 24(12)**:** 2293-2296.
Abstract: The use of cardiac resynchronization therapy in patients with QRS prolongation (left-sided interventricular conduction delay) and symptomatic (New York Heart Association class III and IV) heart failure despite optimal medical therapy is well established. This case report describes the use of cardiac resynchronization therapy to treat symptomatic congestive heart failure in 2 patients with congenitally corrected transposition of the great vessels

338. Kubo T, Kitaoka H, Okawa M, Matsumura Y, Hitomi N, Yamasaki N *et al*.: **Lifelong left ventricular remodeling of hypertrophic cardiomyopathy caused by a founder frameshift deletion mutation in the cardiac myosin-binding protein C gene among Japanese.** *Journal of the American College of Cardiology (J AM COLL CARDIOL)* /20, J.
Abstract: AB- OBJECTIVES: We studied the longitudinal evolution of hypertrophic cardiomyopathy (HCM) caused by a founder frameshift mutation in the cardiac myosin-binding protein C (MyBPC) gene. BACKGROUND: Mutations in the MyBPC gene have been associated with delayed expression of HCM and a good prognosis. Few studies, however, demonstrated the phenotype-genotype correlations in the longitudinal study. METHODS: We studied long-term evolution of clinical features of 15 unrelated families who were found to have an identical frameshift mutation in the MyBPC gene: a one-base deletion of a thymidine at nucleotide 11645 (V592fs/8). RESULTS: Thirty-nine individuals in 15 families were genotype-positive. Thirty of the 39 individuals with the mutation were phenotype-positive. The disease penetrance was 100% in subjects >=50 years and 65% in those <50 years. "End-stage" HCM (ejection fraction <50%) was observed in 7 (18%) of the 39 genotype-positive individuals (7 [23%] of the 30 phenotype-positive patients); 6 of them were 60 years or older. Seven patients were hospitalized for treatment of repeated congestive heart failure, and four patients died or had implantable cardioverter-defibrillator discharge (13%; incidence, 1.4%/year) during a mean follow-up period of 9.2 +/- 5.5 years.

CONCLUSIONS: Elderly patients with a V592fs/8 mutation in the MyBPC gene may evolve into the "end-stage" HCM, characterized by left ventricular systolic dysfunction, cavity dilation, and irreversible heart failure. The clinical course in patients with this mutation is not benign in the long run, with progressive left ventricular remodeling with advancing age. (c) 2005 by the American College of Cardiology Foundation

339. Kubota S, Nogami A, Sugiyasu A, Kasuya K: **Cardiac resynchronization therapy in a patient with isolated noncompaction of the left ventricle and a narrow QRS complex.** *Heart rhythm - the official journal of the Heart Rhythm Society* 2006, 3(5)**:** 619-620.

340. Kurzidim K, Reinke H, Sperzel J, Schneider HJ, Danilovic D, Siemon G *et al*.: **Invasive optimization of cardiac resynchronization therapy: role of sequential biventricular and left ventricular pacing.** *Pacing and clinical electrophysiology - PACE* 2005, 28(8)**:** 754-761.
Abstract: BACKGROUND: Aim of this invasive study was to characterize and quantify changes in left ventricular (LV) systolic function due to sequential biventricular pacing (BV) as compared to right atrial triggered simultaneous BV (BV(0)), LV, and right ventricular (RV) pacing in patients with congestive heart failure (CHF). METHODS: In 22 CHF patients, all in sinus rhythm, temporary multisite pacing was performed prior to implantation of a permanent system. LV systolic function was evaluated invasively by the maximum rate of LV pressure increase (dP/dt(max)). Sequential BV pacing was performed with preactivation of either ventricle at 20-80 ms. RESULTS: In comparison to RV pacing, LV and BV(0) pacing increased dP/dt(max) by 33.9 +/- 19.3% and 34.0 +/- 22.6%, respectively ($P < 0.001$). In 9 patients, optimized sequential BV pacing further improved dP/dt(max) by 8.5 +/- 4.8% compared to BV(0) (range 3.3-17.1, $P < 0.05$). In 10 patients exhibiting a PR interval < or =200 ms, LV pacing was either superior ($n = 6$) or equal to BV(0) pacing ($n = 4$). In these 10 patients, LV pacing yielded a 7.4 +/- 8.0% higher dP/dt(max) than BV(0) pacing ($P < 0.05$). CONCLUSIONS: Using sequential BV pacing, generally with LV preactivation, moderate improvements in LV systolic function can be achieved in selected patients. Baseline PR interval may aid in the selection of the optimum cardiac resynchronization therapy (CRT) mode, favoring LV pacing in patients with a PR interval < or =200 ms

341. Kusaba T, Tanda S, Kameyama H, Tamagaki K, Okigaki M, Hatta T *et al*.: **Efficacy of biventricular pacing for dialysis-related hypotension due to idiopathic dilated cardiomyopathy.** *Clinical and experimental nephrology* 2005, 9(3)**:** 255-259.
Abstract: A 45-year-old man who had been undergoing maintenance hemodialysis for end-stage renal failure, caused by chronic glomerulonephritis 4 years before, was admitted to our hospital for biventricular pacemaker implantation (BVP). Ten years ago, he was diagnosed with idiopathic dilated cardiomyopathy, and had been suffering from dialysis-related hypotension (DRH) due to low cardiac function over the past year. An electrocardiogram revealed complete left bundle branch block with a QRS duration of 180 ms, and echocardiography showed moderate hypokinesis of the left ventricular wall and systolic asynchronized motion of the septum and free wall. After BVP, the left ventricular ejection fraction had increased from 29% to 40%, and the transmitral rapid left ventricular filling (E wave) and atrial contraction (A wave) ratio (E/A) had improved from 1.3 to 1.0. Before and after BVP, we measured hemodynamic parameters during hemodialysis by successive echocardiography. Before BVP, systemic vascular resistance had decreased, cardiac output had not changed, and hypotension was noted. In contrast, after BVP, cardiac output had increased and systemic vascular resistance had not changed, which caused an increase in blood pressure. We conclude that BVP improved the cardiac function which resulted in an improvement in dialysis-related hypotension (DRH)

342. Kusumoto F, Goldschlager N: **Beyond heart rhythms: new directions for implantable devices.** *Journal of interventional cardiac electrophysiology - an international journal of arrhythmias and pacing* 2005, 14(1)**:** 5-7.

Abstract: Implantable cardiac devices have become firmly entrenched as important therapeutic tools for a variety of conditions. Pacemakers are the only available treatment for symptomatic bradycardia not due to reversible causes. Large randomized studies have demonstrated a small but statistically significant reduction in atrial fibrillation associated with pacing modes that maintain atrioventricular synchrony. In contrast, pacing mode appears to have a less dramatic effect in patients with atrioventricular block. Cardiac resynchronization with specialized left ventricular leads has been shown to reduce symptoms and improve survival in patients with symptomatic heart failure, systolic dysfunction, and widened QRS complexes. The implantable cardioverter defibrillator has become the standard therapy for protecting patients against sudden cardiac death. Two recent trials, Multicenter Automatic Defibrillator Trial II (MADIT II) and the Sudden Cardiac Death Heart Failure Trial (SCD-HEFT), demonstrated that the ICD is associated with a significant survival benefit for patients with reduced ejection fraction (< 0.30-0.35) particularly if heart failure symptoms are present. Finally the implantable loop recorder has become an important diagnostic tool for the patient with unexplained syncope. This brief overview summarizes the indications and follow-up of the wide array of implantable cardiac devices available to the clinical cardiologist

343. Kusumoto FM, Goldschlager N: **Implantable cardiac arrhythmia devices--part I: pacemakers.** *Clinical cardiology* 2006, 29(5)**:** 189-194.
Abstract: Implantable cardiac devices have become firmly entrenched as important therapeutic tools for a variety of cardiac conditions. The first part of this two-part review will discuss the contemporary use and follow-up of pacemakers, while the second part will address the use of implantable cardioverter defibrillators and implantable loop recorders. Pacemakers are the only available treatment for symptomatic bradycardia not due to reversible causes. Large randomized studies have demonstrated a small but statistically significant reduction in atrial fibrillation associated with pacing modes that maintain atrioventricular synchrony. In contrast, pacing mode appears to have a less dramatic effect in patients with atrioventricular block. Cardiac resynchronization with specialized left ventricular leads has been shown to reduce symptoms and improve survival in patients with symptomatic heart failure, systolic dysfunction, and widened QRS complexes. For all patients, careful follow-up is necessary to ensure optimal therapeutic benefit of pacing systems

344. Kuznetsov VA, Kolunin G, V, Kharats VE, Krinochkin D, V, Gorbunova T, I, Pavlov A, V *et al*.: **[Effect of cardiac resynchronization therapy in the treatment of chronic heart failure].** *Kardiologiia* 2005, 45(9)**:** 29-31.
Abstract: As a result of cardiac resynchronization therapy in all 10 patients with chronic NYHA class III-IV heart failure at duration of observation from 2 to 20 months was noted positive dynamics: improvement of self feeling, increase of 6 min walking distance, decrease of heart failure class, and improvement of functional parameters of the heart according to echocardiography data. Implantation of biventricular cardiac pacemaker to patients with chronic heart failure is relatively safe and accomplish-able from technical point of view. Cardiac resynchronization in patients with pronounced chronic heart failure appears to be an effective supplementation of drug therapy

345. Kuznetsov VA, Kolunin G, V, Kharats VE, Zyr'ianov IP, Gorbunov T, I, Krinochkin D, V *et al*.: **[Resynchronising cardiac therapy in a patient with chronic heart failure without expansion of QRS complex].** *Terapevticheskii arkhiv* 2005, 77(3)**:** 77-79.

346. Kuznetsov VA, Krinochkin D, V, Kolukhin G, V, Kharats VE, Gorbunova T, I, Pavlov A, V *et al*.: **[Echocardiography and selection of patients with chronic cardiac failure for cardiac resynchronizing therapy (review of literature and original results)].** *Terapevticheski arkhiv* 2006, 78(4)**:** 87-90.

347. Lappegard KT, Bjornstad H: **Anti-inflammatory effect of cardiac resynchronization therapy.** *Pacing and clinical electrophysiology - PACE* 2006, 29(7)**:** 753-758.
Abstract: Background: Congestive heart failure (CHF) is associated with persistent immune activation. Medical therapy has been shown to exert only limited anti-inflammatory effects. Cardiac resynchronization therapy (CRT) reduces morbidity and mortality in a subset of patients with heart failure, but it is not known whether this treatment affects the immune system as well. To test this hypothesis, eight patients with heart failure scheduled for CRT were investigated for immune activation before and 6 months after CRT treatment. Methods and Results: After 6 months, all patients had improved in NYHA-class and LVEF, and there was a statistically significant reduction in serum N-terminal pro brain natriuretic peptide (BNP). Furthermore, there was a statistically significant reduction in plasma levels of the chemokines monocyte chemoattractant protein 1 (MCP-1) and interleukin 8 (IL-8) and the cytokine interleukin 6 (IL-6). We observed no changes in the levels of interleukin 1beta (IL-1beta), tumor necrosis factor alpha (TNF-alpha), interleukin 10 (IL-10), or complement activation products. There was a significant correlation between changes in BNP and IL-6 ($r = 0.74$, $P = 0.037$). Conclusion: Although based upon a limited number of patients, this report indicates that CRT reduces peripheral markers of immune activation in patients with CHF. Further large scale studies are warranted to verify these findings

348. Larsen A, I, Nilsen DW: **Persistent left superior vena cava. Use of an innominate vein between left and right superior caval veins for the placement of a right ventricular lead during ICD/CRT implantation.** *European heart journal* 2005, 26(20)**:** 2178.

349. Laske TG, Skadsberg ND, Iaizzo PA: **A novel ex vivo heart model for the assessment of cardiac pacing systems.** *Journal of Biomechanical Engineering (J BIOMECH ENG)* /20, J.
Abstract: AB- Background: Advances in endocardial device design have been limited by the inability to visualize the device-tissue interface. The purpose of this study was to assess the validity of an isolated heart approach, which allows direct ex vivo intracardiac visualization, as a research tool for studying endocardial pacing systems. Method of approach: Endocardial pacing leads were implanted in the right atria and ventricles of intact swine ($n = 8$) under fluoroscopic guidance. After collection of pacing and sensing performance parameters, the hearts were excised with the leads intact and reanimated on the isolated heart apparatus, and parameters again recorded. Results: Atrial ex vivo parameters significantly decreased compared with in vivo measurements: P-wave amplitudes by 39%, slew rates by 61%, and pacing impedances by 42% ($p<0.05$ for each). Similarly, several ventricular ex vivo parameters decreased: R-wave amplitudes by 39%, slew rates by 62%, and pacing impedances by 31%. In contrast, both atrial (4.4+/-2.8 vs 3.3+/-2.8 V; p=ns) and ventricular thresholds increased (1.2+/-0.7 vs 0.6+/-0.1 V; $p<0.05$ for all). Three distinct phenomena were observed at the lead-tissue interface. Normal implants (70%) demonstrated minimal tissue distortion and resulted in elevated impedance and threshold values. Three implants (13%) resulted in severe tissue distortion and/or tissue wrapping and were associated with highly elevated pacing parameters. Tissue coring occurred in four implants (17%) where the lead would spin freely in the tissue after overtorquing of the lead. Conclusions: The utility of the isolated heart approach was demonstrated as a tool for the design and assessment of the performance of endocardial pacing systems. Specifically, the ability to visualize device-heart interactions allows new insights into the impact of product design and clinical factors on lead performance and successful implantation. Copyright (c) 2005 by ASME

350. Laske TG, Vieau SA, Skadsberg ND, Iaizzo PA: **High pacing impedances: are you overtorquing your leads?** *Pacing and clinical electrophysiology - PACE* 2005, 28(9)**:** 883-891.
Abstract: BACKGROUND: Variations in measured pacing impedances that occur at the time of lead implantation remain largely unexplained and may be due to the morphology of

the tissue-lead interface. METHODS: An endocardial pacing lead was implanted under direct endoscopic visualization and parameters were measured for defined stages of implantation into multiple sites within the right atrium of in vitro swine hearts (n = 6, 38 implants), in vivo swine hearts (n = 2, 10 implants), and an in vitro human heart (n = 1, 15 implants). RESULTS: Steady increases in impedance values up to 2 turns fully fixed (2TF) were associated with minimal tissue distortion in all implants. Overtorquing of the in vitro swine implants resulted in severe distortion at the tissue-lead interface demonstrating either tissue wrapping (24 implants) or tissue coring (14 implants). Impedance and threshold values remained elevated (953 +/- 282 Omega, 7.86 +/- 3.0 V; both P < 0.05 vs 2TF) during tissue distortion/wrapping, while tissue-cored implants were associated with significant decreases (552 +/- 187 Omega, 6.2 +/- 2.2 V; both P < 0.05 vs 2TF). P-wave amplitudes demonstrated no significant changes or correlation to tissue distortion. Importantly, both swine in vivo and human in vitro data demonstrated similar trends compared with the swine in vitro data. CONCLUSIONS: In this study, one is able to directly observe and correlate the degree of distortion at the tissue-lead interface with measured electrical parameters. Instantaneous impedance values obtained during fixation serve as a superior indicator of an acceptable lead implantation, and should therefore be carefully monitored during implantation

351. Laskey WK, Maisel WH: **Cardiac resynchronization therapy: a regulatory perspective.** *American heart journal* 2006, 151(4)**:** 757-761.

352. Leclercq Christophe Sr R, Crocq C, Sr., de PC, Sr., Donal E, Sr., Pavin D, Sr., Mabo P, Sr. *et al*.: **Long term effects of cardiac resynchronization therapy on atrial and ventricular remodeling in advanced heart failure patients with permanent atrial fibrillation and atrioventricular node ablation.**

353. Leclercq C: **[Cardiac resynchronisation therapy: what kind of equipment to use?] <Original> La resynchronisation cardiaque: quel type d'appareil utiliser?** *Annales de cardiologie et d'angeiologie* 2005, 54(1)**:** 12-16.
Abstract: Cardiac resynchronization therapy is indicated in advanced heart failure refractory to optimal drug treatment patients with left ventricular systolic dysfunction and QRS >120 milliseconds. The choice of the device has to consider several parameters: Do we have to implant a CRT pacemaker or a intracardiac cardioverter defibrillator (ICD)? The prevalence of sudden cardiac death is high in heart failure patients. In patients with an ischemic cardiomyopathy, primary prevention of sudden cardiac death trials suggests to implant a biventricular ICD. In patients with a non ischemic cardiomyopathy, the question is more controversial althought the resullts of the SCD-HeFT and COMPANION trials yielded interesting results for iCD implantation. However, the final decision has to consider the patient's baseline characteristics such as age, presence of comorbidities and cost of the device. Today, devices with totally independent ports of the right and left ventricles have technical advantages and thus are more relevant. Cardiac resynchronization therapy is a heart failure treatment and the new devices provide new tools to assess heart failure parameters such as patient's activity, respiratory parameters or heart rate variability. Left ventricular pacing alone is currently under evaluation such as atrial fibrillation prevention algorithms, atrial fibrillation being frequent in herta failure patients with hemodynamic deleterious consequences

354. Leclercq C, Ansalone G, Gadler F, Boriani G, Perez-Castellano N, Grubb N *et al*.: **Biventricular vs. left univentricular pacing in heart failure: rationale, design, and endpoints of the B-LEFT HF study.** *Europace - European pacing, arrhythmias , and cardiac electrophysiology - journal of the working groups on cardiac pacing, arrhythmias , and cardiac cellular electrophysiology of the European Society of Cardiology* 2006, 8(1)**:** 76-80.
Abstract: AIMS: Cardiac resynchronization therapy (CRT) confers sustained therapeutic benefits to patients suffering from congestive heart failure (CHF) due to systolic

dysfunction associated with ventricular dyssynchrony. Biventricular (BiV) pacing has, thus far, been the preferred method, as it corrects both electrical and mechanical dyssynchrony. Left ventricular (LV) only pacing, which has conferred similar benefits in pilot studies, may be an alternative treatment method. 'Biventricular vs. left univentricular pacing with ICD back-up in heart failure patients' (B-LEFT HF) is an international, prospective, randomized, parallel-design, double-blind, clinical trial to examine whether LV only pacing is as safe and effective as BiV pacing in patients suffering from CHF. METHODS AND RESULTS: The trial will randomly assign 172 patients to either LV only or BiV pacing. The study has prospectively defined efficacy endpoints to be evaluated at 6 months, which are (i) changes in functional capacity and degree of reverse remodelling (primary) and (ii) changes in the heart failure clinical composite response (secondary). CONCLUSION: Because LV only pacing in CRT is likely to be technically less challenging and costly than BiV, a specifically designed study is needed to compare the safety and effectiveness of the two configurations. B-LEFT HF has been designed to settle this critical issue

355. Lecoq G, Leclercq C, Leray E, Crocq C, Alonso C, de PC *et al*.: **Clinical and electrocardiographic predictors of a positive response to cardiac resynchronization therapy in advanced heart failure.** *European heart journal* 2005, 26(11)**:** 1094-1100.
Abstract: AIMS: Cardiac resynchronization therapy (CRT) is an effective treatment for refractory congestive heart failure (CHF). However, up to 30% of patients do not respond to CRT. The aim of this study was to identify clinical and electrocardiographic (ECG) predictors of a positive response to CRT. METHODS AND RESULTS: This retrospective study included 139 consecutive patients successfully implanted with a CRT device (mean age, 68+/-9 years, 113 men). At baseline, 69% of patients were in New York Heart Association (NYHA) functional class III, and 31% in class IV, mean left ventricular ejection fraction was 21+/-6%, and mean QRS duration was 188+/-28 ms. In each patient, left and right ventricular leads were placed to attain the shortest QRS duration during biventricular stimulation. Patients were classified at 6 months as responders to CRT (n=100) if they were alive, they had not been re-hospitalized for management of CHF, and the NYHA class had decreased by 1 point, and/or peak VO(2) or 6 min hall-walk increased by >10%. All others were classified as non-responders (n=38; one patient was lost to follow-up). Uni- and multivariate logistic regression analyses were performed to detect a pre- or intra-operative predictor of a positive response to CRT. Among multiple demographic, clinical, and ECG variables, the amount of QRS shortening (DeltaQRS) associated with biventricular stimulation was the only independent predictor of a positive (37+/-23 ms) vs. negative (11+/-23 ms) response to CRT (P<0.001). CONCLUSION: A positive response to CRT was observed in 73% of patients at 6 months and predicted only by DeltaQRS

356. Lee MY: **Cardiac resynchronization therapy; biventricular pacing.** *Korean Circulation Journal (KOREAN CIRC J)* /20, KOREAN.
Abstract: AB- Although the estimates from limited studies vary on the proportion of patients with heart failure who also have ventricular dyssynchrony as reflected by a prolonged QRS complex, often in the form of left bundle branch block, the number of such patients is large (27% to 53%) and it is certainly in excess of the rate for the general population. Among these patients, 10% to 15% are candidates for cardiac resynchronization therapy (CRT) via biventricular pacing. Accumulated evidence from randomized controlled studies over the last few years has indicated that significant hemodynamic and clinical improvement is conferred by CRT to the class III or IV heart failure patients with idiopathic or ischemic dilated cardiomyopathy and who also have a low left ventricular ejection fraction (<=35%) and a wide QRS complex (>=120-150 ms). Newer data suggest a significant reduction in mortality and heart failure hospitalization, particularly when CRT is combined with an automatic defibrillator backup. This technique has transformed the traditional concepts associated with stimulation of the heart, and it is now being applied not only to restore an appropriate heart rate, but also to change the

process of cardiac mechanical activation. Since this treatment must be integrated within a comprehensive and multidisciplinary CHF management program, CRT has altered the medical practice of heart experts in the field of cardiac pacing. Technical advances with percutaneous methods that access the tributaries of the cardiac veins have raised the success rate of implanting left ventricular leads to >90%. Further confirmation from ongoing trials is eagerly awaited, and more data from the studies on this procedure's cost effectiveness are needed before CRT is considered as a prime therapy in the heart failure population. (c) 2006, The Korean Society of Circulation

357. Lee W-L, Ting C-T: **Y-adaptor connection for LV lead in upgrading to biventricular pacing.** *Acta Cardiologica Sinica (ACTA CARDIOL SIN)* /20, ACTA.
Abstract: AB- In recent years, cardiac resynchronization therapy or biventricular pacing has been proved to be effective in alleviating congestive heart failure in 70% of patients. For patients who have bradycardia devices in place before presentation of heart failure and the devices are well before end of life, the RV pacing system can be effectively, efficiently and safely upgraded to bi-ventricular pacing through a bipolar IS-1 Y adaptor converting the single ventricular output of the original pacemaker to dual outlets conjoining the two ventricular leads in parallel. Patients who are successfully upgraded enjoy benefits similar to those of de novo implantation of bi-ventricular pacemaker. At implantation, the pacing threshold of the newly implanted unipolar left ventricular lead should be measured in the Y adaptor-on or LV lead cathode tip to RV anode ring configuration to allow for additional resistance elements

358. Legay T: **Measurement of the complex impedance of an implantable lead.**
Abstract: A process for the measurement of the complex impedance of a lead for an active implantable medical device, in particular a pacemaker, defibrillator and or cardiovertor. This process includes the steps of producing a stimulation pulse by the discharge on the lead (10) of a tank-capacitor (22) of the device (20), charged beforehand to a given voltage level; measuring the voltage variation (V(t)) at the terminals of the tank-capacitor during the discharge; and determining the lead impedance (Zs) from the voltage thus measured. The measurement stage includes sampling at least three successive values of the voltage at the terminals of the tank capacitor, and the determining stage includes the separate determination of the resistive (Rs) and/or capacitive (CH) components of the complex impedance of the lead from the aforesaid at least three sampled values of voltage thus obtained

359. Lehmann MH, Aaronson KD: **CRT-D therapy in heart failure: how much do NYHA class IV patients benefit?** *Journal of cardiovascular electrophysiology* 2006, 17(5)**:** 491-494.

360. Leibovitch ER: **Geriatrics advisor: Once upon a time, heart failure was easy.** *Geriatrics (Geriatrics)* /20, GERIATRICS.
Abstract: AB- When heart failure was "easy," we understood that the heart was a pump and that it functioned poorly in many situations. Today, we now understand the molecular, cellular, and anatomical changes that occur with myocardial injury, and given this understanding, evaluation and therapy has become much more complicated and involved. This commentary discusses the benefits of the implantable cardioverter-defibrillator, while raising issues about the economics of such care

361. Lelakowski J, Czunko A, Majewski J, Bednarek J, Malecka B, Dreher A *et al.*: **[Cardiac resynchronization therapy in refractory heart failure]**
<Original> Terapia resynchronizujaca w niewydolnosci serca. *Polski merkuriusz lekarski - organ Polskiego Towarzystwa Lekarskiego* 2005, 18(106)**:** 440-445.
Abstract: Congestive heart failure remains associated with substantial morbidity and mortality. A common finding in advanced heart failure is abnormal electrical activation of the ventricles or electrical ventricular dyssynchrony. In the early 90s, standard dual-

chamber pacing with short AV delay was proposed as a supplementary treatment of drug-resistant heart failure. Initial results were encouraging but were never confirmed. These studies however made it possible to select a population of potentially responsive patients, especially those with a prolonged PR interval reflecting major atrioventricular asynchrony in the left heart. That relative failure of standard dual-chamber pacing could be linked to the fact that by capturing the ventricle from the right apex, it increases, or at least it cannot correct the marked asynchrony of activation, contraction and relaxation, which characterizes a number of patients with chronic left ventricular dysfunction. Such is the case in particular in patients with important QRS enlargement linked to major intraventricular conduction delay. Biventricular pacing, which simultaneously activates both ventricles, may contribute to correcting the asynchrony and thus improve cardiac performance

362. Lenom V, Materne P, Hoffer E, Lecoq E, Desiron Q, Waucquez JL *et al*.: **[Clinical value of cardiac resynchronization therapy in patients with congestive heart failure] <Original> Resynchronisation ventriculaire dans la decompensation cardiaque refractaire.** *Revue medicale de Liege* 2005, 60(2)**:** 101-108.
Abstract: Besides major progress in the pharmacologic treatment of severe chronic heart failure, cardiac resynchronization therapy (CRT) has developped over the last ten years. We report the follow-up of the 36 first patients with a CRT device implanted from July 2000 to November 2002 at the CHR de la Citadelle Hospital in Liege. After a mean follow up of 6 months, no death was observed. The functional benefit of resynchronization is validated by a significant improvement in the NYHA class, an increase in the walking distance measured by the six minute walk test from 268 +/- 103 to 342 +/- 106 meters ($p < 0.004$) and by a not significant rise in the VO2 max (from 11.1 +/- 2.8 to 14 +/- 10 ml/kg/min; P=0.1). The quality of life, assessed by the Minnesota-Living-In-CHF score, improves from 49 +/- 20 to 35 +/- 22 after the six month follow-up (P=0.02) The echocardiogram also shows a better left ventricular ejection fraction at six months, from 24 +/- 7% to 31 +/- 7% ($P<0.05$). Based on a better NYHA functional class, responders (n=24; 71%) and non responders (n=10; 29%) were compared; a correlation between the functional class change and the improvement of the ejection fraction was documented, but not with the reduction in QRS width. Our registry, with the potential pitfalls of a monocentric prospective study, confirms the feasability, safety and efficacy of CRT in severe chrbnic heart failure uncompletely corrected pharmocalogically. It remains however approximately 30% of non responding patients, in whom the current clinical studies should help identify the right criteria to predict and discriminate responders

363. Leon AR, Abraham WT, Curtis AB, Daubert JP, Fisher WG, Gurley J *et al*.: **Safety of transvenous cardiac resynchronization system implantation in patients with chronic heart failure: combined results of over 2,000 patients from a multicenter study program.** *Journal of the American College of Cardiology* 2005, 46(12)**:** 2348-2356.
Abstract: OBJECTIVES: The purpose of this study was to evaluate the safety of implanting a cardiac resynchronization therapy (CRT) system. BACKGROUND: Clinicians and patients require data on the safety of the CRT implant procedure to estimate procedural risk. METHODS: We evaluated outcomes of transvenous CRT system implantation in 2,078 patients from the Multicenter InSync Randomized Clinical Evaluation (MIRACLE) study, the MIRACLE Implantable Cardioverter-Defibrillator (ICD) study, and the InSync III study. We compared the MIRACLE study to the InSync III study and the MIRACLE ICD study randomized phase to its general phase to evaluate the effect of new technologies. RESULTS: The implant attempt succeeded in 1,903 of 2,078 (91.6%) patients. Implant time decreased from 2.7 h in the MIRACLE study to 2.3 h in the InSync III study ($p < 0.001$), and from 2.8 h in the MIRACLE ICD study randomized phase to 2.4 h in the general phase ($p < 0.001$). The implant procedure produced 62 perioperative complications in 53 (9.3%) MIRACLE trial patients; 159 in 135 (21.1%) MIRACLE ICD study randomized phase patients and 71 in 62 (13.9%) general phase patients ($p < 0.05$ vs. randomized); and 41 in 37 (8.8%) InSync III study patients (p = NS vs. the MIRACLE

study). We observed 73 postoperative complications in 62 (11.7%) MIRACLE trial patients, 77 in 68 (11.9%) MIRACLE ICD study randomized phase patients and 56 in 45 (11.0%) general phase patients (p = NS), and 37 in 34 (8.6%) InSync III study patients (p = NS). A total of 8% of patients required reoperation to treat lead dislodgement, extracardiac stimulation, or infection during follow-up. CONCLUSIONS: Transvenous CRT system implantation appears safe, well-tolerated, has a high success rate, and improves with operator experience and the addition of new technologies

364. Leon AR: **New tools for the effective delivery of cardiac resynchronization therapy.** *Journal of cardiovascular electrophysiology* 2005, 16 Suppl 1 S42-S47.
Abstract: Cardiac resynchronization therapy (CRT) has been shown to provide symptom relief to many patients who have congestive heart failure (CHF). Still, there are technical concerns with implanting CRT systems, and these range from inadequate venous anatomy to a variety of left ventricular (LV) lead problems. Fortunately, there are several new implant tools to help physicians achieve a stable and adequate LV pacing site. There are a number of guiding catheter shapes to tailor the choice to specific anatomic abnormalities that may be encountered during implants. Key to success was the development of over-the-wire LV leads that are capable of maneuvering within complex venous anatomy. Improvements in LV leads have included increasing lead diameter and bipolar design. In some cases, epicardial LV lead placement may be necessary at surgery. The latest systems have begun to integrate disease management modalities, which hopefully will reduce the need for CHF hospitalizations

365. Leon AR, Delurgio DB, Mera F: **Practical approach to implanting left ventricular pacing leads for cardiac resynchronization.** *Journal of cardiovascular electrophysiology* 2005, 16(1)**:** 100-105.

366. Leon AR, Abraham WT, Brozena S, Daubert JP, Fisher WG, Gurley JC *et al.*: **Cardiac resynchronization with sequential biventricular pacing for the treatment of moderate-to-severe heart failure.** *Journal of the American College of Cardiology* 2005, 46(12)**:** 2298-2304.
Abstract: OBJECTIVES: The InSync III study evaluated sequential cardiac resynchronization therapy (CRT) in patients with moderate-to-severe heart failure and prolonged QRS. BACKGROUND: Simultaneous CRT improves hemodynamic and clinical performance in patients with moderate-to-severe heart failure (HF) and a wide QRS. Recent evidence suggests that sequentially stimulating the ventricles might provide additional benefit. METHODS: This multicenter, prospective, nonrandomized, six-month trial enrolled a total of 422 patients to determine the effectiveness of sequential CRT in patients with New York Heart Association (NYHA) functional class III or IV HF and a prolonged QRS. The study evaluated: whether patients receiving sequential CRT for six months experienced improvement in 6-min hall walk (6MHW) distance, NYHA functional class, and quality of life (QoL) over control group patients from the reported Multicenter InSync Randomized Clinical Evaluation (MIRACLE) trial; whether sequential CRT increased stroke volume compared to simultaneous CRT; and whether an increase in stroke volume translated into greater clinical improvements compared to patients receiving simultaneous CRT. RESULTS: InSync III patients experienced greater improvement in 6MHW, NYHA functional class, and QoL at six months compared to control (all p < 0.0001). Optimization of the sequential pacing increased (median 7.3%) stroke volume in 77% of patients. No additional improvement in NYHA functional class or QoL was seen compared to the simultaneous CRT group; however, InSync III patients demonstrated greater exercise capacity. CONCLUSIONS: Sequential CRT provided most patients with a modest increase in stroke volume above that achieved during simultaneous CRT. Patients receiving sequential CRT had improved exercise capacity, but no change in functional status or QoL

367. Lercher P, Scherr D, Maier R, Wonisch M, Rotman B, Kraxner W *et al*.: **The "Model Graz" for implementation of guidelines and study results in heart failure patients with device therapy**
<Original> Das "Grazer modell" Der umsetzung von studienergebnissen und guidelines zur elektrischen therapie bei chronischer herzinsuffizienz. *Journal fur Kardiologie (J KARDIOL)* /20, J.
Abstract: AB- Guidelines for heart failure leave some place for interpretation in cases of device therapy. The so-called "Model Graz" reduces possible interpretations to a minimum. We give clear-cut indications for cardiac resynchronisation therapy (CRT), implantable cardioverter-defibrillators (ICD) and their combination

368. Levine PA, Shankar B, McNeil KR, Florio JJ: **Implantable cardiac stimulation system providing autocapture and lead impedance assessment and method.**
Abstract: An implantable cardiac stimulation system provides autocapture assessment and lead impedance surveillance. The system includes a pulse generator that provides pacing stimulation pulses and a lead system including a plurality of electrodes that provide a plurality of different electrode configurations. The system further includes a switch that selectively couples the pulse generator to any one of the plurality of pacing electrode configurations and an autocapture circuit that performs autocapture tests with the pulse generator. The autocapture circuit includes a capture detector that detects evoked responses with an evoked response electrode configuration. When there is a failure to detect an evoked response, an impedance measuring circuit measures the lead impedance of the evoked response electrode configuration. If the measured lead impedance is outside of a given range, the switch couples the pulse generator to an electrode configuration other than the evoked response electrode configuration. Thereafter, the autocapture circuit performs a further autocapture and impedance measuring test or sets the pacing output to a level which assures capture

369. Lewicka-Nowak E, Sterlinski M, browska-Kugacka A, Maciag A, Kutarski A, Wilczek R *et al*.: **Complications of permanent biventricular pacing in patients with advanced heart failure**
<Original> Problemy i niepowodzenia zwiazane ze stosowaniem stymulacji dwukomorowej u pacjentow z zaawansowana niewydolnoscia serca. *Folia Cardiologica (FOLIA CARDIOL)* /20, FOLIA.
Abstract: AB- Background: Biventricular pacing (BiV) has proven to be a useful adjunctive therapy for selected patients with advanced heart failure. One of the technical difficulties of this novel therapeutic approach is to achieve effective, safe, and permanent left ventricular (LV) pacing. The aim of the study was to analyze problems related to implantation of the BiV system in pts referred for this therapy in two centers: II Department of Cardiology of Medical University in Gdansk and National Institute of Cardiology in Warsaw. Material and methods: LV lead implantation was attempted in 92 patients with advanced dilatative cardiomyopathy, NYHA class 3 +/- 0.4, widened QRS complex 170 +/- 29 ms and LVEF 22 +/- 7%. There were 22 patients eligible for BiV-ICD. Results: In 17 patients the LV lead implantation was unsuccessful: inability to cannulate coronary sinus (CS) or coronary vein - 12, LV lead instability within the CS tributaries - 4, high LV pacing threshold and phrenic nerve stimulation - 1 patient. Five of these patients were successfully reoperated (1 patient with endocardial LV lead placement, that was introduced transseptally). The overall implantation success rate was 87%. Perioperative LV lead-related complications occurred in 14 patients (18%) (the LV lead dislodgement - 12, proarrhythmic effect - 1, phrenic nerve stimulation - 1 patient). Eight of these patients were successfully reoperated. Eleven +/- 6.3 months after implantation 4 patients required reoperation due to an increase in BiV pacing threshold. The long-term retention of BiV pacing was 94% during the mean follow-up of 14.5 +/- 10 months (1-49 months). Conclusions: The LV lead dislodgement is the most frequent complication related to BiV pacing. Complications are likely to occur perioperatively. BiV pacing is accompanied by higher complication and reopearation rate,

however the long-term retention is over 90% during follow-up. Copyright (c) 2005 Via Medica

370. Lin Grace R, Brady PA, Hayes DL: **Gender differences in outcomes from cardiac resynchronization therapy.**

371. Linde C, Gold M, Abraham WT, Daubert J: **Rationale and design of a randomized controlled trial to assess the safety and efficacy of cardiac resynchronization therapy in patients with asymptomatic left ventricular dysfunction with previous symptoms or mild heart failure--the REsynchronization reVErses Remodeling in Systolic left vEntricular dysfunction (REVERSE) study.** *American heart journal* 2006, 151(2)**:** 288-294.
Abstract: BACKGROUND: Cardiac resynchronization therapy (CRT) improves symptoms, reduces heart failure (HF)-related hospitalizations, and reverses left ventricular remodeling in some patients with moderate to severe HF and ventricular dyssynchrony defined by a prolonged QRS duration. The effects of CRT on HF outcomes in patients with asymptomatic left ventricular dysfunction (ALVD) or mild HF remain to be determined. METHODS: The REsynchronization reVErses Remodeling in Systolic left vEntricular dysfunction (REVERSE) study is a prospective, multicenter, randomized, double-blind, parallel, controlled clinical trial designed to establish whether CRT combined with optimal medical treatment can attenuate HF disease progression compared with optimal medical treatment alone in patients with ALVD +/- New York Heart Association class I American College of Cardiology/American Heart Association stage C or New York Heart Association class II HF, QRS duration > or =120 milliseconds, left ventricular ejection fraction < or =0.40, and left ventricular end-diastolic diameter > or =55 mm. The primary end point is the HF clinical composite response and left ventricular end-systolic volume index is the first-order secondary end point. Approximately 500 patients from 100 centers in the United States, Canada, and Europe will be randomized to CRT versus no CRT. The follow-up is 5 years in total with the primary and first secondary end points reported at 12 months. Enrollment began in September 2004 and is expected to be completed in 2006. CONCLUSION: REVERSE will assess the safety and efficacy of CRT in patients with ALVD or mild HF and electrocardiographic evidence of ventricular dyssynchrony

372. Lindenfeld JoAnne R, Feldman A, Saxon L, Boehmer J, Carson P, Ghali J *et al*.: **Cardiac resynchronization therapy with and without defibrillator improve time to death and hospitalization in NYHA class IV heart failure patients.**

373. Lindner O, Vogt J, Kammeier A, Wielepp P, Holzinger J, Baller D *et al*.: **Effect of cardiac resynchronization therapy on global and regional oxygen consumption and myocardial blood flow in patients with non-ischaemic and ischaemic cardiomyopathy.** *European heart journal* 2005, 26(1)**:** 70-76.
Abstract: AIMS: We studied the effects of cardiac resynchronization therapy (CRT) on global and regional myocardial oxygen consumption (MVO2) and myocardial blood flow (MBF) in non-ischaemic (NICM) and ischaemic dilated cardiomyopathy (ICM). METHODS AND RESULTS: Thirty-one NICM and 11 ICM patients, all of them acute responders, were investigated. MVO2 and MBF were obtained by 11C-acetate PET before and after 4 months of CRT. In NICM global MVO2 and MBF did not change during CRT, while the rate pressure product (RPP) normalized MVO2 increased (P=0.03). Before CRT regional MVO2 and MBF were highest in the lateral wall and lowest in the septum. Under therapy, MVO2 and MBF decreased in the lateral wall (P=0.045) and increased in the septum (P=0.045) resulting in a more uniform distribution. In ICM, global MVO2, MBF, and RPP did not change under CRT. Regional MVO2 and MBF showed no significant changes but a similar tendency in the lateral and septal wall to that in NICM. CONCLUSION: CRT induces changes of MVO2 and MBF on a regional level with a more uniform distribution between the myocardial walls and improved ventricular efficiency in

NICM. Based on the investigated parameters, CRT appears to be more effective in NICM than in ICM

374. Lindner O, Sorensen J, Vogt J, Fricke E, Baller D, Horstkotte D *et al*.: **Cardiac efficiency and oxygen consumption measured with 11C-acetate PET after long-term cardiac resynchronization therapy.** *Journal of nuclear medicine - official publication , Society of Nuclear Medicine* 2006, 47(3)**:** 378-383.
Abstract: Cardiac resynchronization therapy (CRT) is a treatment option in patients with severe heart failure and left bundle-branch block (LBBB). This study evaluated the effects of 4 and 13 mo of CRT on myocardial oxygen consumption (MVO2) and cardiac efficiency as compared with mild heart failure patients without LBBB. METHODS: Sixteen patients with severe heart failure and LBBB due to idiopathic cardiomyopathy were studied at baseline and after 4 and after 13 mo of therapy. Thirteen patients with mild heart failure without LBBB served as a comparison group. The clearance rate (k2) of 11C-acetate was measured with PET to assess MVO2. Stroke volume was derived from the dynamic PET data according to the Stewart-Hamilton principle and, furthermore, cardiac efficiency using the work metabolic index. RESULTS: After 4 mo of CRT, stroke volume index (SVI) increased by 50% (P = 0.012) and cardiac efficiency increased by 41% (P < 0.001). Global k2 remained unchanged but regional k2 demonstrated a more homogeneous distribution pattern. The parameters showed no significant changes during therapy. Under CRT, cardiac efficiency, SVI, and the distribution pattern of regional k2 did not differ from mild heart failure patients without LBBB. CONCLUSION: CRT improves cardiac efficiency for at least 13 mo, as demonstrated by a higher SVI, whereas MVO2 remains unchanged. Cardiac efficiency, SVI, and the MVO2 distribution pattern reach the level of patients with mild heart failure without LBBB. The unfavorable hemodynamic performance in heart failure with LBBB is effectively restored by long-term CRT to the level of an earlier disease state

375. Lopez JA: **Patient selection for cardiac resynchronization therapy: how to identify responders and non-responders.** *Texas Heart Institute journal / from the Texas Heart Institute of St Luke's Episcopal Hospital , Texas Children's Hospital* 2005, 32(2)**:** 207-208.

376. Lucas CMHB, Cleuren GVJ, Kirchhof CJHJ: **Selection of patients for cardiac resynchronisation therapy (CRT) in an unselected heart failure population.** *Netherlands Heart Journal (NETH HEART J)* /20, NETH.
Abstract: AB- Background. In patients with chronic heart failure (CHF), the presence of conduction delay across the myocardium is a well-known feature. During recent years an increasing number of CHF patients have been treated with cardiac resynchronisation therapy (CRT). So far in many protocols patients have been selected using the criteria of left ventricular ejection fraction (LVEF) <=35% concomitant with signs of widening of the QRS on the surface electrocardiogram, either with or without left bundle branch block (LBBB) morphology. Methods. In this article we discuss which of the patients admitted with CHF to a regular cardiology practice could be candidates for this therapy. Data were obtained from January 2000 to December 2004 on a total of 861 CHF patients, of whom 309 had an LVEF <=35%. Of these patients, 123 patients showed a QRS width >120 msec, while 81 patient had a QRS width >140 msec. In total, 89 patients had an LBBB morphology on the electrocardiogram, while 21 patients had univentricular pacing devices in situ. In those patients with an LVEF >35%, QRS width was 108+/-27 msec. Conclusion. A substantial number of patients presenting with CHF in a regular cardiology practice are suitable candidates for CRT therapy according to currently used criteria of QRS width and LVEF. This number could be increased even more if recent information concerning intraventricular conduction delay in CHF patients with less widening of the QRS complex were to be applied, as judged by echocardiographic techniques

377. Luechinger R, Zeijlemaker VA, Pedersen EM, Mortensen P, Falk E, Duru F *et al*.: **In vivo heating of pacemaker leads during magnetic resonance imaging.** *European Heart*

Journal (EUR HEART J) /20, EUR.
Abstract: AB- Aims: Magnetic resonance imaging (MRI) is well established as an important diagnostic tool in medicine. However, the presence of a cardiac pacemaker is usually regarded as a contraindication for MRI due to safety reasons. In this study, heating effects at the myocardium-pacemaker lead tip interface have been investigated in a chronic animal model during MRI at 1.5 Tesla. Methods and results: Pacemaker leads with additional thermocouple wires as temperature sensors were implanted in nine animals. Temperature increases of up to 20degreesC were measured during MRI of the heart. Significant impedance and minor stimulation threshold changes could be seen. However, pathology and histology could not clearly demonstrate heat-induced damage. Conclusions: MRI may produce considerable heating at the lead tip. Changes of pacing parameters due to MRI could be seen in chronic experiments. Potential risk of tissue damage cannot be excluded even though no reproducible alterations at the histological level could be found

378. Luthje L, Drescher T, Zenker D, Vollmann D: **Detection of heart failure decompensation using intrathoracic impedance monitoring by a triple-chamber implantable defibrillator.** *Heart Rhythm (Heart Rhythm)* /20, HEART.

379. Lux RL, Hamdan MH: **Cardiac resynchronization therapy and the arrhythmogenic substrate: Editorial comment.** *Journal of Cardiovascular Electrophysiology (J CARDIOVASC ELECTROPHYSIOL)* /20, J.

380. Lux RL, Hamdan MH: **Cardiac resynchronization therapy and the arrhythmogenic substrate.** *Journal of cardiovascular electrophysiology* 2005, 16(6)**:** 618-619.

381. Macioce R, Cappelli F, Demarchi G, Lilli A, Ricciardi G, Pieragnoli P *et al*.: **Resynchronization of mitral valve annular segments reduces functional mitral regurgitation in cardiac resynchronization therapy.** *Minerva cardioangiologica* 2005, 53(4)**:** 329-333.
Abstract: AIM: Cardiac resynchronization therapy (CRT) reduces the severity of functional mitral regurgitation (FMR) in patients with heart failure and left bundle branch block. Our hypothesis was that the induction of a more synchronous mitral valve anulus contraction can be a mechanism of FMR reduction in CRT patients. METHODS: An echo tissue Doppler imaging (TDI) examination was performed at baseline and 6 months after biventricular pacing system implant in 30 patients (4 females and 26 males, 74.1+/-6.1 years) with dilatative or ischemic chronic heart failure, NYHA class = or >III, ejection fraction (EF) = or <35% and QRS = or >140 ms. EF, Myocardial Performance Index (MPI), left end-diastolic and systolic volumes (LVEDV, LVESV), mitral regurgitation jet area/left atrial area (JA/LAA), effective regurgitant orifice area (EROA), mitral anulus contraction (MAC) were evaluated. Using TDI, at the 6 left ventricle (LV) basal segments the time to the peak myocardial sustained systolic velocity (Ts) and the standard deviation (SD) of TS were evaluated. RESULTS: At 6 months follow-up NYHA class, EF, MPI were significantly improved, LV volumes were reduced. FMR degree, evaluated both as JA/LAA and EROA, was significantly reduced. This effect was associated with the 6 basal segments resynchronization and with a more effective annular contraction. CONCLUSIONS: Our data show that CRT by resynchronizing left ventricular basal segments produces a more effective mitral valve annulus contraction and contributes to FMR improvement. Further studies need to evaluate if this could be taken into account as new therapeutic perspective of functional mitral valve regurgitation

382. Madaric Juraj R, Vanderheyden M, Van LC, Wijns W, Verstreken S, Goethals M *et al*.: **Cardiopulmonary performance, dynamic mitral regurgitation and left ventricular remodeling, early and late after cardiac resynchronization therapy. An exercise echocardiography study.**

383. Madaric Juraj R, Vanderheyden M, Van LC, Wijns W, Goethals M, Verstreken S *et al*.: **Contractile reserve and exercise-induced left ventricular asynchrony predict acute effects of cardiac resynchronization therapy on mitral regurgitation.**

384. Madaric J, Vanderheyden M, Goethals M, Malacky T, Bartunek J: **Pacing-induced mitral regurgitation treated by cardiac resynchronisation therapy. Evaluation by exercise echocardiography.** *Kardiologia (Kardiologia)* /20, KARDIOLOGIA.
Abstract: AB- In patients with functional mitral regurgitation and left ventricular dysfunction, exercise-induced mitral regurgitation can identify patients at high risk of poor clinical outcome. Cardiac resynchronisation therapy is associated with improvement in mitral regurgitation, exercise tolerance and left ventricular function, leading to improved survival in patients with congestive heart failure and cardiac dyssynchrony. However, the effects of cardiac resynchronisation therapy on dynamic mitral regurgitation in relation to resynchronisation and left ventricular remodelling are not known. The authors refer to the case of a 63 year-old woman with mitral regurgitation induced by right ventricular apical pacing, successfully treated by cardiac resynchronisation therapy. Described are the effects of cardiac resynchronisation therapy on left ventricular synchrony and dynamic mitral regurgitation assessed by exercise echocardiography including tissue Doppler imaging, three days and one year after cardiac resynchronisation therapy. The cardiac resynchronisation therapy was associated with acute improvement in right ventricular apical pacing induced mitral regurgitation at rest, but did not attenuate exercise-induced mitral regurgitation soon after cardiac resynchronisation therapy. In contrast, the long-term effect of cardiac resynchronisation therapy resulted in the left ventricular reverse remodelling preventing both the recurrence of left ventricular dyssynchrony during exercise, as well as exercise-induced mitral regurgitation. Reduction of dynamic mitral regurgitation could represent a mechanism contributing to beneficial effects of cardiac resynchronisation therapy on clinical outcomes of patients with congestive heart failure

385. Madias JE: **The impact of changing oedematous states on the QRS duration: implications for cardiac resynchronization therapy and implantable cardioverter/defibrillator implantation.** *Europace - European pacing, arrhythmias , and cardiac electrophysiology - journal of the working groups on cardiac pacing, arrhythmias , and cardiac cellular electrophysiology of the European Society of Cardiology* 2005, 7(2)**:** 158-164.
Abstract: Increased ECG QRS duration (QRSd) in patients with dilated cardiomyopathy (DCM) or heart failure (HF) is a well-known phenomenon. The QRSd is not a static ECG measurement but shows fluctuations, and its recent inclusion among the parameters used in referring patients for implantable cardioverter/defibrillators (ICDs) or cardiac resynchronization therapy (CRT) has led to renewed interest in its natural course and its determinants. Although clinical deterioration has been traditionally associated with increasing QRSd, its changes often are left unexplained. Also, the recent description of a decrease in QRSd, well correlated with attenuated amplitude of QRS complexes in patients with peripheral oedema (PERO) in the context of a variety of illnesses, has added complexity to the matter. This communication aims at calling attention to the importance of a few clinical and ECG parameters when documenting changes in the QRSd in serial ECGs. Thus, presence or absence of PERO and change in the patients' weight, along with alteration in the amplitude of QRS complexes and shifts to/from incomplete/complete bundle branch block patterns, all should be considered when assessing changes in QRSd for meaningful follow-up of patients with DCM or CHF, or referral for ICD or CRT. Evaluation of the QRSd as a selection parameter for referring patients suitable for device implantation should continue along with the employment of mechanical analysis of ventricular dyssynchrony. Although reference here is made to QRSd particularly in connection with DCM and HF, the above apply to other oedematous states (i.e. patients with chronic renal failure, or those undergoing haemodialysis)

386. Madias JE, Macfarlane PW: **Artificial attenuation of ECG voltage produces shortening of the corresponding QRS duration: clinical implications for patients with edema.** *Pacing and clinical electrophysiology - PACE* 2005, 28(10)**:** 1060-1065.
Abstract: BACKGROUND: Prolonged QRS duration (QRSd) is a useful index for the management of patients with congestive heart failure (CHF). QRSd is affected by changes in the ECG voltage (ECGV) in the context of development and amelioration of peripheral edema (PERE), independent of underlying pathology. Nowadays, physicians accept QRSd measured by computer techniques. The latter offers the possibility of testing the hypothesis that artificial alteration of the ECGV, simulating effects of PERE, could lead to changes in the QRSd. METHODS: To this end, voltage was attenuated by 25%, 50%, and 75% in 100 digital ECGs recorded from normal subjects and in 20 patients with complete left bundle branch block (LBBB), by merely increasing the calibration strength by 4/3, 2, and 4, respectively, and by using the same data. RESULTS: All ECGs were analyzed by the same computer program and this led to a reduction of global QRSd by 2.3 +/- 2.9%, 5.7 +/- 4.0%, and 11.9 +/- 6.2%, respectively, in the normal subjects, and 1.6 +/- 1.4%, 3.4 +/- 1.7%, and 8.2 +/- 3.6%, respectively, in the patients with LBBB. Correlation of the percent change in the global QRSd and the percent change in ECGV was good with an r = 0.65, and P = 0.00005 in the normal subjects, and an r = 0.74 and P = 0.00005 in the patients with LBBB. CONCLUSIONS: Apparent shortening in QRSd as a function of ECGV attenuation due to PERE could have implications in the follow-up of patients with CHF, and their selection for implantable cardioverter/defibrillators, or cardiac resynchronization therapy

387. Mair H, Sachweh J, Meuris B, Nollert G, Schmoeckel M, Schuetz A *et al*.: **Surgical epicardial left ventricular lead versus coronary sinus lead placement in biventricular pacing.** *European journal of cardio-thoracic surgery - official journal of the European Association for Cardio-thoracic Surgery* 2005, 27(2)**:** 235-242.
Abstract: OBJECTIVE: Biventricular pacing has demonstrated improvement in cardiac function in treating congestive heart failure (CHF). Two different operative strategies (coronary sinus vs. epicardial stimulation) for left ventricular (LV) pacing were compared. METHODS: Since April 1999, a total of 86 patients (pts, age: 63+/-10 years) with depressed systolic LV function (mean ejection fraction 24+/-9%), left bundle-branch-block (mean QRS 182+/-22 ms) and congestive heart failure NYHA III or higher were enrolled. For biventricular stimulation coronary sinus (CS) leads were placed in 79 pts. Nine of these devices were converted to surgical epicardial LV-leads, because of CS-lead failure. In 7 patients epicardial LV-leads were initially implanted surgically, accounting for a total of 16 pts with surgical placed epicardial steroid-eluting LV-leads. For these, a limited left-lateral thoracotomy (7+/-4 cm) was used. Thirty-three (38%) pts had an indication for a defibrillator. The mean follow-up time was 16.4+/-15.4 months (0.1-45 months), representing 107.1 patient-years. RESULTS: In the biventricular pacing mode, QRS duration decreased to 143+/-16 ms (P<0.001). Threshold capture of the CS-leads increased significantly compared to surgically placed epicardial leads (18 month control: 2.2+/-1.4V/0.5 ms vs. 0.7+/-0.3V/0.5 ms), which had no increase in threshold (P<0.001). At the 18 month follow-up 7 CS-leads had a threshold of >4V/0.5 ms vs. epicardial leads which were under 1.1V/0.5 ms, except for one (1.8V/0.5 ms). After CS-lead implantation 25 LV-lead related complications occurred, (failed implantation, CS-dissection, loss of pacing capture, diaphragm stimulation or lead dislodgment), vs. one dislodgement after surgical epicardial lead placement (P<0.05). Correct lead positioning (obtuse marginal branch area) was achieved in all surgical epicardial placements but only in 70% with CS-leads (P<0.03). In the follow up period, 9 pts died (4 cardiac related). Heart transplantation was necessary in 4 pts due to deterioration of the cardiomyopathy. CONCLUSIONS: Surgical epicardial lead placement revealed excellent long-term results and a lower LV-related complication rate compared to CS-leads. Although, the approach via limited thoracotomy for biventricular pacing is associated with 'more surgery', it is a safe and reliable technique and should be considered as an equal alternative

388. Manfredi Joseph R, Holt J, Gurley JC: **Pseudo-stenosis of the coronary sinus: Recognizing normal contractility during cardiac resynchronization therapy.**

389. Mangiavacchi M, Gasparini M, Faletra F, Klersy C, Morenghi E, Galimberti P *et al.*: **Clinical predictors of marked improvement in left ventricular performance after cardiac resynchronization therapy in patients with chronic heart failure.** *American heart journal* 2006, 151(2)**:** 477.
Abstract: BACKGROUND: Previous studies have shown that cardiac resynchronization therapy (CRT) improves cardiac performance and decreases mortality and hospital admission rates. However, it is not yet clear which patients will benefit from the procedure the most. The purpose of the study was to identify the pre-implant characteristics that better predict which patients will have the best outcome after CRT. METHODS: In this observational study, 156 patients were studied with echocardiography and a 6-minute walking test at baseline and 12 months after CRT. RESULTS: After CRT, we observed an increase in left ventricular ejection fraction (+29.6%, P < .0001), a decrease in left ventricular end systolic volume (-26.4%, P < .0001), in the proportion of patients with grade 2-4 mitral regurgitation (from 47.1% to 34.0%, P = .002), and with NYHA functional class III-IV (from 83.2% to 11.6%, P < .0001), an increase in exercise tolerance (+31.1%, P < .0001). Sixty-two patients had a marked increase in left ventricular ejection fraction (> 10 units); the only independent predictor of a marked effect of CRT was the nonischemic etiology of heart failure. In patients with ischemic cardiomyopathy, the benefit on ejection fraction correlates inversely with the extension of the ischemic damage. CONCLUSIONS: CRT improves left ventricular function and exercise tolerance in the long term. The nonischemic etiology of the cardiomyopathy is the only independent predictor of a marked effect of CRT; this is probably due to the absence of ischemic, nonviable scar tissue in these patients

390. Mannaerts H: **Regression of left ventricular mass and wall thickness after cardiac resynchronization therapy: proof of pathophysiological concept.** *European heart journal* 2006, 27(12)**:** 1392-1393.

391. Marcus F, I, He DS: **Optimization method for cardiac resynchronization therapy.**
Abstract: The patterns of contraction and relaxation of the heart before and during left ventricular or biventricular pacing are analyzed and displayed in real time mode to assist physicians to screen patients for cardiac resynchronization therapy, to set the optimal A-V or right ventricle to left ventricle interval delay, and to select the site(s) of pacing that result in optimal cardiac performance. The system includes an accelerometer sensor; a programmable pace maker, a computer data analysis module, and may also include a 2D and 3D visual graphic display of analytic results, i.e. a Ventricular Contraction Map. A feedback network provides direction for optimal pacing leads placement. The method includes selecting a location to place the leads of a cardiac pacing device, collecting seismocardiographic (SCG) data corresponding to heart motion during paced beats of a patient's heart, determining hemodynamic and electrophysiological parameters based on the SCG data, repeating the preceding steps for another lead placement location, and selecting a lead placement location that provides the best cardiac performance by comparing the calculated hemodynamic and electrophysiological parameters for each different lead placement location

392. Marcus GM, Rose E, Viloria EM, Schafer J, De MT, Saxon LA *et al.*: **Septal to posterior wall motion delay fails to predict reverse remodeling or clinical improvement in patients undergoing cardiac resynchronization therapy.** *Journal of the American College of Cardiology* 2005, 46(12)**:** 2208-2214.
Abstract: OBJECTIVES: The aim of this study was to test the hypothesis that a longer septal-to-posterior wall motion delay (SPWMD) would predict greater reverse remodeling and an improved clinical response in heart failure patients randomized to cardiac resynchronization therapy (CRT) in the CONTAK-CD trial. BACKGROUND: The

SPWMD predicted clinical benefit with CRT in two previous studies from the same center. METHODS: In this retrospective analysis of the CONTAK-CD trial, SPWMD was measured from the baseline echocardiogram of 79 heart failure patients (ejection fraction 22 +/- 7%, QRS duration 159 +/- 27 ms, 72% ischemic, 84% male) randomized to CRT and compared with six-month changes in echocardiographic and clinical parameters. Patients with a left ventricular end-systolic volume index (LVESVI) reduction of at least 15% were considered responders. RESULTS: The feasibility and reproducibility of performing the SPWMD measurements were poor. Larger values for SPWMD did not correlate with six-month changes in left ventricular end-diastolic volume index ($p = 0.26$), LVESVI ($p = 0.41$), or left ventricular ejection fraction ($p = 0.36$). Responders did not have a significantly different SPWMD than non-responders ($p = 0.26$). The SPWMD did not correlate with measures of clinical improvement. At a threshold of SPWMD >130 ms, the test characteristics to predict reverse remodeling or a clinical response were inadequate. CONCLUSIONS: The previous findings that SPWMD predicts reverse remodeling or clinical improvement with CRT were not reproducible in patients randomized in the CONTAK-CD trial

393. Mariani JA, Gould PA, Broughton A, Kaye DM: **Cardiac resynchronisation therapy for heart failure.** *Internal medicine journal* 2006, 36(2)**:** 114-123.
Abstract: Heart failure (HF) is increasingly common and, despite advances in pharmacotherapeutic management, often progresses. Progression is marked by structural and electrical changes-remodelling. In approximately one-third of patients, ventricular dilatation is accompanied by intraventricular conduction delays, most commonly the left bundle branch block (LBBB). The presence of LBBB is associated with mechanical dyssynchrony of the heart. Cardiac resynchronisation therapy (CRT), the use of special pacemakers with or without implantable cardioverter defibrillators, aims to resynchronise the failing heart, improving myocardial contraction without increased energetics. Several, large, randomised clinical trials have now established the benefit of CRT in a select group of HF patients, providing functional and, recently shown, mortality benefits. However, a substantial proportion of patients are considered non-responders to CRT, and studies are now underway to identify the patients most likely to respond to CRT

394. Markowitz SM: **Cardiac arrhythmias.**

395. Marquis MD, I: **Multicenter, prospective, randomized safety and efficacy study of a new atrial-based managed ventricular pacing mode (MVP) in dual chamber ICDs.**
Abstract: Background: Ventricular desynchronization caused by right ventricular pacing may impair ventricular function and increase risk of heart failure (CHF), atrial fibrillation (AF), and death. Conventional DDD/R mode often results in high cumulative percentage ventricular pacing (Cum% VP). We hypothesized that a new managed ventricular pacing mode (MVP) would safely provide AAI/R pacing with ventricular monitoring and DDD/R during AV block (AVB) and reduce Cum% VP compared to DDD/R.Methods: MVP RAMware was downloaded in 181 patients with Marquis DR ICDs. Patients were initially randomized to either MVP or DDD/R for 1 month, then crossed over to the opposite mode for 1 month. ICD diagnostics were analyzed for cumulative percentage atrial pacing (Cum% AP), Cum% VP, and duration of DDD/R pacing for spontaneous AVB.Results: Baseline characteristics included age 66 +/- 12 years, EF 36 +/- 14%, and NYHA Class II-III 36%. Baseline PR interval was 190 +/- 53 msec and programmed AV intervals (DDD/R) were 216 +/- 50 (paced)/189 +/- 53 (sensed) msec. Mean Cum% VP was significantly lower in MVP versus DDD/R (4.1 +/- 16.3 vs 73.8 +/- 32.5, $P < 0.0001$). The median absolute and relative reductions in Cum% VP during MVP were 85.0 and 99.9, respectively. Mean Cum% AP was not different between MVP versus DDD/R (48.7 +/- 38.5 vs 47.3 +/- 38.4, $P = 0.83$). During MVP overall time spent in AAI/R was 89.6% (intrinsic conduction), DDD/R 6.7% (intermittent AVB), and DDI/R 3.7% (AF). No adverse events were attributed to MVP.Conclusions: MVP safely achieves functional atrial pacing by limiting ventricular pacing to periods of intermittent AVB and AF in ICD

patients, significantly reducing Cum% VP compared to DDD/R. MVP is a universal pacing mode that adapts to AVB and AF, providing both atrial pacing and ventricular pacing support when needed

396. Matsuda N: **[Implantable cardioverter-defibrillator in patients with chronic heart failure].** *Nippon rinsho Japanese journal of clinical medicine* 2006, 64(5)**:** 949-954.
Abstract: Sudden cardiac death (SCD) is a major cause of death in patients with chronic heart failure. The implantable cardioverter-defibrillator (ICD) effectively treats malignant ventricular tachyarrhythmias and reduces significantly the total mortality as well as the incidence of SCD in heart failure patients. It is evident that ICD is indicated for the secondary prevention of SCD. There is growing evidence for the use of the ICD for the primary prevention of SCD in patients with LV systolic dysfunction without documented arrhythmia. However, the efficacy of ICD seems to be modest in patients with advanced heart failure. Individualized combined therapies such as ICD plus amiodarone and ICD plus cardiac resynchronization therapy are necessary for advanced heart failure patients. It is doubtful whether ICD is indicated for MADIT II and SCD -HeFT population in Japan, where the incidence of SCD is thought to be lower than the Western countries

397. Matsushita K, Ishikawa T, Sumita S, Kobayashi T, Ogawa H, Inoue N *et al.*: **[Improvement of central sleep disordered breathing with severe congestive heart failure by biventricular pacing therapy: a case report].** *Journal of cardiology* 2006, 47(1)**:** 25-30.
Abstract: A 74-year-old man with ischemic cardiomyopathy was repeatedly admitted for congestive heart failure. His left ventricular ejection fraction was 21% and diastolic left ventricular dimension was 73.5mm by echocardiography. He was treated with biventricular pacing and heart failure improved from New York Heart Association class III to II. Before the treatment, brain natriuretic peptide was 600.5 pg/ml. Apnea hypopnea index was 23.8 and all events were central type. After biventricular pacing, apnea hypopnea index was improved to 21.9 after 11 days, 14.0 after 33 days, and 4.8 after 48 days. His left ventricular ejection fraction was 36%, diastolic left ventricular dimension was 71.4mm, and brain natriuretic peptide was 383.8 pg/ml. In this patient, central sleep disordered breathing was improved by biventricular pacing therapy after only 48 days

398. McAlister FA, Ezekowitz JA, Wiebe N, Rowe B, Spooner C, Crumley E: **Erratum: Systematic review: Cardiac resynchronization in patients with symptomatic heart failure (Annals of Internal Medicine (2004) 141 (381-390)).** *Annals of Internal Medicine (ANN INTERN MED)* /20, ANN.

399. McAlister FA, Tu J, V, Newman A, Lee DS, Kimber S, Cujec B *et al.*: **How many patients with heart failure are eligible for cardiac resynchronization? Insights from two prospective cohorts.** *European heart journal* 2006, 27(3)**:** 323-329.
Abstract: AIMS: To determine what proportion of patients with heart failure are eligible for cardiac resynchronization therapy (CRT). METHODS AND RESULTS: Eligibility criteria from the trials establishing the efficacy of CRT were applied to two prospective cohorts: the first enrolled patients with newly diagnosed heart failure discharged from 103 hospitals between April 1999 and March 2001 ('the hospital discharge cohort'); the second enrolled patients seen in a specialized clinic between August 2003 and January 2004 ('the specialty clinic cohort'). In the hospital discharge cohort, 73 patients (3% of the 2640 patients with ischaemic or dilated cardiomyopathy and 1% of all 9096 patients with heart failure discharged alive) met trial eligibility criteria: LVEF< or =0.35, QRS > or =120 ms, sinus rhythm, and NYHA class III or IV symptoms despite the treatment with ACE-inhibitor/angiotensin receptor blocker and beta-blocker. In the specialty clinic cohort, 54 patients (21% of the 263 patients with ischaemic or dilated cardiomyopathy and 17% of all 309 patients with heart failure) met these criteria. If persistent symptoms despite taking spironolactone were required for CRT eligibility, then the proportions qualifying dropped

to 1% in the hospital discharge cohort and 18% in the specialty clinic cohort. CONCLUSION: Few heart failure patients meet trial eligibility criteria for CRT

400. McMurray JJ, V, Pfeffer MA: **Heart failure.** *Lancet* /5/28, 365(9474)**:** 1877-1889.
Abstract: Although heart failure is common, disabling, and deadly, there are now many effective treatments, at least for patients with low left-ventricular ejection fraction. For all, angiotensin-converting-enzyme inhibitors and beta blockers are the essential disease-modifying treatments, improving symptoms, reducing hospital admissions, and increasing survival. Implantable cardioverter defibrillators also improve survival. For patients with persistent symptoms, angiotensin-receptor blockers and aldosterone antagonists have additional benefits. These treatments are now preferred to digoxin, although this drug can still be useful at an earlier stage in patients with atrial fibrillation. In some patients with persistently severe symptoms and a wide QRS on the electrocardiogram, cardiac resynchronisation therapy also reduces mortality and morbidity. The role of other markers of ventricular dys-synchrony is under investigation. There is growing evidence that left-ventricular assist devices are indicated in some patients with end-stage heart failure. Organised delivery of care also improves outcome. However, there is still no firmly evidence-based treatment for heart failure with preserved ejection fraction. Many new pharmacological, device, and surgical treatments for heart failure are currently under evaluation in clinical trials, and other approaches, including stem-cell treatment, are at an earlier stage of investigation

401. McSwain RL, Schwartz RA, Delurgio DB, Mera F, V, Langberg JJ, Leon AR: **The impact of cardiac resynchronization therapy on ventricular tachycardia/fibrillation: an analysis from the combined Contak-CD and InSync-ICD studies.** *Journal of cardiovascular electrophysiology* 2005, 16(11)**:** 1168-1171.
Abstract: OBJECTIVES: To determine the potential influence of cardiac resynchronization therapy (CRT) on the frequency and types of ventricular arrhythmia (VA) in patients with an indication for the implantable cardioverter-defibrillator (ICD), we performed a retrospective electrogram (EGM) analysis of stored VA events from the two largest CRT-ICD trials. BACKGROUND: Previous reports suggest that CRT might promote polymorphic VT (PVT), while a beneficial effect of CRT on ventricular function might reduce the frequency of monomorphic VT (MVT). Theoretically, a balanced effect produces no change in overall VA. METHODS: We analyzed stored EGMs from patients in the Contak-CD and Insync-ICD studies receiving appropriate therapy for VA. EGM inspection distinguishes MVT and PVT using morphologic criteria rather than cycle length classification alone. RESULTS: Of 1,041 subjects entering the two trials, 880 were randomized CRT (N = 439) or control (N = 441). We were able to analyze 840 EGMs in 150 patients with VA, including 678 MVT episodes and 162 PVT episodes. These events were distributed among 68 patients with active CRT (390 MVT vs 111 PVT) and 82 patients assigned to control (288 MVT compared to 51 PVT). The apparent increase in PVT episodes in the CRT group is not significant and can be explained by a disproportionate number of episodes in a few patients. We were unable to identify clinical variables predictive of PVT during CRT. CONCLUSIONS: CRT is not associated with a measurable increase in the incidence of PVT, or in a reduction in MVT in the combined InSync-ICD and Contak-CD populations

402. Meade TH, Lopez JA: **Balloon occlusion technique to cannulate angulated and tortuous coronary sinus branches in cardiac resynchronization therapy.** *Pacing and clinical electrophysiology - PACE* 2005, 28(11)**:** 1243-1244.
Abstract: We present two cases that demonstrate a new technique to cannulate angulated and tortuous coronary sinus branches during left ventricular lead placement for cardiac resynchronization therapy. The technique uses an occlusive pulmonary artery balloon just beyond the takeoff of the coronary sinus branch to assist in the cannulation of the branch

403. Mele D, Pasanisi G, Capasso F, De SA, Morales M, Poggio D *et al*.: **Left intraventricular myocardial deformation dyssynchrony identifies responders to cardiac resynchronization therapy in patients with heart failure.** *European heart journal* 2006, 27(9)**:** 1070-1078.
Abstract: AIMS: We tested the hypothesis that dyssynchrony of left ventricular (LV) myocardial deformation evaluated by ultrasound can predict success of cardiac resynchronization therapy (CRT) in patients with heart failure (HF). METHODS AND RESULTS: Thirty-seven patients with dilated cardiomyopathy, New York Heart Association class III-IV, LV ejection fraction (EF) < or =35%, QRS > 120 ms were studied before, at pre-discharge, and after 3 and 6 months of CRT. The M-mode peak septal-to-posterior wall motion and thickening delay (SPWMD and SPWTD, ms) and the standard deviation of the averaged time-to-peak strain (TPS-SD, ms) of 12 middle and basal LV segments obtained from the three standard apical views were calculated. Responders were defined at month 6 by > or =20% EF increase and/or > or =15% end-systolic volume (ESV) decrease with respect to baseline. Baseline SPWTD (not SPWMD) and TPS-SD differentiated responders from non-responders with good accuracy and reproducibility. A value > or =194 ms for SPWTD and > or =60 ms for TPS-SD was significantly associated with responder identification. Baseline dyssynchrony parameters correlated significantly with EF (r = 0.53 for SPWTD and r = 0.86 for TPS-SD) and ESV variations (r = -0.42 for SPWTD and r = -0.73 for TPS-SD). CONCLUSION: Patients with chronic HF should undergo ultrasound evaluation to quantify dyssynchrony of LV myocardial deformation, which would help identifying CRT responders

404. Melenovsky V, Hay I, Fetics BJ, Borlaug BA, Kramer A, Pastore JM *et al*.: **Functional impact of rate irregularity in patients with heart failure and atrial fibrillation receiving cardiac resynchronization therapy.** *European heart journal* 2005, 26(7)**:** 705-711.
Abstract: AIMS: Atrial fibrillation (AFib) with a rapid ventricular response may adversely impact cardiac performance, especially in patients with heart failure. However, it remains uncertain whether rhythm irregularity per se has unfavourable effects apart from tachycardia, and whether rate regularization alone can improve heart function. METHODS AND RESULTS: Nine subjects with chronic AFib, atrioventricular nodal block, and symptomatic heart failure (ejection fraction 14-30%) were studied using a pressure-volume catheter. Ventricles were biventricularly paced (RV-apex, LV-lateral wall) at 80 or 120 min(-1) mean rate, using regular or irregular, Poisson-distributed stimulation. At 80 min(-1), ventricular function was similar between the two pacing modes. However, at 120 min(-1), irregular pacing impaired systolic (dP/dt(max): -8.2%, P<0.001) and diastolic function (dP/dt(min): +21%, P<0.001, LV end-diastolic pressure: +26%, P=0.007) compared with regular rate pacing. Contractile function during irregular pacing varied with the ratio of preceding/pre-preceding intercycle (RR) interval (dP/dt(max): 80 b.p.m.: r=0.69; 120 b.p.m.: r=0.74), whereas pre-load had little effect on instantaneous contractility. CONCLUSION: In heart failure subjects with AFib, RR-interval irregularity worsens cardiac function at elevated but not at normal range heart rate. Overall rate control is most important in these patients while rate regularization of rapid AFib may impart additional benefits

405. Melzer C, Knebel F, Ismer B, Bondke H, Nienaber CA, Baumann G *et al*.: **Influence of the atrio-ventricular delay optimization on the intra left ventricular delay in Cardiac Resynchronization Therapy.** *Cardiovascular ultrasound electronic resource* 2006, 4 5.
Abstract: BACKGROUND : Cardiac Resynchronization Therapy (CRT) leads to a reduction of left-ventricular dyssynchrony and an acute and sustained hemodynamic improvement in patients with chronic heart failure. Furthermore, an optimized AV-delay leads to an improved myocardial performance in pacemaker patients. The focus of this study is to investigate the acute effect of an optimized AV-delay on parameters of dyssynchrony in CRT patients. METHOD: 11 chronic heart failure patients with CRT who were on stable medication were included in this study. The optimal AV-delay was defined

according to the method of Ismer (mitral inflow and trans-oesophageal lead). Dyssynchrony was assessed echocardiographically at three different settings: AVDOPT; AVDOPT-50 ms and AVDOPT+50 ms. Echocardiographic assessment included 2D- and M-mode echo for the assessment of volumes and hemodynamic parameters (CI, SV) and LVEF and tissue Doppler echo (strain, strain rate, Tissue Synchronisation Imaging (TSI) and myocardial velocities in the basal segments) RESULTS: The AVDOPT in the VDD mode (atrially triggered) was 105.5 +/- 38.1 ms and the AVDOPT in the DDD mode (atrially paced) was 186.9 +/- 52.9 ms. Intra-individually, the highest LVEF was measured at AVDOPT. The LVEF at AVDOPT was significantly higher than in the AVDOPT-50 setting (p = 0.03). However, none of the parameters of dyssynchrony changed significantly in the three settings. CONCLUSION: An optimized AV delay in CRT patients acutely leads to an improved systolic left ventricular ejection fraction without improving dyssynchrony

406. Mensah O-W, Friedl A, Jepsen M, Auricchio A, Klein H, Huth C: **Erratum: Replacement of a severe chronic post-traumatic aneurysm of the ascending aorta with aortic valve conduit - Reconstruction of the anterior mitral valve ring and implantation of A-V sequential/biventricular pacemaker (Thoracic and Cardiovascular Surgeon (2005) 53 (223-225)) 325.** *Thoracic and Cardiovascular Surgeon (THORAC CARDIOVASC SURG)* /20, THORAC.

407. Mensah O-W, Friedl A, Jepsen M, Auricchio A, Klein H, Huth C: **Replacement of a severe chronic post-traumatic aneurysm of the ascending aorta with aortic valve conduit--reconstruction of the anterior mitral valve ring and implantation of A-V sequential/biventricular pacemaker.** *Thoracic and cardiovascular surgeon* 2005, 53(4)**:** 223-225.
Abstract: We present the case of a 23-year-old African professional footballer who was admitted on April 1, 1999 to the Cardiology Department of the University Hospital in Magdeburg, on an emergency basis, from a regional lung clinic. According to the history, he was involved in a collision with an opposing player during a football match in his country (in Africa). He lost consciousness for a short time, but continued playing to the end of the match. About two months later he was invited by a German football club for a check-up, with the view to ultimately playing for the club. The team did not find him physically fit enough to play professional football, so he decided to go to Paris by bus on March 31, 1999. During the journey he suddenly became cardio-pulmonary decompensated and had to undergo cardio-pulmonary resuscitation (CPR). He was intubated and placed on a respirator and immediately transferred to a nearby lung clinic. From the lung clinic he was transferred to the Intensive Care Unit of the Cardiology Department of the Magdeburg University Hospital, on April 1, 1999 as an emergency case. He was intensively treated with catecholamines, intravenous ACE inhibitors and diuretics. His clinical condition did not improve appreciably. His chest X-ray showed extreme dilatation of the right and left heart as well as extreme pulmonary congestion

408. Merchant K, Laborde A: **Implementing a cardiac resynchronization therapy program in a county hospital.** *Journal of nursing administration* 2005, 35(9)**:** 404-409.
Abstract: Clinical trials and research literature show the benefits of cardiac resynchronization therapy and implantable cardioverter defibrillator devices in improving the quality of life for selected patients with heart failure. While translating these positive research results into clinical practice is a major effort requiring a strategic planning process, implementing these practices in-house may result in cost savings and possible increased revenue. The authors describe the planning and implementation process used to introduce these therapies in a cardiac catheterization laboratory at a county teaching hospital

409. Merkely Bela R: **Treatment with pacemaker and implantable cardioverter defibrillators-new results.**

Abstract: Device-based antiarrhythmic therapy is one of the most dinamically evolving branches of the medicine. Brady- and tachyarrhythmias can be treated efficiently and cost-effective with current pacemakers and ICDs. Beside conventional indications new indications have appeared in the last years: resynchronization treatment of severe congestive heart failure with biventricular pacing, primary prevention of sudden cardiac death with ICD, reduction of intraventricular gradient in hypertrophic obstructive cardiomyopathy. Several large clinical studies have investigated the efficacy of treatment in conventional indications, so the role of pacemaker therapy in carotid sinus hyperaesthesia or sinus node disease has been elucidated. Newer studies are trying to clarify the type or programming of the pacemaker in a given indication: physiological pacemakers have a more beneficial effect on the quality of life and decrease the incidence of atrial fibrillation. The implanted devices have frequency adaptation with new sensors, and they are even able to detect heart failure in an early phase. In the near future the number of pacemaker and ICD implantations will grow exponentially based on current trend. This will be due to the aging population, the simplification and increasing safety of implantation, and the widening of the indications for antiarrhythmic device implantation

410. Merkely B: **[Latest results of treatment with pacemaker and implantable cardioverter defibrillators]**
<Original> Pacemaker es implantalhato cardioverter defibrillator kezeles legujabb eredmenyei. *Orvosi hetilap* 2005, 146(20 Suppl 2)**:** 1088-1098.
Abstract: Device-based anti-arrhythmic therapy is one of the most dynamically evolving branches of the medicine. Brady- and tachyarrhythmias can be treated efficiently and cost-effective with current pacemakers and ICDs. Beside conventional indications new indications have appeared in the last years: resynchronization treatment of severe congestive heart failure with biventricular pacing, primary prevention of sudden cardiac death with ICD, reduction of intraventricular gradient in hypertrophic obstructive cardiomyopathy. Several large clinical studies have investigated the efficacy of treatment in conventional indications, so the role of pacemaker therapy in carotid sinus hyperaesthesia or sinus node disease has been elucidated. Newer studies are trying to clarify the type or programming of the pacemaker in a given indication: physiological pacemakers have a more beneficial effect on the quality of life and decrease the incidence of atrial fibrillation. The implanted devices have frequency adaptation with new sensors, and they are even able to detect heart failure in an early phase. In the near future the number of pacemaker and ICD implantations will grow exponentially based on current trend. This will be due to the aging population, the simplification and increasing safety of implantation, and the widening of the indications for antiarrhythmic device implantation

411. Michalkiewicz D, Hendzel P, Gryszko L, Jacewicz K, Olszewski R, Dziuk M *et al*.: **[Cardiac resynchronisation therapy with the use of epicardial lead placement--a case report]**
<Original> Kombinowana terapia resynchronizujaca w leczeniu niewydolnosci serca alternatywa czy metoda z wyboru? *Kardiologia polska* 2005, 62(5)**:** 500-503.

412. Michelucci A, Padeletti L, Giaccardi M, Abbate R: **[Natriuretic peptides and cardiac resynchronization therapy]**
<Original> Peptidi natriuretici e terapia di resincronizzazione elettrica cardiaca. *Giornale italiano di cardiologia (2006)* 2006, 7(4)**:** 296-298.

413. Mickelsen SR, Ashikaga H, DeSilva R, Raval AN, McVeigh E, Kusumoto F: **Transvenous access to the pericardial space: an approach to epicardial lead implantation for cardiac resynchronization therapy.** *Pacing and clinical electrophysiology - PACE* 2005, 28(10)**:** 1018-1024.
Abstract: BACKGROUND: Percutaneous access to the pericardial space (PS) may be useful for a number of therapeutic modalities including implantation of epicardial pacing leads. We have developed a catheter-based transvenous method to access the PS for

implanting chronic medical devices. METHODS: In eight pigs, a transseptal Mullins sheath and Brockenbrough needle were introduced into the right atrium (RA) from the jugular vein under fluoroscopic guidance. The PS was entered through a controlled puncture of the terminal anterior superior vena cava (SVC) (n = 7) or right atrial appendage (n = 1). A guidewire was advanced through the transseptal sheath, which was then removed leaving the wire in PS. The guidewire was used to direct both passive and active fixation pacing leads into the PS. Pacing was attempted and lead position was confirmed by cine fluoroscopy. Animals were sacrificed acutely and at 2 and 6 weeks. RESULTS: All animals survived the procedure. Pericardial effusion (PE) during the procedure was hemodynamically significant in four of the eight animals. At necropsy, lead exit sites appeared to heal without complication at 2 and 6 weeks. Volume of pericardial fluid was 10.8 +/- 6.2 mL and appeared normal in four of the six chronic animals. Moderate fibrinous deposition was observed in two animals, which had exhibited significant over-procedural PE. CONCLUSIONS: Access to the PS via a transvenous approach is feasible. Pacing leads can be negotiated into this region. The puncture site heals with the lead in place. Further development should focus on eliminating PE and performing this technique in appropriate heart failure models

414. Middlekauff HR: **How does cardiac resynchronization therapy improve exercise capacity in chronic heart failure?** *Journal of cardiac failure* 2005, 11(7)**:** 534-541.
Abstract: BACKGROUND: Studies have shown that neither ejection fraction nor hemodynamic abnormalities during exercise in chronic heart failure (HF) correlate with symptoms of fatigue and exhaustion. The concept that exercise limitation in patients with chronic HF is due to abnormal hemodynamics during exercise has been revised to acknowledge that the skeletal myopathy of chronic HF contributes significantly to exercise dysfunction in heart failure. Why then does cardiac resynchronization therapy (CRT), a therapy that improves abnormalities of cardiac function, such as cardiac output and ejection fraction, produce a consistent, measurable, irrefutable increase in exercise capacity? METHODS AND RESULTS: In this review I will (1) review the mechanisms of exercise dysfunction in chronic HF, with special attention to the concept of "coordinated adaptation"; (2) analyze the effects of CRT on autonomic dysfunction in HF; and (3) propose a unifying hypothesis to understand how a therapy that improves cardiac function can improve exercise dysfunction attributable to a skeletal myopathy. Specifically, I will review evidence that CRT improves exercise capacity by attenuating the chronic sympathetic activation of HF. CONCLUSION: The decrease in sympathetic activation, and perhaps inflammation, during CRT likely reverses many features of the skeletal myopathy, leading to improved exercise capacity

415. Min M, Kink A, Parve T: **Rate adaptive pacemaker using impedance measurements and stroke volume calculations.**
Abstract: A rate adaptive pacemaker comprises a means (2) for determining the demand of the patient's organism, a pacing rate controlling means (16) for controlling the pacing rate in response to the patient's demand, and a pacing rate limiting means (20) for preventing the pacing rate from becoming too low. The pacing rate limiting means is adapted to limit the pacing rate downwards such that a first predetermined relation is satisfied between actual cardiac output (CO) and cardiac output (COrest) for the patient in rest conditions and a second predetermined relation is satisfied between actual stroke volume (SV) and rest stroke volume (SVrest)

416. MIRACLE Study Program: **Safety of transvenous cardiac resynchronization system implantation in patients with chronic heart failure - Combined results of over 2,000 patients from a multicenter study program.**
Abstract: OBJECTIVES The purpose of this study was to evaluate the safety of implanting a cardiac resynchronization therapy (CRT) system.BACKGROUND Clinicians and patients require data on the safety of the CRT implant procedure to estimate procedural risk.METHODS We evaluated outcomes of transvenous CRT system implantation in 2,078

patients from the Multicenter InSync Randomized Clinical Evaluation (MIRACLE) study, the MIRACLE Implantable Cardioverter-Defibrillator (ICD) study, and the InSync III study. We compared the MIRACLE study to the InSync III study and the MIRACLE ICD study randomized phase to its general phase to evaluate the effect of new technologies.RESULTS The implant attempt succeeded in 1,903 of 2,078 (91.6%) patients. Implant time decreased from 2.7 h in the MIRACLE study to 2.3 h in the InSync III study ($p < 0.001$), and from 2.8 h in the MIRACLE ICD study randomized phase to 2.4 h in the general phase ($p < 0.001$). The implant procedure produced 62 perioperative complications in 53 (9.3%) MIRACLE trial patients; 159 in 135 (21.1%) MIRACLE ICD study randomized phase patients and 71 in 62 (13.9%) general phase patients ($p < 0.05$ vs. randomized); and 41 in 37 (8.8%) InSync III study patients (p = NS vs. the MIRACLE study). We observed 73 postoperative complications in 62 (11.7%) MIRACLE trial patients, 77 in 68 (11.9%) MIRACLE ICD study randomized phase patients and 56 in 45 (11.0%) general phase patients (p = NS), and 37 in 34 (8.6%) InSync III study patients (p = NS). A total of 8% of patients required reoperation to treat lead dislodgement, extracardiac stimulation, or infection during follow-up.CONCLUSIONS Transvenous CRT system implantation appears safe, well-tolerated, has a high success rate, and improves with operator experience and the addition of new technologies

417. Miske G, Acevedo C, Goodlive TW, Brown CM, Levine TB: **Cardiac resynchronization therapy and tools to identify responders.** *Congestive heart failure (Greenwich , Conn)* 2005, 11(4)**:** 199-206.
Abstract: Heart failure is a major epidemic. Many people with heart failure struggle with refractory symptoms despite optimal medical therapy. Those with severe left ventricular dysfunction and ventricular conduction delay are at significant risk from either dying suddenly or dying from progression of their heart failure. Cardiac resynchronization therapy (CRT) improves hemodynamics and symptoms of heart failure and has recently been shown to improve survival. One problem facing the use of CRT is that 30% of patients fail to respond. The dominant theory is that QRS duration (electrical dyssynchrony) does not accurately reflect mechanical dyssynchrony. Echocardiographic tools have recently been developed that enable clinicians to assess the degree of mechanical dyssynchrony in patients being considered for CRT. These tools are able to predict with a significant amount of accuracy whether a patient will respond to CRT. This allows for a more refined approach to evaluating patients for CRT and optimizing the treatment of congestive heart failure

418. Mohacsi P, Carrel T: **Indication, management and problems of cardiac transplantation <Original> Herztransplantation - indikation, vorgehen, chancen und probleme.** *Therapeutische Umschau (THER UMSCH)* /20, THER.
Abstract: AB- Cardiac transplantation (HTx) remains one of the most important options for the management of end stage heart failure which is treated with optimal medical therapy. Evolving surgical techniques (implantable cardioverter-defibrillator (ICD), cardiac re synchronization therapy (CRT)) and mechanical device-therapie (ventricular assist devices (VAD)) and medical therapies have yielded incremental improvements in outcomes. These alternatives to HTx, however, usually only postpone the occurrence of the final end stage situation. This explains why HTx remains the last option for a substantial number of especially younger severe heart failure patients with upcoming renal failure. It is very recommendable to refer such kind of patients to university-based and specialized advanced heart failure and cardiac transplant centers, in time. This allows the introduction of optimal medical therapy, the careful medical and psychological evaluation and preparation of the considered HTx, as well as the full information procedure which has to be delivered to HTx candidates. HTx candidates should be aware about outcome numbers, medication toxicities, complications of immunosuppression, as well as the ever-present threat of cardiac allograft vasculopathy, infections and neoplasias after HTx. (c) 2005 by Verlag Hans Huber, Hogrefe AG

419. Mohacsi P, Carrel T: **[Indication, management and problems of cardiac transplantation]**
<Original> Herztransplantation--Indikation, Vorgehen, Chancen und Probleme. *Therapeutische Umschau Revue therapeutique* 2005, 62(7)**:** 473-476.
Abstract: Cardiac transplantation (HTx) remains one of the most important options for the management of end stage heart failure which is treated with optimal medical therapy. Evolving surgical techniques (implantable cardioverter-defibrillator (ICD), cardiac resynchronization therapy (CRT)) and mechanical device-therapie (ventricular assist devices (VAD)) and medical therapies have yielded incremental improvements in outcomes. These alternatives to HTx, however, usually only postpone the occurrence of the final end stage situation. This explains why HTx remains the last option for a substantial number of especially younger severe heart failure patients with upcoming renal failure. It is very recommendable to refer such kind of patients to university-based and specialized advanced heart failure and cardiac transplant centers, in time. This allows the introduction of optimal medical therapy, the careful medical and psychological evaluation and preparation of the considered HTx, as well as the full information procedure which has to be delivered to HTx candidates. HTx candidates should be aware about outcome numbers, medication toxicities, complications of immunosuppression, as well as the ever-present threat of cardiac allograft vasculopathy, infections and neoplasias after HTx

420. Molhoek SG, Bax JJ, Bleeker GB, Holman ER, van EL, Bootsma M *et al*.: **Long-term follow-up of cardiac resynchronization therapy in patients with end-stage heart failure.** *Journal of cardiovascular electrophysiology* 2005, 16(7)**:** 701-707.
Abstract: Long-term follow-up of cardiac resynchronization therapy. INTRODUCTION: Cardiac resynchronization therapy (CRT) has been introduced to treat patients with end-stage heart failure, and results of this technique are promising. The aim of our study was to assess the sustained benefit of CRT in a large patient cohort with end-stage heart failure at long-term follow-up. In addition, the prognosis of responders and nonresponders was evaluated. METHODS AND RESULTS: 125 patients with end-stage heart failure, NYHA class III or IV, LVEF<35%, QRS duration>120 msec and left bundle branch block morphology received a biventricular device. At baseline and 6 months after implantation the following parameters were evaluated: NYHA class, Minnesota Quality of life score, QRS duration on surface ECG, 6-minute walking distance and LVEF. Follow-up was obtained up to 3 years. After 6 months, patients were divided in clinical responders and nonresponders according to improvement in NYHA class. All clinical parameters improved significantly at 6-month follow-up. Hospitalization for heart failure was 3.8+/-4.9 days/year before and 0.7+/-1.6 days/year after CRT. Survival at 1-, 2-, and 3-year follow-up was 93%, 88%, and 85%, respectively. Responders (78%) showed a significantly better survival than nonresponders at 2- and 3-year follow-up (96% and 93% for responders versus 81% and 73% for nonresponders, P<0.05). CONCLUSION: The improvement in functional status and symptoms after CRT is maintained at long-term follow-up (up to 3 years). The clinical improvement was associated with a significant reduction in hospitalization rate which was also maintained over the years. Preimplantation selection of responders may result in even better long-term survival

421. Mont L: **Antiarrhythmic effect of cardiac resynchronization**
<Original> Efecto antiarritmico de la resincronizacion cardiaca. *Revista Espanola de Cardiologia (REV ESP CARDIOL)* /20, REV.

422. Mont L: **[Antiarrhythmic effect of cardiac resynchronization]**
<Original> Efecto antiarritmico de la resincronizacion cardiaca. *Revista espanola de cardiologia* 2005, 58(10)**:** 1139-1141.

423. Monteiro V, Goncalves L, Sanfins V, Chaves JC: **[Ventricular cardiac resynchronization--initial surgical experience]**
<Original> Ressincronizacao cardiaca ventricular--experiencia cirurgica inicial.

Revista portuguesa de cirurgia cardio-toracica e vascular - orgao oficial da Sociedade Portuguesa de Cirurgia Cardio-Toracica e Vascular 2005, 12(3)**:** 149-152.
Abstract: Cardiac resynchronization therapy (CRT) is a recent method for patients with myocardial failure resulting from systolic malfunction. CTR is achieved by simultaneous stimulation of both ventricles which resynchronizes the time of depolarization of the left ventricle and improves myocardial contractility, diminishing mitral regurgitation. Usually the TCR is applied percutaneously/transvenously but in some cases it is impossible to use such techniques due to several reasons. The authors of this article suggest the minithoracotomy as an alternative approach of the left ventricle for implantation of the epicardic electrode. This technique has proven to be simple and safe, allowing short implantation times in comparison with the traditional technique, as well as a better choice of the site of electrode implantation

424. Morantz CA, Coughlin L: **Which patients benefit from CRT?** *American Family Physician (AM FAM PHYS)* /20, AM.

425. Morillo CA: **Cardiac resynchronization reduced death and hospitalization in heart failure and cardiac dyssynchrony.** *ACP journal club* 2005, 143(2)**:** 29.

426. Morin t, Barba-Pichardo R, Venegas-Gamero J, Herrera-Carranza M: **Cardiac resynchronization through selective his bundle pacing in a patient with the so-called infraHis atrioventricular block.** *PACE - Pacing and Clinical Electrophysiology (PACE PACING CLIN ELECTROPHYSIOL)* /20, ACE.
Abstract: AB- We present a case of infraHis AV block in which selective His bundle pacing with His-ventricular conduction through the conduction system was accomplished. While further investigations are developed, this approach maybe an alternative for cardiac resynchronization in cases of difficult coronary sinus access

427. Morina-Vazquez P, Barba-Pichardo R, Venegas-Gamero J, Herrera-Carranza M: **Cardiac resynchronization through selective His bundle pacing in a patient with the so-called InfraHis atrioventricular block.** *Pacing and clinical electrophysiology - PACE* 2005, 28(7)**:** 726-729.
Abstract: We present a case of infraHis AV block in which selective His bundle pacing with His-ventricular conduction through the conduction system was accomplished. While further investigations are developed, this approach may be an alternative for cardiac resynchronization in cases of difficult coronary sinus access

428. Moss AJ, Brown MW, Cannom DS, Daubert JP, Estes M, Foster E *et al*.: **Multicenter automatic defibrillator implantation trial-cardiac resynchronization therapy (MADIT-CRT): design and clinical protocol.** *Annals of noninvasive electrocardiology - the official journal of the International Society for Holter and Noninvasive Electrocardiology, Inc* 2005, 10(4 Suppl)**:** 34-43.
Abstract: The planned MADIT-CRT trial is designed to determine if CRT-D will reduce the risk of mortality and HF events by approximately 25% in subjects with ischemic (NYHA class I-II) and non-ischemic (NYHA class II) cardiomyopathy, left ventricular dysfunction (EF<or=0.30), and prolonged intraventricular conduction (QRS duration>or=130 ms)

429. Moynahan M, Faris OP, Lewis BM: **Cardiac resynchronization devices: the Food and Drug Administration's regulatory considerations.** *Journal of the American College of Cardiology* 2005, 46(12)**:** 2325-2328.
Abstract: Cardiac resynchronization therapy (CRT) devices have been studied clinically since 1998, and have been on the U.S. market since the Food and Drug Administration (FDA) approval of the first product in 2001. Since that time, the FDA has approved many different models from three different manufacturers, representing the first and second generations of these products. All of these products have undergone the FDA pre-market

approval process, which examines the safety and effectiveness of the devices for their intended use. Over the last several years, the FDA has adapted recommendations for CRT clinical trials based on an evolving understanding of what these devices can achieve. This paper will outline the dynamic nature of the FDA's approval process for CRT devices and briefly review the clinical trial designs for the first generation devices

430. Munclinger MJ, Thornton AS, Wasiak MM: **Biventricular pacing for heart failure alters electro-mechanical coupling of both ventricles.** *Cardiovascular journal of South Africa - official journal for Southern Africa Cardiac Society and South African Society of Cardiac Practitioners* 2005, 16(4)**:** 220-226.
Abstract: AIM: The exact mechanisms whereby biventricular pacing enables cardiac resynchronisation are not completely understood. This study looked at the effect of biventricular pacing on interventricular asynchrony in patients submitted to biventricular pacing. METHODS: A prospective series of 13 consecutive patients were selected from those referred for biventricular pacing. Criteria used included heart failure and QRS factors, as well as echocardiographic evidence of both intraventricular and interventricular asynchrony. Midterm follow-up of clinical and echocardiographic parameters are presented. RESULTS: All patients' clinical conditions improved significantly. Expectedly, diastolic filling parameters, ejection fraction and mitral regurgitation also improved significantly. The difference in the timing of left and right ventricular ejections of 65 ms at the baseline was corrected to 3 to 5 ms during six-month follow-ups after biventricular pacing. This effect was achieved by significant shortening of the left ventricular pre-ejection interval by 29 to 39 ms ($p < 0.01$) and by significant prolonging of the right ventricular pre-ejection interval by 18 to 30 ms ($p < 0.01$). CONCLUSION: Complete interventricular mechanical resynchronisation due to biventricular pacing occurred not only by the expected advancement in left ventricular ejection, but also by a delay in right ventricular ejection. The specific significance of correcting interventricular asynchrony with regard to the benefit and selection of patients for resynchronisation therapy remains to be fully established

431. Murali S, Baldisseri MR: **Peripartum cardiomyopathy.** *Critical Care Medicine (CRIT CARE MED)* /20, CRIT.
Abstract: AB- Objective: To provide a review of the cardiac and obstetrical literature regarding the development of peripartum cardiomyopathy and, in particular, to examine risk factors, incidence, diagnosis, prognosis, and evidence-based treatment modalities. Design: an extensive review of the current literature. Results: Peripartum cardiomyopathy is a cardiomyopathy of unknown cause that occurs in pregnant females, most commonly in the early postpartum period. It shares many clinical characteristics with idiopathic dilated cardiomyopathy but occurs at a younger age and is associated with a better prognosis. Diagnosis is based upon the clinical presentation of congestive heart failure and objective evidence of left ventricular systolic dysfunction. Conventional pharmacologic therapy for congestive heart failure, such as diuretics, digoxin, angiotensin-converting enzyme inhibitors, angiotensin-receptor blockers, and beta-adrenergic blockers, are routinely used and are quite effective. For those patients who remain refractory to conventional pliarmacologic therapy, cardiac transplantation and mechanical circulatory support are viable options. Conclusion: Mortality rates in peripartum cardiomyopathy have decreased, and this is most likely related to advances over the past 5 yrs in medical therapy for heart failure. Aggressive use of implantable defibrillators has significantly reduced the risk of sudden death in these patients, for >50% of periparium cardiomyopathy patients, left ventricular function normalizes with pharmacologic therapy. However, subsequent pregnancies almost always are associated with recurrence of left ventricular systolic dysfunction. Copyright (c) 2005 by the Society of Critical Care Medicine and Lippincott Williams & Wilkins

432. Muramatsu T, Matsumoto K, Nishimura S: **Efficacy of the phase images in Fourier analysis using gated cardiac POOL-SPECT for determining the indication for cardiac**

resynchronization therapy. *Circulation journal - official journal of the Japanese Circulation Society* 2005, 69(12)**:** 1521-1526.
Abstract: BACKGROUND: Although cardiac resynchronization therapy (CRT) improves quality of life and survival for patients with heart failure, exact methods to estimate the effect of cardiac asynchrony have not yet been defined. METHODS AND RESULTS: Initially, to examine whether the phase analysis images in the Fourier analysis using gated cardiac pool single photon emission computed tomography (POOL-SPECT) could be used to evaluate cardiac asynchrony, 19 consecutive patients with dilated cardiomyopathy were studied. Interventricular asynchrony was defined by whether the peak of the picture elements of the right ventricle in the phase histogram fitted that of the left ventricle and intraventricular asynchrony by whether the phase image was described homogenously or not. The patients with both inter- and intraventricular asynchrony had significant deterioration in both left ventricular ejection fraction ($p<0.01$) and New York Heart Association functional class ($p<0.01$). To evaluate the efficacy of these phase images for CRT setting, 7 patients were tested before and after CRT. During a 3.9+/-3.6 month follow-up period, all patients had an improvement in their condition, and the inter- and intraventricular asynchrony significantly improved after CRT. The degrees of the inter- and intraventricular asynchrony were related to the degree of cardiac depression pre CRT. CONCLUSION: These results have shown that the phase images from POOL-SPECT are useful for assessing the effect of CRT in patients with heart failure, which suggests that it may provide information about the indication for CRT

433. Murphy RT, Sigurdsson G, Mulamalla S, Agler D, Popovic ZB, Starling RC *et al*.: **Tissue synchronization imaging and optimal left ventricular pacing site in cardiac resynchronization therapy.** *American journal of cardiology* 2006, 97(11)**:** 1615-1621.
Abstract: The optimal pacing site in cardiac resynchronization therapy (CRT) remains controversial. Tissue synchronization imaging is a novel echocardiographic technique that color-codes for areas of maximal delay in myocardial velocities. This study aimed to identify whether the left ventricular (LV) pacing lead position in CRT should be guided by a patient's area of maximal mechanical delay. Fifty-four patients with advanced heart failure were assessed echocardiographically before and 6 months after CRT. Response was analyzed according to the relation between the LV lead position and the area of maximal delay to peak velocity by tissue synchronization imaging in the first half of the ejection phase: group 1 (n = 22) had lead placement corresponding to the segment of maximal delay; group 2 (n = 13) had lead placement 1 segment adjacent; and group 3 (n = 19) had lead placement remote from this site. Evidence of LV reverse remodeling and improved systolic function was documented in group 1 (mean percentage decrease in end-systolic volume 23%) more than in group 2 (mean decrease 15%), and more than in group 3 (mean increase 8.9%, $p <0.0001$ compared with groups 1 and 2). In group 1, 16 of 22 patients had reverse remodeling (>15% decrease in end-systolic volume); reverse remodeling was seen in 7 of 13 patients in group 2 and 1 of 19 in group 3. The placing of the lead position proximal to the site of maximal delay by tissue synchronization imaging was correlated with reverse remodeling ($r = 0.449$, $p = 001$). Of 7 patients with delay confined to the septum and anterior wall only, none had evidence of reverse remodeling after CRT. In conclusion, pacing at the site of maximal mechanical delay was associated with reverse remodeling. Individually tailored LV lead positioning should be considered before CRT

434. Mykytsey A, Maheshwari P, Dhar G, Razminia M, Zheutlin T, Wang T *et al*.: **Ventricular tachycardia induced by biventricular pacing in patient with severe ischemic cardiomyopathy.** *Journal of cardiovascular electrophysiology* 2005, 16(6)**:** 655-658.
Abstract: INTRODUCTION: Cardiac resynchronization therapy (CRT) is a new alternative which affords symptomatic improvement in two-thirds of patients who exhibit medically refractory congestive heart failure (CHF) as well as significant prolongation of the QRS duration (>135 msec). As more experience with CRT accrues, unexpected complications of this promising therapy may become apparent. Herein, we describe a patient with severe ischemic cardiomyopathy and refractory CHF who developed incessant ventricular

tachycardia (VT) after the initiation of biventricular pacing. The patient is a 75-year-old man who suffered an inferior myocardial infarction 6 years before presenting for CRT. He underwent a three-vessel CABG in 1997. Subsequently, episodes of near syncopal sustained VT developed, for which he received a dual chamber ICD. In 2001 he developed refractory CHF and ECG revealed LBBB with a QRS duration of 195 msec. Shortly after the initiation of biventricular pacing, the patient developed multiple episodes of drug resistant monomorphic VT that could be terminated only transiently by ICD therapies. Ultimately, the only intervention, which proved to be effective in eliminating VT episodes, was inactivation of LV pacing. Despite subsequent therapeutic regimen of sotalol, lidocaine, tocainide, and quinidine all subsequent attempts to reactivate LV pacing resulted in prompt VT recurrence. CONCLUSION: This case represents a clear example of CRT induced proarrhythmia, which required inactivation of LV pacing for effective acute management. Such an intervention should be considered in CRT patients who exhibit a notable increase in drug refractory VT episodes

435. Naccarella F, Liying C, Jinrong Z, Shu-Zheng L, Bernasconi A, Bijno D *et al*.: **Data from U.S., Europe and Asia-Pacific areas with specific reference to China on worldwide ICD and other devices implantation.** *Mediterranean Journal of Pacing and Electrophysiology (MEDITERR J PACING ELECTROPHYSIOL)* /20, MEDITERR.
Abstract: AB- International guidelines for implantation of cardiac pacemakers and arrhythmia devices have been primarily promoted and continuously updated by ACC/AHA/NASPE-Heart Rhythm Society in the last 20 years, starting from 1984. These guidelines are today accepted and used in Europe, worldwide and, according to the data of the present overview, also in the Asia-Pacific areas and in China. Furthermore, in the last 5 years, new clinical data from controlled clinical trials on device therapy for patients with cardiac rhythm disturbances have been published. It should be also mentioned that new more sophisticated electrical devices for bradi-tachiarrhythmia have been made available by different technologies manufacturers. Nevertheless, we should recognise that different attitudes of physicians in different countries and different penetration mainly of ICD and CRT therapies can be observed in Europe and in some Asia-Pacific countries in comparison to US, which still is the leading market. Economical reasons and resources limitation are probably the main reasons, but also physicians' reluctance, sometimes inadequate knowledge and incomplete proofs of efficacy are the reason for not introducing in everyday clinical practice, these very expensive technologies, the benefits of which are not completely proved in some subgroups of patients. For these reasons, we undertook, together with US, European and Chinese colleagues, a yearly overview of prevalence and penetration of these technologies in the worldwide market

436. Naccarelli G, V: **Post myocardial infarction, left ventricular dysfunction, and the expanding role of cardiac implantable electrical devices.** *Clinical cardiology* 2005, 28(11 Suppl 1)**:** I51-I57.
Abstract: In patients post myocardial infarction (MI) at risk for fatal ventricular arrhythmias, cardiac implantable devices offer a means of preventive therapy that complements optimal pharmacologic therapy. In patients with depressed ejection fractions, prophylactic implantable cardioverter defibrillators (ICDs) significantly improve survival. The efficacy of ICDs in the primary prevention of sudden cardiac death in patients post MI has been examined in a number of major primary prevention trials. These trials demonstrated as much benefit as some secondary prevention trials, which were conducted in high-risk patients who already had a spontaneous sustained ventricular tachyarrhythmia. In patients who are candidates for an ICD, best medical therapy for left ventricular dysfunction should be in place for some time before implanting. This waiting period could mean avoiding the implantation of a device in a patient who would heal sufficiently with pharmacologic therapy alone. In New York Heart Association (NYHA) class III and IV, patients with heart failure, and QRS intervals > or = 120 ms, cardiac resynchronization therapy (CRT) in combination with a defibrillator is a valuable addition to optimal pharmacologic therapy. Recent studies have demonstrated improved survival with CRT as

well as improved quality of life. The high cost of cardiac implantable devices has led the Centers for Medicare and Medicaid Services to impose strict indications for use. However, it is likely that indications will be broadened for ICDs to include selected patients with left ventricular ejection fraction up to 40%, compared with the current indication of < or = 30%. Implanted devices must be followed up appropriately, with periodic interrogation and program adjustment to reduce the risk for pacing-induced desynchronization and to optimize hemodynamic benefit

437. Najem B, Preumont N, Unger P, Jansens J, Houssiere A, Ciarka A *et al*.: **Sympathetic nerve activity after thoracoscopic cardiac resynchronization therapy in congestive heart failure.** *Journal of cardiac failure* 2005, 11(7)**:** 529-533.
Abstract: BACKGROUND: Sympathetic benefits of thoracoscopic cardiac resynchronization therapy (TCRT) in congestive heart failure (CHF) are unknown. We determined cardiac hemodynamics, functional status, and muscle sympathetic nerve activity (MSNA) in a group of TCRT patients. We aimed to compare these patients with CHF patients with cardiac asynchrony (ASY) to substantiate the beneficial effects of TCRT. METHODS AND RESULTS: Eleven patients resynchronized by TCRT 6 +/- 1 months before study inclusion (SYN) and 10 matched ASY patients underwent blood pressure, heart rate, and MSNA recordings. All underwent functional status, cardiac index, and left ventricular ejection fraction (LVEF) assessments. SYN patients had shorter QRS duration and interventricular mechanical delays, longer 6 minute walking distance and lower New York Heart Association class (all P < .05) than ASY patients. MSNA of 56 +/- 2 bursts/min in ASY patients was higher than in SYN patients (48 +/- 3 bursts/min, P < .05). Cardiac index was higher in SYN patients than in ASY patients (2.8 +/- 0.2 versus 1.9 +/- 0.2 L.min.m2, P < .05, respectively). MSNA was highest in the patients with the lowest LVEF (r = -0.49, P < .05), cardiac index (r = -0.48, P < .05) and 6-minute walking distance (r = -0.50, P < .05). CONCLUSION: Lower sympathetic nerve activities in TCRT patients are related to more favorable cardiac indexes and six minute walking distances suggesting a sympathetic, hemodynamic, and functional improvement by TCRT

438. Nakajima H, Wada O, Naito K, Hasegawa T: **Diagnostic X-ray effect on the implantable pacemakers.** *Therapeutic Research (THER RES)* /20, THER.
Abstract: AB- Diagnostic X-ray effect on the pacemakers was evaluated. Using plain X-ray diagnostic unit (DHF-155H II: HITACHI) and single helical CT (X Vision::TOSHIBA), pacemakers (KDR 700, InSync 8040:Medtronic) were irradiated. A few beats over-sensing were observed during radiation. This result denies the rule that the diagnostic X-ray do not disturb the pacemaker function. The duration of the over-sensing during radiation was short enough and this failure would not have influence on the health of pacemaker patients. However, The results could not completely deny the possibility of the system reset. Clinically, we should plan the radiation area leaving out the area of pacemaker

439. nanthram Manjula R, Viloria E, Delurgio DB, Foster E: **Septal to posterior wall motion delay correlates with response to cardiac resynchronization therapy but is inadequate for patient selection.**

440. Naqvi TZ, Rafique AM: **Echocardiography in cardiac resynchronization therapy.** *Minerva cardioangiologica* 2005, 53(2)**:** 93-108.
Abstract: Cardiac resynchronization therapy (CRT) is a new treatment modality for eligible patients with congestive heart failure (CHF). The premise of CRT is that it decreases inter and intra ventricular inhomogeneity during systolic contraction thereby improving efficiency of cardiac pump function. Presence of cardiac dyssynchrony appears to be a prerequisite for a response to CRT. Traditionally this inhomogeneity in contraction has been determined by electrocardiographic QRS widening. More recently several echocardiographic methods of assessment of dyssynchrony have become available. These methods utilize conventional M-mode and pulsed wave (PW) Doppler as well tissue Doppler imaging (TDI) METHODS: These echocardiographic parameters have been

shown to be more important predictors of response to CRT than conventional QRS widening. This article will discuss echocardiographic methods of assessment of dyssynchrony and their role in predicting response to CRT. In addition role of echocardiography in post CRT pacemaker programming will also be discussed

441. Narayan SM: **Implantable defibrillators with and without resynchronization for patients with left ventricular dysfunction.** *Texas Heart Institute journal / from the Texas Heart Institute of St Luke's Episcopal Hospital , Texas Children's Hospital* 2005, 32(3)**:** 358-361.
Abstract: In conclusion, sudden cardiac arrest is a major cause of mortality in patients with LV dysfunction, even in asymptomatic patients. Low EF and heart failure may contribute synergistically to this risk, and may confer a risk of sudden death that accumulates over time. Several studies confirm that ICDs are more effective than optimal medical therapy at reducing SCA, although efforts must focus on optimizing medical therapy. Finally, ventricular dyssynchrony is a major risk factor for cardiac mortality that is best ameliorated by CRT. Future studies using markers of mechanical dyssynchrony will likely enhance the ability of CRT to reduce symptoms, hospitalization, and mortality

442. Navia JL, Atik FA, Grimm RA, Garcia M, Vega PR, Myhre U *et al.*: **Minimally invasive left ventricular epicardial lead placement: surgical techniques for heart failure resynchronization therapy.** *Annals of thoracic surgery* 2005, 79(5)**:** 1536-1544.
Abstract: BACKGROUND: Epicardial lead placement for biventricular pacing is often a rescue procedure after failed coronary sinus cannulation. This study aims to determine perioperative and early postoperative outcome of minimally invasive left ventricular lead placement as a management strategy for heart failure, comparing minithoracotomy and endoscopic approaches. METHODS: From October 2002 through October 2003, 41 patients underwent minimally invasive left ventricular lead placement, 23 (56%) by minithoracotomy and 18 (44%) endoscopically. Thirty-one (76%) were males, 19 (46%) had previous cardiac surgery, 21 (51%) had ischemic cardiomyopathy, 17 (41%) were in New York Heart Association class III or IV, and 28 (65%) had implantable cardioverter-defibrillators. RESULTS: There were no in-hospital deaths, intraoperative complications, or failures to implant the left ventricular lead. Median operative time was longer for the endoscopic approach (188 minutes) than for minithoracotomy (151 minutes; $p = 0.006$). Preoperatively, the endoscopic group had more mitral regurgitation (median, 2.5 versus 1.0, respectively; $p = 0.009$). QRS duration was shorter postoperatively (mean change from preoperative, -32 +/- 24 ms; $p < 0.0001$); this change was unrelated to surgical approach. Impedance also was less postoperatively (mean change, -490 +/- 300 ohms; $p < 0.0001$), and the change was unrelated to surgical approach. Changes were greater the larger their preoperative values ($p < 0.0001$). Threshold increased with follow-up time (adjusted $p < 0.0001$), but impedance decreased (adjusted $p = 0.0009$); these trends were similar for both approaches. No changes were evident in left ventricular dimensions. CONCLUSIONS: Minimally invasive left ventricular epicardial lead placement is safe and effective, offering selection of the best pacing site with minimal morbidity; it can be considered a primary option for resynchronization therapy

443. Nisam S, Breithardt G: **Lessons learned from neutral ICD trials.** *Europace (Europace)* /20, EUROPACE.
Abstract: AB- Multiple prospective randomized trials with implantable cardioverter defibrillators (ICDs) over the past decade have convincingly established the efficacy of ICD therapy in reducing all-cause mortality, by significantly reducing sudden cardiac death. Nevertheless, four trials have failed to show improved survival. Analysing these, in comparison with the positive trials, provides important information concerning the type of patients not likely to receive benefit from ICDs: (i) those with relatively low mortality (<=18% within 2 years of follow-up; (ii) those whose mechanism of death is predominantly non-arrhythmic; (iii) patients early (within 6 weeks) after infarction. (c) 2006 Oxford University Press

444. Nishijima Y, Jenkins P, Feldman D, Bonagura I, Carnes C, Hamlin R: **Beneficial effects of cardiac resynchronization on QRS duration. Distance walked and left ventricular fractional shortening in dogs with long-standing pacing-induced heart failure-a pilot study.**

445. Niu H, Hua W, Wang F, Zhang S, Chen K, Chen X: **Complications of cardiac resynchronization therapy in patients with congestive heart failure.** *Chinese medical journal* 2006, 119(6)**:** 449-453.
Abstract: BACKGROUND: Previous clinical studies have suggested that patients with congestive heart failure and intraventricular conduction delay could benefit from cardiac resynchronization therapy (CRT). Implantation of left ventricular lead is a complex procedure with some potential for complications. This study was conducted to analyse the complications of CRT in patients with congestive heart failure. METHODS: Totally 117 patients, 86 males and 31 females, mean age of 53 years, with congestive heart failure and intraventricular conduction delay were enrolled in this study. Venography was performed on all patients. Different types of coronary sinus leads were used to pace the left ventricle. RESULTS: Left ventricular lead was attempted to implant through coronary sinus for all the 117 patients and was successfully implanted in 111 patients. The success rate was 94.9%. Main complications rate was 6.8%, including coronary sinus dissection in 4 patients, phrenic nerve stimulation required lead repositioning in 2 patients and lead dislodgement in 2 patients. CONCLUSIONS: It is feasible and safe to pace left ventricle through coronary sinus. However, there are some procedural complications

446. Nof E, Glikson M, Bar-Lev D, Gurevitz O, Luria D, Eldar M *et al*.: **Mechanism of diastolic mitral regurgitation in candidates for cardiac resynchronization therapy.** *American journal of cardiology* 2006, 97(11)**:** 1611-1614.
Abstract: It was hypothesized that restricted diastolic leaflet motion is implicated not only in the mechanism of systolic mitral regurgitation (MR) but also in the mechanism of diastolic MR observed in patients with severe heart failure. Cardiac resynchronization therapy (CRT) can oppose increased mitral leaflet tethering by increasing transmitral pressure, thereby providing an opportunity to explore this hypothesis. A total of 26 consecutive candidates for CRT with diastolic MR were compared with 26 candidates without diastolic MR. Maximal diastolic mitral leaflet opening and inflow direction and measures of mitral valve apparatus (i.e., mitral annular diameters, calculated mitral annular area, and tethering distance) were assessed from the apical 4-chamber view before and during CRT. There were no significant differences in New York Heart Association functional class, ejection fraction, QRS duration, PR interval, systolic MR grade, or 2-dimensional geometry of the mitral valve apparatus between the groups. Patients with diastolic MR had more restricted maximal diastolic leaflet openings (54 degrees +/- 17 degrees vs 71 degrees +/- 11 degrees , p = 0.003) and substantially smaller inflow angles (66 degrees +/- 7 degrees vs 79 degrees +/- 9 degrees , p = 0.0003) compared with patients without diastolic MR. After the institution of CRT, diastolic MR was eliminated in all patients, although there were no significant changes in any of the parameters of mitral valve apparatus. In conclusion, abnormal mitral valve tethering is a constitutive element of the mechanism of diastolic MR in patients with left ventricular dysfunction. Its acute resolution after CRT does not seem to be caused by changes in mitral valve geometry but rather by an increase in transmitral closing forces

447. Norton CK, Kesten K: **An update on the treatment of heart failure using biventricular pacing and intravenous nesiritide.** *Journal of emergency nursing - JEN - official publication of the Emergency Department Nurses Association* 2005, 31(1)**:** 76-79.

448. Nowak B, Stellbrink C, Sinha AM, Schaefer WM, Hanrath P, Buell U *et al*.: **Influence of cardiac resynchronization therapy on myocardial blood flow, perfusion, and glucose metabolism**
<Book> Cardio-visionen 2004:Junge exzellenze in der kardiovaskularen forschung.

Abstract: Here we report the influence of cardiac resynchronization therapy (CRT) with biventricular pacing on myocardial glucose metabolism, perfusion, and blood flow (MBF) in idiopathic dilated cardiomyopathy and left bundle branch block (LBBB). Baseline heterogeneity of glucose metabolism was homogenized by CRT whereas the influence on perfusion was less marked. Flexible regulation of gene expression of the insulin-sensitive glucose transporter GLUT-4 provides the likeliest pathophysiological explanation. Left ventricular (LV) MBF was homogeneous in LBBB and not influenced by CRT. Therefore, the beneficial effects of CRT do not require additional oxygen demand or regional reallocation of oxidative metabolism

449. ntonini-Canterin F, Baldessin F, Brieda M, Dametto E, Hrovatin E, Zardo F *et al*.: **Cardiac resynchronization therapy as an 'alternative' approach to a non-operable severe aortic stenosis with left ventricular dysfunction.** *Journal of heart valve disease* 2006, 15(2)**:** 206-208.
Abstract: Severe symptomatic aortic stenosis (AS) is an indication for surgical replacement of the aortic valve in adults. Patients are often affected by comorbidities, and the surgical indication is sometimes problematic. Non-surgical techniques have been developed during the past few years, though their roles have not yet been established. Cardiac resynchronization therapy has been shown to be effective in selected patients, but no data yet exist on the role of this therapy in AS patients. The case is presented of a patient with non-operable severe symptomatic AS and cardiac dissynchrony who showed significant improvement following the implantation of a biventricular pacemaker

450. Nurnberg J-H, Butter C, bdul-Khaliq H, Schlegl M, Lange PE: **Successful cardiac resynchronization therapy in a 9-year-old boy with dilated cardiomyopathy.** *Zeitschrift fur Kardiologie* 2005, 94(1)**:** 44-48.
Abstract: Despite increasing clinical impact of cardiac resynchronization therapy (CRT) with av-synchronous biventricular pacing in adults with dilated cardiomyopathy (DCMP), an ejection fraction (EF) of less than 35% and left bundle branch block (LBBB), there is still only little experience in children. We report on a 9-year-old boy with histologically proven DCMP and LBBB who had fulfilled the criteria for heart transplantation (HTX) after cardiac decompensation including catecholamine therapy. A transvenous CRT pacing system was implanted without technical difficulties. The healing process was uneventful. With optimized AV-interval invasive evaluation during implantation indicated a 16% pulse pressure increase and a 63% augmentation of LV dp/dt by pacing the LV 20 ms prior to the RV. Tissue Doppler imaging demonstrated complete LV resynchronization. Physical capacity increased and HTX could be delayed

451. O'Donnell D, Nadurata V, Hamer A, Kertes P, Mohammed W: **Long-term variations in optimal programming of cardiac resynchronization therapy devices.** *Pacing and clinical electrophysiology - PACE* 2005, 28 Suppl 1 S24-S26.
Abstract: The optimal follow-up and long-term programming of cardiac resynchronization therapy (CRT) devices are uncertain. The aim of this study was to quantify the temporal variations in programming parameters to optimize the follow-up of these devices. Before, during, and at specified intervals over 9 months after implant, 40 recipients of CRT devices were studied. At each visit, the patients were tested with a fixed sequence of stimulation parameters during echocardiographic and electrocardiographic (ECG) recordings. The optimal AV delay and inter-ventricular delays (V-V) were determined according to echocardiographic criteria. The echocardiographic data were, in turn, compared with the ECG recordings. Among the 40 patients, the optimal stimulation parameters remained unchanged throughout the follow-up in only three patients. In 18 patients, adjustments were required at each follow-up sessions. There was a trend toward reduction in the left ventricular (LV) predominance of the optimal V-V delay and an increase in the AV delay during follow-up. The mean optimal V-V delay at implant was 22 ms (-12 to +32 ms) with the LV activated first, versus 12 ms (-16 to +32 ms) at 9 months. The mean AV delay at implant was 115 ms versus 137 ms at 9 months. Individual changes could not be accurately

predicted. The optimal stimulation parameters for CRT vary over time. Detailed, regular reevaluations, and reprogramming of optimal parameters may be appropriate

452. O'Donnell D, Nadurata V, Hamer A, Kertes P, Mohammed W: **Bifocal right ventricular cardiac resynchronization therapies in patients with unsuccessful percutaneous lateral left ventricular venous access.** *Pacing and clinical electrophysiology - PACE* 2005, 28 Suppl 1 S27-S30.
Abstract: Biventricular cardiac resynchronization therapy (CRT) with a lateral left ventricular (LV) lead cannot always be achieved. We report a single center experience of CRT utilizing a protocol that specifically required the implantation of a bifocal right ventricular (RV) lead system when lateral LV pacing could not be achieved. Consecutive candidates for CRT were included in the study. If strict criteria for lateral LV pacing were not met, they underwent implantation of a bifocal RV lead system with two 7F, active fixation leads, one placed septally at the apex, and the other in the high septal outflow tract. All patients were followed for 12 months and the two groups were compared. A biventricular (BiV) stimulation system was implanted in 44 patients, and a bifocal RV system in six. The demographic characteristics of the two groups were similar. Both groups experienced a similar improvement in functional capacity, increase in 6 minutes walking distance, and decreased need for hospitalizations. The mean increase in LV ejection fraction was 11% in the bifocal RV group versus 10% in the BiV group. Though the tissue Doppler indices of LV synchrony improved earlier in the BiV group, (19% vs 10%) the improvement was similar in both groups at 6 months (23% vs 20%). The clinical improvements conferred by CRT can be matched by a bifocal RV system in selected patients. This alternate approach should be considered when implantation of a LV lateral lead was unsuccessful

453. Obias-Manno D: **Clinical considerations for the allied professional: programming issues in cardiac resynchronization therapy.** *Heart rhythm - the official journal of the Heart Rhythm Society* 2005, 2(2)**:** 216-217.

454. Occhetta E, Bortnik M, Pasin F, Marino P: **Upgrade of a single chamber endo-epicardial to a triple chamber biventricular implantable cardioverter-defibrillator.** *Journal of cardiovascular medicine (Hagerstown , Md)* 2006, 7(2)**:** 145-148.
Abstract: In patients with heart failure implanted with conventional pacemakers, cardiac resynchronization therapy results in significant benefits. The upgrade of previously implanted devices to biventricular pacing may be technically challenging. We report one case of upgrade to biventricular pacing and describe the related technical implications and the therapeutic solutions adopted

455. Oliveira GH, Thohan V, Nasir N, Becker K, Shih H, Koerner MM *et al*.: **Cellular evidence of reverse remodeling after cardiac resynchronization therapy in failing human hearts.**

456. Olsovsky GD, Faulknier BA, Preece C, Price LD, Randall JR: **Elderly patients receive equal benefits from cardiac resynchronization compared with younger patients.**

457. Ono H, Hirano M, Goseki Y, Morisaki M, Kawade M, Yamada M *et al*.: **Feasiblity study of multidetector-row computed tomography (MDCT) for detection of the optimum coronary venous system in cardiac resynchronization therapy.** *Journal of Tokyo Medical University (J TOKYO MED UNIV)* /20, J.
Abstract: AB- Multidetector-row computed tomography (MDCT) is a non-invasive method of assessing coronary artery disease. Accurate evaluation of the coronary venous system (CVS) anatomy is required for left ventricular lead placement in cardiac resynchronization therapy (CRT). We assessed the resolution of CVS imaging by MDCT and examined the possibility for CRT application as a pilot study. We performed a pilot MDCT study in 10 patients who were scheduled for permanent pacemaker implantation or

electrophysiological study. We measured the following: 1 coronary sinus (CS) ostium diameter, 2 CS branch diameter, 3 CS branch length, 4 angle between the CS branch and the main tract, 5 distance from CS ostium to the CS branch, in lateral, posterolateral and anterolateral branches. MDCT obtained CVS information in detail without any complications. MDCT may be helpful in detecting the optimal CS branch for CRT

458. Opsite S, I: **Comparative assessment of right, left, and biventricular pacing in patients with permanent atrial fibrillation.**
Abstract: Aims Left ventricular (W) and biventricular (BiV) pacing are potentially superior to right ventricular (RV) apical pacing in patients undergoing atrioventricular (AV) junction ablation and pacing for permanent atria(fibrillation.Methods and results Prospective randomized, single-blind, 3-month crossover comparison between RV and LV pacing (phase 1) and between RV and BiV pacing (phase 2) performed in 56 patients (70 +/- 8 years, 34 mates) affected by severely symptomatic permanent atrial fibrillation, uncontrolled ventricular rate, or heart failure. Primary endpoints were quality of life and exercise capacity. Compared with RV pacing, the Minnesota Living with Heart Failure Questionnaire (LHFQ) score improved by 2 and 10% with LV and BiV pacing, respectively, the effort dyspnoea item of the Specific Symptom Scale (SSS) changed by 0 and 2%, the Karolinska score by 6 and 14% ($P < 0.05$ for BiV), the New York Heart Association (NYHA) class by 5 and 11% ($P < 0.05$ for BiV), the 6-min walked distance by 12 (+4%) and 4m (+1%), and the ejection fraction by 5 and 5% ($P < 0.05$ for both). BiV pacing but not W pacing was slightly better than RV pacing in the subgroup of patients with preserved systolic function and absence of native left bundle branch block. Compared with pre-ablation measures, the Minnesota LHFQ score improved by 37, 39, and 49% during RV, W, and BiV pacing, respectively, the effort dyspnoea item of the SSS by 25, 25, and 39%, the Karolinska score by 39, 42, and 54%, the NYHA class by 21, 25, and 30%, the 6-min walking distance by 35 (12%), 47 (16%), and 51 m (19%) and the ejection fraction by 5, 10, and 10% (all differences $P < 0.05$).Conclusions Rhythm regularization achieved with AV-junction ablation improved quality of life and exercise capacity with all modes of pacing. LV and BiV pacing provided modest or no additional favourable effect compared with RV pacing

459. Ott P: **Cardiac resynchronization therapy: a new therapy for advanced congestive heart failure.** *American journal of geriatric cardiology* 2005, 14(1)**:** 31-34.
Abstract: Despite medical therapy, many patients with advanced systolic dysfunction remain highly symptomatic. In these patients the presence of a left bundle branch block on electrocardiogram indicates significant dyssynchrony of ventricular contraction. Cardiac resynchronization, by means of biventricular pacing, results in important clinical benefits. Due to the risk for malignant ventricular arrhythmias, this technology is best combined with an implantable cardioverter defibrillator

460. Owen A: **Cost-effectiveness of cardiac resynchronization therapy: Results from the CARE-HF trial [5].** *European Heart Journal (EUR HEART J)* /20, EUR.

461. Owen A: **Cost-effectiveness of cardiac resynchronization therapy: results from the CARE-HF trial.** *European heart journal* 2006, 27(9)**:** 1125-1126.

462. Paisey JR, Yue AM, Moore R, Betts TR, Roberts PR, Morgan JM: **Development of indications for cardiac resynchronisation therapy in the implantable cardioverter defibrillator population.** *International journal of cardiology* 2005, 99(2)**:** 187-190.

463. Pan Cuizhen R, Shu X, Shi H: **Evaluating the effect of cardiac resynchronization therapy in patients with congestive heart failure by novel tissue Doppler echocardiographic indices.**
Abstract: Objective Cardiac resynchronization therapy (CRT) by simultaneous biventricular (BiV) pacing is used to improve the left ventricular (LV) systolic synchrony

and LV function in patients with congestive heart failure (CHF). We used Doppler tissue imaging (DTD, tissue synchronization imaging (TSD and tissue tracking (TT) technique to evaluate the effect of sequential CRT in patients with CHF. Methods Twelve patients with CHF who had CRT were enrolled. Two-dimensional echocardiography (2DE) and DTI was carried out in four chamber, two chamber and apical long aixs views when the pacemaker was off and on. Results When the pacemaker was on, the LVEF improved significantly from 35. 25 +/- 11. 36% to 44. 42 +/- 9. 93% (P < 0. 001), and LV systolic maximum (LVSm) was increased significantly from 3. 41 +/- 0. 65 cm/s to 4. 79 +/- 0. 98 cm/s (P < 0. 001), RV-Sm were increased significantly from 6. 79 +/- 1. 82 cm/s to 7. 74 +/- 1. 90 cm/s (P < 0. 001). Delayed long axis contraction (DLCs) were decreased significantly from 35. 16 +/- 6. 41% to 20. 31 +/- 10. 36% (P < 0. 001). Ts-SD was decreased from 95. 17 +/- 44. 56 ms to 54. 86 +/- 19. 42 ms (P < 0. 01), Td-SD was decreased from 87. 16 +/- 20. 51 ms to 59. 52 +/- 29. 90 ms (P < 0. 05), and TSI index was reduced from 2. 13 +/- 0.15 to 1. 62 +/- 0. 32 (P < 0. 001). In addition, the reduction of TSI index correlated significantly with that of Ts (r = 0. 76, P < 0. 05). Conclusions BiV pacing can immediately improve the systolic and diastolic synchrony of the LV and RV and LV function. DTI, TSI and TT are useful in predicting and evaluating the effect of CRT in the patients with CHF

464. Panescu D: **Cardiac resynchronization therapy.** *IEEE engineering in medicine and biology magazine - the quarterly magazine of the Engineering in Medicine & Biology Society* 2005, 24(2)**:** 22-26.

465. Panken EJ, Combs WJ, Shelton MB: **Atrial aware VVI: a method for atrial synchronous ventricular (VDD/R) pacing using the subcutaneous electrode array and a standard pacing lead.**
Abstract: An algorithm is implemented in a circuit for sensing P-waves in a pacemaker to ensure ventricular pacing synchronization with sensed atrial depolarization waves. VDD and VDDR pacing (atrial synchronized, ventricular inhibited pacing) are implemented via a single standard ventricular pacing lead (unipolar or bipolar) and preferably a subcutaneous electrode array (SEA). Specifically, an implanted ventricular lead provides ventricular pacing and ventricular sensing while the SEA enable atrial sensing, thus eliminating the need for an implanted atrial lead or a specialized single pass VDD lead. The algorithm manages the sensed cardiac waves to effect a desired pacing regimen based on the input from the single lead and SEA

466. Parreira L, Santos JF, Madeira J, Mendes L, Seixo F, Caetano F *et al*.: **Cardiac resynchronization therapy with sequential biventricular pacing: impact of echocardiography guided VV delay optimization on acute results.** *Revista portuguesa de cardiologia - orgao oficial da Sociedade Portuguesa de Cardiologia = Portuguese journal of cardiology - an official journal of the Portuguese Society of Cardiology* 2005, 24(11)**:** 1355-1365.
Abstract: BACKGROUND: Cardiac resynchronization therapy (CRT) improves left ventricular synchrony as evaluated by tissue Doppler imaging (TDI), leading to improved left ventricular performance and reverse remodeling. New CRT devices enable programming of left and right VV delay. The aim of this study was to determine whether sequential biventricular (BiV) pacing by echo-guided programming of VV delay would enhance the response to CRT. METHODS: 15 consecutive patients with severe heart failure and left bundle branch block underwent CRT by BiV device implantation. They were studied with conventional and TDI echo the day before implantation. Left ventricular ejection fraction (LVEF) was determined, and the electromechanical delay (QS), defined as the time interval from the beginning of the QRS to the S wave in pulsed TDI, was assessed in each of the four left ventricular basal segments. The dyssynchrony index was calculated as the difference between the longest and shortest electromechanical delay (QS(max-min)). The parameters were re-evaluated the day after implantation during simultaneous BiV pacing and with seven different VV delays. The optimal VV delay was determined by finding the VV interval corresponding to the maximum aortic velocity time interval (VTI).

RESULTS: QS(max-min) decreased from 85.3 +/- 27.0 msec to 46.7 +/- 23.0 msec (p = 0.0002), LVEF increased from 21.7 +/- 7.3% to 30.0 +/- 7.7% (p = 0.0001) and aortic VTI increased from 12.7 +/- 3.6 cm to 15.2 +/- 4.0 cm (p < 0.0001), with simultaneous BiV pacing. The VV intervals were programmed as follows: LV pre-excitation by 10 msec in five patients, 20 msec in three, 30 msec in two, and 40 msec in three; and RV pre-excitation by 10 msec in one and by 20 msec in one. The maximal aortic VTI obtained with VV delay programming increased from 15.2 +/- 4.0 cm to 17.7 +/- 4.0 cm (p = 0.0005). During optimized sequential BiV pacing, QS(max-min) further decreased from 46.7 +/- 23.0 msec to 30.6 +/- 21.0 msec (p = 0.02) and LVEF further increased from 30.0 +/- 7.7% to 35.0 +/- 7.7% (p = 0.0003). CONCLUSIONS: Sequential BiV pacing with VV delay optimized by evaluation of aortic VTI enhanced the response to CRT with additional improvements in left ventricular synchrony and left ventricular function compared to simultaneous CRT

467. Pastore CA, Tobias N, Samesima N, Filho MM, Pedrosa A, Nishioka S *et al*.: **Body surface potential mapping investigating the ventricular activation patterns in the cardiac resynchronization of patients with left bundle-branch block and heart failure.** *Journal of electrocardiology* 2006, 39(1)**:** 93-102.
Abstract: Body surface potential mapping assessed mean cardiac electrical activation times displayed by isochronal maps in the right ventricle (RV; right ventricle mean activation time [mRV]), anterior septal area (anterior septal area mean activation time [mAS]), and left ventricle (left ventricle mean activation time [mLV]) of 28 patients (mean, 61.07 years; congestive heart failure class III-IV; ejection fraction, < or =40%; left bundle-branch block [LBBB] QRS, 180.17 milliseconds), before and after biventricular pacemaker implantation, comparing them, using reference values from a control group of healthy individuals with normal hearts (GNL), in (1) baseline native LBBB, where mRV and mAS values were similar (40.99 vs 43.62 milliseconds), with mLV delayed (80.99 milliseconds, P < .01) and dyssynchronous with RV/anterior septal area; (2) single-site RV pacing, where mRV was greater than in GNL (86.82 milliseconds, P < .001), with greater mAS/mLV difference (63.41 vs 102.7 milliseconds; P < .001); and (3) biventricular pacing (BIV-PM), where mLV and mRV were similar (71.99 vs 71.58 milliseconds), mRV was greater than in GNL and native LBBB (71.58 vs 35.1 and 40.99 milliseconds; P < .001), and mAS approached values in GNL and native LBBB (51.28 vs 50.14 and 43.62 milliseconds). Body surface potential mapping showed that similar RV/left ventricle activation times during biventricular pacing, nearing mAS, indicate synchronized ventricular activation pattern in patients with congestive heart failure/LBBB

468. Patwala AY, Wright DJ: **Device based treatment of heart failure.** *Postgraduate medical journal* 2005, 81(955)**:** 286-291.
Abstract: As the population ages and survival from ischaemic heart disease improves, the incidence and prevalence of congestive cardiac failure has increased dramatically. Medical treatments including ACE inhibitors, beta blockers, and aldosterone antagonists have improved the outlook for most patients. However, despite optimal medical treatment there is a significant group of patients who continue to suffer poor morbidity and mortality. Device based treatment consisting of implantable cardioverter defibrillators (ICD) and cardiac resynchronisation therapy (CRT) devices offer new modes of treatment to patients with symptomatic heart failure despite optimal medical therapy. ICDs have been shown to reduce mortality in patients with severe heart failure while CRT leads to an improvement in functional class, quality of life scores, physiological measures such as peak Vo(2), and reduce hospitalisations. Combination devices, which provide both ICD and CRT functions, have now been seen to provide synergistic benefits in selected patients

469. Patwala AY, Woods P, Barker D, Williams SG, Goldspink DF, Tan L *et al*.: **A longitudinal evaluation of the physiological response to CRT.**

470. Peinado R, Arenal A, Arribas F, Torrecilla E, Alvarez M, Ormaetxe JM *et al*.: **Spanish Implantable Cardioverter-Defibrillator registry. First official report of the Spanish Society of Cardiology Working Group on Implantable Cardioverter-Defibrillators (2002-2004)**
<Original> Registro espan(Tilde)Ol de desfibrilador automatico implantable. Primer informe oficial del grupo de trabajo de desfibrilador implantable de la sociedad espan(Tilde)Ola de cardiologia (An(Tilde)Os 2002-2004). *Revista Espanola de Cardiologia (REV ESP CARDIOL)* /20, REV.
Abstract: AB- Objective. To report the 2002-2004 findings of the Spanish National Implantable Cardioverter-Defibrillator (ICD) Registry, established by the Spanish Society of Cardiology Working Group on Implantable Cardioverter-Defibrillators. Material and method. Data were collected prospectively after implantation using a single-page questionnaire returned to the Spanish Society of Cardiology. Participation was voluntary. Results. The registry received reports on 925, 1,046 and 1414 implants, respectively, in the years 2002, 2003 and 2004. These figures represent 63%, 59% and 67.5%, respectively, of the total number of ICDs implanted. The reported implantation rates were 22, 24 and 33 per million, respectively, and the estimated total implantation rates were 35, 41 and 49, per million, respectively. The number of device replacements increased from 20% to 30% between 2002 and 2004. The majority of patients were male, their median age was 66 years, they had severe or moderate left ventricular dysfunction, and they were in functional class I or II. The most common underlying heart disease was ischemic heart disease. The main indications for an ICD were sustained monomorphic ventricular tachycardia and aborted sudden cardiac death, though the number of prophylactic indications has increased. Most ICDs were implanted in an electrophysiology laboratory by a cardiac electrophysiologist. The implantation rates of dual-chamber ICDs and ICDs with cardiac resynchronization therapy were approximately 30% and 15%, respectively. Very few complications occurred during implantation. Conclusions. The Spanish National ICD Registry contains a representative sample of ICD implantations performed in the country. The registry is one of the largest reported

471. Peinado R, Arenal A, Arribas F, Torrecilla E, Alvarez M, Ormaetxe JM *et al*.: **[Spanish implantable cardioverter-defibrillator registry. First official report of the spanish society of cardiology working group on implantable cardioverter-defibrillators (2002-2004)]**
<Original> Registro Espanol de Desfibrilador Automatico Implantable. Primer Informe Oficial del Grupo de Trabajo de Desfibrilador Implantable de la Sociedad Espanola de Cardiologia (anos 2002-2004). *Revista espanola de cardiologia* 2005, 58(12)**:** 1435-1449.
Abstract: OBJECTIVE: To report the 2002-2004 findings of the Spanish National Implantable Cardioverter-Defibrillator (ICD) Registry, established by the Spanish Society of Cardiology Working Group on Implantable Cardioverter-Defibrillators. MATERIAL AND METHOD: Data were collected prospectively after implantation using a single-page questionnaire returned to the Spanish Society of Cardiology. Participation was voluntary. RESULTS: The registry received reports on 925, 1,046 and 1414 implants, respectively, in the years 2002, 2003 and 2004. These figures represent 63%, 59% and 67.5%, respectively, of the total number of ICDs implanted. The reported implantation rates were 22, 24 and 33 per million, respectively, and the estimated total implantation rates were 35, 41 and 49, per million, respectively. The number of device replacements increased from 20% to 30% between 2002 and 2004. The majority of patients were male, their median age was 66 years, they had severe or moderate left ventricular dysfunction, and they were in functional class I or II. The most common underlying heart disease was ischemic heart disease. The main indications for an ICD were sustained monomorphic ventricular tachycardia and aborted sudden cardiac death, though the number of prophylactic indications has increased. Most ICDs were implanted in an electrophysiology laboratory by a cardiac electrophysiologist. The implantation rates of dual-chamber ICDs and ICDs with cardiac resynchronization therapy were approximately 30% and 15%, respectively. Very few

complications occurred during implantation. CONCLUSIONS: The Spanish National ICD Registry contains a representative sample of ICD implantations performed in the country. The registry is one of the largest reported

472. Pelicano N, Oliveira M, Da SN, Antunes E, Santos S, Conceicao JM *et al*.: **Long-term clinical outcome in patients with severe left ventricular dysfunction and an implantable cardioverter-defibrillator after ventricular tachyarrhythmias.** *Revista portuguesa de cardiologia - orgao oficial da Sociedade Portuguesa de Cardiologia = Portuguese journal of cardiology - an official journal of the Portuguese Society of Cardiology* 2005, 24(4)**:** 487-498.
Abstract: Left ventricular ejection fraction (LVEF) is accepted as an important prognostic marker in patients (pts) with implantable cardioverter-defibrillators (ICD). The impact of this therapeutic approach in the survival of pts with life-threatening arrhythmias and severe left ventricular dysfunction remains a matter of discussion. OBJECTIVE: To evaluate the long-term clinical implications of severe left ventricular dysfunction in pts with an ICD implanted for secondary prevention of sudden cardiac death (SD). METHODS: Out of 70 pts undergoing ICD implantation in our institution over four consecutive years, we studied 24 pts with LVEF <35% and a post-ICD follow-up of >12 months (87.5% male; age 62.79 years). The index arrhythmia was ventricular tachycardia in 19 cases and SD with ventricular fibrillation in 5 cases. The underlying disease was ischemic cardiomyopathy (n=19), dilated cardiomyopathy (n=4) and hypertensive heart disease (n=1). Mean LVEF at the time of implant was 25 +/- 7% (between 11% and 34%; NYHA class II/III in 83.3%). A du chamber system was implanted in 5 cases, and an ICD plus cardiac resynchronization pacing in 2 cases. There was no perioperative mortality. At the time of discharge, 71.2% of the pts were taking amiodarone and 66.7 % beta-blockers. During a 38 +/- 16-month follow-up (4 appointments/year), we analyzed the following parameters: rehospitalization for cardiovascular cause, appropriate ICD shocks, inappropriate detections/therapy, nonfatal major arrhythmic events (arrhythmic storm, therapeutic exhaustion, recurrent ventricular tachycardia), cardiac mortality, SD and total mortality. Results: Forty-five readmissions (1.9 +/- 2.3/pt) occurred in 14 pts (58%), 24.4% due to congestive heart failure. Appropriate ICD shocks (without hospitalization) occurred in 62.5% of the pts, 16.6% had inappropriate therapy (50% because of increased heart rate due to atrial fibrillation) and 37.5% suffered nonfatal major arrhythmic events. Death due to SD was 4.2%, cardiac mortality 12.5% and total mortality 25%. CONCLUSIONS: Severe left ventricular dysfunction is common in ICD pts. During long-term follow-up, the majority of these pts receive appropriate ICD shocks, which emphasizes the importance of SD prevention in this population. The frequent documentation of supraventricular arrhythmias (causing inappropriate ICD therapy) and nonfatal major arrhythmic events also reflects the presence of a worse arrhythmic substrate in this subgroup. Despite the poor initial prognosis associated with ventricular tachyarrhythmias in pts with severe left ventricular dysfunction, ICD therapy may contribute to a better long-term clinical outcome

473. Pelosi F, Morady F: **CRT-D therapy in patients with left ventricular dysfunction and atrial fibrillation.** *Annals of noninvasive electrocardiology - the official journal of the International Society for Holter and Noninvasive Electrocardiology, Inc* 2005, 10(4 Suppl)**:** 55-58.
Abstract: The number of patients with atrial fibrillation and congestive heart failure has steadily increased in the United States. The presence of atrial fibrillation increases morbidity and mortality for patients with left ventricular dysfunction. The emergence of cardiac resynchronization therapy to improve symptoms and survival from congestive heart failure may provide benefits for those with atrial fibrillation; we review the pathophysiology of atrial fibrillation in the presence of left ventricular dysfunction and the promise of cardiac resynchronization therapy to improve symptoms for the for these patients

474. Perisinakis K, Theocharopoulos N, Damilakis J, Manios E, Vardas P, Gourtsoyiannis N: **Fluoroscopically guided implantation of modern cardiac resynchronization devices: radiation burden to the patient and associated risks.** *Journal of the American College of Cardiology* 2005, 46(12)**:** 2335-2339.
Abstract: OBJECTIVES: To establish radiation risks for patients undergoing fluoroscopically guided cardiac resynchronization device implantation. BACKGROUND: Cardiac resynchonization therapy (CRT) may be associated with extended fluoroscopic exposure. METHODS: The fluoroscopy time, dose-area product (DAP), exposure parameters, and percentage contribution of the fluoroscopic projections commonly used were recorded in a series of 14 consecutive patients referred for cardiac resynchronization device implantation and compared to corresponding data obtained from a control group of 20 patients who underwent a conventional rhythm device implantation operation. The DAP to peak skin dose, DAP to effective dose, and DAP to gonadal dose conversion factors were determined for biventricular pacing and conventional rhythm device implantation using a humanoid phantom and thermoluminescence dosimetry. RESULTS: The mean total fluoroscopy time and DAP values were 35.2 min and 4,765 cGy cm2, respectively, for biventricular pacing and 8.2 min and 1,106 cGy cm2, respectively, for conventional rhythm device implantation. Patient skin dose from biventricular pacing procedures requiring extended fluoroscopic exposure may exceed threshold dose for the induction of skin effects only if X-ray source-to-skin distance is kept low. The risk values for fatal cancer and severe hereditary disorders, respectively, associated with a typical CRT procedure were 273 per million and 0.2 per million treated patients. CONCLUSIONS: Radiation risks associated with fluoroscopically guided CRT procedures may be considerable. Present data may be used for the estimation of patient radiation risks from CRT procedures performed in other institutions

475. Perzanowski C, Gilliam FR: **The buddy wire technique: accessing lateral coronary veins while maintaining coronary sinus position.** *Journal of interventional cardiac electrophysiology - an international journal of arrhythmias and pacing* 2005, 13(3)**:** 231-234.
Abstract: There is compelling data to place the coronary sinus lead (CSL) in a lateral or posterolateral tributary. Coronary sinus venography often demonstrates the absence of easily accessible lateral veins or those with sufficient size to accommodate the CSL. The operator may choose to deploy the CSL in the anterior vein but publications and experience highlight the lack of resynchronization benefit when the CSL is deployed in this location. There is often a posterolateral vessel or the middle cardiac vein (MCV) originating from near the coronary sinus (CS) os. These vessels require the operator to pull the CS guide essentially out of the CS to allow successful access. Cannulation of the coronary sinus (CS) is often challenging, and the risk of losing access to the CS may dissuade the implanter from attempting access to a vessel near the CS os. We describe a technique to access vessels near the CS os while maintaining secure position in the main body of the CS

476. Pezzulich B, Montagna L, Lucchina PG: **Successful treatment of end-stage hypertrophic cardiomyopathy with biventricular cardiac pacing.** *Europace - European pacing, arrhythmias , and cardiac electrophysiology - journal of the working groups on cardiac pacing, arrhythmias , and cardiac cellular electrophysiology of the European Society of Cardiology* 2005, 7(4)**:** 388-391.
Abstract: The beneficial use of biventricular pacing is reported in a patient with end-stage hypertrophic cardiomyopathy, intraventricular conduction delay and echocardiographic evidence of intraventricular dyssyncrony. Marked improvement in clinical status, left ventricular ejection fraction and peak VO2 were observed. As far as we know, this is the first report of a beneficial effect of a biventricular device in this subset of patients, and may be worth further investigation

477. Pham PP, Balaji S, Shen I, Ungerleider R, Li X, Sahn DJ: **Impact of conventional versus biventricular pacing on hemodynamics and tissue Doppler imaging indexes of**

resynchronization postoperatively in children with congenital heart disease. *Journal of the American College of Cardiology* 2005, 46(12)**:** 2284-2289.
Abstract: OBJECTIVES: We sought to evaluate the effects of biventricular (BDOO) pacing compared with conventional (CDOO) atrioventricular (AV) sequential and atrial (AOO) pacing in children and infants in the early postoperative period after open heart surgery for congenital heart disease (CHD). BACKGROUND: Biventricular pacing using right ventricular (RV) and left ventricular (LV) leads can improve hemodynamics in patients with CHD, but it is unclear whether this occurs in early postoperative children with CHD. METHODS: Nineteen children (age, 5 days to 5.4 years; median, 5.5 months) with a definitive biventricular repair for CHD underwent AOO, CDOO, and BDOO pacing with temporary epicardial leads for 10 min each. The AV delay was 80% of the PR interval for the CDOO and BDOO modes. Lead placement was two right atrial, two RV, and one LV. Blood samples for cardiac index (arterial and venous) and tissue Doppler (TDI) traces were obtained in each pacing mode with a Vivid 7 BT04 digital ultrasound system (GE/VingMed, Horten, Norway) from an apical four-chamber view and analyzed with EchoPac software. RESULTS: The QRS duration was significantly shorter for BDOO compared with CDOO, and the cardiac index was higher with BDOO compared with CDOO. Systemic blood pressure was not different between the three modes of pacing (AOO, CDOO, BDOO). The TDI-derived strain rate showed minimal dyssynchrony in AOO as seen by isovolumic tensing (IVT) and peak systolic contraction (PSC) timing differences between RV and LV. The CDOO worsened dyssynchrony with prolonged DeltaIVT and PSC. The BDOO showed improved synchrony as seen by DeltaIVT and PSC. CONCLUSIONS: The TDI-derived strain rate showed worsened ventricular dyssynchrony with CDOO and improvement with BDOO. Cardiac index and QRS duration were improved by BDOO compared with CDOO. This suggests that short-term pacing with BDOO may benefit children with CHD needing pacing in the postoperative period

478. Pires LA, Abraham WT, Young JB, Johnson KM: **Clinical predictors and timing of New York Heart Association class improvement with cardiac resynchronization therapy in patients with advanced chronic heart failure: results from the Multicenter InSync Randomized Clinical Evaluation (MIRACLE) and Multicenter InSync ICD Randomized Clinical Evaluation (MIRACLE-ICD) trials.** *American heart journal* 2006, 151(4)**:** 837-843.
Abstract: BACKGROUND: Based on current patient selection criteria, a significant proportion of recipients of cardiac resynchronization therapy (CRT) do not respond to treatment. The purpose of this analysis is to identify predictors and characterize the timing of response to CRT in patients with advanced heart failure. METHODS: Patients randomized to receive CRT in the MIRACLE and MIRACLE-ICD trials, designed to assess the benefit of CRT compared with standard medical therapy in patients with advanced heart failure, left ventricular ejection fraction <0.35, and QRS > or =130 milliseconds, were included for this analysis. Patients with an improvement of > or =1 New York Heart Association (NYHA) class from baseline to the 6-month follow-up were considered responders and those who had no change or worse NYHA class or died were classified as nonresponders. Responders were subdivided into early (within 1-3 months) and late (6 months). RESULTS: One hundred forty-three (64%) of 224 and 190 (61%) of 313 patients in the MIRACLE and MIRACLE-ICD trials, respectively, responded to therapy, with 81 (57%) of 143 and 100 (53%) of 190 responding early. Several but differing factors predicted CRT response and timing in the two trials with a high sensitivity (89%-90%) but, owing to a low specificity (31%-49%), a modest predictive accuracy (66%-75%). CONCLUSIONS: Based on improvement of > or =1 NYHA class, less than two thirds of patients enrolled in the MIRACLE or MIRACLE-ICD trials responded to CRT, with just more than half responding within the first month. Several factors predicted CRT response and timing, but given their modest predictive accuracy, comparable for both studies, additional methods for selecting candidates most likely to benefit from CRT are needed

479. Pires LA: **Implantable devices for management of chronic heart failure: defibrillators and biventricular pacing therapy.** *Current opinion in anaesthesiology* 2006, 19(1)**:** 69-74.
Abstract: PURPOSE OF REVIEW: With chronic heart failure already an epidemic in the USA, its prevalence is expected to rise significantly in the future. Despite improved survival with pharmacologic therapy, the morbidity and mortality of patients with heart failure remain high. The purpose of this review, therefore, is to present recent data on the non-pharmacologic, device-based treatment of patients with chronic heart failure. RECENT FINDINGS: The implantable cardioverter-defibrillator has become standard treatment for the prevention of sudden, arrhythmic death. Recent well-designed clinical trials have led to device-based therapy as an important component in the management of patients with systolic left ventricular dysfunction (resulting from both ischemic and non-ischemic etiologies) and symptomatic chronic heart failure. Implantable cardioverter-defibrillator therapy alone (without biventricular pacing) results in a significant reduction in the overall mortality of patients with mild and moderate heart failure. Biventricular pacing (or cardiac resynchronization therapy) with or without a back-up implantable cardioverter-defibrillator, compared with optimal pharmacologic therapy, improves symptoms, quality of life, exercise tolerance, left ventricular function, and the survival of patients with advanced heart failure, a left ventricular ejection fraction of 35% or less, and intraventricular conduction delays (QRS > 120 ms), although up to approximately 30% of patients do not respond to cardiac resynchronization therapy. Ongoing and planned studies should clarify which patients are most likely to respond to cardiac resynchronization therapy and elucidate its role in those with a normal (< 120 ms) QRS (approximately 70% of patients with heart failure). SUMMARY: Device therapy (implantable cardioverter-defibrillator and cardiac resynchronization therapy) should be considered an integral, but adjunctive, part of the management of patients with chronic heart failure who are receiving appropriate medical therapy. The type of device used will depend on the individual patient's clinical characteristics

480. Pitzalis M, V, Iacoviello M, Romito R, Guida P, De TE, Luzzi G *et al*.: **Ventricular asynchrony predicts a better outcome in patients with chronic heart failure receiving cardiac resynchronization therapy.** *Journal of the American College of Cardiology* 2005, 45(1)**:** 65-69.
Abstract: OBJECTIVES: The aim of this study was to evaluate whether the clinical benefit of cardiac resynchronization therapy (CRT) can be prospectively predicted by means of the baseline evaluation of left ventricular asynchrony. BACKGROUND: The reverse remodeling associated with CRT is more evident in patients with severe heart failure (HF) and left bundle branch block (LBBB) who have left ventricular asynchrony. METHODS: Baseline left ventricular asynchrony was assessed in 60 patients with severe HF and LBBB by calculating the electrocardiographic duration of QRS and the echocardiographic septal-to-posterior wall motion delay (SPWMD). Left ventricular size and left ventricular ejection fraction (LVEF), mitral valve regurgitation, and functional capacity were also evaluated. The progression toward HF (defined as a worsening clinical condition leading to a sustained increase in conventional therapies, hospitalization, cardiac transplantation, and death) was assessed during follow-up, as were the changes in LVEF after six months. RESULTS: During the median follow-up of 14 months, 16 patients experienced HF progression. Univariate analysis showed that ischemic cardiomyopathy, changes in the QRS duration after implantation, and SPWMD significantly correlated with events. At multivariate analysis, a long SPWMD remained significantly associated with a reduced risk of HF progression (hazard ratio: 0.91; 95% confidence interval: 0.83 to 0.99; p <0.05). An improvement in LVEF was observed in 79% of the patients with a baseline SPWMD of > or =130 ms and in 9% of those with an SPWMD of <130 ms (p <0.0001). CONCLUSIONS: Baseline SPWMD is a strong predictor of long-term clinical improvement after CRT in patients with severe HF and LBBB

481. Pitzalis M, V, Iacoviello M, Romito R, Luzzi G, Anaclerio M, Forleo C: **Role of septal to posterior wall motion delay in cardiac resynchronization therapy.** *Journal of the American College of Cardiology* 2006, 48(3)**:** 596-597.

482. Porciani MC, Dondina C, Macioce R, Demarchi G, Pieragnoli P, Musilli N *et al*.: **Echocardiographic examination of atrioventricular and interventricular delay optimization in cardiac resynchronization therapy.** *American journal of cardiology* 2005, 95(9)**:** 1108-1110.
Abstract: In 21 patients implanted with a biventricular pacing device with programmable interventricular delay (VVd), the myocardial performance index (MPI) was evaluated during spontaneous sinus rhythm, simultaneous biventricular pacing, and sequential biventricular pacing at different VVds and atrioventricular delays (AVds). The AVd-VVd combination associated with the minimum MPI defined patient-tailored biventricular pacing. Simultaneous biventricular pacing significantly improved MPI compared with spontaneous sinus rhythm. An additional improvement was obtained by tailored biventricular pacing. The optimal AVds were significantly shorter during right ventricular preactivation than during left ventricular preactivation

483. Porciani MC, Macioce R, Demarchi G, Chiostri M, Musilli N, Cappelli F *et al*.: **Effects of cardiac resynchronization therapy on the mechanisms underlying functional mitral regurgitation in congestive heart failure.** *European journal of echocardiography - the journal of the Working Group on Echocardiography of the European Society of Cardiology* 2006, 7(1)**:** 31-39.
Abstract: AIMS: Functional mitral regurgitation (FMR) improvement induced by cardiac resynchronization therapy (CRT) has been related to left ventricular (LV) remodeling reversal and contractility enhancement. The effects induced by the changes of LV synchronicity indexes on FMR severity have not been investigated. METHODS AND RESULTS: In 30 patients with CRT for heart failure (HF) and QRS>130 ms, LV function parameters, FMR severity as mitral jet regurgitation/left atrial area ratio (JA/LAA) and standard deviation (SD) of the time to the systolic peak velocity at 6-basal and mid-LV segments as asynchrony indexes were evaluated (echo/tissue Doppler) before and 6 months after implant. At follow-up, 15 patients resulted responders to LV reverse remodeling with > or =15% end-systolic volume (ESV) and LV systolic function improvement. Improvement of FMR with > or =15% JA/LAA reduction was observed in 19 patients, 7 were nonresponders to LV reverse remodeling. In patients with > or =15% JA/LAA reduction a significant decrease of LV asynchrony indexes was observed as compared to patients without > or =15% JA/LAA reduction in whom LV asynchrony indexes were increased. Reduction of LV mid-segmental asynchrony was the variable most strongly related to JA/LAA reduction ($r(2)=0.697$, $P<0.01$), with good agreement between observed and predicted values (only 1 patient outside the mean+/-2SD). CONCLUSION: These data reveal that CRT can reduce FMR irrespective to LV remodeling reversal; this effect is related to LV asynchrony reduction and further support CRT employment in patients with HF and FMR

484. Porciani MC, Lilli A, Macioce R, Cappelli F, Demarchi G, Pappone A *et al*.: **Utility of a new left ventricular asynchrony index as a predictor of reverse remodelling after cardiac resynchronization therapy.** *European heart journal* 2006, 27(15)**:** 1818-1823.
Abstract: AIMS: The majority of tissue Doppler indexes proposed to predict left ventricular (LV) reverse remodelling in cardiac resynchronization therapy (CRT) reflects LV asynchrony as assessed in ejection phase. We evaluated the predictive value of a new strain-imaging parameter reflecting the total amount of time spent by 12 LV segments in contracting after aortic valve closure. METHODS AND RESULTS: Fifty-nine patients who fulfilled current treatment recommendations were studied before and 6 months after CRT. Time to tissue Doppler systolic peak velocity (Ts) and time exceeding aortic closure (ExcT) in strain curves were measured in 12 LV segments. Ts standard deviation (Ts-SD) and sum of ExcT of overall 12 LV segments (oExcT) were analysed. After 6 months,

responders were defined according to >/=15% LV end-systolic volume reduction. Responders (47%) when compared with non-responders (53%) had significantly higher baseline Ts-SD and oExcT values. Receiver operating characteristic (ROC) curve analysis demonstrated that an optimal cutoff value of 760 ms for oExcT yielded 93.5% sensitivity and 82.8% specificity. For Ts-SD at the cutoff of 32 ms, 82% sensitivity and 39% specificity were obtained. Area under ROC was significantly larger for oExcT than for Ts-SD. CONCLUSION: o-ExcT is able to predict LV reverse remodelling after CRT

485. Poullis M, Shackcloth M, D'Ancona G: **Coronary grafts flow and cardiac pacing modalities: The importance of the cardiac resynchronisation trials [4] (multiple letters).** *European Journal of Cardio-thoracic Surgery (EUR J CARDIO-THORAC SURG)* /20, EUR-THORAC.

486. Poullis M, Shackcloth M: **Coronary grafts flow and cardiac pacing modalities: the importance of the cardiac resynchronisation trials.** *European journal of cardio-thoracic surgery - official journal of the European Association for Cardio-thoracic Surgery* 2005, 27(1)**:** 177-178.

487. Pourati I, Hyder M, Rosenthal L: **Indications for implantable cardiac defibrillators in patients with congestive heart failure: Implicatons of the sudden cardiac death in heart failure trial.** *Current Cardiology Reports (CURR CARDIOL REP)* /20, CURR.
Abstract: AB- Sudden cardiac death (SCD) is a significant cause of mortality in patients suffering from heart failure and left ventricular dysfunction. Implantable cardioverter defibrillators have been shown to effectively reduce the incidence of SCD in this population. Recent clinical trials have redefined the indications and patient profiles for their use: from secondary prevention to primary prevention of SCD. In this article, we review the clinical trials contributing to the current practice guidelines, which include device therapy. Copyright (c) 2005 by Current Science Inc

488. Proclemer A, Ghidina M, Cicuttini G, Gregori D, Fioretti PM: **The Italian Implantable Cardioverter-Defibrillator Registry. A survey of the national activity during the years 2001-2003.** *Italian heart journal - official journal of the Italian Federation of Cardiology* 2005, 6(3)**:** 272-280.
Abstract: BACKGROUND: In recent years several trials demonstrated the efficacy of implantable cardioverter-defibrillator (ICD) therapy for sudden cardiac death prevention and total mortality reduction in particular high-risk groups of patients. The aim of this review was to report the main epidemiological data and the most important clinical characteristics of patients enrolled in the Italian ICD Registry in the years 2001-2003. METHODS: The Italian ICD Registry--official member of the Italian Association of Arrhythmology and Cardiac Pacing (AIAC)--collects 85% of the data concerning the national ICD implantation activity, based on the European Implantable Defibrillator form (EURID). Data are validated for quality of information and uniqueness at the moment of data entry and in successive steps at the time of the annual analysis. RESULTS: The number of ICDs implanted in Italy has been continuing to increase during the last years according to the general trend in European and non-European countries: 2400 in the year 2001, 3934 in the year 2002, and 5318 in the year 2003. The number of ICDs per million of inhabitants in Italy was 42.1 in the year 2001 (+11.8% with respect to 2000), 69.0 in the year 2002 (+63.9% with respect to 2001), and 93.3 in the year 2003 (+35.2% with respect to 2002). The number of implanting centers increased progressively from 273 in the year 2001 to 304 in the year 2002, and 340 in the year 2003. The median age of patients treated with ICD implantation was 67 years in the years 2001-2002, 68 years in the year 2003. The prevalence of male patients was significantly higher (79.3% in 2001, 82.3% in 2002, and 81.4% in 2003). The main indication was syncope (25.5, 29.3, and 32.9% in the years 2001, 2002, and 2003, respectively), followed by palpitations (17.7, 18.5, and 16.4% in the years 2001, 2002, and 2003, respectively), and cardiac arrest (10.0, 13.1, and 16.5% in the years 2001, 2002, and 2003, respectively). The use of ICD in patients considered at risk but

without history of sustained ventricular tachycardia had a 3-fold increase during the 3 years, from 6.4% in 2001 to 18.2% in 2003. Ventricular tachycardia was the main arrhythmia in 50.4 to 55.0% of cases, ventricular fibrillation in 13.5 to 18.1%, both in 4.1 to 6.5%. The vast majority of patients presented at the enrolment either a mild or severe reduction in ejection fraction (30 to 50%, < 30%). Amiodarone was administered alone or in combination with antiarrhythmics in 29.7 to 40.0% of patients. Single-chamber ICDs were implanted in the years 2002 and 2003 in 45.7 and 39.2% of patients, dual-chamber ICDs in 34.9 and 32.4%, biventricular ICDs in 19.4 and 28.4%, respectively. CONCLUSIONS: The ICD implantation rate in Italy increased significantly in the period 2001-2003, similarly to the trend in the other western countries and following the publication of controlled studies in the field of primary and secondary prevention of sudden cardiac death. The Italian ICD Registry showed during the last 3 years an important increase in prophylactic ICD utilization. A sophisticated ICD, including dual-chamber pacing or cardiac resynchronization therapy, was chosen in a high percentage of patients

489. PROSPECT I: **Predictors of response to cardiac resynchronization therapy (PROSPECT) - study design.**
Abstract: Background Cardiac resynchronization therapy (CRT) is currently indicated in patients with moderate to severe heart failure, a wide QRS complex and significant left ventricular dysfunction despite optimal medical therapy. Adoption of these criteria for CRT results in a favorable response in only two thirds of candidates.Methods Predictors of response to cardiac resynchronization therapy (PROSPECT)," a prospective, multicenter, nonrandomized study, aims to identify echocardiographic measures of dyssynchrony and evaluate their ability to predict response to CRT. PROSPECT will enroll approximately 300 patients in up to 75 centers in the United States, Asia, and Europe with clinical follow-up for 6 months. We will prospectively and individually test a variety of conventional echocardiographic and tissue Doppler imaging parameters against measures of clinical response. The primary response criteria are improvement in the heart failure Clinical Composite Score and left ventricular reverse remodeling. Enrollment began in March 2004 and is expected to conclude early 2005

490. Prystowsky EN: **Prevention of sudden cardiac death.** *Clinical cardiology* 2005, 28(11 Suppl 1)**:** I12-I18.
Abstract: It is often unclear why some patients suffer sudden cardiac death (SCD), or even what risk factors correlate best with the syndrome. This review describes current thinking on the prevention of SCD. Most studies have focused on the prevention of potentially fatal ventricular arrhythmias in patients post myocardial infarction (MI). While pharmacotherapy has a role in the prevention of SCD in patients post MI, the interpretation of drug trials can be problematic. This is because not all patients participating in such trials received optimized medical therapy by today's standards. As a result, trial outcomes for new therapies may not reflect their true efficacy when they are added to a background of best medical care. The two principal prophylactic modalities for SCD studied to date are antiarrhythmic drug therapy and use of an implantable cardioverter defibrillator (ICD). At the present time, antiarrhythmic drugs, such as the class III agent amiodarone, seem to display relatively limited efficacy for the primary prevention of sudden death in most patients post MI. Most clinical trials have found that ICD therapy has a significant mortality benefit in patients at high risk for ventricular arrhythmias. This has been demonstrated in primary prevention trials, and in secondary prevention trials such as Antiarrhythmics Versus Implantable Defibrillators (AVID), which studied patients who survived a near-fatal ventricular arrhythmia. Based on an analysis of secondary prevention trials, the single patient characteristic that best predicted an advantage of ICD therapy over antiarrhythmic drug therapy was a left ventricular (LV) ejection fraction < or = 35%. Cardiac resynchronization therapy has been established as having a mortality benefit in patients with dyssynchronous LV contraction associated with dilated cardiomyopathy

491. Punske BB: **Cardiac resynchronization therapy: finding the true meaning of synchrony.** *Heart rhythm - the official journal of the Heart Rhythm Society* 2006, 3(3)**:** 311-312.

492. Qi S-S, Fang Z-F, Liu Q-M, Zhou S-H: **Modulatory effects of cognitive behavior therapy on depression and anxiety in patients with implantable cardioverter defibrillator.** *Chinese Journal of Clinical Rehabilitation (CHIN J CLIN REHAB)* /20, CHIN.
Abstract: AB- Background: 60% of the patients receiving implantable cardioverter defibrillator(ICD) believe their quality of life has been improved. However, about 30% to 50% of the patients suffer from postoperative depression and anxiety; especially those patients receive electroconvulsive therapy (ECT). Objective: To probe into the modulatory effects of cognitive behavior therapy(CBT) on depression and anxiety in patients with ICD. D.esign: A retrospective case analysis based on ICD patients. Setting: Room of Cardiac Catheterization, Department of Cardiology, Xiangya Second Hospital. Participants: The study was conducted in the Room of Cardiac Catheterization of the Department of Cardiology, Xiangya Second Hospital, Central South University from October 2000 to August 2001. Inclusive criteria: ICD patients that had ineffective medicine therapy for paroxysmal ventricular tachycardia and/or ventricular fibrillation complicated with cardiac syncope. Exclusive criteria: incoorperative patients or patients who unable to receive periodical follow up. A total of 6 patients were involved including 4 male and 2 female patients aged from 45 to 71 years old with an average age of (57.3 +/- 2.4) years old. All of the patients received Micro Jewell 117223 ICD made by Medtronic Company. Diagnoses of basic disease: 2 cases of coronary heart disease, 2 cases of right ventricular myocardial disease, 1 case of paroxysmal ventricular tachycardia due to unknown reason, and 1 case of Brugada syndrome. Methods: "Morita therapy" technique was used. Patients were asked to transfer their spirit energies into feasible objectives of their real life, which would be helpful to the rapid improvement of their symptoms. symptom checklist-90(SCL-90) scale was used to evaluate the psychological symptoms before and after the therapy. Main Outcome Measures: Comparison of the scores gained in SCL-90 between before and after CRT. Results: There were significant differences in the items of somatization, compulsion, sensitive human relationship, depression, anxiety, phobia disorder, etc. between before and after CRT ($P < 0.05$ or 0.01). Conclusion: Psychotherapy shouldn't be neglected in the postoperative follow up of ICD, and CBT is helpful to relieve symptoms especially for those depression and anxiety patients with electroconvulsive experiences

493. Raffa S, Fantoni C, Restauri L, Auricchio A: **Right heart failure due to loss of right ventricular capture in a patient with atrioventricular junction ablation and biventricular pacing.** *Pacing and clinical electrophysiology - PACE* 2005, 28(10)**:** 1127-1130.
Abstract: We describe the case of a patient with atrioventricular (AV) junction ablation and chronic biventricular pacing in which intermittent dysfunction of the right ventricular (RV) lead resulted in left ventricular (LV) stimulation alone and onset of severe right heart failure. Restoration of biventricular pacing by increasing device output and then performing lead revision resolved the issue. This case provides evidence that LV pacing alone in patients with AV junction ablation may lead to severe right heart failure, most likely as a result of iatrogenic mechanical dyssynchrony within the RV. Thus, probably this pacing mode should be avoided in pacemaker-dependent patients with heart failure

494. Raj SR, Roach DE, Sheldon RS: **Letter regarding article by Adamson et al, "Continuous autonomic assessment in patients with symptomatic heart failure: prognostic value of heart rate variability measured by an implanted cardiac resynchronization device".** *Circulation* 2005, 112(2)**:** e37-e38.

495. Rami TG, Bala R, Gerstenfeld EP: **Supraventricular arrhythmias limit effective cardiac resynchronization therapy: Diagnosis using intracardiac electrograms and device**

based pacing maneuvers. *Journal of interventional cardiac electrophysiology - an international journal of arrhythmias and pacing* 2006, 15(2)**:** 119-123.
Abstract: Cardiac resynchronization therapy is an effective tool for the treatment of drug-refractory heart failure in patients with left ventricular dysfunction and inter/intra ventricular conduction delay. Supraventricular tachycardias may prevent effect delivery of this therapy. We report three cases in which effective therapy was limited by asymptomatic supraventricular tachycardia. Diagnostic pacing maneuvers were performed via the implanted device to determine the underlying arrhythmia mechanism. These cases highlight the importance of (1) treating supraventricular tachycardias before and after implantation of cardiac devices and (2) using device based programmed stimulation to diagnose the mechanism of supraventricular tachycardias

496. Rathman L, Repoley J, Tubbs K, Small R: **Monitoring intrathoracic impedance with CRT-D devices: insight into volume status.** *Progress in cardiovascular nursing* 2006, 21(2)**:** 97-99.

497. Reant Patricia R, Lafitte S, Labrousse L, Bordachar P, Serri K, Reuter S *et al*.: **Effects of right, left and biventricular pacing on myocardial perfusion: A contrast echocardiographic study in an ischemic experimental pig model.**

498. Reinhardt D, Surber R, Kuehnert H, Heinke M, Figulla HR: **Implantation of a resynchronisation device in a patient with persistent left superior vena cava - A case report**
<Original> Implantation eines resynchronisations-systems bei persistierender oberer hohlvene - ein fallbericht. *Herzschrittmachertherapie und Elektrophysiologie (HERZSCHRITTMACHERTHER ELEKTROPHYSIOL)* /20, HERZSCHRITTMACHERTHER.
Abstract: AB- We report an implantation of a cardiac resynchronisation system in a patient with persistent left superior vena cava. This anomaly occurs in 0.3 to 0.5% of healthy individuals and remains usually asymptomatic. Variations of the superior vena cava should be considered in venous catheterization and other procedures such as implantation of pacemaker and ICD systems as well as port catheter insertion. In resynchronisation systems, persistent left superior vena cava can be an obstacle for cannulation of the coronary sinus and placement of a transvenous left ventricular lead

499. Reinhardt D, Surber R, Kuehnert H, Heinke M, Figulla HR: **[Implantation of a re-synchronization device in a patient with persistent left superior vena cava-a case report]**
<Original> Implantation eines Resynchronisationssystems bei persistierender oberer Hohlvene Ein Fallbericht. *Herzschrittmachertherapie & Elektrophysiologie* 2006, 17(1)**:** 35-39.
Abstract: We report an implantation of a cardiac re-synchronization system in a patient with persistent left superior vena cava. This anomaly occurs in 0.3 to 0.5% of healthy individuals and remains usually asymptomatic. Variations of the superior vena cava should be considered in venous catheterization and other procedures such as implantation of pacemaker and ICD systems as well as port catheter insertion. In re-synchronization systems, persistent left superior vena cava can be an obstacle for cannulation of the coronary sinus and placement of a transvenous left ventricular lead

500. Reliance I: **Intraoperative comparison of a subthreshold test pulse with the standard high-energy shock approach for the measurement of defibrillation lead impedance.**
Abstract: Subthreshold Test. There are two methods to measure shocking lead impedance: delivery of high-energy shocks that require patient sedation, and the painless measurement of impedance from subthreshold test pulses. The aim of this study was to compare the two methods.Methods: The study included 131 patients implanted with a standard DR (n = 71) or VR (n = 60) ICD connected to either single-coil (n = 39) or dual-coil (n = 92)

defibrillation leads. The noninvasive high-energy impedance test was done using a 17 J shock after induction of ventricular tachyarrhythmias and compared to a 0.4 mu J test pulse used by the ICD for the subthreshold measurements.Results: Defibrillation lead impedance measurements were not significantly different between patients with the same shocking vector configuration. In patients with a single-coil defibrillation lead the impedance was 62 +/- 9 Omega with the high-energy shock and 62 +/- 8 Omega with the subthreshold test pulses (P = 0.13). Patients with a dual-coil configuration recorded average impedances of 40 +/- 5 Omega from both tests (P = 0.44). While there was no difference in values recorded within each lead configuration, there was a significant difference in impedance between the single-coil and the dual-coil patient groups (P = 0.001).Conclusions: There was no significant difference between shocking lead impedances measured with the high-energy shock or the subthreshold test pulses. This offers the possibility of noninvasive, low-energy serial measurements of shocking lead impedance at follow-up visits and removing the need for sedation

501. Reverse SG: **Rationale and design of a randomized controlled trial to assess the safety and efficacy of cardiac resynchronization therapy in patients with asymptomatic left ventricular dysfunction with previous symptoms or mild heart failure - the REsynchronization reVErses Remodeling in Systolic left vEntricular dysfunction (REVERSE) study.**
Abstract: Background Cardiac resynchronization therapy (CRT) improves symptoms, reduces heart failure (HF)-related hospitalizations, and reverses left ventricular remodeling in some patients with moderate to severe HF and ventricular dyssynchrony defined by a prolonged QRS duration. The effects of CRT on HF outcomes in patients with asymptomatic left ventricular dysfunction (ALVD) or mild HF remain to be determined.Methods The REsynchronization reVErses Remodeling in Systolic left vEntricular dysfunction (REVERSE) study is a prospective, multicenter, randomized, double-blind, parallel, controlled clinical trial designed to establish whether CRT combined with optimal medical treatment can attenuate HF disease progression compared with optimal medical treatment alone in patients with ALVD New York Heart Association class I American College of Cardiology/American Heart. Association stage C or New York Heart Association class II HF, QRS duration >= 120 milliseconds, left ventricular ejection fraction <= 0.40, and left ventricular end-diastolic diameter >= 55 mm. The primary end point is the HF clinical composite response and left ventricular end-systolic volume index is the first-order secondary end point.Approximately 500 patients from 100 centers in the United States, Canada, and Europe will be randomized to CRT versus no CRT. The follow-up is 5 years in total with the primary and first secondary end points reported at 12 months. Enrollment began in September 2004 and is expected to be completed in 2006.Conclusion REVERSE will assess the safety and efficacy of CRT in patients with ALVD or mild HF and electrocardiographic evidence of ventricular dyssynchrony

502. Reynolds MR, Cohen DJ, Kugelmass AD, Brown PP, Becker ER, Culler SD *et al*.: **The frequency and incremental cost of major complications among medicare beneficiaries receiving implantable cardioverter-defibrillators.** *Journal of the American College of Cardiology* 2006, 47(12)**:** 2493-2497.
Abstract: OBJECTIVES: We aimed to quantify the frequency and nature of early complications after implantable cardioverter-defibrillator (ICD) implantation in general practice, and estimate the incremental costs of those complications to the health care system. BACKGROUND: Cardioverter-defibrillator implantation rates are rising quickly. Little has been published regarding the outcomes and costs of these procedures in unselected populations. METHODS: Using Medicare Provider Analysis and Review (MedPAR) files, we identified 30,984 admissions containing procedure codes for new ICD or cardiac resynchronization therapy defibrillator implantation in fiscal year 2003. The frequencies of eight complicating diagnoses during these admissions were determined. Length of stay (LOS) and total hospital costs, derived using whole-hospital cost to charge ratios, were calculated for each admission. The incremental effects of any and each

complication on LOS and hospital cost were estimated in multivariable models, adjusting for demographic factors and comorbid conditions. RESULTS: The mean cost for all admissions was 42,184 dollars (median 37,902 dollars) with mean LOS of 4.7 days (median 2.0 days). One or more complications were coded in 10.8% of admissions, most commonly "mechanical complication of the ICD" and hemorrhage/hematoma. The occurrence of any complication increased adjusted LOS by 3.4 days and costs by 7,251 dollars. Each of the individual complications was associated with highly significant increases in both LOS (1 to 10 days) and hospital cost (5,000 dollars to 20,000 dollars). CONCLUSIONS: In fiscal 2003, 10.8% of Medicare patients undergoing cardioverter-defibrillator implantation experienced one or more early complications, associated with significant increases in LOS and costs. Efforts to reduce these complications could have significant clinical and financial benefits

503. Rhee EK: **Cardiac resynchronization therapy in pediatrics: emerging technologies for emerging indications.** *Current treatment options in cardiovascular medicine* 2005, 7(5)**:** 399-409.
Abstract: Cardiac resynchronization therapy (CRT) has become the standard of care for the treatment of heart failure in adults with decreased ventricular function and conduction delay who remain symptomatic despite optimal medical therapy. Indications for CRT in adults include medically refractory heart failure with a QRS duration of >or=120 msec and a left ventricular end-diastolic dimension of >or=55 mm with ejection fraction <or=35%. No such consensus guidelines exist in pediatrics; however, recent preliminary data indicate that CRT is effective therapy for symptomatic heart failure in children in both the acute postoperative setting as well as in the ambulatory setting. CRT is a viable therapeutic option in children with decreased ventricular function and ventricular conduction delay. It is preferable to high-dose inotropic therapy and should be given serious consideration for the treatment of refractory heart failure prior to proceeding with heart transplantation

504. Richardson K, Cook K, Wang PJ, Al-Ahmad A: **Loss of biventricular pacing: what is the cause?** *Heart rhythm - the official journal of the Heart Rhythm Society* 2005, 2(1)**:** 110-111.

505. Riedlbauchova L, Kautzner J, Fridl P: **Influence of different atrioventricular and interventricular delays on cardiac output during cardiac resynchronization therapy.** *Pacing and clinical electrophysiology - PACE* 2005, 28 Suppl 1 S19-S23.
Abstract: Restoration of the atrioventricular (AVD) and interventricular (VVD) delays increases the hemodynamic benefit conferred by biventricular (BiV) stimulation. This study compared the effects of different AVD and VVD on cardiac output (CO) during three stimulation modes: BiV-LV = left ventricle (LV) preceding right ventricle (RV) by 4 ms; BiV-RV = RV preceding LV by 4 ms; LVP = single-site LV pacing. We studied 19 patients with chronic heart failure due to ischemic or idiopathic dilated cardiomyopathy, QRS >/= 150 ms, mean LV end-diastolic diameter = 78 +/- 7 mm, and mean LV ejection fraction = 21 +/- 3%. CO was estimated by Doppler echocardiographic velocity time integral formula with sample volume placed in the LV outflow tract. Sets of sensed-AVDs (S-AVD) 90-160 ms, paced-AVDs (P-AVD) 120-160 ms, and VVDs 4-20 ms were used. BiV-RV resulted in lower CO than BiV-LV. S-AVD 120 ms and P-AVD 140 ms caused the most significant increase in CO for all three pacing modes. LVP produced a similar increase in CO as BiV stimulation; however, AV sequential pacing was associated with a nonsignificantly higher CO during LVP than with BiV stimulation. CO during BiV stimulation was the highest when LV preceded RV, and VVD ranged between 4 and 12 ms. The most negative effect on CO was observed when RV preceded LV by 4 ms. Hemodynamic improvement during BiV stimulation was dependent both on optimized AVD and VVD. LV preceding RV by 4-12 ms was the most optimal. Advancement of the RV was not beneficial in the majority of patients

506. Rioual K, Unanua E, Laguitton S, Garreau M, Boulmier D, Haigron P *et al*.: **MSCT labelling for pre-operative planning in cardiac resynchronization therapy.** *Computerized medical imaging and graphics - the official journal of the Computerized Medical Imaging Society* 2005, 29(6)**:** 431-439.
Abstract: The objective of this paper is twofold: (i) to show how multislice computed tomography (MSCT) data sets bring the information required for cardiac resynchronisation therapy (CRT) planning; (ii) to demonstrate the feasibility of 3D navigation into the veins where left ventricular leads have to be placed. The former has been achieved by exploring and labelling the cardiac structures of concern, the latter has been performed by using the concept of virtual navigation with high resolution surface detection and estimation algorithms

507. Ritter O, Koller ML, Fey B, Seidel B, Krein A, Langenfeld H *et al*.: **Progression of heart failure in right univentricular pacing compared to biventricular pacing.** *International journal of cardiology* 2006, 110(3)**:** 359-365.
Abstract: BACKGROUND: Cardiac resynchronization therapy (CRT) improves hemodynamics and symptoms of heart failure by reducing ventricular dyssynchronity. Conversely, recent studies have demonstrated that right univentricular pacing in patients with an ejection fraction below 40% aggravates heart failure. In this retrospective study, we compared progression of disease in patients with mild to moderate heart failure that were treated with a right univentricular pacing device and patients with congestive heart failure that were treated with a biventricular system. METHODS: 107 patients were included. 59 received a right ventricular pacing device and 48 a biventricular system. Patients were assessed after 1 and 6 months by NYHA class, echocardiographic parameters (EF, LVEDD) and hospitalization for heart failure. RESULTS: Hospitalization for heart failure after implantation of the devices was more frequent in patients that received a conventional pacemaker with a single lead in the right ventricle than in patients that were treated with a CRT system (12% vs. 6%, $p<0.05$), although heart failure was more advanced in the CRT group at baseline. Ejection fraction in the right ventricular pacing group further decreased from 43%+/-4 at baseline to 38%+/-4 after 6 months ($p<0.05$). Left ventricular enddiastolic diameter (LVEDD) was 51+/-7 mm and 58+/-6 mm ($p<0.05$) at 6 months. In the CRT group, EF was 23%+/-4 at baseline and 31%+/-7 after 6 months ($p<0.05$.). LVEDD improved from 56+/-4 mm before implantation to 52+/-7 mm and 6 months ($p<0.05$). CONCLUSION: Progression of heart failure symptoms in the right univentricular pacing group was more pronounced compared to the CRT group, despite the fact that patients assigned to the CRT group had more severe symptoms of heart failure at baseline. Biventricular pacing relieved symptoms of heart failure, whereas right univentricular pacing with subsequent conduction delay of the left ventricle further deteriorated pre-existing heart failure. Therefore, patients with an indication for pacemaker therapy because of bradycardia and co-existing mild to moderate heart failure might benefit from early implantation of a CRT system

508. Rivera DA, Bristow MR: **Cardiac resynchronization--a heart failure perspective.** *Annals of noninvasive electrocardiology - the official journal of the International Society for Holter and Noninvasive Electrocardiology, Inc* 2005, 10(4 Suppl)**:** 16-23.
Abstract: Over the past 15-20 years the development of new heart failure pharmacologic therapy has lowered mortality by 30-40% for this serious and prevalent clinical syndrome, within clinical trials conducted in patients with a dilated cardiomyopathy phenotype. However, over the past 5 years progress in the development of additional effective drugs has slowed, in part due to the success of neurohormonal inhibitors, on which background new therapies must be developed. That there is not an absolute ceiling on the development of new heart failure therapies has been convincingly recently demonstrated in electrophysiologic device trials, conducted on the background of maximal neurohormonal inhibition. Two trials, COMPANION and CARE-HF, have demonstrated unambiguously that in advanced heart failure patients with a marker of mechanical intraventricular dyssynchrony, increased QRS duration, cardiac resynchronization therapy in the form of

biventricular pacing can improve major clinical outcomes including mortality. In addition, COMPANION also demonstrated that the addition of an ICD further improved mortality reduction, by lowering the incidence of sudden death. These trials indicate that device/drug therapy is at least additive in the treatment of heart failure, and they herald a new era in the multi-modality approach to therapeutics

509. Rivero-Ayerza Maximo R, Theuns DA, Boersma E, Jordaens LJ: **Effects of cardiac resynchronization therapy alone on all cause mortality and heart failure hospitalizations. A meta-analysis of randomized controlled trials.**

510. Robledo Nolasco Rogelio R, Ruiz Soto JC, Mendez EF, Trujillo CR, Blanco CM: **Association of biventricular resynchronizer and implantable cardioverter defibrillator**
<ORIGINAL> Asociacion de resincronizador biventriculary desfibrilador cardioverter automatico implantable.
Abstract: Congestive heart failure (HF) remains a major and growing public health problem despite recent therapeutical developments. Thirty to sixty percent of patients with dilated cardiomyopathy (DCM) die suddenly from cardiac arrhythmias. Cardiac resynchronization therapy (CRT) and implantable cardioverter defibrillator (ICD) therapy are effective treatments for HF with a wide QRS and for ventricular arrhythmias respectively. Several trials are currently being performer to evaluate the cardiac resynchronization and implantable cardioverter defibrillator therapy with good results. The objective of this paper is to report the first three patients, in Mexico, that have received this combined therapy. In one patient, a three cameral pacemaker was associated with a unicameral ICD and the other two received a device with both functions. Patients were men, aged 63, 65, and 54 years, two of them with previous myocardial infarct and functional class II to IV of the NYHA. Left ventricular ejection fraction was of 25% in two patients and of 35% in the other. All patients improved their functional class and LVFE, two patients presented discharges of the ICD

511. Robledo NR, Ruiz Soto JC, Mendez EF, Trujillo CR, Blanco CM: **[Association of biventricular resynchronizer and implantable cardioverter defibrillator] <Original> Asociacion de resincronizador biventricular y desfibrilador cardioverter automatico implantable.** *Archivos de cardiologia de Mexico* 2005, 75 Suppl 3 S3-95.
Abstract: Congestive heart failure (HF) remains a major and growing public health problem despite recent therapeutical developments. Thirty to sixty percent of patients with dilated cardiomyopathy (DCM) die suddenly from cardiac arrhythmias. Cardiac resynchronization therapy (CRT) and implantable cardioverter defibrillator (ICD) therapy are effective treatments for HF with a wide QRS and for ventricular arrhythmias respectively. Several trials are currently being performer to evaluate the cardiac resynchronization and implantable cardioverter defibrillator therapy with good results. The objective of this paper is to report the first three patients, in Mexico, that have received this combined therapy. In one patient, a three cameral pacemaker was associated with a unicameral ICD and the other two received a device with both functions. Patients were men, aged 63, 65, and 54 years, two of them with previous myocardial infarct and functional class II to IV of the NYHA. Left ventricular ejection fraction was of 25% in two patients and of 35% in the other. All patients improved their functional class and LVFE, two patients presented discharges of the ICD

512. Rom R, Erel J, Glikson M, Rosenblum K, Ginosar R, Hayes DL: **Adaptive cardiac resynchronization therapy device: a simulation report.** *Pacing and clinical electrophysiology - PACE* 2005, 28(11)**:** 1168-1173.
Abstract: We report the results of a simulation of an adaptive cardiac resynchronization therapy (CRT) device performing biventricular pacing in which the atrioventricular (AV) delay and interventricular (VV) interval parameters are changed dynamically in response to data provided by the simulated IEGMs and simulated hemodynamic sensors. A learning

module, an artificial neural network, performs the adaptive part of the algorithm supervised by an algorithmic deterministic module, internally or externally from the implanted CRT or CRT-D. The simulated cardiac output obtained with the adaptive CRT device is considerably higher (30%) especially with higher heart rates than in the nonadaptive CRT mode and is likely to be translated into improvement in quality of life of patients with congestive heart failure

513. Romers H, Bracke FA, Meijer A, Van Gelder BM: **Preservation of ventricular capture by anodal stimulation after dislodgment of an epicardial electrode.** *Pacing and clinical electrophysiology - PACE* 2006, 29(1)**:** 99-101.
Abstract: A 58-year-old man had a bipolar epicardial left ventricular (LV) implanted for cardiac resynchronization therapy after a failed transvenous approach. The system was programmed in an LV tip-right ventricular coil configuration, but during follow-up loss of LV capture with recurrence of symptoms occurred. Changing to an LV tip-LV ring configuration restored LV pacing through anodal capture. Loss of cathodal capture was caused by dislodgment of the cathodal electrode due to a broken fixation suture. Anodal capture was used to reinstall resynchronization therapy, which resulted in clinical improvement. There were no adverse effects from anodal stimulation in a follow-up period of 6 months

514. Romeyer-Bouchard C, Da CA, Abdellaoui L, Messier M, Thevenin J, Afif Z *et al*.: **Simplified cardiac resynchronization implantation technique involving right access and a triple-guide/single introducer approach.** *Heart rhythm - the official journal of the Heart Rhythm Society* 2005, 2(7)**:** 714-719.
Abstract: BACKGROUND: Biventricular pacing is useful for patients with congestive heart failure but has the disadvantage of being a long, user-dependent, highly technical procedure. OBJECTIVES: The purpose of this study was to simplify the procedure. The simplified technique consists of sinus (CS) venography prior to implantation, direct coronary access for the left ventricular (LV) lead without use of a left-heart delivery system, and triple-guide/one introducer cephalic vein access as the first approach in patients presenting in sinus rhythm. METHODS: A cephalic cutdown was performed, and a steerable hydrophilic guidewire was introduced in the cephalic vein. A 9Fr introducer was advanced over the guidewire, and two other guides were inserted through the introducer. This technique allowed for insertion of a right ventricular lead, an LV lead, and an atrial lead. RESULTS: One hundred three patients were evaluated from January 2002 to September 2004. Four implants failed (3.9%). The 7Fr LV lead was successfully placed in 99 of 103 patients (96.1%) directly via the 9Fr introducer, without use of a dedicated left-heart delivery system. The final position was lateral in 59 patients, posterolateral in 33, posterior in 4, and anterolateral in 3. Sixty patients were in sinus rhythm, 13 were in atrial fibrillation, and 26 had a previous pacemaker (n = 21) or defibrillator (n = 5). Triple cephalic vein access was possible in 48 of the patients in sinus rhythm (80%). Procedure parameters were as follows: LV threshold 0.9 +/- 0.7 V, LV wave amplitude 15 +/- 8 mV, LV impedance 790 +/- 232 Omega, skin-to-skin procedure time 76 +/- 33 minutes, and fluoroscopy time 23 +/- 19 minutes. Ten complications (10.1%) occurred: 7 lead dislodgments (3 within 48 hours and 4 within 6 months) requiring repositioning (7.1%), 1 subacute local infection requiring explantation (1%), 1 phrenic nerve stimulation (1%), and 1 pneumothorax (1%). The long-term success of biventricular pacing was 93.1%. CONCLUSIONS: This study demonstrates that cardiac resynchronization therapy implantation can be simplified with the combined use of a steerable hydrophilic guidewire, three guides, and one introducer via a right cephalic vein, without use of a left-heart delivery system. The triple cephalic vein approach yields an 80% implant success rate for patients in sinus rhythm. The long-term success of biventricular pacing was 93.1%

515. Roosevelt GF, Chase K, Mullin CM: **Predictive value of HRV footprint and SDANN on mortality for cardiac resynchronization therapy patients.**

516. Rosanio S, Schwarz ER, Ahmad M, Jammula P, Vitarelli A, Uretsky BF *et al*.: **Benefits, unresolved questions, and technical issues of cardiac resynchronization therapy for heart failure.** *American journal of cardiology* 2005, 96(5)**:** 710-717.
Abstract: This review aims to provide a synthesis of the published evidence regarding the rationale and clinical benefits of cardiac resynchronization therapy (CRT) with implantable atrial-synchronized biventricular pacing (BVP) devices in patients with moderate to advanced heart failure and intra- and interventricular conduction delays. In addition, it addresses clinical and technical issues that have yet to be resolved, such as the selection of the most suitable candidates for CRT; the usefulness of combining BVP with automatic defibrillation backup; the value of CRT in patients with atrial fibrillation; the importance of alternative sites of pacing, such as the atrial septum and the right ventricular (RV) outflow tract; the harmful effects of the long-standing practice of producing an iatrogenic left bundle branch block by conventional RV pacing in patients receiving standard permanent pacemakers; the question of precisely where on the left ventricle optimal pacing is achieved; and the potential applications of CRT in patients with pediatric or congenital heart disease. Considering how major advances have been achieved since the first clinical application of CRT in 1994, one can be optimistic about the future of the electrotherapeutic management of heart failure

517. Rouleau J: **Treatment of congestive heart failure: present and future.** *Canadian journal of cardiology* 2005, 21(12)**:** 1084-1088.
Abstract: The treatment of patients with congestive heart failure has markedly improved over the past 25 years. The most successful therapy has been attenuation of neurohumoral overactivation with antagonists of the renin-angiotensin-aldosterone system, as well as beta-adrenergic blockade. Cardiac surgical interventions, which include not only aortocoronary artery bypass surgery but also interventions that remodel the heart and repair the mitral valve, have also been advocated. However, randomized clinical trials to prove their benefit and to identify which patients could derive the most benefit from these interventions are lacking. Cardiac devices, such as biventricular pacemakers (for cardiac resynchronization) and implantable cardiac defibrillators, have proved useful in improving survival and quality of life. The treatment of sleep apnea with continuous positive airway pressure has shown some promise, as has immune modulation therapy, but more research to conclusively prove their efficacy is necessary. Cell therapy with skeletal myoblasts or pluripotential stem cells is an interesting and emerging area of research that shows enormous promise. However, fundamental questions regarding the optimal use of this therapy remain unanswered. Finally, although exciting, these developments, along with the changing demographics of the Canadian population, will require a change in the way we provide care for patients with congestive heart failure. These changes will require greater involvement of health care professionals other than physicians, and greater emphasis on outpatient care, early detection and prevention, and evidence-based practice

518. rzola-Castaner D, Taub C, Kevin HE, Fan D, Haelewyn K, Mela T *et al*.: **Left ventricular lead proximity to an akinetic segment and impact on outcome of cardiac resynchronization therapy.** *Journal of cardiovascular electrophysiology* 2006, 17(6)**:** 623-627.
Abstract: BACKGROUND: Previous studies report that the optimal pacing site for cardiac resynchronization therapy (CRT) is along the left ventricular (LV) lateral and postero-lateral (PL) wall. However, little is known regarding whether pacing over an akinetic site impacts the contractile response and long-term outcome from CRT. METHODS AND RESULTS: A total of 38 patients with ischemic cardiomyopathy were studied for their acute hemodynamic and 12-month clinical response to CRT. The intraindividual percentage change in dP/dt (%DeltadP/dt), over baseline, was derived from the mitral regurgitation (MR) Doppler profile with CRT on versus off. Two-dimensional echocardiography was used for myocardial segmentation and determinination of akinetic sites. LV lead implant site was determined using angiographic and radiographic data and categorized as being "on" (group 1) or "off" (group 2) an akinetic site. Long-term response

was measured as a combined endpoint of hospitalization for heart failure and/or all cause mortality at 12 months. Time to primary endpoint was estimated by the Kaplan-Meier method. Clinical characteristics and acute hemodynamic response was similar in both (group 1 [n = 14]; %DeltadP/dt 48.8 +/- 67.4% vs group 2 [n = 24]; %DeltadP/dt 32.2 +/- 40.1%, P = 0.92). No difference in long-term outcome was observed (P = 0.59). In contrast, lead placement in PL or mid-lateral (ML) positions was associated with a better acute hemodynamic response when compared to antero-lateral (AL) positions (PL, %DeltadP/dt 45.7 +/- 50.7% and ML, %DeltadP/dt 45.1 +/- 58.8% vs AL, %DeltadP/dt 2.9 +/- 30.9%, respectively, P = 0.014). CONCLUSION: LV lead proximity to an akinetic segment does not impact acute hemodynamic or 12-month clinical response to CRT

519. Saba S, Baker L, Ganz L, Barrington W, Jain S, Ngwu O *et al*.: **Simultaneous atrial and ventricular anti-tachycardia pacing as a novel method of rhythm discrimination.** *Journal of cardiovascular electrophysiology* 2006, 17(7)**:** 695-701.
Abstract: OBJECTIVE: To evaluate a new discrimination algorithm for supraventricular (SVT) and ventricular (VT) tachycardias, based on the response to simultaneous (A+V) atrial (A) and ventricular (V) anti-tachycardia pacing (ATP). METHODS: Patients undergoing electrophysiological testing or dual-chamber implantable cardioverter-defibrillator (ICD) implantation were enrolled (N = 32) and underwent A+V ATP through a Marquis ICD with investigational software. If persisting after ATP, the rhythm was classified as VT if the first electrical event was sensed on the V channel and as an SVT otherwise. RESULTS: Arrhythmia sequences (N = 275; 53 VT; 222 SVT) were analyzed in 26 patients (age = 51 +/- 17 years, 13 men, LVEF = 0.49 +/- 0.14). In response to A+V ATP, 55% of SVT versus 41% of VT episodes were terminated (P = NS). Termination of VT but not of SVT was more likely with faster (50% at ATP/arrhythmia cycle length (CL) = 0.81 vs 8% at ATP/arrhythmia CL = 0.88, P = 0.02) but not with longer ATP bursts (P = NS). Of the 115 arrhythmias that persisted after A+V ATP, the algorithm correctly classified 24 of 24 VT (GEE-adjusted sensitivity = 100%) and 85 of 91 SVT (GEE-adjusted specificity = 93%). Proarrhythmia was noted after two A+V ATP, in the form of atrial fibrillation induction and VT acceleration. CONCLUSIONS: We describe a new algorithm that can discriminate between SVT and VT with a high sensitivity and specificity. This form of ATP can terminate 55% of SVT sequences. The performance of this new algorithm merits further testing in a large population of dual-chamber ICD patients

520. Sade LE, Ozin B, Muderrisog c: **Echocardiographic evaluation of regional mechanical dyssynchrony and candidates for cardiac resynchronization therapy <Original> Kalpte bolgesel mekanik senkronizasyon bozuklug(Caron)Unun ve resenkronizasyon tedavisine aday hastalarin ekokardiyografi ile deg(Caron)Erlendirilmesi.** *Turk Kardiyoloji Dernegi Arsivi (TURK KARDIYOL DERNEGI ARS)* /20, TURK.
Abstract: AB- Biventricular pacemaker is a novel alternative approach in the management of patients with end-stage refractory heart failure. The fact that regional mechanical dyssynchrony is the major determinant in the selection of candidates for cardiac resynchronization therapy and that QRS duration is not a reliable marker of the regional mechanical dyssynchrony has expanded the role of echocardiography in this field. Echocardiography enables non-invasive quantification of both the hemodynamic status and regional left ventricular contractile function. Conventional echocardiography combined with two-dimensional and tissue Doppler modalities proved to be useful in the assessment of regional mechanical dyssynchrony and atrioventricular, interventricular, and intraventricular delays. Hence, echocardiography has become an indispensable imaging guide to cardiac resynchronization therapy for patient selection, evaluation of the response to resynchronization, and optimal lead localization

521. Saeed Mohammad R, Hakeem A: **Head faiure therapy - Moving from drugs to devices.**

522. Sakamoto S, Matsubara J, Nagayoshi Y, Nishizawa H, Takeuchi K, Nonaka T: **Clinical evaluation of combination therapy for biventricular pacing after cardiac surgery in patients with intractable heart failure.** *Annals of thoracic and cardiovascular surgery - official journal of the Association of Thoracic and Cardiovascular Surgeons of Asia* 2005, 11(6)**:** 408-412.
Abstract: We examined the effectiveness of combination therapy for biventricular pacing after cardiac surgery. We performed biventricular pacing in seven patients until April 2003. The diagnosis of the patients was ischemic cardiomyopathy (ICM) in four patients and dilated cardiomyopathy (DCM) in three patients. The implantation method of biventricular pacing was performed with a myocardial electrode through a median sternotomy. DDD-R and SSI-R were used to perform biventricular pacing. A Y-adapter was connected to a generator so that the 2 leads could be implanted in both the right ventricles (RV) and left ventricles (LV). The clinical symptoms were New York Heart Association (NYHA) classification of 3.7+/-0.3 preoperatively and 1.8+/-0.6 postoperatively, showing a significant improvement ($p<0.001$). The cardiac index (CI) was 1.9+/-0.2 L/min/m2 preoperatively and 3.0+/-0.6 L/min/m2 postoperatively ($p<0.05$). The pulmonary capillary wedge pressure (PCWP) was 19.5+/-2.6 mmHg preoperatively and 13.6+/-2.0 mmHg postoperatively, showing a significant improvement ($p<0.05$). The intracardiac potential and threshold values were: left atrium 1.9+/-1.0 mV, threshold value (PW: 0.45 msec) 2.1+/-0.6 V, LV 4.9+/-4.23 mV, threshold value (PW: 0.45 msec) 2.2+/-1.51 V, and RV 3.6+/-0.9 V, threshold value (PW: 0.45 msec) 2.0+/-0.7 V. The LV and RV threshold values were high. The QRS interval improved from 158.4+/-18.0 msec preoperatively to 110+/-13.4 msec postoperatively, showing a significant reduction. This combination therapy when compared to the use of the biventricular pacing method used at the current time, does have the risks of cardiac surgery, but the clinical symptoms and hemodynamic performance improvement are great

523. Saksena S: **Prophylactic ICDs: Can (and will) the medical marketplace decide their role?** *Journal of Interventional Cardiac Electrophysiology (J INTERVENT CARD ELECTROPHYSIOL)* /20, J.

524. Salukhe T, V, Francis DP, Clague JR, Sutton R, Poole-Wilson P, Henein MY: **Chronic heart failure patients with restrictive LV filling pattern have significantly less benefit from cardiac resynchronization therapy than patients with late LV filling pattern.** *International journal of cardiology* 2005, 100(1)**:** 5-12.
Abstract: BACKGROUND: Cardiac resynchronization fails to improve symptoms in up to one third of patients meeting criteria for this treatment, for reasons which are unclear. Indeed, the very mechanism of benefit from resynchronization is controversial. Resynchronization may work by improving ventricular filling: we tested the hypothesis that benefit from resynchronization depends on filling pattern. METHODS AND RESULTS: We assessed symptoms (NYHA class) and LV filling of 40 patients with chronic heart failure and prolonged QRS who underwent resynchronization. Fifteen had restrictive filling pattern (E velocity>or=1.0 m/s, E/A ratio>1 and E wave deceleration time<or=140 ms) and 25 had late filling pattern (single isolated A wave or summation wave filling in late diastole). At 6 months, the patients with restrictive filling failed to show the improvements observed in those with late filling. They failed to reduce NYHA class (DeltaNYHA: 27% improved one class, 66% unchanged, 7% worsened one class, P=NS; vs. 8% improved two classes, 72% improved one class and 20% unchanged, $P<0.001$; difference between groups, $P<0.001$). They failed to reduce LV end-diastolic dimension (DeltaLVEDD -0.04 cm, P=NS; vs. -0.6, $P<0.001$; difference between groups, $P<0.05$) or end-systolic dimension (DeltaLVESD -0.01 cm, P=NS; vs. -0.6, $P<0.001$; difference between groups, $P<0.05$). They failed to improve cardiac cycle efficiency (Deltatotal isovolumic [wasted] time 2.1 s/min, P=NS; vs. -5.4 s/min; difference between groups, $P<0.001$). CONCLUSION: Among patients routinely eligible for resynchronization, those with restrictive filling may show significantly less (and possibly no) improvement in

symptom class and ventricular dimensions after resynchronization. Their failure to improve cardiac cycle efficiency may account for their attenuated clinical benefit

525. Salukhe T, V, Francis DP, Morgan M, Clague JR, Sutton R, Poole-Wilson P *et al*.: **Mechanism of cardiac output gain from cardiac resynchronization therapy in patients with coronary artery disease or idiopathic dilated cardiomyopathy.** *American journal of cardiology* 2006, 97(9)**:** 1358-1364.
Abstract: The mechanisms underlying cardiac resynchronization therapy have consistently been studied at rest and remain ill defined. Peak stress total isovolumic time (t-IVT) is a major determinant of cardiac output (CO) in chronic heart failure. In this study, pharmacologic stress was used to assess the effects of atrioventricular (AV) delay shortening and ventricular resynchronization elements of cardiac resynchronization therapy. Thirty patients undergoing cardiac resynchronization therapy were studied <6 months after implantation. t-IVT and CO were measured during native activation (left bundle branch block), AV delay shortening (right ventricular dual-chamber pacing), and full resynchronization (atrio-biventricular pacing). Full resynchronization shortened peak stress t-IVT by 9.4 +/- 6.2 s/min ($p < 0.001$) and increased peak stress CO by 0.9 +/- 0.4 L/min ($p < 0.001$), with the effects in individual patients showing a large correlation ($r = -0.64$, $p < 0.001$). In contrast, simple AV delay shortening did not shorten peak stress t-IVT nor increase peak stress CO, nor was CO at rest affected by full resynchronization or AV delay shortening. Of all measurements during native activation, the best predictor of gain in peak stress CO from full resynchronization was peak stress t-IVT ($r = 0.75$, $p < 0.001$), with every 5 s/min increment in peak stress t-IVT during native activation predicting a 6% gain in peak stress CO. No conventional measures during native activation at rest or during stress (including QRS duration, the Tei index, tissue Doppler intraventricular delay, and t-IVT at rest) added significant additional information. In conclusion, only during stress does resynchronization consistently increase CO. Second, little of this increment in CO is achieved by AV delay shortening alone. Third, under native activation, long t-IVT during peak stress is the single best predictor of resynchronization-mediated increment in peak stress CO

526. Santangelo L, Ammendola E, Russo V, Cavallaro C, Vecchione F, Garofalo S *et al*.: **Influence of biventricular pacing on myocardial dispersion of repolarization in dilated cardiomyopathy patients.** *Europace - European pacing, arrhythmias , and cardiac electrophysiology - journal of the working groups on cardiac pacing, arrhythmias , and cardiac cellular electrophysiology of the European Society of Cardiology* 2006, 8(7)**:** 502-505.
Abstract: AIMS: The aim of our study was to evaluate the effect of cardiac resyncronization therapy on QT dispersion (QTd), JT dispersion (JTd), and transmural dispersion of repolarization (TDR), markers of heterogeneity of ventricular repolarization in a study population with severe heart failure. METHODS AND RESULTS: Fifty patients (43 male, 7 female, age 60.2+/-3.1 years) suffering from congestive heart failure (n=39 NYHA class III; n=11 NYHA class IV) as a result of coronary artery disease (n=19) or of dilated cardiomyopathy (n=31), with sinus rhythm (SR), QRS duration >120 ms (mean QRS duration=156+/-21 ms), an ejection fraction <35%, left ventricular end-diastolic diameter >55 mm, presence of atrioventricular asynchrony, intra- and inter-ventricular asynchrony, underwent permanent biventricular pacemaker implantation. A 12-lead standard electrocardiogram was performed at baseline, during right-, left-, and biventricular pacing (BiVP) and QTd, JTd, and TDR were assessed. BiVP significantly reduced QTd (73.93+/-19.4 ms during BiVP vs. 91+/-6.7 ms in SR, P=0.004), JTd (73.18+/-17.16 ms during BiVP vs. 100.72+/-39.04 at baseline, P=0.003), TDR (93.16+/-15.60 vs. 101.55+/-19.08 at baseline, P<0.004), compared with SR. Right ventricular endocardial pacing and left ventricular epicardial pacing both increased QTd (RVendoP 94+/-51 ms, P<0.03; LVepiP 116+/-71 ms, P<0.02), and TDR (RVendoP 108.13+/-19.94 ms, P<0.002; LVepiP 114.71+/-26.1, P<0.05). There was no effect on JTd during right and left ventricular stimulation. CONCLUSIONS: BiVP causes a statistically significant reduction of

ventricular heterogeneity of repolarization and has an electrophysiological anti-arrhythmic influence on the arrhythmogenic substrate of dilated cardiomyopathy

527. Santini M, Brachmann J, Cappato R, Davies W, Farre J, Levy S *et al*.: **Recommendations of the European cardiac arrhythmia society committee on device failures and complications.** *PACE - Pacing and Clinical Electrophysiology (PACE PACING CLIN ELECTROPHYSIOL)* /20, ACE.

528. Sarzi BS, La Rovere MT, Pedretti RFE: **Baroreflex sensitivity normalization after cardiac resynchronization therapy [2].** *International Journal of Cardiology (INT J CARDIOL)* /20, INT.

529. Sarzi BS, La Rovere MT, Pedretti Roberto FE: **Baroreflex sensitivity normalization after cardiac resynchronization therapy.** *International journal of cardiology* 2006, 109(1)**:** 118-120.

530. Satish OS, Yeh K, Wen M, Wang C: **Cardiac resynchronisation therapy versus dual site right ventricular pacing in a patient with permanent pacemaker and congestive heart failure.** *Europace - European pacing, arrhythmias , and cardiac electrophysiology - journal of the working groups on cardiac pacing, arrhythmias , and cardiac cellular electrophysiology of the European Society of Cardiology* 2005, 7(4)**:** 380-384.
Abstract: A 46-year-old male patient who had long-term right ventricular (RV) pacing for symptomatic complete heart block, initially by an epicardial, later with an endocardial pacing lead at the RV apex, developed congestive heart failure (CHF) and chronic atrial fibrillation 7 years following the pacemaker implantation and was medically treated. During follow-up, his pacemaker was upgraded to a cardiac resynchronisation therapy (CRT) device, because of uncontrolled CHF symptoms, New York Heart Association (NYHA) functional class IV, while on drugs. The patient's symptomatic status improved to NYHA functional class II with CRT. After 17 months of CRT, the battery became depleted, because of the high capture threshold of the left ventricular lead. The patient was then given dual site RV pacing (RV outflow tract+RV apex) in place of CRT, which showed similar efficacy at 12 weeks follow-up

531. Sauer WH, Sussman JS, Verdino RJ, Cooper JM: **Increasing left ventricular pacing output decreases interventricular conduction time in patients with biventricular pacing systems.** *Pacing and clinical electrophysiology - PACE* 2006, 29(6)**:** 569-573.
Abstract: OBJECTIVE: To evaluate the effect of increasing LV pacing output on interventricular timing in patients with biventricular pacing systems. BACKGROUND: Clinical improvement with biventricular pacing is likely related to reduction in ventricular dysynchrony in patients with cardiomyopathy. We hypothesized that increasing left ventricular pacing output would reduce interventricular conduction time and could affect ventricular synchrony. METHODS: Forty-two sequential patients with biventricular pacing systems that permitted independent LV pacing were selected at the time of routine device interrogation. The interval between LV pacing stimulus and onset of the RV electrogram was measured during LV pacing at capture threshold and at maximum pacing output for each patient. RESULTS: The average time from LV pacing stimulus to right ventricular electrogram onset was 142.5 +/- 32.5 ms (range 90-230 ms) at threshold and 132.3 +/- 30.4 ms (range 90-220 ms) at maximum pacing output, with a mean decrease in conduction time of 10.2 +/- 10.9 ms (range 0-45 ms). There was significantly greater interventricular conduction shortening with increased pacing output in patients with ischemic cardiomyopathy compared to others (14.9 +/- 11.9 ms vs 4.0 +/- 4.6 ms; $P < 0.01$). CONCLUSIONS: Conduction time from LV to RV shortens as LV pacing output is increased. This effect is seen to a greater degree in patients with ischemic cardiomyopathy, possibly related to the presence of myocardial scar near the pacing electrode. Further investigation is needed to assess the clinical outcomes related to this new method for optimizing resynchronization therapy

532. Saxon LA, Greenfield RA, Crandall BG, Nydegger CC, Orlov M, Van GR: **Results of the multicenter RENEWAL(R) 3 AVT clinical study of cardiac resynchronization defibrillator therapy in patients with paroxysmal atrial fibrillation.** *Journal of Cardiovascular Electrophysiology (J CARDIOVASC ELECTROPHYSIOL)* /20, J.
Abstract: AB- Introduction: Atrial fibrillation impacts the clinical course of up to 50% of patients with advanced heart failure (HF) who are eligible for cardiac resynchronization therapy with a defibrillator (CRT-D). While RV-based defibrillators are available with advanced atrial diagnostics and therapies that provide rapid diagnosis and treatment of spontaneously occurring atrial tachycardia/fibrillation (AT/AF) episodes, there is no CRT-D device that combines atrial/ventricular and CRT therapies. Purpose: The purpose of the prospective multicenter RENEWAL(R) 3 AVT study is to assess the performance of atrial diagnostics and therapies used in combination with a CRT-D device. Methods: Enrolled patients were required to have indications for a CRT-D device and a documented episode of AT/AF within 12 months of enrollment. A total of 170 patients were enrolled over 9 months (85% male; mean age 72 +/- 10 years; NYHA classification: 88% III, 12% IV; left ventricular ejection fraction [LVEF] mean 23 +/- 6%; mean QRS duration 150 +/- 25 msec; 78% ischemic etiology). The documented atrial arrhythmia was AF in 77% of patients. A total of 60% of patients had the CRT-D device placed for primary prevention of sudden death and 40% of patients had a history of ventricular arrhythmia in addition to HF. The device operates in the biventricular (BiV) triggered mode for sensed ventricular events associated with AF. Results: A total of 159 patients (95%) had a successful CRT-D implant. Over a mean follow-up of 5.7 +/- 2.3 months, there were a total of 152 atrial shocks delivered in 108 patients for induced (93%) or spontaneous (7%) occurring episodes of AF. Spontaneously occurring AF was observed in 40 patients (25%). The rate of first shock conversion was 118/152 (78%, mean energy 11.6 +/- 5.9 J). Overall shock therapy conversion rate was 138/152 (91%). The number of shock conversions resulting in sinus rhythm maintained for at least 2 minutes postshock was 87% for induced episodes. Therapy was delivered for spontaneous ventricular tachycardia/fibrillation in nine patients (6%). There was no instance of ventricular proarrhythmia associated with atrial shock therapies, undersensing of ventricular arrhythmias, or interruption of CRT therapy associated with the combined device. Conclusions: In CRT-D candidates with a history of AF, 25% experience recurrent AF within 6 months of implant. Atrial detection and ventricular detection, shock, and resynchronization therapies are not compromised by the addition of atrial therapies to a CRT-D device

533. Saxon L: **Delayed defibrillation testing after CRT-D implant-weighing competing risks.** *Journal of cardiovascular electrophysiology* 2005, 16(12)**:** 1284-1285.

534. Saxon LA: **Sudden cardiac death: epidemiology and temporal trends.** *Reviews in cardiovascular medicine* 2005, 6 Suppl 2 S12-S20.
Abstract: Sudden cardiac death (SCD) now accounts for more than half of all coronary heart disease deaths in the United States. The majority of cases are due to underlying coronary artery disease, and deaths from both coronary artery disease and SCD have declined markedly over the past several decades due to improved primary and secondary prevention and treatment strategies. This review examines the current statistics on the prevalence of SCD, and identifies those patients at greatest risk. It also discusses existing tests and treatments, including medication that results in neurohormonal antagonism, and devices such as the implantable cardioverter defibrillator (ICD) and cardiac resynchronization therapy with a defibrillator (CRT-D). Along with increased public awareness of SCD as a major health risk, physicians are advised to implement proven effective drug and devices that can improve survival

535. Saxon LA, Greenfield RA, Crandall BG, Nydegger CC, Orlov M, VAN GR: **Results of the multicenter RENEWAL 3 AVT clinical study of cardiac resynchronization defibrillator therapy in patients with paroxysmal atrial fibrillation.** *Journal of cardiovascular electrophysiology* 2006, 17(5)**:** 520-525.

Abstract: INTRODUCTION: Atrial fibrillation impacts the clinical course of up to 50% of patients with advanced heart failure (HF) who are eligible for cardiac resynchronization therapy with a defibrillator (CRT-D). While RV-based defibrillators are available with advanced atrial diagnostics and therapies that provide rapid diagnosis and treatment of spontaneously occurring atrial tachycardia/fibrillation (AT/AF) episodes, there is no CRT-D device that combines atrial/ventricular and CRT therapies. PURPOSE: The purpose of the prospective multicenter RENEWAL 3 AVT study is to assess the performance of atrial diagnostics and therapies used in combination with a CRT-D device. METHODS: Enrolled patients were required to have indications for a CRT-D device and a documented episode of AT/AF within 12 months of enrollment. A total of 170 patients were enrolled over 9 months (85% male; mean age 72 +/- 10 years; NYHA classification: 88% III, 12% IV; left ventricular ejection fraction [LVEF] mean 23 +/- 6%; mean QRS duration 150 +/- 25 msec; 78% ischemic etiology). The documented atrial arrhythmia was AF in 77% of patients. A total of 60% of patients had the CRT-D device placed for primary prevention of sudden death and 40% of patients had a history of ventricular arrhythmia in addition to HF. The device operates in the biventricular (BiV) triggered mode for sensed ventricular events associated with AF. RESULTS: A total of 159 patients (95%) had a successful CRT-D implant. Over a mean follow-up of 5.7 +/- 2.3 months, there were a total of 152 atrial shocks delivered in 108 patients for induced (93%) or spontaneous (7%) occurring episodes of AF. Spontaneously occurring AF was observed in 40 patients (25%). The rate of first shock conversion was 118/152 (78%, mean energy 11.6 +/- 5.9 J). Overall shock therapy conversion rate was 138/152 (91%). The number of shock conversions resulting in sinus rhythm maintained for at least 2 minutes postshock was 87% for induced episodes. Therapy was delivered for spontaneous ventricular tachycardia/fibrillation in nine patients (6%). There was no instance of ventricular proarrhythmia associated with atrial shock therapies, undersensing of ventricular arrhythmias, or interruption of CRT therapy associated with the combined device. CONCLUSIONS: In CRT-D candidates with a history of AF, 25% experience recurrent AF within 6 months of implant. Atrial detection and ventricular detection, shock, and resynchronization therapies are not compromised by the addition of atrial therapies to a CRT-D device

536. Saxon LA: **More is better with cardiac resynchronization therapy--but is it enough?** *European heart journal* 2006, 27(16)**:** 1891-1892.

537. Scharf C, Turk A, Brack T, Bloch K, Stellbrink C, Skobel E *et al.*: **Cardiac resynchronization therapy, central sleep apnea, and Cheyne-Stokes respiration in chronic heart failure patients [3] (multiple letters).** *Journal of the American College of Cardiology (J AM COLL CARDIOL)* /20, J.

538. Scharf C, ttenhofer Jost CH: **Concepts and questions in programming cardiac resynchronization devices.** *Heart rhythm - the official journal of the Heart Rhythm Society* 2005, 2(10)**:** 1073-1075.

539. Scharf C, Turk A, Brack T, Bloch K: **Cardiac resynchronization therapy, central sleep apnea, and Cheyne-Stokes respiration in chronic heart failure patients.** *Journal of the American College of Cardiology* 2005, 45(4)**:** 633-634.

540. Scharf C, Li P, Muntwyler J, Chugh A, Oral H, Pelosi F *et al.*: **Rate-dependent AV delay optimization in cardiac resynchronization therapy.** *Pacing and clinical electrophysiology - PACE* 2005, 28(4)**:** 279-284.
Abstract: BACKGROUND: During cardiac resynchronization therapy (CRT), cardiac performance is dependent on an optimized atrioventricular delay (AVD). However, the optimal AVD at different heart rates has not been defined yet during CRT. METHOD: The effects of an increase in heart rate by pacing or physical exercise on optimal AVD were studied in 36 patients with biventricular pacemakers/defibrillators. The velocity time integral (VTI) in the left ventricular outflow tract (LVOT) was measured with pulsed

Doppler either at three different paced heart rates in the supine position or in seated position before and after physical exercise. RESULTS: The baseline AVD was optimized to 99 +/- 19 ms in the supine and 84 +/- 22 ms in the seated position. When the heart rate was increased by DDD pacing, there was a positive linear relationship between an increase in heart rate, in AVD and in VTI (LVOT-VTI + 0.047 cm/s per 10 beats per minute (bpm) heart rate increase per 20 ms increase in AVD, P = 0.007). A similar but more pronounced relationship was found after physical exercise in the seated position (LVOT-VTI + 0.146 cm/s per 10 bpm heart rate increase per 20 ms increase of AVD, P = 0.013). This effect was observed in patients with and without AV block and mitral regurgitation. CONCLUSIONS: In conclusion, the systolic performance of the dilated ventricle, which depends on an elevated preload, is critically affected by the appropriate timing of the AVD during exercise. In contrast to normal pacemaker patients, in CRT the relatively short baseline AVD should be prolonged at increased heart rates. Further studies with other means of measuring exercise cardiac performance are needed to confirm these unexpected findings

541. Schaumann A, Godde M, Tonnis T: **[How many leads are needed for an ICD?] <Original> Wie viele Elektroden braucht der ICD?** *Herz* 2005, 30(7)**:** 591-595.
Abstract: In addition to secondary prevention of sudden cardiac death (SCD), the number of cardioverter defibrillator implantations (ICD) for primary prevention is increasing. An indication for primary prevention of SCD is supported by results of the MADIT II, Companion and SCD-HeFT trials. The main risk factor for SCD is the reduced left ventricular function (LVEF < or = 35%). For selecting the appropriate ICD device and the number of leads, several clinical parameters are important. For the primary prevention of SCD a single-lead VVI ICD is usually sufficient. In case of AV conduction delay and symptomatic heart failure with a prolonged QRS duration a biventricular ICD device is preferred in favor of a ventricular resynchronization. The use of a dual-chamber device should be limited to sinus nodal disease and better discrimination capabilities for slow ventricular tachycardias

542. Schecter SO: **Optimization of impedance signals for closed loop programming of cardiac resynchronization therapy devices.**
Abstract: What are described herein are implantable cardiac devices such as pacemakers and defibrillators that deliver cardiac resynchronization therapy (CRT), and to a method of optimizing acquisition of impedance signals between electrodes present on implanted lead systems. This system then automatically determines which electrodes or electrode combinations acquire impedance waveforms that have the best signal to noise ratio (highest fidelity) and characterize data most representative of dysynchronous electro-mechanical events. Using closed loop algorithms which provide electrograms and a variety of impedance data reflective of the patient's clinical status, the system autonomously modifies interval timing within the CRT device

543. Scheffer M, Van Gelder BM, Van MR: **A giant pseudoaneurysm becoming apparent after cardiac resynchronisation therapy.** *Netherlands Heart Journal (NETH HEART J)* /20, NETH.
Abstract: AB- A 57-year-old male patient with coronary artery disease developed a pseudoaneurysm after an inferior infarct in 1997. He underwent coronary bypass surgery and resection of the pseudoaneurysm located at the inferior wall. Unfortunately, the pseudoaneurysm recurred due to dehiscence of the patch, necessitating a second surgical intervention. After six years he developed progressive heart failure due to severe left ventricular dysfunction. He was referred to our institution for cardiac resynchronisation therapy (CRT) because of drug refractory heart failure which was associated with a left bundle branch block, ejection fraction of 12%, and a NYHA class IV status. After successful implantation of a biventricular pacemaker, a remarkable clinical recovery was observed. Left ventricular function improved and echocardiography now demonstrated that

the pseudoaneurysm at the inferior wall had recurred for the third time. This diagnosis could not be established by preoperative echocardiography

544. Scheiner A, Daum DR: **Cardiac rhythm management system for hypotension.** Abstract: A cardiac rhythm management system detects hypotension based on a measurement of thoracic impedance. It also provides therapy to treat the hypotension

545. Schimpf R, Bauersfeld U, Gaita F, Wolpert C: **Short QT syndrome: Successful prevention of sudden cardiac death in an adolescent by implantable cardioverter-defibrillator treatment for primary prophylaxis.** *Heart Rhythm (Heart Rhythm)* /20, HEART.

546. Schlegl M, Butter C: **[Functional capacity as a criterion for patient selection--too poor or too good for CRT?]**
<Original> Die funktionelle Ausgangsleistung als Kriterium der Patientenselektion -- Zu gut oder zu schlecht fur CRT? *Herzschrittmachertherapie & Elektrophysiologie* 2006, 17 Suppl 1 I42-I50.
Abstract: The article analyses the status of functional tests used in patient selection for cardiac resynchronization therapy (CRT). Based on published randomized trials, the NYHA classification, the quality of life score, the 6-minute walk and the cardio-pulmonary exercise test (CPX) are reviewed. The NYHA classification is a weak and unspecific test and should be used only as a basic consideration in patient selection. The 6-minute walk test shows a wide spread of values and high dependency on patients' motivation. Patients' functional capacity is measured most objectively by the CPX test, which additionally stratifies prognosis. We conclude that functional capacity is an important criterion in patient selection for CRT. However, primary functional status is of minor importance in estimating the expected functional benefit since multiple factors influence the success of CRT

547. Schnetzler B, Reverdin S, Sunthorn H, Kalangos A, Sigwart U: **[Management of end-stage heart failure]**
<Original> Prise en charge de l'insuffisance cardiaque terminale. *Revue medicale suisse* 2005, 1(17)**:** 1159-1164.
Abstract: Non-medical approaches to end-stage heart failure (ESHF) include heart transplantation, but also implantable cardioverter-defibrillators, cardiac resynchronization therapy and ventricular assist devices. These techniques might be used as a bridge to transplant, as a bridge to recovery or as destination therapy. Optimal medical therapy of ESHF should include an angiotensin-converting enzyme inhibitor, a beta-blocker and spironolactone. Risk stratification in ESHF allows to determine the individual prognosis of each patient with parameters such as echocardiographic criteria, peak exercise oxygen consumption, or plasma BNP levels. Heart transplantation is to be considered if the individual prognosis obtained after stratification is worse than the expected survival of transplant recipients

548. Schuchert A, Aydin MA, Israel C, Gaby G, Paul V: **Atrial pacing and sensing characteristics in heart failure patients undergoing cardiac resynchronization therapy.** *Europace - European pacing, arrhythmias , and cardiac electrophysiology - journal of the working groups on cardiac pacing, arrhythmias , and cardiac cellular electrophysiology of the European Society of Cardiology* 2005, 7(2)**:** 165-169.
Abstract: Patients with heart failure and sinus rhythm undergoing cardiac resynchronization therapy (CRT) require the proper detection of atrial signals and reliable atrial pacing for AV-synchronous ventricular pacing. The study aim was to compare atrial pacing and sensing characteristics in patients with transvenous CRT and patients with standard pacing indications. METHODS: The study group consisted of 31 heart failure patients with depressed left ventricular function and bundle branch block, and the control group of 124 patients with dual-chamber pacemakers because of standard pacing indications. The bipolar

steroid-eluting atrial screw-in lead Tendril DX 1388 T (St. Jude Medical) was implanted and connected to pulse generators that provide similar diagnostic features. The unipolar pacing threshold at 0.4 ms duration, bipolar sensing threshold, and unipolar pacing impedance were determined at implantation and after 1, 3, and 6 months. RESULTS: At implantation, the atrial pacing threshold was significantly higher in the CRT group than in the control group, 1.07+/-0.99 V versus 0.74+/-0.36 V (P<0.01). Similar pacing thresholds were recorded after 1 month. The pacing threshold in the CRT group was significantly higher at 1.46+/-0.92 V after 3 and 1.50+/-0.94 V after 6 months (control group: 0.96+/-0.25 V at month 3; 0.98+/-0.32 V at month 6; P<0.05). Sensing threshold was similar at implantation with 2.36+/-1.87 mV in the CRT and 2.54+/-0.78 mV in the control group. The sensing threshold in the CRT group decreased to 1.64+/-0.8 6mV after 3 and to 1.71+/-0.71 mV after 6 months and was significantly lower compared with the control group (2.16+/-0.57 mV at month 3; 2.27+/-0.9 8mV at month 6; P<0.05). At implant, the atrial pacing impedance was not different between the two groups with 443+/-156 ohms in the CRT and 416+/-116 ohms in the control group. During follow-up, the impedance became significantly lower in the CRT group compared with the control group (404+/-84 ohms versus 452+/-101 ohms at month 3; P<0.05). CONCLUSIONS: Compared with patients with standard pacing indications, CRT recipients have less good electrical characteristics in the atrium. Atrial pacing and sensing function should be closely monitored in CRT patients

549. Schuchert A, Boriani G, Wollmann C, Biffi M, Kuhl M, Sperzel J *et al*.: **Implantable dual-chamber defibrillator for the selective treatment of spontaneous atrial and ventricular arrhythmias: arrhythmia incidence and device performance.** *Journal of interventional cardiac electrophysiology - an international journal of arrhythmias and pacing* 2005, 12(2)**:** 149-156.
Abstract: INTRODUCTION: Atrial tachyarrhythmias are a common co-morbidity in patients with an ICD indication. Recently introduced ICD's are equipped to independently detect and treat atrial and ventricular tachyarrhythmias. The purpose of this prospective study was to evaluate the incidence and termination of spontaneous atrial and ventricular tachyarrythmias in patients with a history of atrial tachyarrhythmias. METHODS AND RESULTS: Ninety patients, 70% male with an ICD indication and history of atrial tachyarrhythmia (LVEF 45 +/- 6%, [AT/AF indication 55 +/- 10, AT/VT 45 +/- 16], 46% CAD) were enrolled and 89 were implanted with a VENTAK PRIZM AVT (Guidant). Spontaneous atrial and ventricular tachyarrhythmias were printed and evaluated during an average follow-up period of 272 +/- 72 days utilizing the stored intracardial electrogram function of the device. Nineteen patients (21%) presented had only atrial tachyarrhythmias, 32 patients (36%) had both atrial and ventricular tachyarrhythmias and 18 patients (20%) had only ventricular tachyarrhythmias. Patients with only atrial tachyarrhythmias had a total of 3274 atrial episodes; 2002 terminated spontaneously, 1264 were treated with ATP and 8 with shock therapy. ATP was successful in 735 (58%) of 1264 episodes. Patients with both atrial and ventricular tachyarrhythmias had 7277 documented atrial tachyarrhythmias, 5231 terminated spontaneously, 1153 of 2009 were terminated by ATP (57.4%) and 37 by shock therapy (20 patient controlled). Atrial tachyarrhythmias identified as atrial flutter (AT) by the atrial rhythm classification (ARC) algorithm had a higher ATP conversion success rate than episodes identified as atrial fibrillation (AF); 66.7% for AT and 26.4% for AF. Patients with only ventricular tachyarrhythmias had 690 documented episodes, 401 terminated spontaneously, 248 (85.8%) were terminated by ATP and 41 by shock. CONCLUSION: Seventy-seven percent of patients with an ICD indication had spontaneous atrial and/or ventricular tachyharrhythmias within the first 6 months after ICD implantation. ATP therapy terminated 58% of all atrial tachyarrhytmias and 66.7% of the atrial flutters. The dual chamber ICD detected, classified and terminated all ventricular tacharrhythmias appropriately

550. Schuchert A, Winter J, Binner L, Kuhl M, Meinertz T: **Intraoperative comparison of a subthreshold test pulse with the standard high-energy shock approach for the measurement of defibrillation lead impedance.** *Journal of cardiovascular*

electrophysiology 2006, 17(1)**:** 56-59.
Abstract: There are two methods to measure shocking lead impedance: delivery of high-energy shocks that require patient sedation, and the painless measurement of impedance from subthreshold test pulses. The aim of this study was to compare the two methods. METHODS: The study included 131 patients implanted with a standard DR (n = 71) or VR (n = 60) ICD connected to either single-coil (n = 39) or dual-coil (n = 92) defibrillation leads. The noninvasive high-energy impedance test was done using a 17 J shock after induction of ventricular tachyarrhythmias and compared to a 0.4 microJ test pulse used by the ICD for the subthreshold measurements. RESULTS: Defibrillation lead impedance measurements were not significantly different between patients with the same shocking vector configuration. In patients with a single-coil defibrillation lead the impedance was 62 +/- 9 Omega with the high-energy shock and 62 +/- 8 Omega with the subthreshold test pulses (P = 0.13). Patients with a dual-coil configuration recorded average impedances of 40 +/- 5 Omega from both tests (P = 0.44). While there was no difference in values recorded within each lead configuration, there was a significant difference in impedance between the single-coil and the dual-coil patient groups (P = 0.001). CONCLUSIONS: There was no significant difference between shocking lead impedances measured with the high-energy shock or the subthreshold test pulses. This offers the possibility of noninvasive, low-energy serial measurements of shocking lead impedance at follow-up visits and removing the need for sedation

551. Schuger C, Ellenbogen KA, Faddis M, Knight BP, Yong P, Sample R: **Defibrillation energy requirements in an ICD population receiving cardiac resynchronization therapy.** *Journal of cardiovascular electrophysiology* 2006, 17(3)**:** 247-250.
Abstract: OBJECTIVES: While defibrillation energy requirements (DERs) have been extensively studied in patients receiving conventional defibrillators, the DERs of patients receiving cardiac resynchronization therapy with defibrillation capability (CRT-D) devices have not been well described. The purpose of this analysis was to characterize DERs (defined as true threshold or the presence of appropriate safety margins) in patients undergoing implant of a CRT-D and to determine whether DERs in this population were similar to those reported for patients undergoing implantation of conventional defibrillators. METHODS: Data were analyzed retrospectively from the VENTAK CHF/CONTAK CD biventricular pacing study. An appropriate safety margin of at least 10 J was verified with at least two successful conversions with 21 J or less. Multivariate logistic regression was performed to determine baseline predictors of failed DER testing. RESULTS: Of 501 patients enrolled, 444 (89%) had successful DER test outcomes. Of the remaining 57 patients, 34 converted with energies > or = 21J, and 23 had their testing terminated prematurely or were not tested, primarily due to patient condition. Larger left ventricular internal dimension in diastole (P = 0.003) and prolonged procedure time (P = 0.01) were significant predictors of higher energy requirements. Few significant complications arose from DER testing. CONCLUSIONS: DER testing can be accomplished safely and successfully in the majority of CRT-D patients. However, safety margins cannot be ascertained in a significant number of these patients. Left ventricular inner diameter in diastole (LVIDd) and prolonged procedure time may predict higher DERs, and could be used to anticipate the need for a high-energy device or inclusion of a subcutaneous array

552. Schuler BT, Leon AR: **Cardiac resynchronization therapy.** *Current cardiology reports* 2005, 7(5)**:** 321-328.
Abstract: Cardiac resynchronization therapy (CRT) addresses abnormal left ventricular (LV) activation that produces detrimental effects on cardiac systolic and diastolic function. CRT improves symptoms and ventricular performance, promotes reverse remodeling, and decreases mortality and hospitalization in patients with congestive heart failure (CHF). Atrial-synchronized biventricular stimulation reverses many of the temporal delays in mechanical activation associated with LV dysfunction and conduction system disease. The therapy evolved from anecdotal application through surgical implantation of LV pacing

leads to transvenous delivery of LV pacing leads for use with dedicated CRT devices. The controlled clinical trials included specific patient groups, and provided data leading to widely adopted indications for the therapy. Current indications exclude the use of CRT in patients with permanent atrial fibrillation, although small series suggest a benefit of the therapy in these patients. The role of cardiac imaging with echocardiography to detect cardiac dyssynchrony promises to improve patient selection by not only excluding likely nonresponders, but also extending the therapy to those with dyssynchrony in the absence of QRS prolongation. Expanded indications under evaluation include the role of CRT in patients with mildly symptomatic CHF, mild to moderate LV dysfunction, dyssynchrony in the absence of QRS prolongation, and dyssynchrony induced by right ventricular pacing

553. Schuster I, Habib G, Jego C, Thuny F, Avierinos J, Derumeaux G *et al*.: **Diastolic asynchrony is more frequent than systolic asynchrony in dilated cardiomyopathy and is less improved by cardiac resynchronization therapy.** *Journal of the American College of Cardiology* 2005, 46(12)**:** 2250-2257.
Abstract: OBJECTIVES: To compare the incidence of diastolic and systolic asynchrony, assessed by tissue Doppler imaging (TDI), in patients with congestive heart failure (CHF) and severe left ventricular (LV) dysfunction, and to assess TDI changes induced by cardiac resynchronization therapy (CRT). BACKGROUND: Thirty percent of CRT candidates are nonresponders. Besides QRS width, the presence of echographic systolic asynchrony has been used to identify future responders. Little is known about diastolic asynchrony and its change after CRT. METHODS: Tissue Doppler imaging was performed in 116 CHF patients (LV ejection fraction 26 +/- 8%). Systolic and diastolic asynchrony was calculated using TDI recordings of right ventricular and LV walls. RESULTS: The CHF group consisted of 116 patients. Diastolic asynchrony was more frequent than systolic, concerning both intraventricular (58% vs. 47%; $p = 0.0004$) and interventricular (72 vs. 45%; $p < 0.0001$) asynchrony. Systolic and diastolic asynchrony were both present in 41% patients, but one-third had isolated diastolic asynchrony. Although diastolic delays increased with QRS duration, 42% patients with narrow QRS presented with diastolic asynchrony. Conversely, 27% patients with large QRS had no diastolic asynchrony. Forty-two patients underwent CRT. Incidence of systolic intraventricular asynchrony decreased from 71% to 33% after CRT ($p < 0.0001$), but diastolic asynchrony decreased only from 81% to 55% ($p < 0.0002$). Cardiac resynchronization therapy induced new diastolic asynchrony in eight patients. CONCLUSIONS: Diastolic asynchrony is weakly correlated with QRS duration, is more frequent than systolic asynchrony, and may be observed alone. Diastolic asynchrony is less improved by CRT than systolic. Persistent diastolic asynchrony may explain some cases of lack of improvement after CRT despite good systolic resynchronization

554. Schuster P, Faerestrand S: **Techniques for identification of left ventricular asynchrony for cardiac resynchronization therapy in heart failure.** *Indian Pacing and Electrophysiology Journal (INDIAN PACING ELECTROPHYSIOL J)* /20, INDIAN.
Abstract: AB- The most recent treatment option of medically refractory heart failure includes cardiac resynchronization therapy (CRT) by biventricular pacing in selected patients in NYHA functional class III or IV heart failure. The widely used marker to indicate left ventricular (LV) asynchrony has been the surface ECG, but seems not to be a sufficient marker of the mechanical events within the LV and prediction of clinical response. This review presents an overview of techniques for identification of left ventricular intra- and interventricular asynchrony. Both manuscripts for electrical and mechanical asynchrony are reviewed, partly predicting response to CRT. In summary there is still no gold standard for assessment of LV asynchrony for CRT, but both traditional and new echocardiographic methods have shown asynchronous LV contraction in heart failure patients, and resynchronized LV contraction during CRT and should be implemented as additional methods for selecting patients to CRT

555. Schwab JO, Gasparini M, Anselme F, Mabo P, Peinado R, Lavergne T *et al*.: **Right ventricular versus biventricular antitachycardia pacing in the termination of ventricular tachyarrhythmia in patients receiving cardiac resynchronization therapy: the ADVANCE CRT-D trial.** *Journal of cardiovascular electrophysiology* 2006, 17(5)**:** 504-507.
Abstract: BACKGROUND: The purpose of this investigation is to compare the efficacy of antitachycardia pacing (ATP) delivered via the right ventricular (RV) lead versus ATP delivered simultaneously via the right and left ventricular leads (biventricular [BiV]) in the termination of ventricular tachyarrhythmia (VT) in patients receiving cardiac resynchronization therapy (CRT) with ICD capabilities. METHODS AND RESULTS: The ADVANCE CRT is a prospective, multicenter, randomized, parallel trial evaluating RV versus BiV ATP in the termination of VT in CRT patients. The study will test the hypothesis that BiV ATP is superior to RV ATP in the termination of VT and fast VT. All patients with class I and IIa indications for an ICD implantation and CRT are included. The sample size has been estimated to 400 participants followed for 12 months to show a 10% benefit of BiV versus RV ATP. The efficacy of BiV ATP to terminate all VT presents the primary endpoint. The investigation is expected to be completed in 2007.
CONCLUSIONS: The ADVANCE CRT trial is the first large randomized clinical investigation evaluating the efficacy of BiV ATP in patients under CRT and ICD therapy

556. Seals AA, Mitchem J, Baker S, Saikaly B, Greene T, Thurmond C *et al*.: **Gender gap in Implantable cardioverter defibrillator therapy: Impact of a guidelines based electronic medical record system in patients with ischemic cardiomyopathy.**

557. Shalaby AA, Atwood CW, Walsh S, Hickey KA: **Periodic limb movement disorder: an unusual mechanism of twiddling and potential benefit from cardiac resynchronization therapy.** *Pacing and clinical electrophysiology - PACE* 2005, 28(3)**:** 248-250.
Abstract: Dislodgement of an LV lead is attributed to periodic limb movement disorder. Resynchronization therapy improves CHF and symptoms of periodic limb movement disorder. Potential interaction of disordered sleep and CHF in this case is briefly reviewed

558. Shalaby AA: **Utilization of intracardiac echocardiography to access the coronary sinus for left ventricular lead placement.** *Pacing and clinical electrophysiology - PACE* 2005, 28(6)**:** 493-497.
Abstract: This is a presentation of a case series of 10 consecutive patients undergoing implantation of cardiac resynchronization therapy defibrillator (CRT-D). Intracardiac echocardiography (ICE) is utilized to gain access to the coronary sinus. The method used is detailed with a brief discussion of observations gained from this early experience

559. Sharifi M, Inbar S, Neckels B, Shook H: **"Twiddling" to the extreme: Development of Twiddler syndrome in an implanted cardioverter-defibrillator.** *Journal of Invasive Cardiology (J INVASIVE CADIOL)* /20, J.

560. Shi H, Pan C, Shu X, Wang F, Jin W, Zhang J *et al*.: **[Immediate effect of cardiac resynchronization therapy by tissue synchronization imaging and tissue tracking in patients with congestive heart failure].** *Zhonghua xin xue guan bing za zhi Chinese journal of cardiovascular diseases* 2005, 33(1)**:** 26-29.
Abstract: OBJECTIVE: To evaluate the immediate effect of cardiac resynchronization therapy (CRT) by Doppler tissue imaging (DTI), tissue synchronization imaging (TSI) and tissue tracking imaging (TTI) in patients with congestive heart failure. METHODS: Ten patients with congestive heart failure who had cardiac resynchronization therapy were enrolled. The TSI and TTI imaging were performed by GE vivid 7 with M3s probe. The TTI image was obtained in diastole to determine delayed longitude contraction (DLC). The left ventricular ejection fraction (LVEF), the percentage of delayed longitude contraction segments (DLC), the standard deviation of the time to peak myocardial systolic contraction of 16 segments (Ts-SD), the standard deviation of the time to peak myocardial diastole of

16 segments (Td-SD), the systolic velocity of right ventricule (RV-Sm) and the average systolic velocity of mitral valve annulus (LV-Sm) were measured. The intraventricular dyssynchrony could be semi-quantified by TSI as 4 (red), 3 (orange), 2 (yellow), 1 (green), and the average value of 16 segments was defined as the TSI index. The immediate changes of these parameters were investigated when the pacemaker was turned on and off. The correlation of the Ts and TSI index was also analyzed. RESULTS: When the pacemaker was on, the LVEF improved significantly from (37 +/- 11.30)% to (46 +/- 10.10)% ($P < 0.01$), and LV-Sm increased significantly from (3.16 +/- 0.87) cm/s to (3.76 +/- 0.74) cm/s ($P < 0.01$), RV-Sm increased significantly from (6.79 +/- 1.78) cm/s to (7.75 +/- 1.92) cm/s ($P < 0.01$). DLCs decreased significantly from (35 +/- 6.04)% to (18.13 +/- 9.97)% ($P < 0.01$), Ts-SD decreased from (83.97 +/- 33.02) ms to (52.67 +/- 19.65) ms, $P < 0.05$, Td-SD decreased from (87.81 +/- 22.34) ms to (63.45 +/- 31.49) ms, $P < 0.05$ and TSI index reduced from 2.11 +/- 0.15 to 1.60 +/- 0.33 ($P < 0.01$) respectively. In addition, the reduction of TSI index correlated significantly with that of Ts-SD ($r = 0.75$, $P < 0.05$). CONCLUSIONS: CRT could immediately improve the systolic and diastolic synchrony of the left ventricle and ventricular function. TSI and TTI may be as the new effective modalities to assess the mechanical dyssynchrony. TSI index was direct and reliable in this study

561. shikaga Hiroshi R, Kellman P, Mickelsen SR, McVeigh ER: **Simple and rapid quantification of mechanical dyssynchrony for cardiac resynchronization therapy.**

562. Shukla Gunjan R, Orlov M, V, Maysky M, Chauchry GM, Ujhelyi M, Patel S *et al.*: **Does bi-ventricular pacing improve myocardial perfusion?**

563. Shukla G, Chaudhry GM, Orlov M, Hoffmeister P, Haffajee C: **Potential proarrhythmic effect of biventricular pacing: fact or myth?** *Heart rhythm - the official journal of the Heart Rhythm Society* 2005, 2(9)**:** 951-956.
Abstract: BACKGROUND: Hemodynamic improvement from biventricular pacing is well documented; however, its electrophysiologic effects have not been systematically studied. Sporadic case reports suggest a proarrhythmic effect of biventricular pacing resulting primarily in polymorphic ventricular tachycardia/ventricular fibrillation (VT/VF). OBJECTIVES: The purpose of this study was to report a series of patients in whom implantation of a biventricular system resulted in VT/VF storm with predominance of monomorphic VT. METHODS: In a retrospective analysis of all biventricular implants over a 4-year period at a single medical center, we identified 5 of 145 patients (3.4%) who developed VT/VF after they were upgraded to a biventricular system. All patients were male, age 71 +/- 8 years, with ejection fraction of 0.25 +/- 0.1. Four of five patients had ischemic cardiomyopathy. RESULTS: All patients developed incessant VT/VF within 1 week of implantation. Monomorphic VT of single morphology was noted in 3 of 5 patients, monomorphic VT of multiple morphologies in 1, and polymorphic VT/VF in 1. VT was managed by temporary discontinuation of biventricular pacing in all patients, amiodarone in 3 of 5, sotalol in 1, and beta-blocker in 1. During 11 +/- 7 months of follow-up, 4 of 5 patients remain alive and are arrhythmia-free. CONCLUSION: Biventricular pacing may result in precipitation of VT/VF storm in a minority of patients with prior history of VT/VF. This may be the first case series reporting both monomorphic and polymorphic VT after an upgrade to a system with biventricular pacing capabilities. The arrhythmias can be managed by conventional therapy and may require temporary discontinuation of left ventricular pacing. This observation is relevant to patients receiving a biventricular pacemaker without an implantable cardioverter-defibrillator backup

564. Silva Carlos ES, Barretto Antonio CP: **[Echocardiographic assessment of cardiac resynchronization therapy.]**
<Original> Avaliacao ecocardiografica da terapia de ressincronizacao cardiaca.
Arquivos brasileiros de cardiologia 2005, 84(6)**:** 503-507.

565. Simpson CS, Gillis AM: **The pacemaker and implantable cardioverter defibrillator recall issue - A Canadian perspective.** *Canadian Journal of Cardiology (CAN J CARDIOL)* /20, CAN.
Abstract: AB- In 2005, an unprecedented number of recalls were issued on pacemakers and implantable cardioverter defibrillators. While recalls in the cardiac rhythm device industry are not new, the sheet magnitude of potentially affected patients in 2005 led to a great deal of concern, frustration, and even anger. Physicians have, in many instances, been uncertain when (or if) to recommend device replacement in an environment where the magnitude of the risk and the potential consequences of device failure have not been well defined in a timely way. Doctors and patients are now calling for reform of postmarket analysis and reporting mechanisms. The present article provides a uniquely Canadian perspective on this international issue. Potential solutions include the development of a set of realistic and common expectations, a restoration of confidence in postmarket analysis and reporting mechanisms, increased data transparency, and an increased role for patient and physician groups. (c) 2006 Pulsus Group Inc. All rights reserved

566. Singarayar S, Kistler PM, De WC, Mond H: **A comparative study of the action of dexamethasone sodium phosphate and dexamethasone acetate in steroid-eluting pacemaker leads.** *Pacing and clinical electrophysiology - PACE* 2005, 28(4)**:** 311-315.
Abstract: BACKGROUND: The aim of this study was to characterize acute and medium-term pacemaker lead performance with the two most commonly used glucocorticosteroids: dexamethasone sodium phosphate and dexamethasone acetate. METHODS: Forty sets of atrial and ventricular passive-fixation leads containing either dexamethasone sodium phosphate or dexamethasone acetate were implanted as dual chamber pacemakers. Randomization was equally distributed to both arms of the study. Stimulation thresholds, lead impedance, and sensing were measured on the day of implant, day 1, 1 month, 3 months, and 6 months following the implant. RESULTS: For the dexamethasone sodium phosphate arm, the atrial stimulation thresholds were 0.9 +/- 0.1 V at implant and 0.8 +/- 0.1 V at 6 months, and in the ventricle 0.5 +/- 0.1 V at implant and 0.6 +/- 0.1 V at 6 months. In the dexamethasone acetate arm, the atrial stimulation thresholds were 0.7 +/- 0.1 V at implant and at 6 months, and in the ventricle 0.5 +/- 0.1 V at implant and at 6 months. There were no significant differences between dexamethasone sodium phosphate or dexamethasone acetate leads for stimulation thresholds at any of the intervals of follow-up. P- and R-wave sensing were similarly maintained over the duration of follow-up with no significant differences between groups at any of the intervals of follow-up. Pacing lead impedance showed a trend towards lower values in the dexamethasone acetate arm, which only reached statistical significance at 3 months and beyond for ventricular leads. CONCLUSIONS: Leads containing dexamethasone sodium phosphate and dexamethasone acetate demonstrate equivalent and excellent acute and medium-term pacemaker lead performance characteristics

567. Singh JP, Ruskin JN: **Cardiac resynchronization therapy: the MGH experience.** *Annals of noninvasive electrocardiology - the official journal of the International Society for Holter and Noninvasive Electrocardiology, Inc* 2005, 10(4 Suppl)**:** 44-54.
Abstract: Cardiac resynchronization therapy (CRT) has gained acceptance as a useful form of device therapy for patients with refractory congestive heart failure. Despite recent technical advances, a significant number of patients continue to remain unresponsive to this form of therapy. This article provides an overview of CRT, highlights several unresolved issues and describes ongoing research efforts to address some of these important questions

568. Singh JP, Houser S, Heist E Kevin, Ruskin JN: **The coronary venous anatomy: a segmental approach to aid cardiac resynchronization therapy.** *Journal of the American College of Cardiology* 2005, 46(1)**:** 68-74.
Abstract: The coronary sinus is the gateway for left ventricular (LV) epicardial lead placement for cardiac resynchronization therapy. The implanting electrophysiologist is usually challenged by a high degree of variability in the coronary venous anatomy, making

it important to have a more consistent and uniform segmental approach to describe the coronary venous tree and its branches. Classifying the coronary sinus branches and tributaries by the segment of their location rather than by conventional anatomic names (i.e., middle cardiac vein, great cardiac vein, and so on), would provide more relevant anatomic and functional information at the time of LV lead placement. This would enable the implanting physician to proactively correlate the venous anatomy with the segmental wall motion abnormalities or dyssynchrony, as defined by echocardiography and other imaging modalities. The current viewpoint calls for a more systematic segmental approach for describing the coronary venous anatomy

569. Sinha A-M, Breithardt O-A: **[Are neurohumoral parameters predictive for the efficacy of cardiac resynchronization therapy? The role of natriuretic peptides] <Original> Sind neurohumorale Blutparameter wegweisend fur die Effizienz der kardialen Resynchronisationstherapie? Die Rolle der natriuretischen Peptide.** *Herzschrittmachertherapie & Elektrophysiologie* 2006, 17 Suppl 1 I51-I55.
Abstract: During recent years, heart failure has been recognized as a complex disease involving both hemodynamic abnormalities caused by reduced contractile forces and neurohormonal changes characterized by an increase in sympathetic tone and an activation of the renin-angiotensin-aldosterone system as well as the endothelial pathways. Neurohumoral factors represent the natural response of the individual to heart failure. Among them natriuretic peptides, i. e., brain natriuretic peptide (BNP) and amino-terminal pro BNP (Nt-proBNP) release have recently been shown to be a reliable and rapid marker for diagnosis, optimization of pharmacological treatment and risk stratification in heart failure patients. This article summarizes important aspects of the release of natriuretic peptides as a guide for diagnosis, therapy and prognosis of patients with heart failure and cardiac resynchronization therapy

570. Skobel EC, Sinha A, Norra C, Randerath W, Breithardt O, Breuer C *et al*.: **Effect of cardiac resynchronization therapy on sleep quality, quality of life, and symptomatic depression in patients with chronic heart failure and Cheyne-Stokes respiration.** *Sleep & breathing = Schlaf & Atmung* 2005, 9(4)**:** 159-166.
Abstract: Patients with heart failure (HF) often suffer from sleep-related breathing disorders (SRBD) like Cheyne-Stokes respiration (CSR). Cardiac resynchronization therapy (CRT) improves myocardial function and exercise capacity in patients with HF and conduction disturbances. As CRT has been shown to reduce CSR in patients with HF, it is not clear whether CRT improves quality of life and symptomatic depression by improvement of apnea/hypopnea index (AHI) and sleep quality. Forty-two HF patients with conduction disturbance before CRT were screened for CSR and evaluated for sleep quality [Pittsburgh Sleep Quality Index (PSQI)], quality of life score [36-item short form (SF-36)], depression, and exercise capacity (VO2peak) and ejection fraction (EF). Eighteen patients (three females, age 61+/-10, body mass index 24+/-4 kg m(-2), EF 24+/-4%, QRS complex duration 156+/-32 ms) presented CSR with an AHI of 18+/-8 (11 CSR, 7 mixed). Fourteen patients showed no SRBD (PSQI<5,AHI<5). All patients received CRT and were reevaluated after 18+/-7 weeks. CSR worsen quality of life in seven of eight terms compared to patients without SRBD. Symptomatic depressive symptoms (Beck Depression Inventory>10) were only present in patients with CSR. CRT results in improvement of peakVO2 and EF. There was no difference between patients with CSR and without SRBD on exercise capacity or EF under CRT, whereas CRT led to a significant decrease in AHI (18+/-8 to 3+/-2, p<0.0001), PSQI (18+/-4 to 6+/-3, p=0.0007), with reduction of depression score (12+/-3 to 4.8+/-3, p=0.004). In patients with HF, CSR is associated with symptomatic depressive syndromes and impaired quality of life. CRT reduced CSR with improvement of sleep quality and symptomatic depression

571. Smedema JP, van EL, Schreur JHM, jkman-Domanska B, Snoep G, Crijns HJGM: **[Cardiac sarcoidosis: improved prognosis through new diagnostic tests and treatment]**

<Original> Cardiale sarcoidose: betere prognose door nieuwe diagnostiek en behandeling. *Nederlands tijdschrift voor geneeskunde* 2005, 149(21)**:** 1168-1173.
Abstract: Cardiac sarcoidosis was diagnosed in 3 patients: 2 men aged 52 and 51 years, respectively, and a woman aged 55 years. Both men had ventricular tachycardia. In the first man, a right-ventricle biopsy revealed a non-caseating granuloma. The second man had active granulomatous cardiac infiltration, according to a gallium scintigram. The first man recovered after receiving immunosuppression, heart-failure medication, and an implantable defibrillator; the second received the same plus radio-frequency catheter ablation, but experienced serious heart failure. The woman was being treated for pulmonary sarcoidosis but complained of progressive cardiac symptoms. She recovered after receiving heart-failure medication, immunosuppression, and a biventricular pacemaker. Sarcoidosis is a multi-system granulomatous disorder of unknown aetiology with cardiac involvement in 20 to 30% of patients, resulting in severe morbidity and mortality. With the help ofgadolinium MRI and positron emission tomography (PET), these conditions can be detected at an earlier stage, which allows for improved evaluation of the efficacy of available therapies. The use of resynchronisation therapy and implantable defibrillators has improved the prognosis of patients with cardiac sarcoidosis

572. Smyth YM, Barrett CD, Fahy GJ: **Images in cardiology. Biventricular pacemaker implant in a patient with persistent left sided superior vena cava.** *Heart (British Cardiac Society)* 2005, 91(11)**:** 1427.

573. Souza Fernando Sergio Oliva de, Mortati NL, Braile DM, Vieira RW, Rojas SO, Rabelo AC *et al*.: **[Technical aspects of coronary sinus catheterization based on the atrial component of the intracavitary electrogram and radiological anatomy during the implantation procedure of a biventricular pacemaker]**
<Original> Aspectos tecnicos da cateterizacao do seio coronariano baseada no componente atrial do eletrograma intracavitario e anatomia radiologica durante o procedimento de implante de marcapasso biventricular. *Arquivos brasileiros de cardiologia* 2006, 86(4)**:** 261-267.
Abstract: OBJECTIVE: To present a technical proposal based on the experience of 130 implantations using a simplified technique for coronary sinus catheterization, based on the atrial component of the intracavitary electrogram and radiological anatomy. METHODS: From October, 2001 to October, 2004, 130 biventricular pacemaker implantations were performed, using radiological anatomy and observation of the intracavitary electrogram, focusing on the atrial component. RESULTS: The implantation of the system using left ventricular pacing via coronary sinus was not possible in 8 patients. Difficulties on the cannulation of the coronary ostium were felt in 12 patients and difficulties of lead advancement through the coronary sinus were felt in 15 patients. The mean time of radioscopy utilization was 18.69 min. CONCLUSION: The implantation technique, using the atrial component morphology of the intracavitary electrogram and radiological anatomy showed to be workless, safe and effective for the cannulation of the coronary sinus ostium requesting reduced time of radioscopy

574. St John Sutton Martin(Reprint), Hilpisch K, Plappert T, Chinchoy E: **Severity of mitral regurgitation determines structural and functional reverse remodeling with cardiac resynchronization in advanced heart failure.**

575. St John Sutton MG, Plappert T, Hilpisch KE, Abraham WT, Hayes DL, Chinchoy E: **Sustained reverse left ventricular structural remodeling with cardiac resynchronization at one year is a function of etiology - Quantitative Doppler echocardiographic evidence from the Multicenter InSync Randomized Clinical Evaluation (MIRACLE).**
Abstract: Background - Cardiac resynchronization therapy (CRT) is an effective therapy for patients with moderate to severe heart failure and prolonged QRS duration. The purpose of this study was to determine whether reverse left ventricular (LV) remodeling and

symptomatic benefit from CRT were sustained at 12 months, and if so, in what proportion of patients this occurred.Methods and Results - Serial Doppler echocardiograms were obtained at baseline and 6 and 12 months after CRT in 228 patients enrolled in the Multicenter InSync Randomized Clinical Evaluation (MIRACLE) trial. Measurements were made of LV end-diastolic (EDV) and end-systolic (ESV) volumes, ejection fraction, LV mass, severity of mitral regurgitation (MR), peak transmitral velocities during early (E wave) and late (A wave) diastolic filling, and myocardial performance index. At both 6 and 12 months, respectively, CRT was associated with reduced LV EDV ($P < 0.0001$ and $P = 0.007$) and LV ESV ($P < 0.0001$ and $P < 0.0001$), improved ejection fraction ($P < 0.0001$ and $P < 0.0001$), regression of LV mass ($P = 0.012$ and $P < 0.0001$), and reduced MR ($P < 0.0001$ and $P < 0.0001$). LV filling time, transmitral E/A ratio, and myocardial performance index all improved at 12 months compared with baseline ($P < 0.001$, $P = 0.031$, and $P < 0.0001$). Reverse LV remodeling with CRT occurred in more patients at 6 than at 12 months (74% versus 60%, respectively; $P < 0.05$) and was greater in patients with a nonischemic than an ischemic etiology.Conclusions - Reverse LV remodeling and symptom benefit with CRT are sustained at 12 months in patients with New York Heart Association class III/IV heart failure but occur to a lesser degree in patients with an ischemic versus a nonischemic etiology, most likely owing to the inexorable progression of ischemic disease

576. Stahlberg M, Braunschweig F, Gadler F, Karlsson H, Linde C: **Three year outcome of cardiac resynchronization therapy: a single center evaluation.** *Pacing and clinical electrophysiology - PACE* 2005, 28(10)**:** 1013-1017.
Abstract: AIMS: To evaluate the long-term clinical outcome and device performance of cardiac resynchronization therapy in a consecutive sample of patients with moderate to severe heart failure. METHODS AND RESULTS: Between 1998 and 2000, forty consecutive patients with drug-refractory heart failure due to ischemic or idiopathic dilated cardiomyopathy were selected for cardiac resynchronization therapy (CRT). After successful implantation of the coronary sinus lead (n = 35, 88%), patients were followed every sixth month by New York Heart Association (NYHA) functional class, the 6-minute walking test (6 walk), quality of life (QoL, Minnesota), and pacemaker control. NYHA-class and 6 walk were significantly improved after 6 months and continued to improve gradually until 36 months of follow-up. The QoL improvement at 6 months was sustained over 3 years. After 3 years, the beta-blocker dose could be increased in 10/23 patients as compared to baseline. Nine patients had to be re-operated. Coronary sinus lead thresholds were stable over time. CONCLUSION: The clinical improvements by CRT are sustained over 3 years of follow-up. In the setting of a University Medical Center, CRT can be applied in clinical routine with excellent clinical outcome, acceptable implantation success, and stable device performance over time

577. Stambler BS, Ellenbogen KA, Liu Z, Levine P, Porter TR, Zhang X: **Serial changes in right ventricular apical pacing lead impedance predict changes in left ventricular ejection fraction and functional class in heart failure patients.** *Pacing and clinical electrophysiology - PACE* 2005, 28 Suppl 1 S50-S53.
Abstract: Pacing impedance has been proposed to monitor the clinical status of patients with congestive heart failure (CHF). This study examined whether changes in right ventricular (RV) pacing impedance correlate with changes in left ventricular ejection fraction (LVEF) and New York Heart Association (NYHA) functional class during long-term follow-up in pacemaker recipients with CHF. The study included 67 patients, 70 +/- 12 years of age, in NYHA class II or III, and with a mean LVEF = 29 +/- 8% at implant. LVEF, NYHA class, and bipolar pacing impedance at the RV outflow tract (RVOT) and apex (RVA) were measured at implant and at 3, 6, 9, and 12 months of follow-up. At implant, impedance was similar in RVOT (548 +/- 115 Omega) and RVA (571 +/- 174 Omega). Between implant and 3 months, mean impedance decreased ($P < 0.0001$) at both the RVOT (472 +/- 62 Omega) and RVA (488 +/- 86 Omega), LVEF increased (43 +/- 14%, $P < 0.0001$), and the NYHA class decreased from 2.4 +/- 0.5 to 2.1 +/- 0.6 ($P =$

0.0001). Changes in RVA impedance correlated with changes in LVEF (r = 0.45, P = 0.002). A 50 Omega decrease in RVA impedance corresponded to a 3% decrease in LVEF. RVA impedance decreased significantly as NYHA class increased from I to IV (P = 0.04). There was no correlation between impedance measured at the RVOT and LVEF or NYHA class. A decrease in bipolar pacing impedance at the RVA was associated with worsening LVEF and the NYHA class. The use of pacing impedance to monitor the clinical status in CHF is dependent on the RV pacing site

578. Steendijk P, Tulner SA, Bax JJ, Oemrawsingh P, V, Bleeker GB, van EL *et al.*: **Hemodynamic effects of long-term cardiac resynchronization therapy: analysis by pressure-volume loops.** *Circulation* 2006, 113(10)**:** 1295-1304.
Abstract: BACKGROUND: Acute hemodynamic effects of cardiac resynchronization therapy (CRT) were reported previously, but detailed invasive studies showing hemodynamic consequences of long-term CRT are not available. METHODS AND RESULTS: We studied 22 patients scheduled for implantation of a CRT device based on conventional criteria (New York Heart Association class III or IV, left ventricular [LV] ejection fraction <35%, left bundle-branch block, and QRS duration >120 ms). During diagnostic catheterization before CRT, we acquired pressure-volume loops using conductance catheters during atrial pacing at 80, 100, 120, and 140 bpm. Studies were repeated during biventricular pacing at the same heart rates after 6 months of CRT. Our data show a significant clinical benefit of CRT (New York Heart Association class change from 3.1+/-0.5 to 2.1+/-0.8; quality-of-life score change from 44+/-12 to 31+/-16; and 6-minute hall-walk distance increased from 260+/-149 to 396+/-129 m; all P<0.001), improved LV ejection fraction (from 29+/-10% to 40+/-13%, P<0.01), decreased end-diastolic pressure (from 18+/-8 to 13+/-6 mm Hg, P<0.05), and reverse remodeling (end-diastolic volume decreased from 257+/-67 to 205+/-54 mL, P<0.01). Previously reported acute improvements in LV function remained present at 6 months: dP/dtmax increased 18%, -dP/dtmin increased 13%, and stroke work increased 34% (all P<0.01). Effects of increased heart rate were improved toward more physiological responses for LV ejection fraction, cardiac output, and dP/dtmax. Moreover, our study showed improved ventricular-arterial coupling (69% increase, P<0.01) and improved mechanical efficiency (44% increase, P<0.01). CONCLUSIONS: Hemodynamic improvements with CRT, previously shown in acute invasive studies, are maintained chronically. In addition, ventricular-arterial coupling, mechanical efficiency, and chronotropic responses are improved after 6 months of CRT. These findings may help to explain the improved functional status and exercise tolerance in patients treated with CRT

579. Stellbrink Christoph R, Skobel E, Sinha A: **Cardiac resynchronization therapy, central sleep apnea, and Cheyne-Stokes respiration in chronic heart failure patients - Reply.**

580. Stellbrink C: **Cardiac resynchronization therapy - What holds the future? <Original> Kardiale resynchronisationstherapie - was bringt die zukunft?** *Herzschrittmachertherapie und Elektrophysiologie (HERZSCHRITTMACHERTHER ELEKTROPHYSIOL)* /20, HERZSCHRITTMACHERTHER.

581. Stellbrink C: **[Cardiac resynchronization therapy--what will the future bring?] <Original> Kardiale Resynchronisationstherapie-Was bringt die Zukunft?** *Herzschrittmachertherapie & Elektrophysiologie* 2005, 16(1)**:** 58-62.

582. Stellbrink C: **[Cardiac resynchronization therapy-always with ICD?] <Original> Kardiale Resynchronisationstherapie-immer mit ICD?** *Herz* 2005, 30(7)**:** 596-600.
Abstract: Sudden cardiac death is responsible for about 50% of all deaths in heart failure. In studies on primary and secondary prevention of sudden cardiac death, the implantable cardioverter defibrillator (ICD) has proven superior to antiarrhythmic drug therapy mainly in patients with coronary artery disease and reduced left ventricular function. Thus, in

recent years the question arose whether prophylactic ICD treatment can reduce mortality as well in an unselected patient group with heart failure of any etiology. This is even more important for patients that are candidates for cardiac resynchronization therapy because, first, presence of an intraventricular conduction delay indicates an increased risk of sudden death and, second, the additional operative morbidity of ICD implantation is minimal compared to implant of a biventricular pacemaker. Recent studies have proven the benefit of conventional ICD treatment in patients with heart failure as well as the benefit of biventricular pacing in heart failure patients with ventricular conduction delay. In the present article, these studies and their influence on the system choice in cardiac resynchronization therapy are discussed

583. Stephens DN, Thomenius K, Shung KK, Chia R, Dentinger A, O'Donnell M *et al*.: **A new multifunctional intracardiac imaging catheter and EP recording for use in cardiac resynchronization: Experimental studies.**

584. Sterlinski M, Szwed H: **How much is cardiac resynchronization therapy legitimated today in patients with optimal congestive heart failure pharmacotherapy?** *Polski Przeglad Kardiologiczny (POL PRZ KARDIOL)* /20, OL.

585. Stirbys P: **Cardiac resynchronization therapy with special focus on patency of coronary sinus and its branches: conceptual viewpoint and semi-theoretical considerations on lead-induced obstruction.** *Medicina (Kaunas , Lithuania)* 2006, 42(4)**:** 273-277.
Abstract: Cardiac resynchronization therapy appears to be useful for patients with severe chronic congestive heart failure. However, many questions still arise concerning the effectiveness of this kind of therapy since hemodynamic improvement is not observed in all patients. Heterogeneity of conclusions reported by several multicenter clinical trials and prominent experts demonstrates that many uncertainties related to cardiac resynchronization therapy still exist. We tried to reveal some inadequacies in clinical results by focusing on cardiac venous blood return which is likely complicated by the presence of lead inside the coronary sinus and its branches. Downstream traversing lead may occlude (partially or completely) the ostia of minor tributaries and target vein of lead final positioning. Thrombosis may also be incited within the coronary sinus itself. Remaining lumen predetermined by the lead body and subsequent thrombosis may be insufficient to provide adequate blood flow. Resulting detrimental venous return presumably may slightly depress myocardial contractility which may be significant in very sensitive group of patients assigned to the New York Heart Association class III or IV. Cardiac venous blood pumping conditions (or venous drainage) are likely also complicated by abnormal activation of left ventricle. The contributory role of these two subtle causes unfavorably influencing venous drainage is still unknown. It may be treated as a hypothetical attempt to find the clue and needs future studies for verification

586. Stockburger M: **Strategies to avoid complications and to solve technical problems during the implantation of CRT and CRT-D systems**
<Original> Strategien zur vermeidung von komplikationen und losung von problemen bei der implantation von c. *Herzschrittmachertherapie und Elektrophysiologie (HERZSCHRITTMACHERTHER ELEKTROPHYSIOL)* /20, HERZSCHRITTMACHERTHER.
Abstract: AB- Cardiac resynchronization with or without antitachycardiac treatment is now an established option to improve the functional status, morbidity and mortality of patients with severe symptomatic systolic heart failure, ventricular conduction delay and asynchrony. Increasing implant numbers are to be expected. The transvenous left ventricular lateral lead placement can now be achieved in up to 97% of patients. But due to the coronary venous anatomy it may still constitute a challenge even for experienced pacemaker and ICD implanters. In addition, it confers a considerable risk for complications like coronary sinus dissection and perforation, diaphragmatic stimulation and lead

dislodgement. An overview is given on possible technical problems, solutions, complications and preventive strategies

587. Stockburger M: **[Strategies to avoid complications and to solve technical problems during the implantation of CRT and CRT-D systems]**
<Original> Strategien zur Vermeidung von Komplikationen und Losung von Problemen bei der Implantation von CRT- und CRT-D-Systemen.
Herzschrittmachertherapie & Elektrophysiologie 2006, 17 Suppl 1 I20-I27.
Abstract: Cardiac resynchronization with or without antitachycardiac treatment is now an established option to improve the functional status, morbidity and mortality of patients with severe symptomatic systolic heart failure, ventricular conduction delay and asynchrony. Increasing implant numbers are to be expected. The transvenous left ventricular lateral lead placement can now be achieved in up to 97% of patients. But due to the coronary venous anatomy it may still constitute a challenge even for experienced pacemaker and ICD implanters. In addition, it confers a considerable risk for complications like coronary sinus dissection and perforation, diaphragmatic stimulation and lead dislodgement. An overview is given on possible technical problems, solutions, complications and preventive strategies

588. Stollberger C, Finsterer J: **Left ventricular synchronization by biventricular pacing in Becker muscular dystrophy as assessed by tissue Doppler imaging.** *Heart & lung - the journal of critical care* 2005, 34(5)**:** 317-320.
Abstract: Biventricular (BiV) pacing is a promising therapy for severe heart failure. The effect of BiV pacing is cardiac resynchronization of both ventricles. Asynchrony of the ventricular contraction and restoration of cardiac synchronization can be assessed by tissue Doppler imaging. Here we describe a patient with Becker muscular dystrophy with heart failure caused by dilated cardiomyopathy in whom a BiV pacemaker was implanted

589. Strickberger S Adam, Conti J, Daoud EG, Havranek E, Mehra MR, Pina IL *et al*.: **Patient selection for cardiac resynchronization therapy: from the Council on Clinical Cardiology Subcommittee on Electrocardiography and Arrhythmias and the Quality of Care and Outcomes Research Interdisciplinary Working Group, in collaboration with the Heart Rhythm Society.** *Circulation* 2005, 111(16)**:** 2146-2150.
Abstract: Cardiac resynchronization therapy (CRT) is a relatively new therapy for patients with symptomatic heart failure resulting from systolic dysfunction. CRT is achieved by simultaneously pacing both the left and right ventricles. Biventricular pacing resynchronizes the timing of global left ventricular depolarization and improves mechanical contractility and mitral regurgitation. Published clinical trials have demonstrated that CRT results in improved clinical status and lower mortality rate when selected patients with systolic ventricular dysfunction and heart failure are treated with CRT. This advisory identifies appropriate candidates for CRT on the basis of the inclusion criteria and results from the published clinical trials

590. Strohmer B, Schernthaner C, Pichler M: **T-wave oversensing by an implantable cardioverter defibrillator after successful ablation of idiopathic ventricular fibrillation.** *PACE - Pacing and Clinical Electrophysiology (PACE PACING CLIN ELECTROPHYSIOL)* /20, ACE.
Abstract: AB- Focal ablation of trigger premature ventricular complexes (PVCs) from the Purkinje system helped to suppress idiopathic ventricular fibrillation (VF) in an athlete who had suffered from frequent appropriate shock therapies. However, only a few days after successful ablation T-wave oversensing occurred during exercise and resulted in repetitive distressing defibrillator shocks. Despite lack of any changes on the surface ECG, the endocardially recorded electrogram revealed an unfavorable ratio of R-to-T-wave amplitude predisposing to double counting with accelerated heart rates. This case illustrates that T-wave oversensing may complicate the clinical course after successful ablation of malignant Purkinje ectopy. (c)2006, The Authors

591. Strohmer B, Schernthaner C, Pichler M: **Underdetection of atrial flutter in cardiac resynchronisation devices**
<Original> Nichterkennung von vorhofflattern bei patienten mit kardialer resynchronisationstherapie. *Journal fur Kardiologie (J KARDIOL)* /20, J.
Abstract: AB- Although intolerance of cardiac resynchronisation therapy is uncommon, its occurrence emphasises the need for careful follow-up of affected patients. Atrial tachyarrhythmias are commonly associated with heart failure. We report about 7 patients with paroxysmal atrial flutter that was not detected by CRT pacemakers. Alternate flutter waves coincided with atrial blanking times explaining the mode switch failure. The "2:1 lock-in" response during atrial flutter resulted in rapid sustained ventricular pacing and cardiac decompensation

592. Strohmer B, Schernthaner C, Pichler M: **Blanked atrial flutter in patients with cardiac resynchronization therapy: clinical significance and implications for device programming.** *Pacing and clinical electrophysiology - PACE* 2006, 29(4)**:** 367-373.
Abstract: BACKGROUND: Atrial arrhythmias are frequently observed in patients with heart failure and may be a primary cause for decompensation during cardiac resynchronization therapy (CRT). The accurate detection of organized atrial tachyarrhythmias poses a challenge to the function of mode-switching biventricular pacemakers/defibrillators. METHODS: The purpose of the study was to determine retrospectively the incidence of blanked atrial flutter and mode switch failure (2:1 lock-in), and to look for factors predisposing to this problem. A total number of 65 patients with CRT devices has been followed regularly over 18 +/- 12 months. Five patients were excluded because of chronic atrial fibrillation and reprogramming to VVIR mode. RESULTS: Seven out of 60 patients (12%) were diagnosed with blanked atrial flutter at unscheduled device interrogation. Sustained biventricular pacing at a median rate of 125/min-mimicking sinus tachycardia-resulted in rapid deterioration of heart failure and hospitalization. Mode switch failure occurred due to coincidence of every second flutter wave with atrial blanking. The group with 2:1 lock-in was programmed to longer atrial blanking times (143 +/- 34 ms vs 105 +/- 32 ms; P = 0.026) and AV intervals (126 +/- 8 ms vs 107 +/- 29; P = 0.001) than the group without lock-in. Other clinical characteristics examined did not differ between the two groups apart from a previous history of atrial fibrillation (P = 0.032). CONCLUSION: Blanked atrial flutter with rapid ventricular pacing is a clinically important problem in heart failure patients treated with CRT devices. Efforts should be made to avoid this complication by atrial lead implantation without ventricular farfield oversensing, by programming short PVAB and AV intervals, and by implementation of dedicated device algorithms

593. Struble C, Grandjean P: **Cardiac resynchronization with adaptive A1-A2 and/or V1-V2 intervals.**
Abstract: In a system that provides bi-atrial and/or bi-ventricular pacing, the system adjusts an interval between paces delivered to the atria, and/or an interval between paces delivered to the ventricles, as a function of pressure data from the heart. In an exemplary embodiment, the system uses the pressure data from the ventricles to identify the times that each ventricle begins ejection of blood. The system may adjust the interval between paces to cause the ventricles to begin ejection at the same time, or to cause one ventricle to commence blood ejection prior to the other ventricle with a desired time offset. The system may further adjust the interval in response to changing conditions, such as a changing heart rate

594. Sturdivant JL, Gold MR: **Myocardial contractile reserve as a predictor of cardiac resynchronization therapy response.** *Heart rhythm - the official journal of the Heart Rhythm Society* 2006, 3(4)**:** 414-415.

595. Suaide Suva CE, Pereira Barretto AC: **Echocardiographic assessment of cardiac resynchronization therapy**

<Original> Avaliac(Cedil)A(Tilde)O ecocardiografica da terapia de ressincronizac(Cedil)A(Tilde)O cardiaca. *Arquivos Brasileiros de Cardiologia (ARQ BRAS CARDIOL)* /20, ARQ.

596. Suffoletto MS, Dohi K, Cannesson M, Saba S, Gorcsan J: **Novel speckle-tracking radial strain from routine black-and-white echocardiographic images to quantify dyssynchrony and predict response to cardiac resynchronization therapy.** *Circulation* 2006, 113(7)**:** 960-968.
Abstract: BACKGROUND: Mechanical dyssynchrony is a potential means to predict response to cardiac resynchronization therapy (CRT). We hypothesized that novel echocardiographic image speckle tracking can quantify dyssynchrony and predict response to CRT. METHODS AND RESULTS: Seventy-four subjects were studied: 64 heart failure patients undergoing CRT (aged 64+/-12 years, ejection fraction 26+/-6%, QRS duration 157+/-28 ms) and 10 normal controls. Speckle tracking applied to routine midventricular short-axis images calculated radial strain from multiple circumferential points averaged to 6 standard segments. Dyssynchrony from timing of speckle-tracking peak radial strain was correlated with tissue Doppler measures in 47 subjects (r=0.94, P<0.001; 95% CI 0.90 to 0.96). The ability of baseline speckle-tracking radial dyssynchrony (time difference in peak septal wall-to-posterior wall strain > or =130 ms) to predict response to CRT was then tested. It predicted an immediate increase in stroke volume in 48 patients studied the day after CRT with 91% sensitivity and 75% specificity. In 50 patients with long-term follow-up 8+/-5 months after CRT, baseline speckle-tracking radial dyssynchrony predicted a significant increase in ejection fraction with 89% sensitivity and 83% specificity. Patients in whom left ventricular lead position was concordant with the site of latest mechanical activation by speckle-tracking radial strain had an increase in ejection fraction from baseline to a greater degree (10+/-5%) than patients with discordant lead position (6+/-5%; P<0.05). CONCLUSIONS: Speckle-tracking radial strain can quantify dyssynchrony and predict immediate and long-term response to CRT and has potential for clinical application

597. Sutton Martin St John(Reprint), Plappert T, Abraham WT, Leon A, Fieberg A, Chinchoy E: **Optimization of sequential ventricular delay reduces left ventricular dyssynchrony during cardiac resynchronization therapy resulting in improved patient functional response: Results from the Insync III Marquis Trial.**

598. Sutton Martin GSJ, Plappert T, Hilpisch KE, Abraham WT, Hayes DL, Chinchoy E: **Sustained reverse left ventricular structural remodeling with cardiac resynchronization at one year is a function of etiology: quantitative Doppler echocardiographic evidence from the Multicenter InSync Randomized Clinical Evaluation (MIRACLE).** *Circulation* 2006, 113(2)**:** 266-272.
Abstract: BACKGROUND: Cardiac resynchronization therapy (CRT) is an effective therapy for patients with moderate to severe heart failure and prolonged QRS duration. The purpose of this study was to determine whether reverse left ventricular (LV) remodeling and symptomatic benefit from CRT were sustained at 12 months, and if so, in what proportion of patients this occurred. METHODS AND RESULTS: Serial Doppler echocardiograms were obtained at baseline and 6 and 12 months after CRT in 228 patients enrolled in the Multicenter InSync Randomized Clinical Evaluation (MIRACLE) trial. Measurements were made of LV end-diastolic (EDV) and end-systolic (ESV) volumes, ejection fraction, LV mass, severity of mitral regurgitation (MR), peak transmitral velocities during early (E wave) and late (A wave) diastolic filling, and myocardial performance index. At both 6 and 12 months, respectively, CRT was associated with reduced LV EDV (P<0.0001 and P=0.007) and LV ESV (P<0.0001 and P<0.0001), improved ejection fraction (P<0.0001 and P<0.0001), regression of LV mass (P=0.012 and P<0.0001), and reduced MR (P<0.0001 and P<0.0001). LV filling time, transmitral E/A ratio, and myocardial performance index all improved at 12 months compared with baseline (P<0.001, P=0.031, and P<0.0001). Reverse LV remodeling with CRT occurred in more patients at 6 than at 12 months (74% versus 60%, respectively; P<0.05) and was

greater in patients with a nonischemic than an ischemic etiology. CONCLUSIONS: Reverse LV remodeling and symptom benefit with CRT are sustained at 12 months in patients with New York Heart Association class III/IV heart failure but occur to a lesser degree in patients with an ischemic versus a nonischemic etiology, most likely owing to the inexorable progression of ischemic disease

599. Svensson C, Hultgren J, Oltenacu PA: **Morbidity in 3-7-month-old dairy calves in south-western Sweden, and risk factors for diarrhoea and respiratory disease.** *Preventive veterinary medicine* 2006, 74(2-3)**:** 162-179.
Abstract: The health status of 2947 heifer calves born in 1998 and raised in 122 Swedish dairy herds was monitored from birth to 210 days of age. Disease occurrence was recorded by farmers and by veterinarians who visited the farms six times yearly, examined the calves clinically and auscultated their lungs. The incidence risks of diarrhoea, ringworm and clinical respiratory-tract disease (CRTD) in calves from 3 to 7 months of age were 2.7%, 5.6% and 5.7%, respectively. The herd-level incidence risks of the three diseases were zero in 63.1%, 76.2% and 48.4%, respectively, of the herds. In positive herds incidence risks were 2.2-46.4%, 2.6-47.0% and 2.2-53.3%, respectively. The associations between the potential risk factors age at first grazing, air quality, birth place, feeding of colostrum, hygiene, number of animals, age range within the pen or building, pen area, pen location, previous housing type, present housing type, previous disease and season, and each of three binary outcome variables (diarrhoea, increased respiratory sounds and CRTD) were evaluated using two-level (calf; herd) variance component logistic models. Predictors significantly associated ($P<0.05$) with diarrhoea were pen area, season and the interaction between pen location and previous CRTD. Previous CRTD, season and heart girth at weaning were significantly associated with moderately to severely increased respiratory sounds. Predictors significantly associated with CRTD were previous diarrhoea, previous housing and season. It was concluded that the incidence of diarrhoea and CRTD in 91-210-day-old Swedish dairy calves is higher than previously reported from dairy herds in Sweden and the USA, and that diarrhoea, increased respiratory sounds and CRTD are associated with season, a history of disease during the first 90 days of age and, to some extent, housing factors

600. Sweeney MO, Ellenbogen KA, Casavant D, Betzold R, Sheldon T, Tang F *et al*.: **Multicenter, prospective, randomized safety and efficacy study of a new atrial-based managed ventricular pacing mode (MVP) in dual chamber ICDs.** *Journal of cardiovascular electrophysiology* 2005, 16(8)**:** 811-817.
Abstract: BACKGROUND: Ventricular desynchronization caused by right ventricular pacing may impair ventricular function and increase risk of heart failure (CHF), atrial fibrillation (AF), and death. Conventional DDD/R mode often results in high cumulative percentage ventricular pacing (Cum%VP). We hypothesized that a new managed ventricular pacing mode (MVP) would safely provide AAI/R pacing with ventricular monitoring and DDD/R during AV block (AVB) and reduce Cum%VP compared to DDD/R. METHODS: MVP RAMware was downloaded in 181 patients with Marquis DR ICDs. Patients were initially randomized to either MVP or DDD/R for 1 month, then crossed over to the opposite mode for 1 month. ICD diagnostics were analyzed for cumulative percentage atrial pacing (Cum%AP), Cum%VP, and duration of DDD/R pacing for spontaneous AVB. RESULTS: Baseline characteristics included age 66 +/- 12 years, EF 36 +/- 14%, and NYHA Class II-III 36%. Baseline PR interval was 190 +/- 53 msec and programmed AV intervals (DDD/R) were 216 +/- 50 (paced)/189 +/- 53 (sensed) msec. Mean Cum%VP was significantly lower in MVP versus DDD/R (4.1 +/- 16.3 vs 73.8 +/- 32.5, $P < 0.0001$). The median absolute and relative reductions in Cum%VP during MVP were 85.0 and 99.9, respectively. Mean Cum%AP was not different between MVP versus DDD/R (48.7 +/- 38.5 vs 47.3 +/- 38.4, $P = 0.83$). During MVP overall time spent in AAI/R was 89.6% (intrinsic conduction), DDD/R 6.7% (intermittent AVB), and DDI/R 3.7% (AF). No adverse events were attributed to MVP. CONCLUSIONS: MVP safely achieves functional atrial pacing by limiting ventricular pacing to periods of intermittent

AVB and AF in ICD patients, significantly reducing Cum%VP compared to DDD/R. MVP is a universal pacing mode that adapts to AVB and AF, providing both atrial pacing and ventricular pacing support when needed

601. Swerdlow CD, Friedman PA: **Advanced ICD troubleshooting: Part II.** *PACE - Pacing and Clinical Electrophysiology (PACE PACING CLIN ELECTROPHYSIOL)* /20, ACE.

602. Tada H, Toide H, Naito S, Kurosaki K, Ito S, Miyaji K *et al*.: **Tissue Doppler imaging and strain Doppler imaging as modalities for predicting clinical improvement in patients receiving biventricular pacing.** *Circulation journal - official journal of the Japanese Circulation Society* 2005, 69(2)**:** 194-200.
Abstract: BACKGROUND: The purpose of this study was to determine the utility and efficacy of tissue Doppler imaging (TDI) and strain Doppler imaging (SDI) for evaluating ventricular synchrony and function, and for predicting the long-term clinical improvement in patients undergoing biventricular pacing (BVP). METHODS AND RESULTS: TDI and SDI were performed before and <1 month after initiating BVP in 17 patients with advanced heart failure. An intraventricular conduction delay between the left ventricular (LV) septal and lateral walls was measured by TDI. The average LV strain (LV-strain) was calculated from data obtained at the center of 6 regions of the LV (base and mid-point between the basal and apical portions, and the mid-point between these 2 points on the septal and lateral walls). During a 23+/-7 month follow-up period, 12 patients improved clinically and did not require re-hospitalization for heart failure (responder group), but the remaining 5 did not improve (nonresponder group). Before BVP, the intraventricular conduction delay was greater in the responder group than in the nonresponder group ($p<0.01$), but after BVP, it did not differ between the 2 groups. LV-strain improved after BVP in the responder group but not in the nonresponder group ($p<0.05$). CONCLUSION: A high intraventricular conduction delay before BVP and decreased strain shortly after BVP may predict long-term clinical improvement in patients undergoing this treatment

603. Taieb JM, Barnay C, Linde C, Mortensen P, Menardis M: **Left atrial far-field sensing by left ventricular leads: a potential hazard in cardiac resynchronisation therapy.** *Europace - European pacing, arrhythmias , and cardiac electrophysiology - journal of the working groups on cardiac pacing, arrhythmias , and cardiac cellular electrophysiology of the European Society of Cardiology* 2005, 7(6)**:** 611-616.
Abstract: BACKGROUND: Cardiac resynchronisation therapy (CRT) requires a lead advanced through the coronary sinus (CS) to pace the left ventricle (LV). Left atrial far-field signals (LAFFS) may be sensed by the LV lead at the time of implant or after lead dislodgement, and may inhibit ventricular pacing. OBJECTIVE: To assess the incidence of detection of LAFFS > 2 mV and its correlation with the CS lead position. METHODS: Data from the first 75 consecutive patients enrolled in the InSync III multicentre study were analysed. The position of the LV lead was recorded at implant. During follow-up, pacing was temporarily inhibited and the LV channel electrogram was recorded. The amplitude of LAFFS observed before discharge from the hospital and at 1 month of follow-up was retrospectively analysed. A LAFFS > 2 mV was considered clinically significant. RESULTS: CRT systems were successfully implanted in 71 of 75 patients. A LAFFS > 2 mV was recorded by the LV lead channel in six of 71 patients (8.5%). This phenomenon developed between hospital discharge and 1 month of follow-up in two of these patients and in one case disappeared within 1 month. It was observed in all CS tributaries except the anterior and mid-cardiac veins. CONCLUSIONS: Left atrial far-field signals sensed by the LV lead were not rare. Implanting physicians should be aware of this phenomenon in order to prevent potentially serious complications

604. Tang Anthony SL, Ellenbogen KA: **A futuristic perspective on clinical studies of cardiac resynchronization therapy for heart failure patients.** *Current opinion in cardiology* 2006, 21(2)**:** 78-82.
Abstract: PURPOSE OF REVIEW: Heart failure is a major public health problem. Many

heart failure patients have electrical and mechanical ventricular dyssynchrony, which are risk factors for death in heart failure patients. RECENT FINDINGS: Cardiac resynchronization therapy, by stimulating both ventricles, is a strategy to improve ventricular dyssynchrony. SUMMARY: This paper describes the historic development of this therapy; reviews the results of completed clinical cardiac resynchronization therapy studies, and discusses ongoing and future studies

605. Tang AS, Ross H, Simpson CS, Mitchell LB, Dorian P, Goeree R *et al*.: **Canadian Cardiovascular Society/Canadian Heart Rhythm Society position paper on implantable cardioverter defibrillator use in Canada.** *Canadian journal of cardiology* 2005, 21 Suppl A 11-18.
Abstract: The Canadian Heart Rhythm Society in conjunction with the Canadian Cardiovascular Society is committed to the promotion of evidence-based practice in Canada. Since the last Canadian guidelines on the management of sudden cardiac death were published in 2000, several well-conducted clinical trials evaluating the implantable cardioverter defibrillator have been completed and published. The Canadian Cardiovascular Society Council has granted permission to review and update guidelines for the indications for implantable cardioverter defibrillators. Furthermore, data are emerging on the potential benefits of biventricular pacing therapy (cardiac resynchronization) for heart failure; recommendations for the use of this therapy have been included in the present paper. Ethical considerations and the economic implications of these recommendations are also included. Canada's heart rhythm specialists, represented by the Canadian Heart Rhythm Society, have been joined by two heart failure specialists, a medical ethicist and an economist, to develop the present position paper. Members of the Canadian Heart Rhythm Society participated in the discussion of these recommendations in open forum meetings and by electronic communication

606. Tang WHW, Francis GS: **The year in heart failure.** *Journal of the American College of Cardiology (J AM COLL CARDIOL)* /20, J.
Abstract: AB- The rate of generation of new knowledge and expansion of therapeutic approaches to the diagnosis and treatment of acute and chronic HF continues to be dramatic. Recent updates of major clinical guidelines have facilitated the translation of clinical evidence into everyday practice. However, as more and more options become available for this patient population, resource allocation and cost-effectiveness become challenging issues. Device therapies will continue to evolve with newer and broader indications. However, there are still major knowledge gaps regarding the prediction of treatment response and disease progression. New concepts in HF therapeutics (such as NO homeostasis and renal preservation) will need rigorous testing, and traditional strategies should continue to be challenged. (c) 2005 by the American College of Cardiology Foundation

607. Tedrow UB, Kramer DB, Stevenson LW, Stevenson WG, Baughman KL, Epstein LM *et al*.: **Relation of right ventricular peak systolic pressure to major adverse events in patients undergoing cardiac resynchronization therapy.** *American journal of cardiology* 2006, 97(12)**:** 1737-1740.
Abstract: The degree to which increased right-sided heart pressures influence outcome in cardiac resynchronization therapy (CRT) is unclear. High right ventricular (RV) pressures may contribute to septal malpositioning, thus hindering effective resynchronization. We hypothesized that patients with high RV systolic pressures before CRT implantation would have poorer outcome. We evaluated echocardiograms, electrocardiograms, and clinical records from 75 consecutive patients with CRT. RV systolic pressure was calculated from the peak tricuspid regurgitant, time-velocity profile. The primary end point was a composite of mortality, cardiac transplantation, or need for a left ventricular assist device. Events were evaluated by Kaplan-Meier curves and Cox proportional hazard ratios. Patients grouped by RV systolic pressure divided at the median of 35 mm Hg were similar except for more renal insufficiency and RV dysfunction when RV systolic pressure was

>35 mm Hg. Univariate analysis identified RV systolic pressure >35 mm Hg (hazard ratio [HR] 3.32), diabetes (HR 2.45), renal insufficiency (HR 3.52), atrial fibrillation (HR 3.07), use of nonamiodarone antiarrhythmic medications (HR 2.86), atrial pacing (HR 2.57), and prolonged PR interval (HR 1.009) as associated with poorer outcome. Normal sinus rhythm at implantation (HR 0.34), baseline left bundle branch block (HR 0.44), and beta-blocker use (HR 0.47) were associated with improved outcome. In a multivariable model, high RV systolic pressure (HR 3.71, 95% confidence interval 1.31 to 10.4), renal insufficiency (HR 3.18, 95% confidence interval 1.29 to 7.86), and atrial fibrillation (HR 4.22, 95% confidence interval 1.54 to 11.6) remained significant. In conclusion, despite resynchronization, patients with high RV pressures have significantly decreased survival after adjusting for significant contributing influences

608. Thamasett S: **Cardiac resynchronization therapy (CRT) for the treatment of chronic heart failure**
<Original> Die kardiale resynchronisations-therapie (Crt) Zur behandlung der chronischen herzinsuffizienz. *Kardiotechnik (Kardiotechnik)* /20, KARDIOTECHNIK.
Abstract: AB- Heart failure is an endemic which will only grow in time with the ongoing improvement of interventional cardiology and drug therapy. Cardiac Resynchronization Therapy (CRT) is a new procedure that has recently been approved by the Food and Drug Administration of the United States of America for the treatment of Heart Failure (HF). CRT is delivered by means of bi-ventricular pacing to the heart. This indicates that in addition to the right ventricular lead, there is an epicardial lead placed on the left ventricle by way of the coronary venous system. CRT has been demonstrated to increase the Net Cardiac Output of the diseased heart, yet without any increase in the oxygen consumption. CRT therefore does not increase the work performed by the myocardium but rather ensures better coordination and more effective work. Many clinical studies have been published demonstrating a decrease in hospitalization time, and better quality of life, submaximal exercise, and peak oxygen uptake. The COMPANION trail shows the first time a dramatically reduction of mortality due to CRT and CRT-P next to an improvement of all functional parameters. Furthermore, significant reduction in the size of the left ventricle at the end of both systole and diastole have been demonstrated repeatedly. The patients that are best suited for CRT are the patients suffering from symptomatic heart failure with left ventricular dysfunction, and intra-ventricular conduction disorder such as left bundle branch block (LBBB). This would correspond from 10% to 30% of patients suffering from HF

609. Theodorakis GN, Flevari P, Kroupis C, Adamopoulos S, Livanis EG, Kostopoulou A *et al.*: **Antiinflammatory effects of cardiac resynchronization therapy in patients with chronic heart failure.** *Pacing and clinical electrophysiology - PACE* 2006, 29(3)**:** 255-261.
Abstract: BACKGROUND: Cardiac resynchronization therapy (CRT) pacing has been proposed as an additional treatment to medical therapy to improve heart failure patients with left ventricular asynchrony. The aim of this study was to evaluate the influence of CRT treatment on proinflammatory cytokines in patients with heart failure. METHODS: Twenty patients, with a mean age 64 +/- 2 years, with severe chronic heart failure NYHA class II-IV (mean ejection fraction 25 +/- 2%), were included in the study. Patients were treated with CRT pacing, after failure of optimal therapy. Blood samples were taken at baseline, 3 months after pacing therapy, and after a subsequent 3-month period of no pacing for the assessment of proinflammatory cytokines TNF-alpha and its receptors (sTNFR-I, sTNFR-II), IL-6, adhesion molecules sICAM-1 and sVCAM-1, and the apoptotic indices sFas and sFas-Ligand. RESULTS: Levels of TNF-alpha, sTNFR-I, and sTNFR-II were reduced at the end of 3 months of CRT therapy and further reduced at the end of the no pacing period ($P < 0.05$, compared to baseline). Levels of IL-6 also declined after 3 months of CRT pacing (from 8.9 +/- 2.5 pg/mL to 4.7 +/- 1.3 pg/mL, $P < 0.05$) and this was maintained during the no pacing period (3.9 +/- 1.1 pg/mL $P < 0.05$ compared to baseline). The adhesion molecule sICAM-1 levels also reduced (from 265 +/- 17 ng/mL to

235 +/- 12, P < 0.05) after 3 months of CRT pacing and remained unchanged at the end of the no pacing period (219 +/- 12 ng/mL, P < 0.05 compared to baseline values). CONCLUSION: Major proinflammatory cytokines and the adhesion molecule sICAM-1 are reduced with CRT therapy and this effect is maintained for at least 3 months after discontinuation of pacing

610. Theuns Dominic AMJ, Thornton AS, Klootwijk AP, Scholten MF, Vantrimpont Pascal JMJ, Balk Aggie HMM *et al*.: **Outcome in patients with an ICD incorporating cardiac resynchronisation therapy: differences between primary and secondary prophylaxis.** *European journal of heart failure - journal of the Working Group on Heart Failure of the European Society of Cardiology* 2005, 7(6)**:** 1027-1032.
Abstract: BACKGROUND: The incidence of ventricular tachyarrhythmias in ICD patients with cardiac resynchronisation therapy (CRT-D) is not well studied. AIM: To analyse event free survival in CRT-D patients with a primary or a secondary prophylactic ICD indication. METHODS: Prospective, single centre. Eighty-six patients, 44% with a primary prophylactic indication. Actuarial event-free rates for mortality and arrhythmias were calculated. RESULTS: Baseline clinical characteristics were not significantly different between primary and secondary prophylaxis. Primary prophylaxis patients were more likely to be in NYHA class III. Over 21 months, 724 ventricular events with therapy occurred in 36 patients (42%). The actuarial event-free rates, at 1 and 3 years, from appropriate ICD therapy were higher (P<0.001) for primary (79.0% and 67.8%) than for secondary prophylaxis (45.6% and 27.0%). Appropriate ICD therapy occurred more in NYHA class II compared to class III (P=0.016). Underlying disease (ischemic versus non-ischemic) and functional class did not play a role in multivariate analysis. CONCLUSION: Important arrhythmic events in patients with heart failure, and CRT-D occur at a very high rate when the indication is secondary prophylaxis. Patients with primary prophylaxis have an annual event rate of 10%, even though they tend to have a worse heart failure class

611. Thibault B, Roy D, Guerra PG, Macle L, Dubuc M, Gagne P *et al*.: **Anodal right ventricular capture during left ventricular stimulation in CRT-implantable cardioverter defibrillators.** *Pacing and clinical electrophysiology - PACE* 2005, 28(7)**:** 613-619.
Abstract: BACKGROUND: Cardiac resynchronization therapy (CRT) has been shown to improve symptoms of patients with moderate to severe heart failure. Optimal CRT involves biventricular or left ventricular (LV) stimulation alone, atrio-ventricular (AV) delay optimization, and possibly interventricular timing adjustment. Recently, anodal capture of the right ventricle (RV) has been described for patients with CRT-pacemakers. It is unknown whether the same phenomenon exists in CRT systems associated with defibrillators (CRT-ICD). The RV leads used in these systems are different from pacemaker leads: they have a larger diameter and shocking coils, which may affect the occurrence of anodal capture. METHODS: We looked for anodal RV capture during LV stimulation in 11 consecutive patients who received a CRT-ICD system with RV leads with a true bipolar design. Fifteen patients who had RV leads with an integrated design were used as controls. Anodal RV and LV thresholds were determined at pulse width (pw) durations of 0.2, 0.5, and 1.0 ms. RESULTS: RV anodal capture during LV pacing was found in 11/11 patients at some output with true bipolar RV leads versus 0/15 patients with RV leads with an integrated bipolar design. Anodal RV capture threshold was more affected by changes in pw duration than LV capture threshold. In CRT-ICD systems, RV leads with a true bipolar design with the proximal ring also used as the anode for LV pacing are associated with a high incidence of anodal RV capture during LV pacing. This may affect the clinical response to alternative resynchronization methods using single LV stimulation or interventricular delay programming

612. Timperley J, Mitchell Andrew RJ, Brown P, Betts TR: **Changes in intrathoracic impedance from a pneumothorax: insights from an implanted monitoring system.** *Pacing and clinical electrophysiology - PACE* 2005, 28(10)**:** 1109-1111.

Abstract: The measurement of transthoracic impedance is now possible using new implantable cardioverter-defibrillators. This can be used to monitor fall in impedance associated with increasing pulmonary oedema. We describe a case of a large rapid increase of impedance and dyspnoea related to a pneumothorax

613. Tomioka H, Liakopoulos OJ, Buckberg GD, Hristov N, Tan Z, Trummer G: **The effect of ventricular sequential contraction on helical heart during pacing: high septal pacing versus biventricular pacing.** *European journal of cardio-thoracic surgery - official journal of the European Association for Cardio-thoracic Surgery* 2006, 29 Suppl 1 S198-S206.
Abstract: OBJECTIVE: To investigate the effect of biventricular and high septal pacing on the normal contraction sequence of the helical ventricular myocardial band, and its impact on left ventricular function. METHODS: Ten pigs (25-68 kg) underwent analysis of percent segmental shortening (SS%) by sonomicrometry, with crystals placed along the fiber orientation of the ascending, descending segments, and posterior LV wall within the spatial geometry of the helical heart. Unipolar pacing electrodes stimulated the right atrium (RA) and either the right ventricular apex and left ventricular posterior wall (atrio-biventricular), or the proximal high septum (atrio-high septal). Systemic hemodynamics, QRS-interval, cardiac index (CI), systolic and diastolic LV functions and pressure-dimension loops (P-D) were analyzed and cardiac motion was monitored by video analysis. RESULTS: Pacing increased normal sinus heart rate (NSR) from 77+/-9 beats/min to 98+/-5 beats/min. Atrial pacing did not change the NSR hemodynamic variables. Conversely, atrio-biventricular pacing prolonged the QRS-interval (91+/-14 ms vs 56+/-11 ms at baseline, $p<0.05$) and decreased mean arterial pressure (50+/-4 mmHg vs 58+/-12 mmHg), CI (3.4+/-0.3 L/(min m2) vs 4.0+/-0.8 L/(min m2)) and PRSW (71+/-25%) compared to NSR ($p<0.05$). Furthermore, atrio-biventricular pacing decreased SS% in all segments, especially at the LV posterior wall (71% of baseline, $p<0.05$), and disrupted the NSR shortening sequence (progression from descending to posterior to ascending regions). Changes were characterized by premature stimulation of the posterior wall segment adjacent to the pacer stimulus, with associated (1) decrease of pressure-dimension loop area, (2) desynchronization of P-D loops and (3) consistent loss of the twisting pattern of visible cardiac motion. In contrast, atrio-high septal pacing restored systemic hemodynamics, LV systolic and diastolic functions to baseline values and preserved the normal sequence of shortening of the ventricular myocardial band. CONCLUSIONS: (1) Biventricular pacing disrupts of the natural sequence of shortening of the myocardial band and results in impaired LV function. (2) High septal pacing preserves the sequential shortening pattern of the myocardial band and LV function

614. Trupp RJ: **Cardiac resynchronization therapy: a practical guide for device optimization, part I.** *Congestive heart failure (Greenwich , Conn)* 2006, 12(3)**:** 169-173.
Abstract: This is the first part of a two-part series on strategies for optimizing the delivery of cardiac resynchronization therapy (CRT), focusing on device-related aspects. There is overwhelming evidence from prospective randomized controlled trials providing consistent and concordant support for CRT in patients with symptomatic heart failure and ventricular dyssynchrony. CRT has consistently improved quality of life, cardiac structure and function, and survival in the majority of patients enrolled in these trials. No longer a consideration for select individuals with heart failure, the 2005 American College of Cardiology/American Heart Association Guidelines for Managing Adults with Chronic Heart Failure now consider CRT a class IA recommendation for stage C patients (QRS duration > or = 120 milliseconds, left ventricular ejection fraction < or = 35%) who remain symptomatic despite optimal medical therapy. However, not everyone experiences clinical improvement from CRT. This article discusses measures that should be considered to ensure proper functioning of a CRT device. A subsequent article will present strategies to optimize patients' responses to CRT

615. Tse H, Siu C, Lee Kathy LF, Fan K, Chan H, Tang M *et al*.: **The incremental benefit of rate-adaptive pacing on exercise performance during cardiac resynchronization therapy.** *Journal of the American College of Cardiology* 2005, 46(12)**:** 2292-2297.
Abstract: OBJECTIVES: The purpose of this research was to investigate the effect of using rate-adaptive pacing and atrioventricular interval (AVI) adaptation on exercise performance during cardiac resynchronization therapy (CRT). BACKGROUND: The potential incremental benefits of using rate-adaptive pacing and AVI adaptation with CRT during exercise have not been studied. METHODS: We studied 20 patients with heart failure, chronotropic incompetence (<85% age-predicted heart rate [AP-HR] and <80% HR reserve), and implanted with CRT. All patients underwent a cardiopulmonary exercise treadmill test using DDD mode with fixed AVI (DDD-OFF), DDD mode with adaptive AVI on (DDD-ON), and DDDR mode with adaptive AVI on (DDDR-ON) to measure metabolic equivalents (METs) and peak oxygen consumption (VO2max). RESULTS: During DDD-OFF mode, not all patients reached 85% AP-HR during exercise, and 55% of patients had <70% AP-HR. Compared to patients with >70% AP-HR, patients with <70% AP-HR had significantly lower baseline HR (66 +/- 3 beats/min vs. 80 +/- 5 beats/min, p = 0.015) and percentage HR reserve (27 +/- 5% vs. 48 +/- 6%, p = 0.006). In patients with <70% AP-HR, DDDR-ON mode increased peak exercise HR, exercise time, METs, and VO2max compared with DDD-OFF and DDD-ON modes ($p < 0.05$), without a significant difference between DDD-OFF and DDD-ON modes. In contrast, there were no significant differences in peak exercise HR, exercise time, METs, and VO2max among the three pacing modes in patients with >70% AP-HR. The percentage HR changes during exercise positively correlated with exercise time ($r = 0.67$, $p < 0.001$), METs ($r = 0.56$, $p < 0.001$), and VO2max ($r = 0.55$, $p < 0.001$). CONCLUSIONS: In heart failure patients with severe chronotropic incompetence as defined by failure to achieve >70% AP-HR, appropriate use of rate-adaptive pacing with CRT provides incremental benefit on exercise capacity during exercise

616. Tse H, Lee KL, Wan S, Yu Y, Hoersch W, Pastore J *et al*.: **Area of left ventricular regional conduction delay and preserved myocardium predict responses to cardiac resynchronization therapy.** *Journal of cardiovascular electrophysiology* 2005, 16(7)**:** 690-695.
Abstract: Cardiac resynchronization therapy. BACKGROUND: A significant proportion of patients with dilated cardiomyopathy and left bundle branch block (LBBB) do not respond to cardiac resynchronization therapy (CRT). The purpose of this study was to investigate whether the electromechanical properties of the myocardium would predict acute hemodynamic improvement during left ventricular (LV) pacing. METHODS AND RESULTS: We studied 10 patients with idiopathic dilated cardiomyopathy and LBBB (ejection fraction (EF): 27%+/-7%; QRS duration: 166+/-16 msec) using three-dimensional electromechanical endocardial mapping technique to assess endocardial activation time (Endo-AT), unipolar voltage, and local linear shortening during sinus rhythm. LV stimulation was performed in VDD mode at five different sites and three atrioventricular delays within the coronary sinus. LV+dP/dtmax changes from baseline were measured during LV stimulation at each site (%DeltadP/dtmax). There was no significant relationship between maximum %DeltadP/dtmax during LV stimulation at the best coronary sinus site and LV EF, baseline LV+dP/dtmax, total LV Endo-AT, baseline QRS duration nor changes in QRS duration during LV pacing. However, the maximum %DeltadP/dtmax was significantly positively correlated with percentage area of late Endo-AT ($r=0.97$, $P<0.001$) and preserved LV myocardium ($r=0.81$, $P=0.005$), respectively. Patients with >20% of LV area with late Endo-AT and >30% of preserved LV myocardium had five times better acute hemodynamic response with LV stimulation. Multivariate analysis showed that only percentage area of late Endo-AT was independently correlated with %DeltadP/dtmax ($P<0.05$). CONCLUSION: The presence of a larger amount of LV area with late Endo-AT and preserved LV myocardium measured by electromechanical mapping could identify patients who have better acute improvement in systolic performance during LV stimulation

617. Turer AT, Rao SV: **Device therapy in the management of congestive heart failure.** *Cardiology in Review (CARDIOL REV)* /20, CARDIOL.
Abstract: AB- Despite significant advancements in the treatment of heart failure over the past 2 decades, this patient population is still subject to considerably high morbidity and mortality rates. In recent years, the field of device therapy as adjunctive treatment to the medical management of congestive heart failure has grown in the wake of the large number of randomized trials that have demonstrated the safety and efficacy of these devices. The implantable defibrillator currently represents the standard of care in certain segments of the heart failure population, even in those without a prior arrhythmic event. Biventricular pacing systems appear to have a role in heart failure patients with prolongation of their QRS duration in improving ventricular performance and symptoms, if not mortality. Last, the shortage of organs available for orthotopic transplant has heightened interest in using ventricular-assist devices as destination therapy, and although there is evidence for the feasibility for this approach at the current time, there is a next generation of devices that appear even more promising. Copyright (c) 2005 by Lippincott Williams & Wilkins

618. Turitto G, Haq S, Benson D, El-Sherif N: **Torsade de pointes: an electrophysiological effect of cardiac resynchronization?** *Pacing and clinical electrophysiology - PACE* 2006, 29(5)**:** 520-522.

619. Tzeis S, Kranidis A, Andrikopoulos G, Kappos K, Manolis AS: **The contribution of echocardiography to cardiac resynchronisation therapy.** *Hellenic journal of cardiology - HJC = Hellenike kardiologike epitheorese* 2005, 46(4)**:** 289-299.

620. Van Gelder BM, Bracke FA, Meijer A, Pijls Nico HJ: **The hemodynamic effect of intrinsic conduction during left ventricular pacing as compared to biventricular pacing.** *Journal of the American College of Cardiology* 2005, 46(12)**:** 2305-2310.
Abstract: OBJECTIVES: We sought to investigate the effect of intrinsic conduction over the right bundle on the maximum rate of left ventricular pressure rise (LVdP/dt(max)) during left ventricular (LV) pacing compared to biventricular (BiV) pacing. BACKGROUND: Simultaneous BiV pacing and LV pacing both improve LV function in patients with heart failure and LV asynchrony. We studied the hemodynamic effect of intrinsic conduction leading to ventricular fusion during LV pacing. METHODS: In 34 patients with New York Heart Association functional class III or IV, sinus rhythm with normal atrioventricular (AV) conduction, left bundle branch block, QRS >130 ms, and optimal medical therapy, LVdP/dt(max) was measured invasively during LV and simultaneous BiV pacing. The AV interval was varied in four steps starting (AV1) with an AV interval 40 ms shorter than the intrinsic PQ time and decreased with 25% for each step. RESULTS: At AV1, LVdP/dt(max) was 996 +/- 194 mm Hg/s for LV pacing and 960 +/- 200 mm Hg/s for BiV pacing (p = 0.0009), with all patients showing ventricular fusion during LV pacing. At AV2, 21 patients had ventricular fusion with a LVdP/dt(max) of 983 +/- 213 mm Hg/s and 957 +/- 202 mm Hg/s for LV and BiV pacing, respectively. In the remaining 13 patients without fusion these values were 919 +/- 164 mm Hg/s and 957 +/- 174 mm Hg/s, respectively. The difference between LV and BiV at AV2 is significantly higher when fusion is present (p = 0.01). CONCLUSIONS: The LVdP/dt(max) is higher in LV than in BiV pacing provided that LV pacing is associated with ventricular fusion caused by intrinsic activation

621. Van Gelder BM, Bracke FA, van d, V, Meijer A: **Right ventricular anodal capture during left ventricular stimulation in CRT-implantable cardioverter defibrillators (ICD).** *Pacing and clinical electrophysiology - PACE* 2006, 29(3)**:** 337-338.

622. van Huysduynen BH, Swenne CA, Bax JJ, Bleeker GB, Draisma Harmen HM, van EL *et al.*: **Dispersion of repolarization in cardiac resynchronization therapy.** *Heart rhythm - the official journal of the Heart Rhythm Society* 2005, 2(12)**:** 1286-1293.
Abstract: BACKGROUND: Proarrhythmic effects of cardiac resynchronization therapy

(CRT) as a result of increased transmural dispersion of repolarization (TDR) induced by left ventricular (LV) epicardial pacing in a subset of vulnerable patients have been reported. The possibility of identifying these patients by ECG repolarization indices has been suggested. OBJECTIVES: The purpose of this study was to test whether repolarization indices on the ECG can be used to measure dispersion of repolarization during pacing. METHODS: CRT devices of 28 heart failure patients were switched among biventricular, LV, and right ventricular (RV) pacing. ECG indices proposed to measure dispersion of repolarization were calculated. The effects of CRT on repolarization were simulated in ECGSIM, a mathematical model of electrocardiogram genesis. TDR was calculated as the difference in repolarization time between the epicardial and endocardial nodes of the heart model. RESULTS: Patients: The interval from the apex to the end of the T wave was shorter during biventricular pacing (102 +/- 18 ms) and LV pacing (106 +/- 21 ms) than during RV pacing (117 +/- 22 ms, P < or =.005). T-wave amplitude and area were low during biventricular pacing (287 +/- 125 microV and 56 +/- 22 microV.s, respectively, P = .0006 vs RV pacing). T-wave complexity was high during biventricular pacing (0.42 +/- 0.26, P = .004 vs RV pacing). Simulations: Repolarization patterns were highly similar to the preceding depolarization patterns. The repolarization patterns of different pacing modes explained the observed magnitudes of the ECG repolarization indices. Average and local TDR were not different between pacing modes. CONCLUSION: In patients treated with CRT, ECG repolarization indices are related to pacing-induced activation sequences rather than transmural dispersion. TDR during biventricular and LV pacing is not larger than TDR during conventional RV endocardial pacing

623. van Veldhuisen DJ, van Dessel Pascal FHM: **Cardiac resynchronization therapy in chronic heart failure: how to select the patient that will benefit?** *International journal of cardiology* 2005, 100(1)**:** 13-15.

624. van BE, Backx A, Singh S: **Cardiac resynchronization as therapy for congestive cardiac failure in children dependent on chronic cardiac pacing.** *Cardiology in the young* 2006, 16(2)**:** 187-189.
Abstract: Three patients with heart failure after chronic right ventricular apical pacing were treated with resynchronization. Biventricular pacing was used for two patients, and the other was treated with left univentricular pacing. In all patients, we observed a dramatic improvement of left ventricular dimension, function, and clinical state. We conclude that biventricular or left ventricular pacing is superior to right ventricular apical pacing in children who are pacemaker-dependent

625. Vanderheyden M, De BT, Rivero-Ayerza M, Geelen P, Bartunek J, Verstreken S *et al.*: **Tailored echocardiographic interventricular delay programming further optimizes left ventricular performance after cardiac resynchronization therapy.** *Heart rhythm - the official journal of the Heart Rhythm Society* 2005, 2(10)**:** 1066-1072.
Abstract: BACKGROUND: The aim of cardiac resynchronization therapy is correction of left ventricular (LV) dyssynchrony. However, little is known about the optimal timing of LV and right ventricular (RV) stimulation. OBJECTIVES: The purpose of this study was to evaluate the acute hemodynamic effects of biventricular pacing, using a range of interventricular delays in patients with advanced heart failure. METHODS: Twenty patients with dilated ischemic (n = 12) and idiopathic (n = 8) cardiomyopathy (age 66 +/- 6 years, New York Heart Association class III-IV, LV end-diastolic diameter >55 mm, ejection fraction 22% +/- 18%, and QRS 200 +/- 32 ms) were implanted with a biventricular resynchronization device with sequential RV and LV timing (VV) capabilities. Tissue Doppler echocardiographic parameters were measured during sinus rhythm before implantation and following an optimal AV interval with both simultaneous and sequential biventricular pacing. The interventricular interval was modified by advancing the LV stimulus (LV first) or RV stimulus (RV first) up to 60 ms. For each stimulation protocol, standard echocardiographic Doppler and tissue Doppler imaging (TDI) echo were used to measure the LV outflow tract velocity-time integral, LV filling

time, intraventricular delay, and interventricular delay. RESULTS: The highest velocity-time integral was found in 12 patients with LV first stimulation, 5 patients with RV first stimulation, and 3 patients with simultaneous biventricular activation. Compared with simultaneous biventricular pacing, the optimized sequential biventricular pacing significantly increased the velocity-time integral (P <.001) and LV filling time (P = .001) and decreased interventricular delay (P = .013) and intraventricular delay (P = .010). The optimal VV interval could not be predicted by any clinical nor echocardiographic parameter. At 6-month follow-up, the incidence of nonresponders was 10%. CONCLUSION: Optimal timing of the interventricular interval results in prolongation of the LV filling time, reduction of interventricular asynchrony, and an increase in stroke volume. In patients with advanced heart failure undergoing cardiac resynchronization therapy, LV hemodynamics may be further improved by optimizing LV-RV delay

626. Vanderheyden M, Wellens F, Bartunek J, Verstreken S, Walraevens M, Geelen P *et al*.: **Cardiac resynchronization therapy delays heart transplantation in patients with end-stage heart failure and mechanical dyssynchrony.** *Journal of heart and lung transplantation - the official publication of the International Society for Heart Transplantation* 2006, 25(4)**:** 447-453.
Abstract: BACKGROUND: Cardiac dyssynchrony is frequent in advanced heart failure, and cardiac resynchronization therapy (CRT) may offer an alternative to heart transplantation. We aimed to investigate the impact of CRT on freedom from Tx and death in transplant candidates with end-stage heart failure. METHODS: Over a period of 2 years, 46 consecutive patients with refractory congestive heart failure due to dilated cardiomyopathy were referred for heart transplant evaluation. Patients with cardiac dyssynchrony > 107 milliseconds according to tissue Doppler imaging (TDI) or QRS duration > 150 milliseconds were treated with CRT (CRT group, n = 24), whereas patients without dyssynchrony were not treated (non-CRT group, n = 22). RESULTS: At baseline, both groups showed similar hemodynamic and functional parameters, including ejection fraction (19 +/- 10% vs 21 +/- 12%, not statistically significant [NS]) and Vo2max (11.9 +/- 2.0 vs 12.0 +/- 1.8 ml/kg/min, NS). After a follow-up of 488 +/- 346 days, cumulative survival with freedom from transplantation and death was higher in CRT vs non-CRT patients (92% vs 39%; p < 0.001). CRT patients showed a decrease in New York Heart Association (NYHA) class from 3.2 +/- 1.1 to 2.2 +/- 0.9 (p = 0.003) and an increase in Vo2max from 11.9 +/- 2.0 to 13.1 +/- 1.8 ml/kg/min (p = 0.02), and 71% (17 of 24) of these patients were successfully removed from the waiting list. CONCLUSIONS: In heart transplant candidates with significant dyssynchrony, CRT delays heart transplantation and improves NYHA class and exercise capacity. For these patients, CRT should be considered before heart transplantation

627. Vanhout WL: **Adjustable cardiac resynchronization.**
Abstract: Techniques are presented for providing adjustable cardiac resynchronization with an implanted medical device such as a pacemaker. For example, cardiac resynchronization may be provided during some time periods but not during other time periods, or cardiac resynchronization may be provided in response to selected sensed events. Adjustable cardiac resynchronization is applicable to therapy such as bi-ventricular pacing, in which both ventricles of the heart are paced in response to sensed atrial events

628. Vannan MA, Pedrizzetti G, Li P, Gurudevan S, Houle H, Main J *et al*.: **Effect of cardiac resynchronization therapy on longitudinal and circumferential left ventricular mechanics by velocity vector imaging: description and initial clinical application of a novel method using high-frame rate B-mode echocardiographic images.**
Echocardiography (Mount Kisco , N Y) 2005, 22(10)**:** 826-830.
Abstract: Cardiac resynchronization therapy (CRT) has emerged as an important method to treat patient with symptomatic heart failure with evidence of intraventricular dyssynchrony. Tissue Doppler imaging by echocardiography has been shown to be an excellent tool for the assessment of mechanical left ventricular dyssynchrony and the selection of patients for

CRT. However, there are some patients who do not show symptomatic improvement following CRT. One possible explanation for this is the need to optimize not only longitudinal synchrony, but also improve the circumferential and radial dynamics of the left ventricle. Doppler imaging does not allow reliable assessment of the latter because of the angle-dependency of the technique. Velocity Vector Imaging (VVI) is a newer technique which is angle-independent and thus provides an avenue to evaluate short-axis mechanics of the left ventricle. We describe a case in which VVI was used to assess the left ventricular dynamics in a patient with heart failure who did not respond to CRT

629. Ventak Chf Contak-Cd Biventricular: **Septal to posterior wall motion delay fails to predict reverse remodeling or clinical improvement in patients undergoing cardiac resynchronization therapy.**
Abstract: Objectives: The aim of this study was to test the hypothesis that a longer septal-to-posterior wall motion delay (SPWMD) would predict greater reverse remodeling and an improved clinical response in heart failure patients randomized to cardiac resynchronization therapy (CRT) in the CONTAK-CD trial.Backround: The SPWMD predicted clinical benefit with CRT in two previous studies from the same center.Methods: In this retrospective analysis of the CONTAK-CD trial, SPWMD was measured from the baseline echocardiogram of 79 heart failure patients (ejection fraction 22 +/- 7%, QRS duration 159 +/- 27 ms, 72% ischemic, 84% male) randomized to CRT and compared with six-month changes in echocardiographic and clinical parameters. Patients with a left ventricular end-systolic volume index (LVESVI) reduction of at least 15% were considered responders.Results: The feasibility and reproducibility of performing the SPWMD measurements were poor. Larger values for SPWMD did not correlate with six-month changes in left ventricular end-diastolic volume index ($p = 0.26$), LVESVI ($p = 0.41$), or left ventricular ejection fraction ($p = 0.36$). Responders did not have a significantly different SPWMD than non-responders ($p = 0.26$). The SPWMD did not correlate with measures of clinical improvement. At a threshold of SPVMD > 130 ms, the test characteristics to predict reverse remodeling or a clinical response were inadequate.Conclusions: The previous findings that SPWMD predicts reverse remodeling or clinical improvement with CRT were not reproducible in patients randomized in the CONTAK-CD trial

630. Verbeek Xander AAM, Auricchio A, Yu Y, Ding J, Pochet T, Vernooy K *et al*.: **Tailoring cardiac resynchronization therapy using interventricular asynchrony. Validation of a simple model.** *American journal of physiology Heart and circulatory physiology* 2006, 290(3)**:** H968-H977.
Abstract: This study explores the use of interventricular asynchrony (interVA) for optimizing cardiac resynchronization therapy (CRT), an idea emerging from a simple pathway model of conduction in the ventricles. Measurements were performed in six dogs with chronic left bundle branch block (LBBB) and in 29 patients of the Pacing Therapies for Congestive Heart Failure (PATH-CHF)-I study. In the dogs, intraventricular asynchrony (intraVA) was determined using left ventricular (LV) endocardial activation maps. In dogs and patients, the maximum rate of rise of LV pressure (LV dP/dt(max)) and the pulse pressure (PP) and interVA [time delay between upslope of LV and right ventricular (RV) pressure curves] were measured during LV, RV, and biventricular (BiV) pacing with various atrioventricular (AV) delays. Measurements in the canine hearts supported the pathway model in that optimal resynchronization occurred at approximately 50% reduction of intraVA and at an interVA value halfway that during LBBB and LV pacing. In patients with significant hemodynamic response during pacing ($n = 22$), intrinsic interVA and interVA at peak improvement (interVA(p)) varied widely between patients (from -83 to -15 ms and from -42 to +31 ms, respectively). However, the model predicted individual interVA(p) accurately (SD of +/-6 ms and +/-12 ms for LV dP/dt(max) and PP, respectively). At equal interVA, LV and BiV pacing produced equal hemodynamic response, but in 11 of 22 responders, BiV pacing reduced interVA insufficiently to reach the maximum hemodynamic response. LV pacing at short AV delay proved to result in

better hemodynamics than predicted by the model, indicating that additional factors determine hemodynamics during LV preexcitation. Guided by a simple pathway model, interVA measurements accurately predict optimal hemodynamic performance in individual CRT patients

631. Verma S: **Coronary sinus flow reversal in congestive heart failure detected during biventricular pacing.** *Journal of interventional cardiac electrophysiology - an international journal of arrhythmias and pacing* 2005, 14(1)**:** 45-49.
Abstract: This report describes a phenomenon observed during implantation of a left ventricular lead through the coronary sinus. During coronary sinus venography there was reflux of dye from the coronary sinus ostium towards the distal part of the sinus against the anticipated direction of flow. This was correlated to elevation of the right atrial pressure above the pressure within the coronary sinus. A review of data is provided and suggests several deleterious effects of this phenomenon on left ventricular function

632. Vidal B, Sitges M, Marigliano A, az-Infante E, Azqueta M, Tamborero D *et al*.: **Relation of response to cardiac resynchronization therapy to left ventricular reverse remodeling.** *American journal of cardiology* 2006, 97(6) **:** 876-881.
Abstract: Cardiac resynchronization therapy (CRT) reverses left ventricular (LV) remodeling in patients with congestive heart failure. However, the mechanisms leading to the clinical response to CRT remain unclear. The aim of this study was to analyze whether patients who improve clinically have greater LV reverse remodeling than nonresponders after a 12-month follow-up period. The sample comprised 64 consecutive patients with heart failure, complete left bundle branch block, and LV ejection fractions (EFs) < or =35% who were treated with CRT. Doppler echocardiographic scans were taken just before and immediately after the implantation of the pacemakers and at 6- and 12-month follow-up examinations. LV diameters, volumes, and EFs were compared. Responders were defined as those patients who were alive without cardiac transplantation and with > or =10% improvement in the 6-minute walking test after 1 year of follow-up. There were no clinical differences at baseline between responders and nonresponders. At 6- and 12-month follow-up, LV dimensions decreased significantly in responders but did not change in nonresponders. Furthermore, LVEFs improved only in responders. In conclusion, patients who clinically respond to CRT have greater LV reverse remodeling than nonresponders after 6 and 12 months of follow-up. The effect of CRT on LV remodeling may explain, at least in part, the clinical benefit of this therapy

633. Vieira Marcelo LC, Maddukuri P, V, Phang RS, Pandian NG, Mathias JW, Ramires Jose AF: **[Mechanism of cardiac resynchronization therapy by real-time three-dimensional echocardiography in patients with heart failure]**
<Original> Demonstracao do mecanismo da terapia de ressincronizacao ventricular com ecocardiografia tridimensional em tempo real em paciente com insuficiencia cardiaca. *Arquivos brasileiros de cardiologia* 2005, 85(5)**:** 333-336.
Abstract: We report the case of a 66-year-old man with heart failure NYHA class IV treated with biventricular pacing for cardiac resynchronization. The patient was evaluated by real-time three-dimensional transthoracic echocardiography before and 48 hours after pacemaker implantation. The use of three-dimensional echocardiography contributed to understanding the underlying mechanism involved in cardiac resynchronization therapy by demonstrating enhanced synchrony of myocardial segments, which resulted in the patient's clinical improvement

634. Vlay SC, Kort S: **Biventricular pacing using dual-site right ventricular stimulation: is it placebo effect?** *Pacing and clinical electrophysiology - PACE* 2006, 29(7)**:** 779-783.
Abstract: Alternate site lead placement in cardiac resynchronization therapy has been used successfully but remains to be validated. A 62-year-old heart failure patient in whom coronary sinus lead placement was not possible underwent implantation of the lead in the right ventricular outflow tract (RVOT) and demonstrated clinical improvement as

measured by New York Heart Association class and noninvasive parameters. When heart failure recurred, it was determined that his RVOT electrode had been pulled back (Twiddler's syndrome). Repositioning again improved his clinical status and noninvasive hemodynamic measurements. With dual-site right ventricular (RV) pacing there was no echocardiographic measurable intraventricular dyssynchrony. Tissue Doppler imaging correlated with clinical improvement using dual-site RV pacing, providing evidence that this technique may represent a viable alternative in cardiac resynchronization therapy

635. Voigt A, Barrington W, Ngwu O, Jain S, Saba S: **Biventricular pacing reduces ventricular arrhythmic burden and defibrillator therapies in patients with heart failure.** *Clinical cardiology* 2006, 29(2)**:** 74-77.
Abstract: BACKGROUND: Cardiac resynchronization therapy (CRT) has recently emerged as a new modality for the treatment of patients with advanced heart failure (HF). HYPOTHESIS: Cardiac resynchronization therapy reduces atrial and ventricular arrhythmia burdens. METHODS: We analyzed the clinical data of patients who underwent an upgrade from a dual-chamber to a biventricular implantable cardioverter-defibrillator (ICD) at a tertiary care center. RESULTS: Nineteen patients (age 67 +/- 10 years, 18 men, left ventricular [LV] ejection fraction 0.24 +/- 0.07) underwent an upgrade to CRT-ICD. The LV lead was placed in a lateral position in 11, posterolateral in 4, and anterolateral in 3 patients. Baseline New York Heart Association class of HF improved in 11 (58%) patients who were considered "responders." After adjusting for the duration of follow-up before and after the upgrade, the number of patients receiving any ICD therapy decreased significantly from 13 to 4 ($p = 0.004$) and the total number of therapies decreased from 72 to 17 ($p = 0.067$). Also, the number of detections of sustained ventricular arrhythmias decreased from 40 to 11 episodes ($p = 0.05$), but the decrease in the number of detected supraventricular arrhythmias and mode switch episodes was not significant. The reduction in the ventricular arrhythmia load was independent of whether or not the patient responded to CRT. CONCLUSION: Our data suggest that CRT reduces ventricular but not atrial arrhythmia burden in patients with HF irrespective of their clinical response. This suggests that the reduction in arrhythmia is primarily an electrical phenomenon. Further studies are needed to confirm these findings and to uncover their underlying mechanisms

636. Volkmann H, Bergmann C, Walter M: **[Cardiac resynchronization therapy: who is suitable? Who requires an additional ICD as a backup?]**
<Original> Kardiale Resynchronisation: Wer ist geeignet?--Wer benotigt einen zusatzlichen ICD als Backup? *Zeitschrift fur Kardiologie* 2005, 94 Suppl 4 IV/60-IV/64.
Abstract: Cardiac resynchronization therapy (CRT) has significant positive effects on the quality of life, enables patients to cope more efficiently with cardiopulmonary stress and leads to a reduction of total mortality in patients suffering from congestive heart failure NYHA classes III and IV, reduced ventricular function and left bundle branch block with a QRS complex wider than 150 ms. In a large number of patients suited for CRT, an additional defibrillator function seems to work out well concerning an additional prognostic improvement by means of reducing sudden cardiac death. Due to partially contradictory study outcomes, it still remains to be discussed whether all patients suited for CRT really need an ICD

637. Vollmann D, Erdogan A, Himmrich E, Neuzner J, Becker D, Unterberg-Buchwald C *et al.*: **Patient Alert to detect ICD lead failure: efficacy, limitations, and implications for future algorithms.** *Europace - European pacing, arrhythmias , and cardiac electrophysiology - journal of the working groups on cardiac pacing, arrhythmias , and cardiac cellular electrophysiology of the European Society of Cardiology* 2006, 8(5)**:** 371-376.
Abstract: AIMS: An algorithm that alerts implantable cardioverter-defibrillator (ICD) patients, in case of abnormal lead impedance (Patient Alerttrade mark, Medtronic), may help to recognize lead dysfunction. We aimed to determine the utility of Patient Alert for ICD lead-failure detection in a prospective study. METHODS AND RESULTS: Three

hundred and sixty ICD patients were followed for 22+/-14 months. Patient Alert was active for pacing impedance <200 and >2000-3000 Omega, and high-voltage conductor impedance <10-20 and >200 Omega. Ten alert events and a total of 29 severe system complications occurred. Patient Alert detected three of 10 ICD lead failures, with a positive predictive value (PPV) of 77.8% for any severe system complication. Retrospective analysis identified 23 patients with a sensing integrity counter (SIC) >300 and revealed an additional four prior undetected lead defects. SIC detected ICD lead failure with 92.9% sensitivity and a PPV of 59.1%. Eight of nine patients with a false-positive SIC had an integrated bipolar lead. Patient Alert combined with SIC detected all ICD lead failures and 71.4% of all severe lead complications. CONCLUSIONS: Patient Alert, based on daily lead-impedance measurement, detected one-third of all ICD lead failures. Combined use with continuous lead integrity monitoring (SIC) increased sensitivity to 100%. Integrated bipolar leads may yield a false-positive SIC. Incorporating SIC and automated pace/sense threshold measurement may improve Patient Alert sensitivity for severe lead complications

638. Vollmann D, Luthje L, Schott P, Hasenfuss G, Unterberg-Buchwald C: **Biventricular pacing improves the blunted force-frequency relation present during univentricular pacing in patients with heart failure and conduction delay.** *Circulation* 2006, 113(7)**:** 953-959.
Abstract: BACKGROUND: In patients with chronic heart failure (CHF) and conduction delay, biventricular (BiV) and left ventricular (LV) pacing similarly improve systolic function at resting heart rates. We hypothesized that BiV and univentricular pacing differentially affect contractile function at increasing heart rates. METHODS AND RESULTS: Twenty-two patients (aged 66+/-2 years, QRS 179+/-8 ms, LV ejection fraction 23+/-1%) underwent cardiac catheterization before device implantation to measure LV hemodynamics at baseline (rate 68+/-2 bpm; sinus rhythm n=18; atrial fibrillation n=4) and during BiV, LV, and right ventricular (RV) stimulation at 80, 100, 120, and 140 bpm. BiV and LV pacing at 80 bpm equally augmented dP/dtmax as compared with baseline and RV pacing (P<0.001). Stimulation rate significantly interacted with the effect of BiV, LV, and RV pacing on LV end-diastolic pressure (LVEDP), systolic pressure (LVSP), and dP/dtmax. Increasing the rate from 80 to 140 bpm enhanced dP/dtmax from 913+/-28 to 1119+/-50 mm Hg/s during BiV stimulation (P<0.001) but had no significant effect on contractility during single-site LV (951+/-47 versus 1002+/-54 mm Hg/s) or RV (800+/-46 versus 881+/-49 mm Hg/s) pacing. At 140 bpm, LVEDP was lower and LVSP higher during BiV pacing than during RV and LV pacing (LVEDP 12+/-1 versus 17+/-1 and 16+/-1 mm Hg, P<0.001; LVSP 112+/-5 versus 106+/-5 and 108+/-6 mm Hg, P<0.01 and P=0.09; BiV versus RV and LV pacing, respectively). CONCLUSIONS: Different modes of ventricular stimulation alter the in vivo force-frequency relation of CHF patients. In contrast to single-site LV and RV pacing, contractile function improves with increasing heart rates during BiV stimulation. This effect may contribute to the enhanced exercise capacity during BiV pacing and could provide a functional benefit over LV-only pacing in patients for whom resynchronization therapy is indicated

639. Vural A, Agacdiken A, Ural D, Sahin T, Kozdag G, Kahraman G *et al*.: **Effect of cardiac resynchronization therapy on left atrial appendage function and pulmonary venous flow pattern.** *International journal of cardiology* 2005, 102(1)**:** 103-109.
Abstract: BACKGROUND: Previous studies have shown improvement in left ventricular function and development of the reverse remodeling in the left ventricle and left atrium after cardiac resynchronization therapy (CRT). The aim of this study was to investigate the effect of CRT on left atrial appendage (LAA) function and pulmonary venous flow pattern. METHODS: Eighteen patients with systolic heart failure and complete left bundle branch block underwent implantation of biventricular pacemaker devices. In order to follow changes in LAA, transthoracic and transesophageal echocardiographic examinations were performed 1 week before and repeated 1 and 6 months after pacemaker implantation. RESULTS: CRT resulted in significant clinical improvement and decrease in NYHA functional class in 17 patients (94%). Maximum and minimum areas of left atrial

appendage (LAAAmax and LAAAmin) decreased, with a concomitant increase in LAA ejection fraction. [LAAAmax: from 4.6+/-2 to 4.2+/-1.8 cm2 at the first (P < 0.001) and to 4.0+/-1.8 cm2 at the sixth month (P < 0.001); LAAAmin: from 2.7+/-1.3 to 2.3+/-1.2 cm2 at the first (P < 0.001) and to 2.2+/-1.2 cm2 at the sixth month (P < 0.001) and LAA ejection fraction: from 41+/-12% to 46+/-10% at the first (P = 0.007) and to 47+/-8% at the sixth month (P = 0.003)]. LAA active emptying and filling flow and pulmonary venous systolic velocities also increased after CRT. The appendage active emptying velocity correlated significantly with left ventricular ejection fraction (r = 0.50, P = 0.002), LAA ejection fraction (r = 0.51, P = 0.002), left atrial maximal volume, LAVmax (r = -0.44, P = 0.007), left atrial minimal volume, LAVmin (r = -0.50, P = 0.002) and pulmonary vein systolic flow velocity (r = 0.33, P = 0.05). CONCLUSION: Treatment of heart failure by CRT results with marked improvements in LAA function and increases pulmonary venous systolic velocity

640. Wadman M: **Medicare compels heart patients to enlist in follow-up research.** *Nature (Nature)* /20, NATURE.

641. Waggoner AD, Faddis MN, Gleva MJ, de las FL, Osborn J, Heuerman S *et al*.: **Cardiac resynchronization therapy acutely improves diastolic function.** *Journal of the American Society of Echocardiography - official publication of the American Society of Echocardiography* 2005, 18(3)**:** 216-220.
Abstract: BACKGROUND: Invasive studies have shown that cardiac resynchronization therapy (CRT) acutely improves left ventricular (LV) systolic performance and lowers filling pressures in a majority of patients with medically-refractory severe heart failure. Measurements included LV volume, ejection fraction, PWD early (E-wave) and atrial (A-wave) velocities, diastolic filling time (DFT), and DTI early diastolic mitral annular velocity (Em) at the lateral and septal annulus; PWD mitral E-wave/Em and E/FP were calculated to estimate LV filling pressures. RESULTS: Immediately after CRT, LV volumes decreased and LVEF increased significantly. PWD mitral E-wave velocity decreased and E-wave duration and DFT increased significantly; mitral E/FP ratio also decreased significantly, consistent with a decrease in LV filling pressure. Patients with a pre-CRT mitral E/A ratio >1 (n = 20), demonstrated improvements in LV diastolic filling and lower filling pressures whereas those with an E/A ratio < or =1 (n = 21) did not show significant changes in diastolic indices. CONCLUSIONS: The acute effects of CRT include echocardiographic evidence of reduced LV volumes and increased LVEF with improved diastolic filling and lower filling pressures; LV relaxation is not significantly altered. The benefits in diastolic function are dependent on the PWD-determined LV filling characteristics prior to CRT

642. Waggoner AD, Faddis MN, Gleva MJ, de las FL, vila-Roman VG: **Improvements in left ventricular diastolic function after cardiac resynchronization therapy are coupled to response in systolic performance.** *Journal of the American College of Cardiology* 2005, 46(12)**:** 2244-2249.
Abstract: OBJECTIVES: To determine the short-term effects of cardiac resynchronization therapy (CRT) on measurements of left ventricular (LV) diastolic function in patients with severe heart failure. BACKGROUND: Cardiac resynchronization therapy improves systolic performance; however, the effects on diastolic function by load-dependent pulsed-wave Doppler transmitral indices has been variable. METHODS: Fifty patients with severe heart failure were evaluated by two-dimensional Doppler echocardiography immediately prior to and 4 +/- 1 month after CRT. Measurements included LV volumes and ejection fraction (EF), pulsed-wave Doppler (PWD)-derived transmitral filling indices (E- and A-wave velocities, E/A ratio, deceleration time [DT], diastolic filling time [DFT], and isovolumic relaxation time). Tissue Doppler imaging was used for measurements of systolic and diastolic (Em) velocities at four mitral annular sites; mitral E-wave/Em ratio was calculated to estimate LV filling pressure. Color M-mode flow propagation velocities were also obtained. RESULTS: After CRT, LV volumes decreased significantly (p <

0.001) and LVEF increased >5% in 28 of 50 patients (56%) and were accompanied by reduction in PWD mitral E-wave velocity and E/A ratio (both $p < 0.01$), increased DT and DFT (both $p < 0.01$), and lower filling pressures (i.e., E-wave/Em septal; $p < 0.01$). Patients with LVEF response < or =5% after CRT had no significant changes in measurements of diastolic function; LV relaxation (i.e., Em velocities) worsened in this group. CONCLUSIONS: In heart failure patients receiving CRT, improvement in LV diastolic function is coupled to the improvement in LV systolic function

643. Waggoner AD, Rovner A, de las FL, Faddis MN, Gleva MJ, Sawhney N *et al*.: **Clinical outcomes after cardiac resynchronization therapy: importance of left ventricular diastolic function and origin of heart failure.** *Journal of the American Society of Echocardiography - official publication of the American Society of Echocardiography* 2006, 19(3)**:** 307-313.
Abstract: BACKGROUND: Cardiac resynchronization therapy (CRT) improves functional outcomes in patients with severe systolic heart failure. Whether the effects of CRT on left ventricular (LV) diastolic function and clinical outcomes are influenced by the cause as either ischemic or nonischemic cardiomyopathy (CM) has not been well established. METHODS: A total of 57 patients (age 60 +/- 11 years; 25% women; LV ejection fraction 25 +/- 5%) were studied before and 4 +/- 2 months after CRT by echocardiography. Heart failure cause was ischemic CM in 19 and nonischemic CM in 38. Measurements of LV systolic and diastolic function were determined by 2-dimensional and Doppler echocardiography with Doppler tissue imaging of regional myocardial velocities. Clinical outcome events were assessed at long-term follow-up and included hospitalization for heart failure exacerbation, heart transplantation, or cardiac-related death. RESULTS: There were significant increases in LV ejection fraction, reductions in end-systolic volumes, and improved LV systolic dyssynchrony in both groups. However, significant improvements in LV diastolic function were observed only in the patients with nonischemic CM. Clinical events occurred in 53% of the ischemic group versus 26% of the nonischemic group ($P < .05$) after 20 +/- 11 months of CRT. Univariate and multivariate analysis revealed that Doppler-estimated LV filling pressures were predictors of clinical outcome events. CONCLUSIONS: After CRT patients with ischemic CM exhibit lack of improvement in LV diastolic function despite favorable effects on LV systolic performance. The Doppler-derived LV filling indices may be an important predictor of long-term clinical outcomes after CRT

644. Wakayama Y, Shiba N, Shirato K: **[CRT. ICD. LVAS].** *Nippon rinsho Japanese journal of clinical medicine* 2006, 64(5)**:** 818-820.

645. Wang D, Han Y, Zang H, Zhou W, Jing Q, Wang Z *et al*.: **[Long-term effects and mortality of biventricular pacing therapy in patients with congestive heart failure].** *Zhonghua xin xue guan bing za zhi Chinese journal of cardiovascular diseases* 2005, 33(8)**:** 717-719.
Abstract: OBJECTIVE: To study the long-term effects and mortality of biventricular pacing therapy in patients with congestive heart failure. METHODS: Twenty-five patients, 18 men and 7 women, aged 34-75 [mean aged of (61.42 +/- 10.36)] years, with a cardiac function of New York Heart Association (NYHA) class III (n = 10) or IV (n = 15) received biventricular pacing therapy from Mar. 2001 to Feb. 2005. The etiologies of heart failure were idiopathic dilated cardiomyopathy (16 cases), hypertensive heart disease (3 cases) and ischemic heart disease (6 cases). Left ventricular end-diastolic dimension (LVEDD) was > 60 mm, Left ventricular ejection fraction (LVEF) was < 0.40 and QRS duration was > 130 ms in all the patients. Heart function parameters were repeatedly measured before and 3 months, 6 months, 1 year, 2 years and 3 years after pacemaker implantation. Mortality was also determined. The average follow up period was (20.88 +/- 11.51) months. RESULTS: (1) Mortality: 5 patients died during follow-up (3 non-cardiac and 1 cardiac sudden death and 1 acute myocardial infarction). (2) The mean 6-min walking distance was increased significantly ($P < 0.05$) at 3 months to 3 years of follow-up. (3) NYHA class: The cardiac

function of all patients improved significantly, with a reduction of mean NYHA class of more than one grade at 3 months to 3 years follow-up. (4) LVEDD: LVEDD reduced significantly (P < 0.05) at 3 months to 3 years follow-up. (5) LVEF: LVEF increased significantly (P < 0.05) at 3 months to 2 years follow-up. LVEF also improved at third year's follow-up, but the difference was not significant statistically. CONCLUSIONS: Cardiac resynchronization, a pacemaker-based therapy for heart failure, may enhance quality of life and heart function and reverse LV remodeling. The long-term effects of treatment were stable, leading to the reduction of mortality from advanced heart failure

646. Wang L, Lahtinen S, Lentz L, Rakow N, Kaszas C, Ruetz L *et al*.: **Feasibility of using an implantable system to measure thoracic congestion in an ambulatory chronic heart failure canine model.** *Pacing and clinical electrophysiology - PACE* 2005, 28(5)**:** 404-411.
Abstract: BACKGROUND: Noninvasive measures of impedance reflect alterations in thoracic fluid and pulmonary edema in acute animal and human studies. MATERIALS AND METHODS: We evaluated the feasibility of using an implantable impedance measuring device and cardiac lead system to monitor intrathoracic congestion in a pacing-induced heart failure canine model. Three devices were implanted in each of five dogs: a modified pacemaker to measure impedance from a defibrillation lead implanted in the right ventricle; an implantable hemodynamic monitoring device to measure left ventricular end diastolic pressure (LVEDP) and a second pacemaker to deliver rapid (240 pulses per minute) ventricular pacing to induce heart failure. RESULTS: All five dogs developed severe heart failure after 3-4 weeks of rapid pacing and recovered following pacing termination. The LVEDP increased and impedance decreased during pacing-induced heart failure and recovered after pacing cessation. At the end of pacing, there was a mean impedance reduction of 10.6 +/- 8.3% and a mean LVEDP increase of 18.1 +/- 4.5 mmHg compared to baseline. The impedance and LVEDP were inversely correlated (r =-0.41 to -0.85, all P < 0.05). CONCLUSIONS: In the canine model, measurement of chronic intrathoracic impedance with an implantable system effectively revealed changes in thoracic congestion due to heart failure reflected by LVEDP. These data suggest that implantable device-based impedance measurement merits further investigation as a tool to monitor the fluid status of heart failure patients

647. Warkentin DH: **Mechanically-based interval optimization for a biventricular pacing engine.**
Abstract: According to the present invention, discrete measurements of fluid pressure development (and derivatives thereof) are used in optimizing hemodynamics for cardiac resynchronization therapy (CRT) delivery and multiple chamber cardiac pacing, and in enhancing hemodynamics in the event of a sub-optimal left-side lead placement. For example, such diverse pressure measurements include: maximum positive or negative dP/dt values, ePAD, RV systolic, RV diastolic, pulse pressure, and the like. According to the present invention, on a periodic basis or upon demand one or more cardiac pacing intervals are iteratively cycled through a predetermined range and the resulting pressure measurements stored for comparison. The cardiac pacing intervals are then adjusted based at least in part upon the most appropriate, or desirable, measured hemodynamics of the patient. The present invention may be implemented as computer readable instructions executed by a microprocessor-based implantable medical device

648. Whang W: **Single-lead, shock-only ICD therapy reduces sudden death in people with congestive heart failure.** *Evidence-based Cardiovascular Medicine (EVID -BASED CARDIOVASC MED)* /20, EVID-BASED.

649. Whinnett Z, I, Davies JER, Lane RE, Francis DP, Mayet J: **Echocardiographic methods for selecting patients suitable for biventricular pacing therapy.** *Minerva cardioangiologica* 2005, 53(3)**:** 211-220.
Abstract: The large outcome studies of biventricular pacing to date have selected patients

using electrocardiogram criteria (prolonged QRS and left bundle branch block morphology). However, 20-30% of patients do not appear to respond clinically, and as a result there has been much interest in developing more specific methods of detecting mechanical dyssynchrony. A number of different echocardiographic techniques have been developed which appear to offer greater sensitivity and specificity than ECG in selecting these patients. This paper reviews the most promising of the echocardiographic techniques and gives guidance for the clinical use of echocardiography in selecting patients for biventricular pacing

650. Whinnett Z, I, vies Justin ER, Willson K, Chow AW, Foale RA, Davies DW *et al*.: **Determination of optimal atrioventricular delay for cardiac resynchronization therapy using acute non-invasive blood pressure.** *Europace - European pacing, arrhythmias , and cardiac electrophysiology - journal of the working groups on cardiac pacing, arrhythmias , and cardiac cellular electrophysiology of the European Society of Cardiology* 2006, 8(5)**:** 358-366.
Abstract: AIMS: In this study, we apply non-invasive blood pressure (BP) monitoring, by continuous finger photoplethysmography (Finometer), to detect directly haemodynamic responses during adjustment of the atrioventricular (AV) delay of cardiac resynchronization therapy (CRT), at different heart rates. METHODS AND RESULTS: Twelve patients were studied with six re-attending for reproducibility assessment. At each AV delay, systolic BP relative to a reference AV delay of 120 ms (SBPrel) was calculated. We found that at higher heart rates, altering the AV delay had a more pronounced effect on BP (average range of SBPrel=17.4 mmHg) compared with resting rates (average range of SBPrel=6.5 mmHg), P<0.0001. Secondly, peak AV delay differed between patients (minimum 120 ms, maximum 200 ms). Thirdly, small changes in AV delay had significant BP effects: programming AV delay 40 ms below the peak AV delay reduced SBPrel by 4.9 mmHg (P<0.003); having it 40 ms above the peak decreased SBPrel by 4.4 mmHg (P<0.0005). Finally, the peak AV delay is highly reproducible both on the same day and at 3 months (Bland-Altman difference: 3+/-8 ms). CONCLUSIONS: Continuous non-invasive arterial pressure monitoring demonstrates that even small changes in AV delay from its haemodynamic peak value have a significant effect on BP. This peak varies between individuals, is highly reproducible, and is more pronounced at higher heart rates than resting rates

651. White JA, Yuan XP, Drangova M, Yee R: **Delayed enhancement magnetic resonance imaging predicts clinical response to bi-ventricular pacing in heart failure.**

652. Wichter T, Paul M, Eckardt L, Gerdes P, Kirchhof P, Bocker D *et al*.: **Arrhythmogenic right ventricular cardiomyopathy: Antiarrhythmic drugs, catheter ablation, or ICD?** *Herz (Herz)* /20, HERZ.
Abstract: AB- Arrhythmogenic right ventricular cardiomyopathy (ARVC) is a major cause of sudden cardiac death and ventricular tachyarrhythmias in young, apparently healthy individuals and athletes. Myocardial atrophy with subsequent fibrofatty replacement predominantly affects right ventricular myocardium and results in global and regional dysfunction as well as areas of slow conduction and dispersion of refractoriness which are prerequisites for reentrant ventricular tachyarrhythmias. Patients affected with ARVC should be excluded from competitive sports and vigorous training. To provide optimal treatment, a detailed diagnostic evaluation and risk stratification are mandatory. Tailored treatment strategies aim at the suppression or effective termination of recurrent ventricular tachyarrhythmias and prevention of sudden death by antiarrhythmic drug therapy, catheter ablation, or implantation of a cardioverter defibrillator (ICD). Antiarrhythmic drugs maybe used as a stand-alone treatment to suppress ventricular tachycardia (VT) recurrences in patients with ARVC and low risk of sudden death. Sotalol (preferred) or amiodarone in combination with beta-blockers showed the highest efficacy rates. In patients at higher risk, an ICD should be implanted and antiarrhythmic drugs be used only as an adjunct to prevent or suppress frequent VT recurrences and ICD discharges. Catheter ablation using

conventional or electroanatomic mapping techniques yields good acute results for eliminating the targeted arrhythmia substrate. However, during the progressive long-term course of ARVC, VT recurrences from new arrhythmia foci are frequent and therefore limit the curative value of catheter ablation. In patients with frequent VT recurrences and ICD discharges, however, catheter ablation plays an important role as a palliative and adjunctive treatment option for arrhythmia suppression. ICD therapy has been increasingly used for secondary and also primary prevention of sudden death in patients with ARVC. In secondary prevention, the ICD has shown to improve the long-term prognosis of patients at high risk of sudden death by effective termination of life-threatening recurrences of ventricular tachyarrhythmias. However, adequate lead placement may be difficult and lead-related complications during long-term follow-up must be taken into account. The role of ICD therapy for primary prevention of sudden death in ARVC is not yet adequately defined. Ongoing international registries will provide important additional data to improve risk stratification and refine treatment algorithms in order to select the best individual treatment for arrhythmia suppression and prevention of sudden death in patients with ARVC. (c) Urban & Vogel 2005

653. Wijetunga M, Strickberger S Adam: **Cardiac resynchronization therapy for congestive heart failure.** *Expert review of cardiovascular therapy* 2005, 3(1)**:** 107-110.
Abstract: Cardiac resynchronization represents a novel therapeutic strategy for the treatment of congestive heart failure due to systolic dysfunction. Since its modest beginnings in the 1990s, cardiac resynchronization therapy has gained widespread acceptance as a useful adjunct to pharmacologic therapy for congestive heart failure. Randomized trials have consistently shown functional improvement in patients with congestive heart failure due to systolic dysfunction, a wide QRS complex on electrocardiogram and sinus rhythm, that are treated with cardiac resynchronization therapy. This review article will address the rationale, mechanisms of action, limitations and appropriate selection of patients for cardiac resynchronization therapy

654. Wilkoff BL, Ousdigian KT, Sterns LD, Wang ZJ, Wilson RD, Morgan JM: **A Comparison of Empiric to Physician-Tailored Programming of Implantable Cardioverter-Defibrillators. Results From the Prospective Randomized Multicenter EMPIRIC Trial.** *Journal of the American College of Cardiology (J AM COLL CARDIOL)* /20, J.
Abstract: AB- Objectives: The purpose of this randomized study was to determine whether a strategically chosen standardized set of programmable settings is at least as effective as physician-tailored choices, as measured by the shock-related morbidity of implantable cardioverter-defibrillator (ICD) therapy. Background: Programming of ventricular tachyarrhythmia (ventricular tachycardia [VT] or ventricular fibrillation [VF]) detection and therapy for ICDs is complex, requires many choices by highly trained physicians, and directly influences the frequency of shocks and patient morbidity. Methods: A total of 900 ICD patients were randomly assigned to standardized (EMPIRIC, n = 445) or physician-tailored (TAILORED, n = 455) VT/VF programming and followed for 1 year. Results: The primary end point was met: the adjusted percentages of both VT/VF (22.3% vs. 28.7%) and supraventricular tachycardia or other non-VT/VF event episodes (11.9% vs. 26.1%) that resulted in a shock were non-inferior and lower in the EMPIRIC arm compared to the TAILORED arm. The time to first all-cause shock was non-inferior in the EMPIRIC arm (hazard ratio = 0.95, 90% confidence interval 0.74 to 1.23, non-inferiority p = 0.0016). The EMPIRIC trial had a significant reduction of patients with 5 or more shocks for all-cause (3.8% vs. 7.0%, p = 0.039) and true VT/VF (0.9% vs. 3.3%, p = 0.018). There were no significant differences in total mortality, syncope, emergency room visits, or unscheduled outpatient visits. Unscheduled hospitalizations occurred significantly less often (p = 0.001) in the EMPIRIC arm. Conclusions: Standardized empiric ICD programming for VT/VF settings is at least as effective as patient-specific, physician-tailored programming, as measured by many clinical outcomes. Simplified and pre-specified ICD programming is possible without an increase in shock-related morbidity. (c) 2006 American College of Cardiology Foundation

655. Wilkoff BL, Stern R, Williamson B, Wathen M, Holloman K, Fieberg A *et al*.: **1Design of the Primary Prevention Parameters Evaluation (PREPARE) trial of implantablecardioverter defibrillators to reduce patient morbidity [NCT00279279].** *Trials electronic resource* 2006, 7 18.
Abstract: ABSTRACT: BACKGROUND: Implantable Cardioverter Defibrillator (ICD) therapy has been proven to be beneficial and efficacious for the treatment of serious ventricular tachyarrhythmias in primary prevention patients. However, primary prevention patients appear to have a lower incidence of ventricular arrhythmias in comparison to secondary prevention patients and consequently likely experience a higher proportion of detections due to supraventricular arrhythmias. Recent trials have demonstrated that strategic and specific programming choices reduce the number of inappropriate shocks and that anti-tachycardia pacing (ATP) is an effective alternative to shock therapy for many sustained ventricular arrhythmias. METHODS: The Primary Prevention Parameters Evaluation (PREPARE) study is a multi-center cohort study, evaluating the efficacy of a pre-specified strategic profile of VT/VF detection and therapy settings in 700 primary prevention patients in an effort to safely reduce the number of shock therapies delivered. The patients, both with and without cardiac resynchronization therapy, are compared to a well-qualified set (n = 691) of historical controls derived from the MIRACLE ICD and EMPIRIC trials. This manuscript describes the design of the PREPARE study. The study results, to be presented separately, will characterize the efficacy of this programming set (PREPARE) compared with physician-tailored programming (MIRACLE ICD and EMPIRIC)

656. Williams L, Ellery S, Frenneaux M: **The role of cardiac resynchronization therapy in heart failure.** *Minerva cardioangiologica* 2005, 53(4)**:** 249-263.
Abstract: The worldwide prevalence of heart failure is increasing in part due to an ageing population. In the developed world, heart failure affects 1-2% of the general population, accounting for 5% of adult hospital admissions. There is now convincing evidence supporting the beneficial effects of cardiac resynchronization therapy for the treatment of heart failure. Numerous observational studies, as well as a series of randomised controlled trials, have demonstrated the safety, efficacy, and long-term benefits for patients with chronic systolic heart failure who have broad QRS complexes and refractory symptoms despite optimal medical therapy. These studies have consistently demonstrated statistically significant improvements in quality of life, NYHA functional class, exercise tolerance, and left ventricular reverse remodeling. Recent evidence suggests that the benefit may at least in part be due to a reduction in mechanical dyssynchrony

657. Wimmer A, Chugh A: **Antitachycardia pacing during tachycardia: What is the mechanism?** *Heart Rhythm (Heart Rhythm)* /20, HEART.

658. Winslow RD, Pinney S, Fuster V: **Impact of implantable-cardioverter-defibrillator trials on clinical management of patients with heart failure.** *Nature Clinical Practice Cardiovascular Medicine (NAT CLIN PRACT CARDIOVASC MED)* /20, NAT.
Abstract: AB- Heart failure is a deadly disease. Every year, tens of thousands of patients die from this condition, many of them suddenly. Efforts aimed at reducing mortality centered initially on antagonizing the neurohormonal system, which is maladaptively upregulated in response to myocardial failure. Antagonists of the renin-angiotensin-aldosterone and adrenergic nervous systems have reduced the rates of cardiovascular mortality and sudden cardiac death. Antiarrhythmic drug therapy has not fared as well. Consequently, efforts to reduce the risk of sudden death have focused on the use of implantable cardioverter-defibrillators (ICDs). How best to identify patients who will benefit from this invasive and expensive therapy has yet to be clearly determined. In this review, we discuss the effectiveness of ICDs in primary and secondary prevention of sudden death in heart failure patients, and examine the impact that the use of ICDs has had on clinical decision making. (c) 2006 Nature Publishing Group

659. Witte Klaus KA, Kelly SJ, Parker JD, Nanthakumar K: **Deployment of left ventricular lead from the ipsilateral side of central vein obstruction.** *Journal of interventional cardiac electrophysiology - an international journal of arrhythmias and pacing* 2005, 13(1)**:** 47-50.
Abstract: Cardiac resynchronisation therapy improves symptoms and reduces mortality in patients with chronic heart failure. In patients with previously implanted devices, particularly automatic defibrillators, central venous stenoses provide a challenge to upgrading to resynchronisation devices. We present a patient with central venous obstruction secondary to previously implanted defibrillator leads, in whom we achieved coronary sinus pacing through the ipsilateral internal jugular vein

660. Witte Klaus KA, Pipes RR, Nanthakumar K, Parker JD: **Biventricular pacemaker upgrade in previously paced heart failure patients--improvements in ventricular dyssynchrony.** *Journal of cardiac failure* 2006, 12(3)**:** 199-204.
Abstract: BACKGROUND: Cardiac resynchronization therapy (CRT) reduces symptoms and mortality in patients with left bundle branch block (LBBB) and severe chronic heart failure. There are few data demonstrating the effects of CRT on contemporary dyssynchrony variables in patients with advanced heart failure who have been chronically paced from the right ventricle (RV). METHODS AND RESULTS: We reviewed baseline and follow-up clinical and echocardiographic data on patients receiving CRT in a single centre. Indices of global left ventricular (LV) function and dyssynchrony before and after CRT were measured. Patients were then divided into those receiving their first device (n = 39) and those receiving CRT as an upgrade to existing RV pacemakers (n = 32). Baseline demographic variables, indices of global LV function, symptomatic status, renal function, hemodynamics, and diuretic requirements were not different between previously paced patients and nonpaced patients. Mean length of RV pacing in the previously paced patients was 59 months (range 12-167 months). Patients in the previously paced group had a broader QRS complex than patients with intrinsic LBBB. Aortopulmonary delay of longer than 40 ms was present in 68% of all subjects, 67% had intraventricular septal and posterior wall motion delay longer than 130 ms, and 59% had an intraventricular delay as measured by tissue Doppler imaging of longer than 65 ms. There was no difference between paced and nonpaced patients for any of these measures of dyssynchrony. QRS duration was reduced to a greater extent in the previously paced patients than those with no previous device therapy. CRT led to important reductions in each dyssynchrony variable in both patients with previous RV pacing and those with intrinsic LBBB. The magnitude of these changes in measures of dyssynchrony was not different between the 2 groups. In all patients undergoing CRT, 50% had a reduction in furosemide dose at 3 months, 56% an improvement of at least 1 grade in New York Heart Association status, and 66% an improvement of at least 5% in LVEF. Divided by group, previously paced patients were no more or less likely than newly implanted patients to achieve one or more of these clinical outcomes. CONCLUSION: Our data suggest that patients with RV pacing and heart failure have similar dyssynchrony as patients with intrinsic LBBB. CRT leads to improvements in LV global function, dyssynchrony variables and symptoms in patients chronically paced from the RV that are similar to those observed in patients with LBBB without preexisting devices

661. Witte KK, Parker JD: **Identification of lateral cardiac veins for cardiac resynchronization therapy.** *Europace - European pacing, arrhythmias , and cardiac electrophysiology - journal of the working groups on cardiac pacing, arrhythmias , and cardiac cellular electrophysiology of the European Society of Cardiology* 2006, 8(7) **:** 506-507.

662. Wong EML, Wu EB, Chan WWM, Yu CM: **A review of the management of patients after percutaneous coronary intervention.** *International journal of clinical practice* 2006, 60(5)**:** 582-589.
Abstract: The exponential increase in the numbers of percutaneous coronary interventions

(PCIs) has led to many clinicians having to care for post-PCI patients. We review the management of early problems seen in post-PCI patients, such as vascular access site complications, contrast nephropathy, drug-induced thrombocytopaenia and chest pain. The management of possible restenosis and the use of stress testing are discussed. The complications from dual antiplatelet therapy are addressed. The prognosis of the post-PCI patient, the implications of co-existent heart failure and the newer technologies of implantable defibrillator and cardiac resynchronisation therapy are reviewed. We conclude by emphasising the importance of secondary prevention by risk factor modification as well as the communication between the clinician and the cardiologist

663. Woo GW, Petersen-Stejskal S, Johnson JW, Conti JB, Aranda JA, Curtis AB: **Ventricular reverse remodeling and 6-month outcomes in patients receiving cardiac resynchronization therapy: analysis of the MIRACLE study.** *Journal of interventional cardiac electrophysiology - an international journal of arrhythmias and pacing* 2005, 12(2)**:** 107-113.
Abstract: OBJECTIVE: The objective of this analysis was to determine if there were differences in ventricular reverse remodeling and 6-month outcome with cardiac resynchronization therapy (CRT) among specific subgroups enrolled in the Multicenter InSync Randomized Clinical Evaluation (MIRACLE) Study. BACKGROUND: Analysis of major subgroups receiving CRT is important in determining who may be most likely to benefit, since all patients who receive CRT do not demonstrate improvement. METHODS: Differences in response to CRT between subgroups based on baseline echocardiographic parameters, New York Heart Association (NYHA) class, age, gender, beta blocker use, and etiology of heart failure (HF) were analyzed for the clinical end points of the study as well as 6-month HF re-hospitalization or death. RESULTS: The benefit of CRT over control was similar in all subgroups with respect to all clinical endpoints. However, non-ischemic HF patients had greater improvements with CRT compared to ischemic HF patients in left ventricular end diastolic volume ($P < 0.001$) and ejection fraction (EF) (6.7% increase vs. 3.2% [$P < 0.001$]). Greater improvements in EF were also seen in those patients with less severe baseline mitral regurgitation (MR) ($P < 0.001$). Women but not men receiving CRT were more likely to be event-free from first HF hospitalization or death compared to the control group (Hazard Ratio = 0.157). CONCLUSIONS: The benefits of CRT with respect to EF and reverse remodeling were greater in patients with non-ischemic HF and less severe MR. Women may also derive more benefit than men with respect to the occurrence of HF hospitalization or death

664. Woollett IF, Pinney S, Magnano AR: **Images in cardiovascular medicine. Balloon dilatation of coronary sinus spasm during placement of a biventricular pacing lead.** *Circulation* 2005, 111(20)**:** e304-e305.

665. Yaacoby E, Akselrod S, Eldar M, Glikson M: **Algorithm for ventricular capture verification based on the mechanical evoked response.** *Medical & biological engineering & computing* 2005, 43(4)**:** 511-515.
Abstract: Automatic pacemaker capture verification is important for maintaining safety and low energy consumption in pacemaker patients. A new algorithm was developed, based on impedance measurement between pacing electrode poles, which reflects the distribution of the conducting medium between the poles and changes with effective contraction. Data acquired during pacemaker implant in 17 subjects were analysed, with intracardiac impedance recorded while pacing was performed in the ventricle at varying energies, resulting in multiple-captured and non-captured beats. The impedance signals of all captured/non-captured beats were analysed using three different algorithms, based on the morphology of the impedance signal. The algorithm decision for each beat was compared with an actual capture or non-capture, as determined from the simultaneous recording of surface ECG. Two of the three algorithms (Z1 and Zn) were based on impedance values, and one (Z'n) was based on the first derivative of the impedance. Z1 was based on a single sample, whereas Z'n and Z'n were based on several samples in each beat. The total

accuracy for each was Z1: 43%, Zn: 87%, Z'n: 92%. It was concluded that impedance-based capture verification is feasible, that a multiple rather than single sample approach for signal classification is both feasible and superior, and that first derivative analysis with multiple samples (Z'n) provides the best results

666. Yadav AV, Das MK, Zipes DP: **Selection of patients for ICDs: 'Where Are We in 2005?'.** *Acc Current Journal Review (Acc Curr J Rev)* /20, ACC.

667. Yancy CW, ADHERE Sci Advisory Comm Invest(Reprint): **Clinical presentation, management, and in-hospital outcomes of patients admitted with acute decompensated heart failure with preserved systolic function: A report from the acute decompensated heart failure national registry (ADHERE) database (vol 47, pg 76, 2006).**

668. Yancy CW: **Comprehensive treatment of heart failure: state-of-the-art medical therapy.** *Reviews in cardiovascular medicine* 2005, 6 Suppl 2 S43-S57.
Abstract: Despite advances in therapy and better outcomes for heart failure, this disease remains burdensome in terms of hospitalization costs, quality of life, and mortality. Many treatment strategies are available for heart failure, including medical therapy with agents such as angiotensin-converting enzyme inhibitors, and b-blockers, and device therapy including implantable cardioverter-defibrillators and cardiac resynchronization. However, data now demonstrate that compliance with these evidence-based strategies is well below acceptable thresholds, negatively affecting quality of care. The implementation of guidelines such as those of the American College of Cardiology/American Heart Association and the application of dedicated disease management programs are two mechanisms aimed toward helping physicians construct and adhere to effective treatment regimens for their patients with heart failure

669. Yang Q, Wang J, Dong L, He H, Sheng X, Sun Y *et al*.: **[Tissue Doppler imaging evaluate the effect of optimal biventricular resynchronization for congestive heart disease in left ventricular synchrony and function].** *Zhonghua xin xue guan bing za zhi Chinese journal of cardiovascular diseases* 2005, 33(12)**:** 1109-1113.
Abstract: OBJECTIVE: To evaluate the immediate change of left ventricular systolic performance and asynchronization between simultaneous biventricular pacing and sequential biverntricular pacing by tissue synchronization imaging (TSI) and tissue velocity imaging (TVI) in patients with congestive heart failure. The effect of sequential biventricular resynchronization therapy was also observed. METHODS: Ten patients with dilated cardiomyopathy who received sequential biventricular resynchronization were enrolled. The TVI and TSI imagings were performed by GE vivid7 with M3S probe. The left ventricular ejection fraction (LVEF), stroke volume (SV), aortic velocity time integral (VTI), left ventricular end diastolic diameter (LVEDd), the standard deviation of the electro-mechanical delay (EMD-SD) of 6 segments and TSI index were measured before implanting of InSync 8042 and 1 month, 3 months, 6 months after implanting respectively. RESULTS: After 6 months of implanting, the LVEF, SV and VTI were obviously increased from (22.0 +/- 8.8)% to (38.0 +/- 9.9)%; (36.0 +/- 14.9) ml to (57.0 +/- 15.7) ml; (20.22 +/- 5.72) cm to (26.20 +/- 5.98) cm, $P < 0.05$, respectively, compared with the before of implanting. The LVEDd was decreased from (6.6 +/- 0.6) cm, to (6.0 +/- 0.9) cm, $P < 0.05$. The EMD-SD and TSI-index were declined gradually after implanting, which was more evident in the 6 months after implanting, from (83.07 +/- 46.99) ms to (22.37 +/- 16.38) ms; (2.20 +/- 0.36) to (1.50 +/- 0.43), $P < 0.05$, respectively, but the immediate EMD-SD did not change obviously between simultaneous biventricular pacing and sequential biventricular pacing, whereas, the TSI index and VTI were significantly improved from (1.87 +/- 0.31) to (1.71 +/- 0.29); (22.44 +/- 5.43) cm to (25.44 +/- 5.36) cm, $P < 0.05$, respectively, in the sequential biventricular pacing. CONCLUSION: Sequential biventricular resynchronization could improve the left ventricular systolic function and synchronism of wall motion in the patients with congestive heart failure,

which is more effective than simultaneous biventricular pacing after implanting immediately

670. Yang W: **Apparatus and method for bi-ventricular pacing and sensing in an implantable device.**
Abstract: An apparatus and method for pacing and sensing the right side as well as the left side of the heart (bi-ventricular pacing and sensing). The bi-ventricular pacing and sensing is accomplished by introducing an additional dedicated pacing and sensing path for the left ventricle of the heart. Two additional terminals are added to the pacing and sensing path for the left ventricle to enable pacing and sensing in the left ventricle of the heart. In addition, switches are added to the pacing path for the left ventricle of the heart. The switches are controlled by a programmable controller and allow the selection of the desired ventricle(s) in which pacing is to occur

671. Yousef Z, Paul V, Leyva F: **Cardiac resynchronization via the femoral vein: a novel method in cases with contraindications to the pectoral approach.** *Europace - European pacing, arrhythmias , and cardiac electrophysiology - journal of the working groups on cardiac pacing, arrhythmias , and cardiac cellular electrophysiology of the European Society of Cardiology* 2006, 8(2)**:** 144-146.
Abstract: We describe a case involving biventricular pacemaker implantation via the right femoral vein in a patient where subclavian vein access was not possible

672. Ypenburg C, Schalij MJ, van der Wall EE: **The practice guideline 'Heart failure' (first revision) from the Dutch College of General Practitioners; a response from the perspective of cardiology**
<Original> De standaard 'hartfalen' (Eerste herziening) Van het nederlands huisartsen genootschap; Reactie vanuit de cardiologie. *Nederlands Tijdschrift voor Geneeskunde (NED TIJDSCHR GENEESKD)* /20, NED.
Abstract: AB- The Dutch College of General Practitioners' practice guideline 'Heart failure' provides a clear insight into the history, diagnosis and treatment of patients with chronic heart failure. The revised guideline does however warrant some minor comments. It suggests that an elevated BNP value contributes towards the diagnosis of heart failure, however taking into account the high negative predictive value, BNP should, for the time being at least, only act as an 'instrument of exclusion' in the diagnosis of heart failure. The section on pharmacological treatment could have been expanded with the additional information that ACE-inhibitors should be replaced by angiotensin-II receptor blockers if angioneurotic oedema appears. Another recommendation might be that early treatment with ACE-inhibitors and statins in high-risk patients reduces the incidence of heart failure. Furthermore, the guideline does not provide information about non-pharmacological treatment such as biventricular pacing and implantable cardioverter defibrillators. Prevention is not dealt with even though it is a task particularly suited to the GP. Lastly, it could have been more clearly pointed out that outpatient clinics providing special care for heart-failure patients are well-recognized support facilities for patients with heart failure. In conclusion, the first revision can be considered as an adequate and workable practice guideline for the GP

673. Ypenburg C, van EL, Bleeker GB, Bax JJ, Bootsma M, Wijffels MC *et al*.: **Benefit of combined resynchronization and defibrillator therapy in heart failure patients with and without ventricular arrhythmias.** *Journal of the American College of Cardiology* 2006, 48(3)**:** 464-470.
Abstract: OBJECTIVES: We attempted to assess the efficacy of combined cardiac resynchronization therapy-implantable cardioverter-defibrillator (CRT-ICD) in heart failure patients with and without ventricular arrhythmias. BACKGROUND: Because CRT and ICDs both lower all-cause mortality in patients with advanced heart failure, combination of both therapies in a single device is challenging. METHODS: A total of 191 consecutive patients with advanced heart failure, left ventricular ejection fraction <35%, and a QRS

duration >120 ms received CRT-ICD. Seventy-one patients had a history of ventricular arrhythmias (secondary prevention); 120 patients did not have prior ventricular arrhythmias (primary prevention). During follow-up, ICD therapy rate, clinical improvement after 6 months, and mortality rate were evaluated. RESULTS: During follow-up (18 +/- 4 months), primary prevention patients experienced less appropriate ICD therapies than secondary prevention patients (21% vs. 35%, $p < 0.05$). Multivariate analysis revealed, however, no predictors of ICD therapy. Furthermore, a similar, significant, improvement in clinical parameters was observed at 6 months in both groups. Also, the mortality rate in the primary prevention group was lower than in the secondary prevention group (3% vs. 18%, $p < 0.05$). CONCLUSIONS: As 21% of the primary prevention patients and 35% of the secondary prevention patients experienced appropriate ICD therapy within 2 years after implant, and no predictors of ICD therapy could be identified, implantation of a CRT-ICD device should be considered in all patients eligible for CRT

674. Yu Cheuk-Man R, Zhang D, Chan Y, Chan C, Ling Alice HM, Yip GW *et al*.: **Biventricular pacing in patients with congestive heart failure with narrow ORS complexes: Comparison of changes in LV volume during pacing "on" and "off" periods.**

675. Yu Cheuk-Man R, Bleeker GB, Fung JW, Schalij MJ, Zhang Q, van der Wall EE *et al*.: **Lack of early LV reverse remodeling predicts long-term heart failure events and mortality after cardiac resynchronization therapy.**

676. Yu C, Zhang Q, Fung JW-H: **Images in cardiovascular medicine. Visualization of regional left ventricular mechanical delay by tissue synchronization imaging in heart failure patients with wide and narrow QRS complexes undergoing cardiac resynchronization therapy.** *Circulation* 2005, 112(7)**:** e93-e95.

677. Yu C, Fung JW-H, Zhang Q, Chan C, Chan I, Chan Y *et al*.: **Improvement of serum NT-ProBNP predicts improvement in cardiac function and favorable prognosis after cardiac resynchronization therapy for heart failure.** *Journal of cardiac failure* 2005, 11(5 Suppl)**:** S42-S46.
Abstract: BACKGROUND: Cardiac resynchronization therapy (CRT) is now an established therapy for patients with advanced heart failure with electromechanical delay, although nonresponders have been observed. Because natriuretic peptides are relevant markers to reflect the severity of heart failure and filling pressure of cardiac chambers, it may be helpful to assess the efficacy of CRT. METHODS AND RESULTS: Forty-two patients with heart failure with QRS of >120 msec were recruited; their serial N-terminal pro-B-type natriuretic peptide (NT-proBNP) levels were measured at baseline and at 1 and 3 months after CRT. There was a reduction in NT-proBNP level 1 month after CRT (2655 +/- 2242 pg/mL vs 2149 +/- 2033 pg/mL; P = .03), which was further reduced at 3 months (1473 +/- 1786 pg/mL; P < .001 vs baseline). The reduction of NT-proBNP correlated with the change of left ventricular (LV) end-systolic volume (r = 0.53; P = .001) or LV ejection fraction (r = -0.49; P = .002) and with improvement in exercise capacity after CRT for 3 months (r = 0.50; P = .002). The patients were classified by the degree of reduction in NT-proBNP as group 1 (reduction of > or =50% vs baseline; n = 19) and group 2 (reduction of <50% vs baseline; n = 23). The degree of LV reverse remodeling (-31.8 +/- 24.7 mL vs -12.6 +/- 19.2 mL; P = .007) and gain in LV ejection fraction (+12.5% +/- 8.8% vs +4.6% +/- 5.8%; P = .002) were significantly better in group 1 than group 2. Both the all-cause mortality rate (Log-rank chi 2 = 4.01; P = .04) and the composite end-point of mortality rate or hospitalization rate for cardiovascular causes (Log-rank chi 2 = 4.31; P = .02) were significantly lower in group 1 than in group 2. CONCLUSION: Serial monitoring of NT-proBNP may be helpful to predict a favorable outcome after CRT. Those who had a reduction of NT-proBNP level of >/=50% were more likely to exhibit a favorable response

678. Yu C, Bleeker GB, Fung JW-H, Schalij MJ, Zhang Q, van der Wall EE *et al*.: **Left ventricular reverse remodeling but not clinical improvement predicts long-term survival after cardiac resynchronization therapy.** *Circulation* 2005, 112(11)**:** 1580-1586.
Abstract: BACKGROUND: In patients with severe heart failure and dilated cardiomyopathy, cardiac resynchronization therapy (CRT) improves left ventricular (LV) systolic function associated with LV reverse remodeling and favorable 1-year survival. However, it is unknown whether LV reverse remodeling translates into a better long-term prognosis and what extent of reverse remodeling is clinically relevant, which were investigated in this study. METHODS AND RESULTS: Patients (n=141) with advanced heart failure (mean+/-SD age, 64+/-11 years; 73% men) who received CRT were followed up for a mean (+/-SD) of 695+/-491 days. The extent of reduction in LV end-systolic volume (LVESV) at 3 to 6 months relative to baseline was examined for its predictive value on long-term clinical outcome. The cutoff value for LV reverse remodeling in predicting mortality was derived from the receiver operating characteristic curve. Then the relation between potential predictors of mortality and heart failure hospitalizations were compared by Kaplan-Meier survival analysis, followed by Cox regression analysis. There were 22 (15.6%) deaths, mostly due to heart failure or sudden cardiac death. The receiver operating characteristic curve found that a reduction in LVESV of > or =9.5% had a sensitivity of 70% and specificity of 70% in predicting all-cause mortality and of 87% and 69%, respectively, for cardiovascular mortality. With this cutoff value, there were 87 (61.7%) responders to reverse remodeling. In Kaplan-Meier survival analysis, responders had significantly lower all-cause morality (6.9% versus 30.6%, log-rank chi2=13.26, P=0.0003), cardiovascular mortality (2.3% versus 24.1%, log-rank chi2=17.1, P<0.0001), and heart failure events (11.5% versus 33.3%, log-rank chi2=8.71, P=0.0032) than nonresponders. In the Cox regression analysis model, the change in LVESV was the single most important predictor of all-cause (beta=1.048, 95% confidence interval=1.019 to 1.078, P=0.001) and cardiovascular (beta=1.072, 95% confidence interval=1.033 to 1.112, P<0.001) mortality. Clinical parameters were unable to predict any outcome event. CONCLUSIONS: A reduction in LVESV of 10% signifies clinically relevant reverse remodeling, which is a strong predictor of lower long-term mortality and heart failure events. This study suggests that assessing volumetric changes after an intervention in patients with heart failure provides information predictive of natural history outcomes

679. Yu C, Wing-Hong FJ, Zhang Q, Sanderson JE: **Understanding nonresponders of cardiac resynchronization therapy--current and future perspectives.** *Journal of cardiovascular electrophysiology* 2005, 16(10)**:** 1117-1124.
Abstract: INTRODUCTION: Cardiac resynchronization therapy (CRT) is now an established nonpharmacologic therapy for advanced heart failure with electromechanical delay. Despite compelling evidence of the benefits of CRT, one troubling issue is the lack of a favorable response in about one-third of patients. METHODS AND RESULTS: Currently, there is no unifying definition of responders, and published data were based on acute hemodynamic changes, chronic left ventricular reverse remodeling, as well as the intermediate or long-term clinical response. The lack of improvement with CRT can be due to many factors including the placement of the left ventricular pacing lead in an inappropriate location, the absence of electrical conduction delay or mechanical dyssynchrony despite wide QRS complexes, and possibly failure to optimize the CRT settings after device implantation. In acute hemodynamic studies, placing the left ventricular leads at the free wall region has been suggested to generate the best pulse pressure and positive dp/dt. The degree of mechanical dyssynchrony has recently been assessed noninvasively in CRT patients by echocardiography and in particular by tissue Doppler imaging. These studies suggested that responders of left ventricular reverse remodeling or systolic function had more severe systolic dyssynchrony. However, further studies are needed to examine the clinical utility of these parameters when applied to the standardized anatomic or functional endpoints. Optimization of atrioventricular and interventricular pacing intervals may also reduce the number of nonresponders, though

newer methods, especially interventricular pacing intervals, are still under clinical investigation. CONCLUSION: With the adjunctive use of imaging technology, physicians are able to characterize the response to CRT objectively, and cardiac imaging is an important clinical tool for determining more precisely the presence and degree of mechanical dyssynchrony

680. Yu C, Abraham WT, Bax J, Chung E, Fedewa M, Ghio S *et al*.: **Predictors of response to cardiac resynchronization therapy (PROSPECT)--study design.** *American heart journal* 2005, 149(4)**:** 600-605.
Abstract: BACKGROUND: Cardiac resynchronization therapy (CRT) is currently indicated in patients with moderate to severe heart failure, a wide QRS complex and significant left ventricular dysfunction despite optimal medical therapy. Adoption of these criteria for CRT results in a favorable response in only two thirds of candidates. METHODS: "Predictors of response to cardiac resynchronization therapy (PROSPECT)," a prospective, multicenter, nonrandomized study, aims to identify echocardiographic measures of dyssynchrony and evaluate their ability to predict response to CRT. PROSPECT will enroll approximately 300 patients in up to 75 centers in the United States, Asia, and Europe with clinical follow-up for 6 months. We will prospectively and individually test a variety of conventional echocardiographic and tissue Doppler imaging parameters against measures of clinical response. The primary response criteria are improvement in the heart failure Clinical Composite Score and left ventricular reverse remodeling. Enrollment began in March 2004 and is expected to conclude early 2005

681. Yu C, Zhang Q, Fung JW-H, Chan HC-K, Chan Y, Yip GW-K *et al*.: **A novel tool to assess systolic asynchrony and identify responders of cardiac resynchronization therapy by tissue synchronization imaging.** *Journal of the American College of Cardiology* 2005, 45(5)**:** 677-684.
Abstract: OBJECTIVES: This study was designed to investigate if tissue synchronization imaging (TSI) is useful to identify regional wall delay and predict left ventricular (LV) reverse remodeling after cardiac resynchronization therapy (CRT). BACKGROUND: Echocardiographic assessment of systolic asynchrony is helpful to predict a positive response to CRT. Tissue synchronization imaging is a new imaging technique that allows quick evaluation of regional systolic delay. METHODS: Tissue synchronization imaging was performed in 56 heart failure patients at baseline and three months after CRT. Regional wall delay was identified on TSI images and the time to regional peak systolic velocity (Ts) in LV was measured by the six-basal-six-mid-segmental model. Eight TSI parameters of systolic asynchrony were computed when Ts was measured in ejection phase or also included postsystolic shortening. RESULTS: Severe lateral wall delay occurred in 17 patients, which predicted LV reverse remodeling (chi-square = 8.13, $p = 0.004$). Among the eight quantitative parameters of asynchrony, the predictive values were higher for parameters that measured Ts in ejection phase than in postsystolic shortening. The standard deviation of Ts of 12 LV segments in ejection phase (Ts-SD-12-ejection) was most powerful to predict reverse remodeling ($r = -0.61$, $p < 0.001$) and gain in ejection fraction ($r = 0.53$, $p < 0.001$). The area of the receiver-operating characteristic (ROC) curve was the largest for Ts-SD-12-ejection (0.90, $p < 0.001$), with a sensitivity of 87% and specificity of 81% at a cutoff of 34.4 ms. The combination of lateral wall delay with Ts-SD-12-ejection gave a sensitivity and specificity of 82% and 87%. CONCLUSIONS: Tissue synchronization imaging allows quick evaluation of regional wall delay, and combined with Ts-SD-12-ejection provides a reliable way of predicting reverse remodeling after CRT

682. Yu C, Wang L, Chau E, Chan RH-W, Kong S, Tang M *et al*.: **Intrathoracic impedance monitoring in patients with heart failure: correlation with fluid status and feasibility of early warning preceding hospitalization.** *Circulation* 2005, 112(6)**:** 841-848.
Abstract: BACKGROUND: Patients with heart failure are frequently hospitalized for fluid overload. A reliable method for chronic monitoring of fluid status is therefore desirable. We evaluated an implantable system capable of measuring intrathoracic impedance to

identify potential fluid overload before heart failure hospitalization and to determine the correlation between intrathoracic impedance and standard measures of fluid status during hospitalization. METHODS AND RESULTS: Thirty-three patients with NYHA class III and IV heart failure were implanted with a special pacemaker in the left pectoral region and a defibrillation lead in the right ventricle. Intrathoracic impedance was regularly measured and recorded between the lead and the pacemaker case. During hospitalizations, pulmonary capillary wedge pressure and fluid status were monitored. Ten patients were hospitalized for fluid overload 25 times over 20.7+/-8.4 months. Intrathoracic impedance decreased before each admission by an average of 12.3+/-5.3% (P<0.001) over an average of 18.3+/-10.1 days. Impedance reduction began 15.3+/-10.6 days (P<0.001) before the onset of worsening symptoms. There was an inverse correlation between intrathoracic impedance and pulmonary capillary wedge pressure (r=-0.61, P<0.001) and between intrathoracic impedance and net fluid loss (r=-0.70, P<0.001) during hospitalization. Automated detection of impedance decreases was 76.9% sensitive in detecting hospitalization for fluid overload, with 1.5 false-positive (threshold crossing without hospitalization) detections per patient-year of follow-up. CONCLUSIONS: Intrathoracic impedance is inversely correlated with pulmonary capillary wedge pressure and fluid balance and decreased before the onset of patient symptoms and before hospital admission for fluid overload. Regular monitoring of impedance may provide early warning of impending decompensation and diagnostic information for titration of medication

683. Yu Y, Ding J, Zhu Q: **Apparatus and method for determining responders to cardiac resynchronization therapy using implantable accelerometers.**
Abstract: A device for measuring a synchronicity of contraction of a heart to determine if an individual would be a responder to cardiac resynchronization therapy. The device may include a first electrode positioned at a first ventricular wall location to measure movement of the first ventricular wall location and generate a first signal, as well as a second electrode positioned at a second ventricular wall location to measure movement of the second ventricular wall location and generate a second signal. A processing module may process the first and second signals, for example, integrate the signals multiple times, and generate an output based on the processed signals. Based on this output, an individual can be labeled a responder or non-responder to cardiac resynchronization therapy. The electrodes may each include an accelerometer to measure acceleration of the heart wall

684. Zacharias J, Forty J, Doig JC, Bourke JP, Hilton CJ: **Right ventricular disarticulation. An 18-year single centre experience.** *European Journal of Cardio-thoracic Surgery (EUR J CARDIO-THORAC SURG)* /20, EUR-THORAC.
Abstract: AB- Objective: Right ventricular disarticulation (RVD) is an accepted procedure in the treatment of ventricular tachycardia of right ventricular origin. We set out to review the long-term outcomes with RVD at our institution for patients with arrhythmogenic right ventricular dysplasia (ARVD) or refractory tachycardia. A renewed interest in this operation has come about in patients unable to tolerate implantable cardioverter defibrillators. Methods: Seventeen patients had RVD carried out between 1985 and 2003. There were 15 males and 2 females. The age range was 14-72 (median: 34). Six patients had partial RVD and 11 a complete RVD. ARVD was confirmed in 15 patients at histology. Biventricular pacing was used post-operatively in the two most recent patients. Results: The follow-up was complete in 94% (16/17). The median follow-up was 13 years (0-18). The overall hospital mortality was 6% (1/17). Over the follow-up period there were three deaths 9, 11 and 17 years post-surgery. Heart transplantation due to biventricular failure was required in two patients. In the group followed up for more than 10 years the over all event free survival at 10 years was 77% (3/13). Conclusions: In cases of refractory ventricular tachycardia, where multiple antiarrhythmic medication, repeated catheter ablation and ICD insertion are unsuccessful at symptom control, RVD is an excellent antiarrhythmic procedure. In the long term, signs of biventricular failure present, possibly, dependent on the natural history of ARVD. The long-term effect of biventricular pacing on

the disarticulated right ventricle is yet to be defined. (c) 2005 Elsevier B.V. All rights reserved

685. Zeppenfeld K, Schalij MJ, Bleeker GB, Holman ER, Bax JJ: **Acceleration-dependent left bundle branch block with severe left ventricular dyssynchrony results in acute heart failure: are there more patients who benefit from cardiac resynchronization therapy?** *Journal of cardiovascular electrophysiology* 2006, 17(1)**:** 101-103.
Abstract: Cardiac resynchronization therapy (CRT) has been proposed to improve hemodynamics in patients with heart failure and left bundle branch block (LBBB) by resynchronization of left ventricular (LV) dyssynchrony. The current report concerns a patient with narrow QRS complex without LV dyssynchrony who experienced an acute exacerbation of heart failure following exercise. Careful analysis revealed that an increase of heart rate induced acceleration-dependent LBBB with severe LV dyssynchrony and mitral regurgitation followed by acute heart failure and hemodynamic collapse. CRT prevented these adverse reactions. Accordingly, optimal evaluation for CRT may include testing for LV dyssynchrony during exercise

686. Zhang Q, Yu C, Fung JW-H, Zhang Y, Chan Y, Chan HC-K *et al*.: **Assessment of the effect of cardiac resynchronization therapy on intraventricular mechanical synchronicity by regional volumetric changes.** *American journal of cardiology* 2005, 95(1)**:** 126-129.
Abstract: A new echocardiographic technology, the timing of regional volumetric changes by 3-dimensional echocardiography, was applied to assess intraventricular mechanical synchronicity in 13 patients who had received cardiac resynchronization therapy (CRT). When biventricular pacing was withheld, left ventricular (LV) asynchrony occurred as reflected by these echocardiographic parameters, whereas LV volume increased and the ejection fraction decreased. Further studies are needed to explore whether this novel method can be used to select suitable candidates for CRT and to predict a favorable response

687. Zhang Q, Fung JW-H, Auricchio A, Chan JY-S, Kum Leo CC, Wu LW *et al*.: **Differential change in left ventricular mass and regional wall thickness after cardiac resynchronization therapy for heart failure.** *European heart journal* 2006, 27(12)**:** 1423-1430.
Abstract: AIMS: LV reverse remodelling has been shown to be a favourable response after cardiac resynchronization therapy (CRT) in many clinical trials. This study investigated whether left ventricular (LV) reverse remodelling after CRT has any structural benefit, which include the improvement of LV mass or regional wall thickness. METHODS AND RESULTS: Fifty patients (66 +/- 11 years) receiving CRT were followed up for at least 3 months. Echocardiography with tissue Doppler imaging was performed serially before and at day 1 and 3 months after CRT. Although LV end-systolic volume (LVESV) was decreased at day 1 after CRT (141 +/- 74 vs. 129 +/- 71 cm(3), $P < 0.001$), further LV reverse remodelling was observed at 3 months (110 +/- 67 cm(3), $P < 0.001$ vs. day 1). LV ejection fraction increased at day 1 (26.5 +/- 9.3 vs. 28.5 +/- 9.1%, $P < 0.005$) and was further improved at 3 months (34.2 +/- 10.5%, $P < 0.001$ vs. day 1). However, reduction of LV mass (231 +/- 67 vs. 213 +/- 59 g, $P < 0.001$) and regional wall thickness was only observed at 3 months, but not at day 1. The improvement of LV mass correlated with the change in LVESV ($r = 0.66$, $P < 0.001$) and the baseline systolic asynchrony index (Ts-SD) ($r = -0.52$, $P < 0.001$). LV mass was only decreased significantly in responders of LV reverse remodelling (245 +/- 66 vs. 207 +/- 61 g, $P < 0.001$), but increased in non-responders (209 +/- 64 vs. 223 +/- 56 g, $P = 0.02$). Responders had significant decrease in thickness of all the four walls for -6 to -11% (all $P <$ or $=0.02$), whereas non-responders had increased thickness in septal and lateral walls for +11% (both $P < 0.05$). CONCLUSION: The acute reduction in LV volume after CRT is mediated by haemodynamic and geometric benefits without actual changes in LV mass. However, at 3-month follow-up, reduction in LV mass and regional wall thickness was demonstrated,

which represents structural reverse remodelling. Such benefit was only observed in volumetric responders but was worsened in non-responders

688. Zhu Q, Spinelli JC, Ding J, Yu Y: **Capture verification for cardiac resynchronization pacing optimization.**
Abstract: A system and method for automatically selecting among a plurality of pacing modes based upon capture detection. Patients suffering from heart failure may be optimally treated with different resynchronization pacing modes or configurations. By detecting whether capture is being achieved by a particular configuration or mode, a device is able to automatically switch to one that is both optimal in treating the patient and is successful in capturing the heart with pacing pulses.

DEVICE EXPERIENCE INFORMATION

The CRM Product Performance Report (PPR) presents device survival estimates, advisory summaries, technical articles and other information pertinent to assessing the performance of Medtronic IPG, ICD and CRT devices, and implantable pacing and defibrillation leads.

Medtronic tracks device performance using returned product analysis and an active multicenter clinical study.

Defibrillation Leads are found starting on page 117 of this submission (page 79 - 86 of the PPR report).

ATTACHMENT A - Product Performance Report (PPR)

Pages removed for the following reason: (b)(4)

P920015/R13

PMA Annual Report Review

PMA Number: P920015/R013 Company Name: Medtronic, Inc.

ODE Reviewer: Vivianne Holt V. Holt 4/26/07 OC Reviewer: n/a
ODE Branch: FDA/CDRH/ODE/DCD/PDLB OC Branch: n/a

Basic Information

This annual report covers the reporting period from December 10, 2005 to December 31, 2006.

The following device models are covered in this report:

Model 6963, 6966, and 6999 leads for the initial Transvene® lead system
Model 6933, 6936, and 6939 leads for Transvene DF-1 system Model 6934 leads for Transvene® Right Ventricular system
Model 6937 Transvene® SVC lead
Model 6707 Lead adaptor
Model 6932, 6942, 6943 and 6945 Sprint™ leads
Model 6944 Sprint™ Quattro™ lead
Model 6947 Sprint™ Quattro Secure™ lead
Model 6996 SQ lead system and 6996T tunneling tool
Model 6725 Pin-Plug Kit
Model 6726 DF-1 Y-Adaptor/Extender Kit
Model 6948, 6949, 6930, and 6931 Sprint Fidelis™ leads

Note: The Model 6948, 6949, 6930, and 6931 Sprint Fidelis™ leads are the subject of a "Dear Doctor" letter dated March 21, 2007 (attached). These leads are indicated for single, long-term use in the ventricle. The leads have application for patients for whom implantable cardioverter defibrillators are indicated (6949 & 6931) or for whom arrhythmia management systems are indicated (6948 and 6930). The sponsor issued the "Dear Doctor" Letter because they had recently received reports from a limited number of implanting physicians indicating they had experienced higher than expected conductor fracture rates with Sprint Fidelis leads. In addition, FDA's office of compliance (OC), acting on physician-submitted information regarding Sprint Fidelis fractures that occurred between September 2004 and February 2007, requested additional information in a letter dated March 7, 2007 (attached). The sponsor's responses to OC's letter have been received by FDA but OC has not yet notified ODE of their final decision. I reviewed the responses as part of the annual report review.

At this point, the sponsor claims their investigation suggests that variables within the implant procedure may contribute significantly to Sprint Fidelis lead fractures. In the Dear Dr. Letter, they notified physicians to take precautions to avoid severe bending or kinking of the distal end of the lead over the lead body while passing through tortuous vasculature. They also suggested that physicians should avoid excessive bending or kinking of the lead during lead suturing or pocket formation or both, to address fractures that occur around the suture sleeve. It is of note

that while the Dear Dr. Letter lists distal fractures and fractures around the suture sleeve, the response to OC's questions also lists DF-1 cable fractures within the RV or SVC connector legs as a location where fracture has occurred. Also, in the response to OC, distal fractures are further broken down into DF-1 cable fracture proximal of the proximal RV coil/crossgroove and sense cable fractures in or near the cast zone.

The sponsor has not notified FDA of any current or proposed changes to the device design or manufacturing processes for the distal end or suture sleeve fractures. However, as of April 25, 2007 they had submitted a real-time review request for proposed changes to the strain relief in the DF-1 connector leg, DF-1 cables in the trifurcation and connector leg, and jumper tubing in the trifurcation. These changes address the observed DF-1 cable fractures within the RV or SVC connector legs although the sponsor has not explicitly stated that the changes were made in response to field failures.

The sponsor notes that performance of the model 6949 Sprint Fidelis lead currently followed in the System Longevity Study indicates lead survival of 98.9% at two years. Returned product analysis shows 6949 performance at 99.86% chronic fracture-free survival at two years. They provided comparison charts to other currently marketed leads:

System Longevity Study

Lead Model	Survival at Two Years
Sprint (6945)	99.1%
Sprint Quattro (6947)	99.3%
Sprint Fidelis (6949)*	98.9%

Returned Product Analysis

Lead Model	Survival at Two Years
Sprint (6945)	99.92%
Sprint Quattro (6947)	99.94%
Sprint Fidelis (6949)*	99.86%

*This is the only Sprint Fidelis model for which there is sufficient reporting information due to the small implant population for the model 6948, 6931, and 6930 leads

Based on the data provided, the Sprint Fidelis lead survival rates appear to be within the normal limits for leads at two years. Therefore, no additional information will be requested at this time. See "Analysis of Explants, Deaths, and Returned Units," below, for additional information regarding the performance of the Sprint Fidelis leads.

Attachments

- Medtronic response to FDA/OC's letter of March 7, 2007 Reference MDR Reports for Sprint Fidelis Leads (includes "Dear Doctor" Letter)
- email from OSB dated February 7, 2007

Reportable Changes

Are any of the reportable changes intended to address issues observed in the field?
☒No ☐Yes

If yes, please list (by number) which changes are intended to address field issues and attach a brief description of those field issues: n/a

If no, has the sponsor provided a statement that none of the reportable changes are intended to address issues observed in the field?
☒No ☐Yes

The sponsor did not provide this statement; however, the nature of the changes (see descriptions below) makes it clear that they were not intended to address issues observed in the field.

Has the sponsor provided a detailed description of those field issues and documentation of when and how FDA was first notified of those field issues? ☐No ☐Yes n/a

By checking "Annual Reportable" (AR) in the following table, I am asserting that the modification does not raise issues of safety or effectiveness.

ODE **OC**

(Choose Whether Design or Manufacturing Change)

Manufacturing/Design Change (by number or page number)	Device/Design Changes	Manufacture/Process Changes	Does OC Concur? (Please provide comment if not)
1. Editorial changes to work instructions to notify personnel to minimize heptane exposure to hands.	☐ AR ☐ PMA-S ☐ A/I ☐	☒ AR ☒ 30-Day ☐ A/I ☐	Concur ☐ Not concur ☐ Note:
2. Replaced labeling and traceability software to be consistent and current with the same validated software systems used in other Medtronic manufacturing facilities	☐ AR ☐ PMA-S ☐ A/I ☐	☒ AR ☒ 30-Day ☐ A/I ☐	Concur ☑ Not concur ☐ Note: per email from Albert Moyal 5/3/07
3. Editorial changes to work instructions to explicitly call out 100%	☐ AR PMA-S A/I	☒ AR 30-Day A/I	Concur ☐ Not concur ☐ Note:

inspection of stylets for bending after DSP solution is applied to the lead.	☐	☐	☐	☒	☐	☐	

Note: The changes listed above were not sent for OC review since changes 1 and 3 are editorial in nature and change 2 was a change to software programs that are already used and validated in other Medtronic facilities. Technically, these are manufacturing changes but they are not changes in which any of the manufacturing processes would be affected, hence these are annual-reportable changes. Note Change #2 also confirmed w/ OC (5/3/07)

Analysis of Explants, Deaths, and Returned Units

☒An analysis of explants, deaths, and returned units has been provided and is adequate
☐An analysis of explants, deaths, and returned units has not been provided, or is inadequate, or raises concerns (provide comment):

The report contained a summary of system experience for each model of device included in this report per the conditions of approval. The summary did not identify any patient deaths associated with the devices subject to this reports. The analyses of returned explants had failures of various types but no numerous or repeated mode failures through the family of leads. The sponsor provided health device alerts in the submission. The number of adverse events was few compared with the number of marketed leads. Based on an email from OSB dated February 7, 2007 (attached), Soma Kalb pulled the MDR's from the MAUDE database for ODE review. OSB noted that there are no deaths reported in Maude for the Sprint Fidelis model 6949 (this is the only Sprint Fidelis model for which there is sufficient reporting information due to the small implant population for the model 6948, 6931, and 6930 leads). They noted that there were 165 of 525 events in MAUDE with model 6949 reporting fractures or breakages. Some were distal fractures and some were proximal fractures. Some may have been related to the implant procedure and some to the explant procedure. Suture sleeve fractures can be related to sutures being tied too tight and fracturing the lead. There was at least one report that mentioned a proximal weld defect.

Safety Alerts

☒A summary of safety alerts has been provided and is adequate
☐A summary of safety alerts has not been provided, or is inadequate, or raises concerns (provide comment):

_____

_____

Bibliography

☒A Bibliography has been provided and is adequate

☐ A Bibliography has not been provided, or is inadequate (provide comment):

_____

_____

Recommendation

☒ Complete final report, no response necessary. (Report OK Letter, APPB in CTS)

☐ Incomplete final report, request additional information, 30-Day Notice, or PMA-S. (Deficiency Letter, RPT1 in CTS)

Explanation of Decision

(Explain ODE "PMA-S", "30-Day" or "A/I" Decisions from chart above)

Additional Information Required:
N/A

Explanation of why 30-Day Notice(s) Required:
N/A

Explanation of why PMA Supplement(s) Required:
N/A

cancer -

4/30/07

Medtronic

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Cardiac Rhythm Disease Management
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Shoreview, MN 55126-3082
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Phone 763.514.4000 763.505.7888
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April 6, 2007

FDA/CDRH Medical Device Reporting
P.O. Box 3002
Rockville, MD 20847-3002

Attention: Diane Dwyer

Reference: Letter of March 7, 2007, Reference MDR Reports for Sprint Fidelis Leads

The letter referenced above requested additional information regarding various Sprint Fidelis leads. Our response to each of your questions follows.

Question:

1. To assist us in determining the overall failure rate for the Sprint Fidelis defibrillator lead since first marketed in the U. S., please provide an Actuarial Survival Probability table for each Sprint Fidelis model your firm has marketed (models 6930, 6931, 6948, and 6949).

Medtronic Response:

1. In our discussion on March 19, 2007 you requested actual product performance data based on confirmed failures, rather than Survival Probability information. The following table details US Fidelis Lead actual product performance data through 01/31/2007, based on return product analysis.

Implant damage is defined as damage to the lead that occurs in the process of implanting the lead during the surgical procedure. Examples of implant damage are stylet perforation, cut or tear of insulation, dented or distorted conductors, and conductor fractures due to mishandling.

Electrical malfunction is defined as a hardware malfunction resulting in a break in the insulation or a break in the conductor that could affect the electrical performance of the lead. Examples of breaks in the insulation include cuts, tears, depressions, environmental stress cracking (ESC) and metal ion oxidation (MIO). Examples of breaks in conductors include fractured conductors and incomplete crimps.

Non-electrical out of specification are other malfunctions or observations that do not affect electrical performance of the lead. Examples of non-electrical out of specifications include discoloration and indentations.

Model	*Initial Implants*	*Estimated Active Implants*	*Analyzed*	*Implant Damage*	*Electrical Malfunction*	*Non-Electrical Out of Specification*
6930	236	215	1	-	-	-
6931	5,387	4,917	99	12	22	-
6948	7,510	6,874	83	5	3	2
6949	144,311	129,047	1,631	350	213	33

Question:

2. For each model number, please submit the number of Sprint Fidelis defibrillation leads manufactured, distributed, implanted and explanted in the U.S.

Medtronic Response:

2. Please reference the following table for the number of Sprint Fidelis leads manufactured, distributed, implanted and explanted in the U.S.

Fidelis Model Number	Product Manufactured in US for Worldwide Use (as of 3/12/07)	US Sold (as of 3/12/07)	US Registered Implants (as of 3/12/07)	US Registered Explants (as of 3/12/07)
6930	3,690	274	253	3
6931	22,807	6,245	5,841	151
6948	27,107	8,626	7,883	140
6949	215,674	161,399	150,933	2,963

Note: Registered explants include leads that are replaced, removed, returned, capped, or non-functional. Returned leads include fully intact leads or lead segments.

Question:

3. Submit any device failures confirmed by manufacturer failure analyses that have not been provided to FDA under the MDR reporting regulation (see Attachment 2).

Medtronic Response:

3. In our discussion on March 19, 2007, you requested a table detailing the status of analysis, actual analysis results (if applicable), and other supporting detail for those leads referenced in Attachment 2 of your letter. As detailed in the attachment, all available analysis results have been submitted, or are scheduled for submission to the FDA. Please refer to Attachment 1 of this response for detail on each serial number referenced.

Question:

4. Please describe any internal and/or regulatory action(s) taken in response to MDRs (internal actions such as manufacturing, labeling, training, design and/or quality assurance, and regulatory actions such as PMA supplement, 30 day notice, CAPA and recalls):

a) **In reference to Attachment 1 (see items c, e through o, and q through t), there are reports for a total of 197 Sprint Fidelis model 6949 defibrillator leads prematurely explanted and confirmed with a fracture. One MDR for model 6949 (b)(4) (b)(4) involves a death during the implant procedure, with the MDR "manufacturer evaluation result code" reported as number (b)(4) (b)(4) device performed according to specifications) and the lead analysis revealed "distal conductor and coil was distorted and fractured in a manner consistent with overstress (implant damage)". For all confirmed lead fractures, breakages and**

distortions, please describe any action(s) taken to address the occurrence of confirmed fractures observed with the device model 6949.

b) For manufacturer confirmed lead fractures associated with the Sprint Fidelis ICD lead models 6930, 6931, and 6948.

c) One model 6949 lead was mislabeled (See Attachment 1, item a: (b)(4) (b)(4)

Medtronic Response:

4a) Based on product field returns, Medtronic has identified four locations on the Fidelis Leads where conductor fractures have occurred. These locations are as follows: DF-1 cable fractures within the RV or SVC connector legs, DF-1 cable fractures proximal of proximal RV coil/crossgroove, sense cable fractures in/near the cast zone, and coil fractures within 5 cm of the end of the anchor sleeve. Please see Figure 1 below.

These fractures have been entered into Medtronic's CAPA system and investigations are ongoing. To date, there have been no design or significant manufacturing process changes as a result of these investigations. If our continued analysis identifies the need for future design or manufacturing changes, these changes will be fully assessed and all appropriate submission to regulatory agencies will be made.

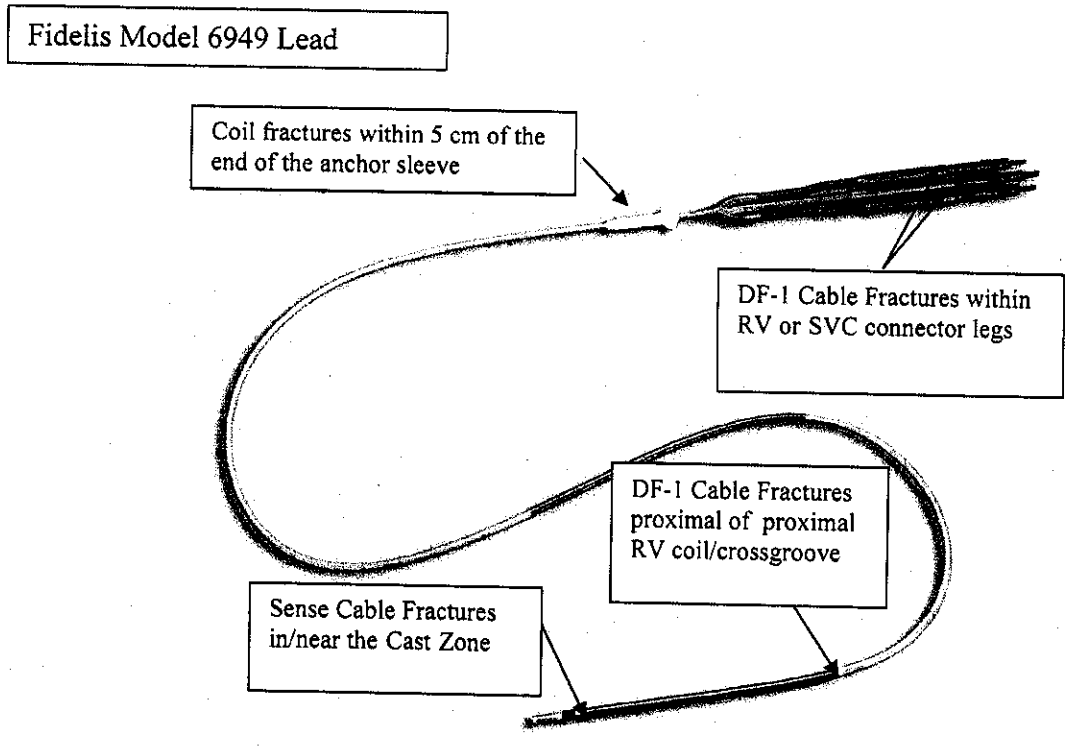

Figure 1

Note: Models 6930 and 6931 does not contain an SVC coil

Attachment 2 of this response includes a recent communication sent to physicians regarding Sprint Fidelis Leads as well as a recent communication to the Minneapolis District Office pertaining to this physician communication.

4b) The CAPA investigations and actions in response to question 4a apply to the entire Fidelis lead family, including models 6930, 6931, 6948 and 6949.

4c) A Product Performance Investigation was initiated with manufacturing to investigate and address this field event. The manufacturing process was also reviewed to ensure that the proper instructions, as well as verification and inspection points are in place. This specific mislabeling incident was addressed with operators to promote awareness of the importance of adhering to procedures for operations and inspection.

Disclaimer:

Submission of information by Medtronic under the Medical Device Reporting regulation does not constitute an admission that the devices have malfunctioned or that there is any causal connection between the performance of the device and any injury that may have occurred. This statement should be included with any information or report disclosed to the public under the Freedom of Information Act.

If you have any additional questions about this event or any other MDR report, please contact me directly at (763) 505-7841. You may also FAX further inquiries to (763) 505-7878.

Sincerely,

Brandy L. Corneil
Sr. MDR Manager
Cardiac Rhythm Management Business

cc: Megan Moynahan
Nicole Wolanski

Attachment 1 (Reference Question 3)

Type of Report and Reference Number	*FDA Report Number*	*Internal Reference Number*	*Status of Analysis*	*Analysis Summary*
A. Voluntary MedWatch				
MW1040340 - LFJ056669V	2649622-2006-01080	E684170	The lead was capped. Lead not returned.	Not applicable
MW1037213 - LFJ021113V	2649622-2006-00181	E658471	MDR report 2649622-2006-00181 including analysis summary submitted 10-JAN-2006	LFJ021113V No anomalies found; proximal segment returned for analysis.
MW1041870 - LFJ069590V	2649622-2006-01516	E689306	Additional information was received. A physician's report states the lead was replaced due to noise, inappropriate therapy, apparent fracture, secondary to subclavian crush. Lead not returned. Supplemental report submitted 10_MAR-2007.	Not applicable
MW1040889 - LFJ026628V	2649622-2007-00031	E693514	MDR report 2649622-2007-00031 including analysis summary submitted 10-JAN-2007	LFJ026628V: Proximal conductor fractured; full lead returned for analysis.
MW1041871 - LFJ028V (INCOMPLETE S/N)	***Possible FDA Report Number 2649622-2006-01446***	***POSSIBLE EVENT # E686814***	***MDR report 2649622-2006-01446 submitted 10-Nov-2006 The lead was not returned for analysis***	***Not applicable***
MW1041872 - LFJ041110V	2649622-2006-01067	E680819	MDR report 2649622-2006-01067 including analysis summary submitted 10-SEP-2006	LFJ041110V The proximal cable and the right ventricle (RV) cable were fractured under the RV coil; full lead returned and analyzed.
MW1041873 - LFJ036021V	No MDR #	E708958	MDR report to be submitted 10-MAY-2007	LFJ036021V Proximal conductor was fractured; full lead was returned for analysis.
MW1041874 - LFJ010404V	2649622-2006-01066	E680817	MDR report 2649622-2006-01066 including analysis summary submitted 10-SEP-2006	LFJ010404V Distal conductor fractured; full lead returned and analyzed.
MW1041885 - LFJ010405V	No MDR #	E708957	MDR report to be submitted 10-MAY-2007	LFJ010405V Proximal conductor fractured; full lead analyzed.
B. User Facility				
4501930000-2006-8007 - LFJ039346V	2649622-2006-01299	E685608	MDR report 2649622-2006-01299 including analysis summary submitted 10-SEP-2006	LFJ039346V Proximal conductor fractured; full lead returned for analysis.
4500680000-2007-0002 - LFJ035665V	2649622-2007-00070	E695193	The lead was replaced. Lead not returned.	Not applicable

Attachment 1 (Reference Question 3), Continued

C. Manufacturer				
2649622-2006-00806	2649622-2006-00806	E678451	Supplemental report submitted 10_NOV-2006.	LFJ137308V Defib conductor fracture (overstress); full lead returned for analysis. The fracture was most likely the result of implant/explant damage.
2649622-2006-00987	2649622-2006-00987	E678555	The lead was explanted. Lead not returned.	Not applicable
2649622-2006-01582	2649622-2006-01582	E691079	Supplemental report submitted 10_MAR-2007.	LFJ148031V No anomalies found; full lead was returned for analysis.
2649622-2006-01587	2649622-2006-01587	E691101	Supplemental report submitted 10_MAR-2007.	No anomalies found; full lead returned. Analysis found there is only one set of setscrew marks on one of the pins, and it is too proximal. The lead was not fully inserted into the device.
2649622-2006-01624	2649622-2006-01624	E691810	Supplemental report submitted 10_JAN-2007.	LFJ057119V Proximal conductor fractured; full lead analyzed
2649622-2006-01717	2649622-2006-01717	E697145	Supplemental report submitted 10_JAN-2007.	LFJ152198V No anomalies found; full lead was returned for analysis.
2649622-2006-01718	2649622-2006-01718	E697149	Supplemental report submitted 10_JAN-2007.	LFJ007151V No anomalies found; proximal segment analyzed; proximal segment returned for analysis.

Medtronic, Inc.
Cardiac Rhythm Management
7000 Central Avenue NE
Minneapolis, MN 55432

March 21, 2007
Re: Physician Information - Sprint Fidelis lead

Dear Doctor,

Medtronic has received reports from a limited number of implanting physicians indicating they have experienced higher than expected conductor fracture rates in their centers with Sprint Fidelis leads. While current overall Sprint Fidelis performance is consistent with other leads, Medtronic is actively investigating these reports, has reviewed them with our Independent Physician Quality Panel, and would like to share what we know at this time.

Through detailed assessment of reported fractures, we have identified two primary locations where conductor fractures have occurred: 1) distal portion of the lead and 2) near the anchoring sleeve tie down. The distal conductor fractures affect the anode (ring electrode) and fractures that occur around the anchoring sleeve affect the cathode (helix tip electrode). Fractures at both locations appear to present clinically as over-sensing, increased interval counts and inappropriate shocks. Medtronic has worked closely with physicians who have experienced fractures and conducted significant bench testing in an attempt to reproduce the fractures and identify root cause. At this point, our investigation suggests that variables within the implant procedure may contribute significantly to these fractures.

For distal conductor fractures, our investigation has identified severe bending or kinking of the distal end of the lead over the lead body while passing through tortuous vasculature as a significant contributing factor. If the lead is severely bent or kinked at the distal end, the conductor may be compromised such that the conductor may fracture after implant due to chronic fatigue from natural cardiac motion. The venous structure or pathway, venous access location, length of introducer sheath and lead insertion force are all factors that may contribute to severe bending or kinking of the lead. Medtronic recommends avoiding severe bending or kinking of the lead during implantation. If you encounter excessive resistance resulting in severe bending or kinking while advancing the lead, please remove the lead and return it to Medtronic.

For conductor fractures that occur around the suture sleeve, our preliminary investigation suggests that under certain implant techniques, the lead appears to be exposed to severe bending or kinking in the pectoral area. We are still investigating and actively partnering with physicians to better understand this type of fracture. If excessive kinking or bending is observed during lead suturing and/or pocket formation, Medtronic recommends the lead be re-sutured and/or the pocket reassembled per guidelines in the Medtronic lead implant manual. In addition, positioning the anchoring sleeve against or near the vein may be helpful.

Sprint Fidelis lead models 6949, 6948, 6931, and 6930 were market released in the U.S. and internationally in September and October 2004. Performance of model 6949, the Sprint Fidelis lead currently followed in our System Longevity Study, indicates survival is 98.9% at two years. Sprint Fidelis 6949 performance based on return product analysis shows 99.86% chronic fracture-free survival at two years. Both evaluation methods suggest performance is in line with other Medtronic leads (see relative Medtronic performance data on the following page) and consistent with lead performance publicly reported by other manufacturers.

Medtronic is committed to ensuring the highest standards of product reliability. As we learn more, we will share additional information and technical guidance through our sales and technical representatives. If you have questions or concerns, please contact your Medtronic Representative or Medtronic Technical Services at 1-800-723-4636 (US).

Sincerely,

Reggie Groves
Vice President, Quality and Regulatory
Medtronic Cardiac Rhythm Disease Management
Medtronic, Inc.

Relative Performance of Sprint Fidelis 6949 vs. other Medtronic Leads

Sprint Fidelis is enrolled in Medtronic's System Longevity Study which tracks chronic lead performance. At this time, we have enrolled 487 model 6949 leads in this study with 6,156 cumulative months of follow up. Results indicate survival is 98.9% at two years based on complications occurring beyond 30 days of implant. The following table summarizes data from Medtronic's System Longevity Study comparing the Sprint Fidelis lead with Sprint and Sprint Quattro:

System Longevity Study

Lead Model	Survival at 2 years
Sprint (6945)	99.1%
Sprint Quattro (6947)	99.3%
Sprint Fidelis (6949)*	98.9%

While Medtronic believes the most accurate method to assess lead performance is the System Longevity Study, we recognize the number of Sprint Fidelis leads followed to date in the System Longevity Study is not sufficient to be used as the sole means of gauging overall performance. Therefore, we have also examined the chronic fracture performance of this lead through Returned Product Analysis. The Sprint Fidelis lead appears to perform in line with other Medtronic leads in the market:

Returned Product Analysis

Lead Model	Chronic Fracture-Free Survival at 2 years
Sprint (6945)	99.92%
Sprint Quattro (6947)	99.94%
Sprint Fidelis (6949)*	99.86%

* Due to the small implant sample size of Sprint Fidelis models 6948, 6931, and 6930, the System Longevity Study and Returned Product Analysis data is based on Sprint Fidelis 6949 leads only.

From: Holgers, Mike
Sent: Thursday, March 29, 2007 10:34 AM
To: 'Zuroski, Kristine E'

Attachments: FidelisLetter31607.pdf
Kristine

This e-mail is to provide you a copy of a letter Medtronic has recently sent to physicians pertaining to conductor fractures of the Medtronic Sprint Fidelis Leads observed by a limited number of implanting physicians.

We wish to maintain clear and open communication with our customers and FDA regarding the performance of our products. Although we believe that this communication to physicians does not fall under the definition of a recall or correction under Part 7, Medtronic is providing this letter to the FDA Minneapolis District Office as a courtesy.

Attached, please find a copy of the letter provided to Fidelis Lead implanting and follow-up physicians.

As indicated in the attached letter, the Fidelis leads are performing in line with other Medtronic and competitive high voltage leads. This communication to physicians does not require submission to the FDA under Part 806 because this letter is not intended to reduce a risk to health posed by the device or remedy a violation of the act caused by the device. The Fidelis Leads are not in violation of the Act.

Additional rationale for the decision that this communication to physicians does not require submission to the FDA under Part 806 is as follows:

- This letter was sent to Fidelis physicians in response to reported conductor fractures from a limited and small number of physicians. Most physicians have not experienced a higher then expected rate of conductor fractures.
- This letter provides physicians System Longevity Study and Returned Product Analysis performance data that is similar to data distributed in the Medtronic Product Performance Report published twice a year.
- This letter does not provide any new instructions to the physician, but provides additional detail on certain failure modes and reminds them the importance of following our defined implant instructions. Our reminders pertaining to the implant procedure contained in this letter are consistent with our approved labeling.

If you have any questions, please contact me at 612-961-4148.

Thank you.

Mike Holgers
Director Regulatory Compliance
CRDM
Medtronic Incorporated

FidelisLetter31607.
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P920015/R14

Medtronic, Inc.
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December 7, 2007

ORIGINAL

Food and Drug Administration
Center for Devices and Radiological Health
Document Mail Center (HFZ-401)
9200 Corporate Boulevard
Rockville, Maryland 20850

Subject: Annual Report for P920015

To Whom It May Concern:

Enclosed, in compliance with 21 CFR 814.84, is the Annual Report for the above referenced PMA number. This report is submitted in compliance with the conditions of approval associated with this PMA.

This Annual Report covers the time period from December 31, 2007 to September 30, 2007.

Table 1 identifies the device model numbers and brand names for the products included in this Annual Report.

Table 1: Products under P920015

Model Numbers	Brand Names
6963, 6966, 6999	Leads for initial Transvene® Leads System
7217B[1]	Pacer-Cardioverter Defibrillator
6933, 6936, 6939	Leads for Transvene® DF-1 System
6934	Lead for Transvene® Right Ventricular System
6934S[2]	Lead for Transvene® Right Ventricular System
6937	Transvene® SVC Lead
6932, 6942, 6943, 6945	Sprint™ Leads
6944	Sprint™ Quattro™ Lead
6947	Sprint™ Quattro Secure™ Lead
6996 SQ	Subcutaneous Lead System
6948, 6949, 6930, 6931	Sprint Fidelis Leads
Accessories	
6707	Lead Adaptor
6996T	Tunneling Tool
6725	Pin-Plug Kit
6726	DF-1 Y-Adaptor/Extender Kit

[1]P900061 is the master PMA file for this model; therefore, this model will be reported under P900061 only.
[2]P980050 is the master PMA file for this model, therefore, this model will be reported under P980050 only.

This submission contains confidential commercial or trade secret information and Medtronic requests that it be given maximum protection provided by the law.

Three (3) copies of this Annual Report are being submitted (two (2) paper copies and one (1) CD-ROM). Per FDA instructions, an eCopy is being provided and the CD-ROM is an exact copy of the paper copies.

If you have any questions, please contact me at the telephone number or email address listed below.

Sincerely;
MEDTRONIC, INC.

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6944	Sprint™ Quattro™ Lead
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Reporting period December 31, 2006 to September 30, 2007

CONDITIONS OF APPROVAL

Required PMA Conditions of Approval – Requirement 1

Beyond the standard "Conditions of Approval for Implantable Defibrillators and Programmers," there is no additional information required in the form of post-approval report. Included in this Annual Report are:

- See **Attachment A**– Device Experience
- See **Attachment B** – Product Performance Report

SUMMARY OF CHANGES

Changes Reported Pursuant to 21 CFR 814.39(a):

The following PMA Supplements were submitted and/or approved during the reporting period:

Supplement Number	Submission Description	Date Submitted	Date Approved
S036	Addition of a paperless chart recorder to the sterilization operations	11/20/06	12/11/06
S037	Minor design and manufacturing changes to improve the DF-1 leg strength and handling characteristics of leads	5/14/07	7/3/07
S038	Minor manufacturing changes and a vendor change for the IS-1 connector sleeve mold	9/12/07	Pending Approval

Changes Reported Pursuant to 21 CFR 814.39(b):

Minor modifications were made to Medtronic's devices during the reporting period and these modifications are described below. These minor modifications were not submitted as PMA supplements because they do not affect the safety or effectiveness of the device and do not impact the Conditions of Approval listed in the FDA approval letters. These changes are included within this annual report.

1. NEW PINS Due to Package Labeling Changes

Reason for Change

News Pins were created due to Packaging Labeling and Bill of Materials changes to lead products for the upcoming Final Package Automation (FPA) line, the general label text was updated.

Models Impacted

6944 and 6947

Nature and Scope of Change

New PINs are being created for several lead models manufactured at MPROC-Villalba. These PINs will incorporate new package label formats /layouts and some labeling/literature component updates. The package labels being updated include the sterile package label, the shelf box label and the FYR (For Your Records) label.

The changes include:

- Update to the lead picture graphic; where a distal and proximal end of the lead may have been shown, the full lead body is now shown on the shelf box label.
- The lead graphic has been removed from the sterile package label.
- The lead length and model number have been removed from the text information: the lead length is now included as part of the lead graphic. The model number is already included in the product title.
- Update the label address to include Villalba, Puerto Rico as manufacturing site per standard CCRA-038 to read: “Manufactured in/at: Villalba, Puerto Rico, USA”
- Symbols for Storage, Serial Number, and Use By added.
- The barcode has been changed from HIBC to UCC format.
- The FYR (For Your Records) labels have been updated to a new format. Peel off labels were previously part of the sterile package label but are now an individual label.
- IS-1 connector type has been added to side label and separate sticker has been eliminated.
- Distal end fixation type graphic has been added to side label on models that didn’t have it previously.
- Trade name may have been updated on some models not done previously to reflect corporate guidelines.

See the list below for existing and new label part numbers:

Model Number	Existing Label Part Number	New Label Part Number
6944	633510	A12009
6947	633615	A12049

In addition to the label text changes, the shelf box part number was changed to 350381-001 from 19434-001 to reflect the following labeling changes:

- There is a slight variation in the location of the barcode print on the bottom.

- The new box width and length are 1/8” smaller than the current measurement. The box height has not changed.
- The box color and raw materials, and construction methods are the same.

In addition to the shelf box label text changes, the following changes regarding processes and components used for each PIN will be changed as follows:

- The software for printing the labels and generating the text is changing from LabelVision to Formscape.
- The label stock was also redesigned. Previously all labels were printed on one sheet. Now the sterile package, shelf box, and FYR labels will each be printed on a different sheet.
- The Medtronic logo graphic has been removed from the shelf box seal labels.
- A Disclaimer of Warranty and general warning literature piece has also been added to the bill of materials for PINs that currently may not include it.
- A new literature envelope was also implemented, the design of the envelope opening was slightly modified to allow for use on the FPA line automated equipment and the text “Pacing Lead Information, Forms to be Completed” and the Medtronic logo were removed and do not appear on the new envelope.

Testing

No product testing is required as the changes are minor formatting differences to created standardization in labeling of Therapy Delivery product and do not affect the use or indications for use of the products.

The new Formscape labeling software has been validated. The automated equipment used as part of the Final Package Automation line (FPA) will be validated as implemented.

Rationale for Change

This change is annual reportable based on the following rationale:

- These changes are minor in nature, with a minor affect to the package labeling and do not affect indications for use.
- The change is not a technology or performance, manufacturing site, control mechanism, operating principle, energy type, environmental specification, performance specification, dimensional change, ergonomic or patient/use interface, software or firmware change.
- The change is being made for standardization purposes and are intended to be used when the packaging line becomes automated, which will be qualified before implementation.

- The change is not designed to improve safety based on clinical experience.
- Additional clinical data is not necessary to establish safety and effectiveness.
- The change is qualified to original specifications; FDA recognized test, standard, or guidance.
- There are no new safety and effectiveness issues raised as a result of the change.
- There are no new or increased risks associated with the change.
- The change does not affect or change device sterility, packaging, sterilization site, sterilization method or expiration date.
- The change is not due to a recall or field corrective action.
- This change does not affect safety and effectiveness of the products and therefore can be reported via Annual Report.

2. Subject: Post Cure Change

Reason for Change

The change being implemented will result in yield improvement.

Models Impacted

6726, 6930, 6931, 6932, 6940, 6942, 6943, 6944, 6947, 6948, 6949

Nature and Scope of Change

A minor change for the post cure pro-- ---------- F-1 connector insulation, which -------- as a strain relief (part number (b)(4) from (b)(4) (b)(4) was made. There were no other manufacturing or process changes -------- ted with this minor change. This change was made to improve manufacturing yield only and not as a result of a field or quality issue. All dimensional and mechanical requirements for the tubing remain unchanged. There are no specification changes, except for the post cure change.

Testing

This minor change in the post cure process was previously made in other Medtronic leads models several years ago. At that time, a post-cure design of experiment (DOE) was completed at that time, along with crush testing. The tubing has performed within expectations during the life of the product and the same post-cure is currently employed on the multi-lumen tubing which is used on the leads of all

Sprint Quattro, and Sprint Fidelis. (part number (b)(4) A comparison is listed below:

Model Name	Part Number	Raw Material	Post Cure	Durometer
Sprint Fidelis	(b)(4)			
Sprint Quattro				

The differences between the two tubes are that the (b)(4) is single-lumen and has much thicker walls based on the inherent design of the product. As such this minor change has no impact on the component performance. The two tubes have different durometers; however they are of the same chemical family. A comparison between the two components is listed below:

Part Number	Tensile Strength	Elongation	Toughness	Durometer	Extractables
(b)(4)					

The single-lumen tubing is used in the connector portion of the lead, located in the device implantation pocket, whereas the multi-lumen tubing is subject to tortuous anatomy. The more difficult load conditions on the tubing and history of acceptable performance of the multi-lumen tubing indicate this change will have no impact on the function of the tubing.

Differential Scanning Calorimetry testing was also performed on the (b)(4) to determine the amount of cure in the old and proposed post-cure cond---------- showed no significant difference in amount of cure between the two post-cure settings. Testing included ensuring that all mechanical and design specifications were met. There were no anomalies noted during testing.

Additionally, there were no new or increased risks and no impact on existing device biocompatibility assessments.

Rationale for not filing a PMA-S

- The change does not affect labeling or indications for use.
- The change is not a technology or performance, manufacturing site, control mechanism, operating principle, energy type, environmental specification, performance specification, dimensional change, ergonomic or patient/use interface, software or firmware change.
- The change is a manufacturing change for a component that allows modification to the post-cure time and temperature as previously outlined. The change aligns the post-cure requirements with existing process requirements of the multi-lumen tubing that is held to more stringent requirements. Therefore, the process change was modified based on

experience with that tubing part number and confirmed by additional testing on the single-lumen tubing. As previously outlined, testing demonstrated that the component meets requirements.

- The change is not designed to improve safety based on clinical experience.
- Additional clinical data are not necessary to establish safety and effectiveness.
- There are not any new safety and effectiveness issues raised as a result of the change.
- There are not any new or increased risks associated with the change.
- The change does not affect or change device sterility, packaging, sterilization site, sterilization method or expiration date.
- This change is not due to a recall, field performance issues, or field corrective action.

3. Addition of Weight Balance to Process (b)(4)

Reason for Change

The change is being made to clarify the process and avoid non-conformances.

Models Impacted

6930, 6931, 6932, 6942, 6943, 6944, 6945, 6947, 6948

Note: This change was previously submitted in P980016/R009, dated September 28, 2007 and is currently under review by FDA.

Nature and Scope of Change

Process (b)(4) Revised manufacturing operation to include instructions about w----------n needs to be checked, related to the aeration time. Operator pulled the baskets from the machine prior to the aeration time limit.

Process (b)(4) Revised manufacturing operation to include the instructions about w----------n needs to be checked related to the aeration time. The weight balance that has been added to the process has the capability of printing a bar code which includes the weight information. The SADR system has the capability of reading the bar code; therefore the operator will now weigh the canister and will print the bar code, which will be read by the SADR system, so the information no longer will be put manually into the SADR system. This did not affect any product in the field.

Testing

An installation/operational qualification testing was performed for the SADR system to establish confidence that the equipment and its support systems are

installed per manufacturer specifications and Medtronic requirements. All testing passed and no anomalies were identified.

Rationale for not filing a PMA-S

- The change does not affect the labeling or indicates for use.
- The change is not a technology or performance, manufacturing site, control mechanism, operating principle, energy type, environmental specification, performance specification, dimensional change, ergonomic or patient/use interface, software or firmware change.
- The change is not a manufacturing change and it is not a change in the QA inspection procedure for a component or finished device.
- The change is not designed to improve safety based on clinical experience.
- Additional clinical data are not necessary to establish safety and effectiveness.
- The change is qualified to original specifications; FDA recognized test, standard, or guidance.
- There are not any new safety and effectiveness issues raised as a result of the change.
- There are not any new or increased risks associated with the change.
- The change does not affect or change device sterility, packaging, sterilization site, sterilization method or expiration date.
- This change is not due to a recall, field performance issues, or field corrective action.

4. Apply Primer To The Outer Coil Weld Assembly

Reason for Change

The change being implemented will result in yield improvement.

Models Impacted

6930, 6931, 6948, 6949

Nature and Scope of Change
As part of the outer coil weld assembly, used for the IS-1 legs of Fidelis Models 6949,6948, 6931, and 6930 a piece of (b)(4) to a (b)(4) The (b)(4) and is (b)(4) (b)(4) abl for su teps. The bond does not serve any functional purpose in the finished device.

A good (b)(4) is not always formed between the (b)(4) as they sometimes separate when handled, requi----- (b)(4) ---------- scrapped. As a ---------- cterized (b)(4) has been applied to the (b)(4) prior to (b)(4) to increase the (b)(4) ----------

1. This (b)(4) is not a new materi-- ------ ------- ------ -------- ------- (b)(4) operati----- ------ (b)(4) is currently used to (b)(4) overlay.

There were no other manufacturing or process changes associated with this minor change. This change was made to improve manufacturing yield only and not as a result of a field or quality issue. All dimensional and mechanical requirements for the (b)(4) remain unchanged. There are no specification changes, except for the po--------- hange.

Testing

The (b)(4) has demonstrated its ability to improve the (b)(4) between (b)(4) and (b)(4) in other parts of the lead, and can therefor-------sed to im---------- (b)(4) ---- hese materials in the (b)(4) for Fidelis leads. Additionally, this (b)(4) ---is not a new mat----------s used in a similar fashion for other (b)(4) ---------- ns. For these reasons, this change will be implemented without --------- ng reliability testing. There is no change to the form, fit, or function of the final product.

(b)(4) prior to (b)(4) it to (b)(4) is a widely used ---------- ----------rocess. ---------- nge w----------y special processes and due to the nature of the change and location of the (b)(4) testing is required to implement this change.

Rationale for not filing a PMA-S

- No change in materials as this adhesive is used for priming other areas of lead.
- No biological assessmen---------- - -------- ----y contained in the product biological assessment as (b)(4) No change in device form, fit or function. Change i- --- --------- --------- ---------- yield.
- The change does not affect the labeling or indicates for use.
- The change is not a technology or performance, manufacturing site, control mechanism, operating principle, energy type, environmental specification, performance specification, dimensional change, ergonomic or patient/use interface, software or firmware change.
- The change is not a manufacturing change and it is not a change in the QA inspection procedure for a component or finished device.
- The change is not designed to improve safety based on clinical experience.

- Additional clinical data are not necessary to establish safety and effectiveness.
- The change is qualified to original specifications; FDA recognized test, standard, or guidance.
- There are not any new safety and effectiveness issues raised as a result of the change.
- There are not any new or increased risks associated with the change.
- The change does not affect or change device sterility, packaging, sterilization site, sterilization method or expiration date.
- This change is not due to a recall, field performance issues, or field corrective action.

DEVICE EXPERIENCE INFORMATION

This section provides device experience information for this reporting period. The information includes number of implants, number of explants, number of deaths and returned product assessment for the following pulse generators:

- Model 6963, 6966, 6999 Transvene Lead System
- Model 7217B – PCD
- Model 6933, 6936, 6939 Transvene DF-1 Leads
- Model 6937 Transvene Superior Vena Cava Lead
- Model 6934S Transvene Right Ventricular Lead
- Model 6707 Adaptor
- Model 6932 Sprint Lead
- Model 6942 Sprint Lead System
- Model 6943, 6945 Sprint Leads
- Model 6944 Sprint Quattro Lead
- Model 6996 SQ Lead System
- Model 6996T Tunneling Tool (because this is not an implant, device experience is not available).
- Model 6726 DF-1 Y-adaptor extender kit
- Model 6947 Sprint Quattro Secure
- Model 6949
- Model 6931
- Model 6948
- Model 6930

BIBLIOGRAPHY AND SUMMARY OF PUBLISHED AND UNPUBLISHED REPORTS

Unpublished Reports

Medtronic is not aware of any unpublished reports of data from any completed clinical investigation involving the device or related devices which relate to the safety and efficacy of the device or related devices during the period during the period covered by this annual report. (Related devices include devices which are the same or substantially similar to Medtronic's devices.)

Published Reports

The following bibliography pertaining to Medtronic leads and/or related devices includes reports identified in the scientific literature that were published or appeared during the reporting period. Abstracts are included, if available.

The published information provided in this document is based on the following search criteria:

- Information published during the Reporting period December 31, 2006 to October 30, 2007 which is the reporting period for this submission. Note: Some searches only allow queries by "year" resulting in reports slightly outside the reporting period.
- Due to the large amount of information, published information search was limited to those available in English and related to "human only".
- The search was conducted using the following databases: Medline, Health Devices Alerts, BIOSYS and EmBase.
- Keywords included "high voltage pacing leads" and all applicable Medtronic model numbers. (Transvenous Lead, Transvenous, Transvene Lead, Transvene, Transvene SVC, Transvene DF-1, 6707 Lead Adaptor, 6725 Pin-Plug Kit, 6726 DF-1 Y-Adaptor/Extender Kit, 6996T Tunneling Tool, 6933, 6936, 6939, 6963, 6966, 6999, 6934, 6937, 6932, 6942, 6943, 6945, 6944, 6947, 6996, 6948, 6949, 6930, 6931, SQ,

Sprint, Sprint Quattro, Sprint Quattro Secure, Sprint Fidelis, Steroid Eluting Lead, Steroid Lead, Defibrillation Lead) High Voltage Pacing Lead (Some searches only allow queries by "year" resulting in reports slightly outside the reporting period.)

Bibliographies

1. Fernengel A, Schwer C, Helber U, Dornberger V, Fernengel A: Inappropriate implantable cardioverter- defibrillator shock induced by electromagnetic interference while taking a shower [2]. *Clinical Research in Cardiology (Clin Res Cardiol)* /20, Clin.

2. Kaltman JR, Buck K, Shah MJ, Vetter VL, Tanel RE, Gaynor JW *et al.*: **Subcutaneous array with active can implantable cardioverter defibrillator configuration: A follow-up study.** *Congenital Heart Disease (Congenit Heart Dis)* /20, Congenit.
Abstract: AB- Background. Novel nontransvenous implantable cardioverter defibrillator (ICD) configurations are sometimes required for small children and children with complex congenital heart disease at risk for sudden death. Mid- to long-term follow-up of these nontraditional implant techniques is not well known. We assessed the mid-term performance of a subcutaneous lead technique used in our practice. Methods. Between July 2002 and November 2003, 4 patients (age 2.1-8.5 years, weight 13-33.3 kg, height 90-126.7 cm) received an ICD with a single-finger (n = 3) or 2-finger (n = 1) subcutaneous array with an active abdominal can and epicardial pace/sense lead. The subcutaneous tunnel was created via a subxiphoid incision using a tunneling tool within a sheath along the seventh intercostal space and extended posterior to the spine. Diagnoses included long QT syndrome (n = 2), idiopathic ventricular fibrillation (n = 1), and idiopathic dilated cardiomyopathy (n = 1). Implantable cardioverter defibrillator indications included syncope (n = 2) and cardiac arrest (n = 2). Results. Mean follow-up was 22.3 +/- 13.9 months. During follow-up, 1 patient underwent heart transplantation and the other 3 patients underwent generator replacement secondary to a manufacturer's advisory. There was 1 appropriate and successful shock for ventricular fibrillation. This patient experienced a second episode of ventricular fibrillation that the ICD discharge failed to terminate. The arrhythmia spontaneously resolved. There were no inappropriate shocks. There was 1 instance of false detection of ventricular fibrillation because of intermittent T wave oversensing but therapy was not administered. There were no infections, lead fractures, or other complications during follow-up. Conclusion. This novel nontransvenous ICD configuration can be used safely in a select group of pediatric patients and allows for the applicability of this life-saving technology to small children at high risk for sudden cardiac death. (c) 2007, the Authors; Journal compilation (c) 2007 Blackwell Publishing, Inc

3. Filippi L, Vangi V, Murzi B, Moschetti R, Colella A, Filippi L: **Temporary epicardial pacing in an extremely low-birth-weight infant with congenital atrioventricular block.** *Congenital Heart Disease (Congenit Heart Dis)* /20, Congenit.
Abstract: AB- Congenital atrioventricular block is a rare, but severe occurrence in the newborn can be related to various cardiac malformations or to maternal autoimmune diseases, particularly systemic lupus erythematosus. We report an extremely low-birth-weight infant affected by congenital heart block, due to positive anti-RO/SSA and anti-LA/SSB antibodies of the mother, with progressively increasing respiratory distress syndrome and heart failure. The infant was successfully treated with an external constant-current, single-chamber ventricular (VVI) temporary epicardial pacing, placed on the second day of life, at the weight of 810 g. After this treatment, cardiac failure resolved and respiratory assistance could be rapidly stopped. A single-chamber, rate-responsive, permanent pacemaker was placed at 3 months of life with steroid-eluting, epicardial-pacing leads. We emphasize that early extrathoracic temporary epicardial pacing is able to resolve heart failure in an extremely low-birth-weight infant. (c) 2007 The Authors; Journal compilation (c) 2007 Blackwell Publishing, Inc

4. Kelle AM, Backer CL, Stewart RD, Mavroudis C, Tsao S, Franklin WH *et al*.: **Dual-chamber epicardial pacing in neonates with congenital heart block.** *Journal of Thoracic and Cardiovascular Surgery (J Thorac Cardiovasc Surg)* /20, J.
Abstract: AB- Objective: This review evaluates the outcome of a treatment strategy using dual-chamber pacemakers for neonates with congenital heart block. Methods: From 1989 to 2006, 10 neonates had dual-chamber epicardial pacemaker placement for congenital heart block. Mean age and weight were 4.4 +/- 5.6 days and 2.8 +/- 0.6 kg. Four patients had heterotaxy syndrome and required concomitant cardiac procedures. One patient had fetal hydrops, myocarditis, and cardiomyopathy. Five patients had structurally normal hearts. Sternotomy (2 partial, 8 full) and unipolar leads (2 non-steroid eluting, 18 steroid-eluting) were used in all. Generators were placed in submuscular bilateral rectus sheath pockets. Results: Successful atrioventricular synchrony was established in all patients. Mean P-wave sensing was 4.7 +/- 2.6 mV and atrial voltage threshold was 0.8 +/- 0.3 V. Mean R-wave sensing was 13.0 +/- 5.7 mV and ventricular voltage threshold 0.9 +/- 0.5 V. There were no wound complications or acute lead failures. Median postoperative stay was 14 days. Three of the 4 patients with heterotaxy died at 3 days, 14 days, and 15 months postoperatively. The patient with cardiomyopathy died suddenly at 6 months of acute myocarditis. No patient with a structurally normal heart died ($P < .05$). Mean follow-up interval in survivors is 6.1 +/- 7.1 years with 1 patient lost to follow-up. Conclusions: Implantation of a dual-chamber epicardial pacemaker in neonates with congenital heart block is technically feasible and results in excellent outcomes in patients with structurally normal hearts. System longevity at 6 years is excellent. Patients with congenital heart block and heterotaxy syndrome have a poor prognosis despite dual-chamber pacing. (c) 2007 The American Association for Thoracic Surgery

5. Wollmann CG, Bocker D, Paul M, Breithardt G, Gradaus R, Loher A *et al.*: **Two different therapeutic strategies in ICD lead defects: Additional combined leadversus replacement of the lead.** *Journal of Cardiovascular Electrophysiology (J Cardiovasc Electrophysiol)* /20, J.
Abstract: AB- Complications in ICD Patients with High Voltage-Pace/Sense Lead. Objectives: Implantation of an additional HV-P/S lead versus extraction of the defective HV-P/S lead and implantation of a new one is one possible therapeutic approach in cases of a defective high-voltage pace/sense lead (HV-P/S). No information is available on potential differences in clinical outcome in these different approaches. Methods: Between January 2000 and February 2006, 86 patients with HV-P/S lead defect received either an additional transvenous HV-P/S lead (n = 33, group 1) or the HV-P/S lead was replaced (n = 53, group 2). The duration of the initially implanted leads was significantly different in the two groups (7.4 +/- 2.9; group 1 and 4.1 +/- 3.4 years; group 2).The outcome of these two groups of patients was retrospectively analyzed. Results: Seventy-three patients [85%] survived until the end of follow-up of 29 +/- 15 (group 1) and 33 +/- 21 (group 2) months (P = ns), respectively. Thirteen patients died: six in group 1 and seven in group 2 (P = ns). Fourteen patients experienced perioperative complications (group 1: six; group 2: eight; P = ns). ICD system-related complications occurred in 22 patients (group 1: seven; group two: 15; P = ns). The event-free cumulative survival of patients with additional and replaced HV-P/S lead for postoperative events (including death) after 1, 2, and 3 years was 82%, 70%, 70%, and 86%, 81%, 66%, respectively (P = 0.93). Conclusions: Implantation of an additional HV-P/S lead or replacement of the HV-P/S lead in case of HV-P/S lead failure is statistically not different concerning mortality and morbidity. There are no predictors for further lead defects. Implantation of an additional HV-P/S lead should not be recommended in young patients or patients with greater likelihood of living many years. Predictors for death were an age over 70 years and renal insufficiency. (c) 2007 by Futura Publishing Company, Inc

6. Kupper B, Yee R, O'Hara G, Simpson CS, Della BP, Workel M *et al.*: Do small (6.6 Fr.) active and passive fixation defibrillation leads perform as well as larger sized leads? A multi-centre analysis. *Europace - European pacing, arrhythmias , and cardiac electrophysiology - journal of the working groups on cardiac pacing, arrhythmias , and cardiac cellular electrophysiology of the European Society of Cardiology* 2007, 9(8): 657-661.
Abstract: AIMS: The 6.6 Fr. Sprint Fidelis lead family may allow multiple lead implantation procedures with reduced risk of venous obstruction. METHODS AND RESULTS: Two prospective, historically controlled, multi-centre studies were conducted in Europe (80 patients) and Canada (79 patients). The purpose was to assess the ventricular lead-related adverse events (LRAEs) and performance of the small Models 6948 and 6949 defibrillation leads, respectively, in patients with a standard indication for an ICD implant. Safety was assessed by demonstrating equivalence of the LRAE free rate at 1 month to comparable but larger leads (Models 6942, 6943, 6944, 6947and 4074). Seventy-five of 80 patients with a 6948 lead (93.8%) remained free of LRAEs. Seventy-four out of 79 patients (93.7%)

with the 6949 lead remained free of LRAEs. The 95% lower confidence bounds were above the critical difference limits. Thus, safety of the Sprint Fidelis((R)) leads is similar to that of larger leads. Electrical performance through 1-month follow-up proved to be acceptable in comparison with other established leads. CONCLUSION: These multi-centre studies confirm that smaller defibrillation leads offer similar safety and efficacy features to widely used larger leads; they have low LRAE rates and defibrillation thresholds, while providing the advantage of a smaller introducer size and reduced venous obstruction

7. Hauser RG, Kallinen LM, Almquist AK, Gornick CC, Katsiyiannis WT: Early failure of a small-diameter high- voltage implantable cardioverter- defibrillator lead. *Heart rhythm - the official journal of the Heart Rhythm Society* 2007, 4(7): 892-896.
Abstract: BACKGROUND: We have observed a higher than expected rate of Sprint Fidelis model 6949 lead failures in our practice. OBJECTIVE: The aim of this study was to assess the performance of small-diameter Sprint Fidelis high-voltage ICD leads. METHODS: The actuarial survival of Sprint Fidelis model 6949 leads implanted at our center was compared with that of the Sprint Quattro Secure model 6947. The United States Food and Drug Administration Manufacturers and User Facility Device Experience (MAUDE) database was searched for Sprint Fidelis models. RESULTS: The survival of 583 Sprint Fidelis 6949 leads implanted at our center between September 2004 and February 2007 was significantly less than 285 Sprint Quattro Secure model 6947 leads implanted by us between November 2001 and February 2007 (P = .005). Six patients presented with Sprint Fidelis lead failure 4-23 months after implant. Five of the six patients experienced multiple inappropriate shocks associated with pace-sense conductor and coil fractures; the sixth patient had a fixation mechanism failure. The MAUDE search rendered reports for 679 Sprint Fidelis leads. The most frequent complaints or observations were inappropriate shocks (33%), high impedance (33%), and fracture (35%). Of 125 leads analyzed by the manufacturer, 62 involved fracture of the pace-sense conductor or coil and the high-voltage (defibrillation) conductor. CONCLUSIONS: The Sprint Fidelis high- voltage lead appears to be prone to early failure. Its use should be limited until the failure mechanism is identified and corrected. Patients should be evaluated quarterly, and automatic lead test features should be enabled. While more data are needed, routine prophylactic replacement of intact, normally functioning Sprint Fidelis leads does not appear justified

8. Kennergren C, Bucknall CA, Butter C, Charles R, Fuhrer J, Grosfeld M *et al.*: Laser-assisted lead extraction: the European experience. *Europace - European pacing, arrhythmias , and cardiac electrophysiology - journal of the working groups on cardiac pacing, arrhythmias , and cardiac cellular electrophysiology of the European Society of Cardiology* 2007, 9(8): 651-656.
Abstract: AIMS: The aim of this study is to investigate the safety and effectiveness of Excimer laser-assisted lead extraction in Europe. The final European multi-centre study experience is presented. METHOD AND RESULTS: The Excimer is a cool cutting laser (50 degrees C) with a wavelength of 308 nm. The energy is

emitted from the tip of a flexible sheath and is absorbed by proteins and lipids, 64% of the energy is absorbed at a tissue depth of 0.06 mm. The sheath is positioned over the lead, and the fibrosis surrounding the lead is vaporized while advancing the sheath without damaging other leads. From August 1996 to March 2001, 383 leads (170 atrial, 213 ventricular) in 292 patients (mean age 61.6 years, range 13-96) were extracted at 14 European centres. Mean implantation time was 74 months (3-358). Most frequent indications were pocket infection (26%), non-functional leads (21%), patient morbidity (21%), septicaemia or endocarditis (14%), erosion (5%), and lead interference (8%). Median extraction time was 15 min (1-300). Complete extraction was achieved in 90.9% of the leads and partial extraction in 3.4%. Extraction failed in 5.7% of the leads. Major complications = perforations caused 10/22 (3.4/5.7%) of the failures. Most partially extracted patients were considered clinically successful, as only minor lead parts without clinical significance were left. Femoral non-laser technique was used to remove 8/12 of the non-complication failures. The total complication rate, including five minor complications (1.7%), was 5.1%. No in-hospital mortality occurred. CONCLUSION: Pacing and implantable cardioverter-defibrillator leads can safely, effectively, and predictably be extracted. Open-heart extractions can be limited to special cases. The results indicate that the traditional policy of abandoning redundant leads, instead of removing them, may be obsolete in many patients

9. Klug D, Balde M, Pavin D, Hidden-Lucet F, Clementy J, Sadoul N *et al.*: Risk factors related to infections of implanted pacemakers and cardioverter-defibrillators: results of a large prospective study. *Circulation* 2007, 116(12): 1349-1355.
Abstract: BACKGROUND: The Prospective Evaluation of Pacemaker Lead Endocarditis study is a multicenter, prospective survey of the incidence and risk factors of infectious complications after implantation of pacemakers and cardioverter-defibrillators. METHODS AND RESULTS: Between January 1, 2000, and December 31, 2000, 6319 consecutive recipients of implantable systems were enrolled at 44 medical centers and followed up for 12 months. All infectious complications were recorded, and their occurrence was related to the baseline demographic, clinical, and procedural characteristics. Among 5866 pacing systems, 3789 included 2 and 117 had >2 leads; among 453 implantable cardioverter-defibrillators, 178 were dual- lead systems. A total of 4461 de novo implantations occurred and 1858 pulse generator or lead replacements. Reinterventions were performed before hospital discharge in 101 patients. Single- and multiple-variable logistic regression analyses were performed to identify risk factors; adjusted odds ratios (aORs) and 95% confidence intervals (CIs) were calculated. At 12 months, device-related infections were reported in 42 patients (0.68%; 95% CI, 0.47 to 0.89). The occurrence of infection was positively correlated with fever within 24 hours before the implantation procedure (aOR, 5.83; 95% CI, 2.00 to 16.98), use of temporary pacing before the implantation procedure (aOR, 2.46; 95% CI, 1.09 to 5.13), and early reinterventions (aOR, 15.04; 95% CI, 6.7 to 33.73). Implantation of a new system (aOR, 0.46; 95% CI, 0.24 to 0.87) and antibiotic prophylaxis (aOR, 0.4; 95% CI, 0.18 to 0.86) were negatively correlated with risk of infection.

CONCLUSIONS: This study identified several factors of risk of device infection and confirmed the efficacy of antibiotic prophylaxis in recipients of new or replacement pacemakers or implantable cardioverter-defibrillators

10. Kolker AR, Redstone JS, Tutela JP: Salvage of exposed implantable cardiac electrical devices and lead systems with pocket change and local flap coverage. *Annals of plastic surgery* 2007, 59(1): 26-29.
Abstract: Erosion and exposure of pacemaker (PPM) and implantable cardiac defibrillator (ICD) devices are potentially dire complications, which have classically required the removal of the entire generator and lead systems. This study evaluates a series of cases wherein debridement, irrigation, pocket change, and local flap coverage were used for the successful salvage of indwelling leads after exposure and infection of implantable cardiac defibrillator devices. Patients with skin erosion, infection, and/or exposure of prepectoral infraclavicular cardiac defibrillator devices were treated over a 23-month period between June 2004 and April 2006. The surgical technique involved wide excision of the exposure site with a rhombic incision pattern, followed by removal of the generator unit and complete debridement of the peridevice capsule. Subclavian atrioventricular (AV) leads were preserved. The pocket was irrigated with antibiotic solution. A new pocket plane was selected and developed, and a new generator unit was implanted. A rhombic flap was developed and transposed to achieve tension-free closure over closed suction drains. Data were reviewed retrospectively. Six patients were treated, all male, mean age 66 years (range, 50 to 83 years). All patients presented with "new" exposure of the implantable generator within 48 hours. None demonstrated gross purulence, sepsis, or endocarditis. Initial gram stain was negative for bacteria in all cases, 1 (17%) grew sensitive Staphylococcus epidermidis species. Mean follow-up is 22 months (range, 8 to 31 months). One patient (17%) developed a hematoma, successfully treated by aspiration. Five patients (83%) were treated successfully, with no wound dehiscence, generator or lead exposure, or recurrence of infection. One patient (17%) developed drainage and exposure at a separate site (AV lead) at 10 months postoperative and required generator and lead explantation and site change to the contralateral anterior chest wall. In conclusion, in the absence of sepsis or gross infection, skin excision, pocket change, generator change with lead preservation, closed-suction drainage, and flap coverage for tension-free closure should be considered in the treatment of early ICD and PPM exposure

11. Mischke K, Schimpf T, Winograd R, Knackstedt C, Zarse M, Plisiene J *et al.*: Simultaneous transesophageal cardioversion and echocardiography: feasibility and safety. *Heart rhythm - the official journal of the Heart Rhythm Society* 2007, 4(3): 304-307.
Abstract: BACKGROUND: Transesophageal echocardiography (TEE) is routinely used to exclude atrial thrombus prior to cardioversion of atrial fibrillation (AF). Because the TEE probe lies adjacent to the atria, cardioversion using an electrode attached to the TEE probe should allow for immediate low-energy transesophageal cardioversion. OBJECTIVE: The purpose of this study was to evaluate a cardioversion electrode sheath that can be affixed to conventional TEE probes for

simultaneous thrombus exclusion and cardioversion of AF. METHODS: A thin electrode was integrated into a latex or polyurethane sheath covering a conventional TEE probe. TEE thrombus exclusion and biphasic transesophageal cardioversion using a step-up protocol were performed during deep sedation. Esophagoscopy was performed immediately after cardioversion and after 1 week. RESULTS: TEE was performed in 27 patients. One patient showed left atrial thrombi. Transesophageal cardioversion was successful in 25 of the remaining 26 patients. Mean atrial cardioversion threshold was 63 +/- 48 J. Transesophageal cardioversion restored sinus rhythm in two patients with unsuccessful transthoracic cardioversion. Transesophageal cardioversion in deep sedation was well tolerated. Esophagoscopy revealed slight mucosal damage in three patients at the site of shock application; two of these patients showed signs of gastroesophageal reflux disease. Mucosal damage unrelated to the site of shock delivery was noted in three patients. CONCLUSION: Atrial thrombus exclusion and transesophageal cardioversion of AF via a disposable cardioversion sheath offers the opportunity to perform transesophageal cardioversion and TEE thrombus exclusion during one sedation. It may not be suitable for use in patients with gastroesophageal reflux disease. Transesophageal cardioversion may establish sinus rhythm in selected patients refractory to transthoracic cardioversion

12. Silvetti MS, Drago F, Marcora S, Rava L: Outcome of single-chamber, ventricular pacemakers with transvenous leads implanted in children. *Europace - European pacing, arrhythmias , and cardiac electrophysiology - journal of the working groups on cardiac pacing, arrhythmias , and cardiac cellular electrophysiology of the European Society of Cardiology* 2007, 9(10): 894-899.
Abstract: AIMS: In children with bradyarrhythmias, ventricular demand, rate-responsive pacemakers (VVI/R PM) are often indicated, but no study is entirely dedicated to their outcome. METHODS AND RESULTS: We evaluated the outcomes of children with VVI/R PM implanted at our centre, with a retrospective analysis. Between 1990 and 2005, 117 children (63 with congenital heart defects), received VVI/R PM with endocardial lead at 5.3 +/- 3.9 years of age for atrioventricular block (n = 105) and sinus node dysfunction. The majority of the leads were unipolar (n = 78), tined (n = 110), and steroid eluting (n = 89). The leads were fixed to subcutaneous tissues by absorbable suture in all patients; in 17 patients, also an atrial loop was created. Follow-up (FU) was 7.8 +/- 4.1 years. There were 22 system failures (19%), due to lead malfunction (n = 20) and system erosion/infection. The log-rank test for equality of survivor functions showed no significant risk factor. However, lead malfunction occurred only in the group without loop, but FU duration was longer in these patients. Complications at implantation were haemothorax (2.5%) and lead dislodgement (5%). Clinically silent occlusion of the subclavian vein was documented at FU by Echo-Doppler in 5%. CONCLUSION: In this particular group of patients, VVI/R pacing has good results, but after long-term FU shows 19% of failures, mainly lead-related

Attachment A - Device Experience

MEDTRONIC, INC.
PMA Annual Postapproval Report
Model 6933, Transvene
Reporting Period from 01/01/07 through 09/30/07

Reported Experience

Implants		
Cumulative Registered Implants		8045
Explants		
Complication, Unresolvable by Programming		0
Other*		146
Complication and Other		1
	Total Explants	147
Patient Deaths		
Device Related		0
Non-Device Related		95
	Total Patient Deaths	95
Returned Product Analysis		
Units Returned for Cause		
Analysis in process		6
No anomalies found		3
Analysis unknown/not analyzed		0
Miscellaneous – Legal – No analysis performed		0
Failures:		
Defib conductor fractured		1
	Total Returned Units	10

New as of FY 2000**

Explant detail:	
No information	50
Apparent lead fracture	1
Heart transplant	1
High resistance/impedance	1
Insulation ruptured/pulled apart (explant damage)	1

* Other includes:
non device-related
non device-related patient complications
**Complies with 1-CARD requirements

MEDTRONIC, INC.
PMA Annual Postapproval Report
Model 6934S, Transvene
Reporting Period from 01/01/07 through 09/30/07

Reported Experience

Implants		
Cumulative Registered Implants		407
Explants		
Complication, Unresolvable by Programming		0
Other*		11
Complication and Other		0
	Total Explants	11
Patient Deaths		
Device Related		0
Non-Device Related		9
	Total Patient Deaths	9
Returned Product Analysis		
Units Returned for Cause		
Analysis in process		0
No anomalies found		0
Analysis unknown/not analyzed		0
Miscellaneous – Legal – No analysis performed		0
Failures		0
	Total Returned Units	0
New as of FY 2000**		
Explant detail:		
No information		2

* Other includes:
non device-related
non device-related patient complications
**Complies with 1-CARD requirements

MEDTRONIC, INC.
PMA Annual Postapproval Report
Model 6936, Transvene
Reporting Period from 01/01/07 through 09/30/07

Reported Experience

Implants		
Cumulative Registered Implants		18879
Explants		
Complication, Unresolvable by Programming		0
Other*		372
Complication and Other		2
	Total Explants	374
Patient Deaths		
Device Related		0
Non-Device Related		215
	Total Patient Deaths	215
Returned Product Analysis		
Units Returned for Cause		
Analysis in process		5
No anomalies found		5
Analysis unknown/not analyzed		0
Miscellaneous – Legal – No analysis performed		0
Failures		0
	Total Returned Units	10
New as of FY 2000**		
Explant detail:		
No information		157
Damaged/cracked/cut insulation		1
Low ventricular impedance/resistance		1
Medical judgment/system upgrade		1
Oversensing		1

* Other includes:
non device-related
non device-related patient complications
**Complies with 1-CARD requirements

MEDTRONIC, INC.
PMA Annual Postapproval Report
Model 6937, Transvene
Reporting Period from 01/01/07 through 09/30/07

Reported Experience

Implants		
Cumulative Registered Implants		2804
Explants		
Complication, Unresolvable by Programming		0
Other*		88
Complication and Other		0
	Total Explants	88
Patient Deaths		
Device Related		0
Non-Device Related		66
	Total Patient Deaths	66
Returned Product Analysis		
Units Returned for Cause		
Analysis in process		6
No anomalies found		2
Analysis unknown/not analyzed		0
Miscellaneous – Legal – No analysis performed		0
Failures		0
	Total Returned Units	8
New as of FY 2000**		
Explant detail:		
No information		22

* Other includes:
non device-related
non device-related patient complications
**Complies with 1-CARD requirements

MEDTRONIC, INC.
PMA Annual Postapproval Report
Model 6939, Transvene
Reporting Period from 01/01/07 through 09/30/07

Reported Experience

Implants		
Cumulative Registered Implants		978
Explants		
Complication, Unresolvable by Programming		0
Other*		13
Complication and Other		0
	Total Explants	13
Patient Deaths		
Device Related		0
Non-Device Related		9
	Total Patient Deaths	9
Returned Product Analysis		
Units Returned for Cause		
Analysis in process		0
No anomalies found		0
Analysis unknown/not analyzed		0
Miscellaneous – Legal – No analysis performed		0
Failures		0
	Total Returned Units	0
New as of FY 2000**		
Explant detail:		
No information		4

* Other includes:
non device-related
non device-related patient complications
**Complies with 1-CARD requirements

MEDTRONIC, INC.
PMA Annual Postapproval Report
Model 6963, Transvene
Reporting Period from 01/01/07 through 09/30/07

Reported Experience

Implants		4629
Cumulative Registered Implants		
Explants		
Complication, Unresolvable by Programming		0
Other*		35
Complication and Other		0
	Total Explants	35
Patient Deaths		
Device Related		0
Non-Device Related		27
	Total Patient Deaths	27
Returned Product Analysis		
Units Returned for Cause		
Analysis in process		3
No anomalies found		0
Analysis unknown/not analyzed		0
Miscellaneous – Legal – No analysis performed		0
Failures		0
	Total Returned Units	3
New as of FY 2000**		
Explant detail:		
No information		8

* Other includes:
non device-related
non device-related patient complications
**Complies with 1-CARD requirements

MEDTRONIC, INC.
PMA Annual Postapproval Report
Model 6966, Transvene
Reporting Period from 01/01/07 through 09/30/07

Reported Experience

Implants		
Cumulative Registered Implants		4755
Explants		
Complication, Unresolvable by Programming		0
Other*		51
Complication and Other		0
	Total Explants	51
Patient Deaths		
Device Related		0
Non-Device Related		33
	Total Patient Deaths	33
Returned Product Analysis		
Units Returned for Cause		
Analysis in process		4
No anomalies found		0
Analysis unknown/not analyzed		0
Miscellaneous – Legal – No analysis performed		0
Failures		0
	Total Returned Units	4
New as of FY 2000**		
Explant detail:		
No information		18

* Other includes:
non device-related
non device-related patient complications
**Complies with 1-CARD requirements

MEDTRONIC, INC.
PMA Annual Postapproval Report
Model 6999, Transvene
Reporting Period from 01/01/07 through 09/30/07

Reported Experience

Implants		
Cumulative Registered Implants		2662
Explants		
Complication, Unresolvable by Programming		0
Other*		21
Complication and Other		0
	Total Explants	21
Patient Deaths		
Device Related		0
Non-Device Related		16
	Total Patient Deaths	16
Returned Product Analysis		
Units Returned for Cause		
Analysis in process		2
No anomalies found		0
Analysis unknown/not analyzed		0
Miscellaneous – Legal – No analysis performed		0
Failures		0
	Total Returned Units	2
New as of FY 2000**		
Explant detail:		
No information		5

* Other includes:
non device-related
non device-related patient complications
**Complies with 1-CARD requirements

MEDTRONIC, INC.
PMA Annual Postapproval Report
Model 6996 SQ
Reporting Period from 01/01/07 through 09/30/07

Reported Experience

Implants		
Cumulative Registered Implants		1856
Explants		
Complication, Unresolvable by Programming		1
Other*		103
Complication and Other		0
	Total Explants	104
Patient Deaths		
Device Related		0
Non-Device Related		78
	Total Patient Deaths	78
Returned Product Analysis		
Units Returned for Cause		
Analysis in process		3
No anomalies found		8
Analysis unknown/not analyzed		1
Miscellaneous – Legal – No analysis performed		0
Failures		0
	Total Returned Units	12
New as of FY 2000**		
Explant detail:		
No information		24
Infection		1
Miscellaneous (other)		1

* Other includes:
non device-related
non device-related patient complications
**Complies with 1-CARD requirements

MEDTRONIC, INC.
PMA Annual Postapproval Report
Model 6932, Sprint
Reporting Period from 01/01/07 through 09/30/07

Reported Experience

Implants		
Cumulative Registered Implants		14979
Explants		
Complication, Unresolvable by Programming		0
Other*		429
Complication and Other		0
	Total Explants	429
Patient Deaths		
Device Related		0
Non-Device Related		389
	Total Patient Deaths	389
Returned Product Analysis		
Units Returned for Cause		
Analysis in process		3
No anomalies found		10
Analysis unknown/not analyzed		0
Miscellaneous – Legal – No analysis performed		0
Failures		0
	Total Returned Units	13
New as of FY 2000**		
Explant detail:		
No information		40
Sensing difficulty		1

* Other includes:
non device-related
non device-related patient complications
**Complies with 1-CARD requirements

MEDTRONIC, INC.
PMA Annual Postapproval Report
Model 6942, Sprint
Reporting Period from 01/01/07 through 09/30/07

Reported Experience

Implants		
Cumulative Registered Implants		17727
Explants		
Complication, Unresolvable by Programming		1
Other*		551
Complication and Other		0
	Total Explants	552
Patient Deaths		
Device Related		0
Non-Device Related		510
	Total Patient Deaths	510
Returned Product Analysis		
Units Returned for Cause		
Analysis in process		2
No anomalies found		12
Analysis unknown; not analyzed		0
Miscellaneous – Legal – No analysis performed		0
Failures:		
Distal conductor fractured		1
	Total Returned Units	15
New as of FY 2000**		
Explant detail:		
No information		41
High resistance/impedance		1
Infection		1
Varying resistance/impedance		1

* Other includes:
non device-related
non device-related patient complications
**Complies with 1-CARD requirements

MEDTRONIC, INC.
PMA Annual Postapproval Report
Model 6943, Sprint
Reporting Period from 01/01/07 through 09/30/07

Reported Experience

Implants		
Cumulative Registered Implants		20755
Explants		
Complication, Unresolvable by Programming		4
Other*		666
Complication and Other		0
	Total Explants	670
Patient Deaths		
Device Related		0
Non-Device Related		558
	Total Patient Deaths	558
Returned Product Analysis		
Units Returned for Cause		
Analysis in process		4
No anomalies found		15
Analysis unknown; not analyzed		0
Miscellaneous – Legal – No analysis performed		0
Failures:		
Defib conductor fractured		1
Distal conductor fractured		3
	Total Returned Units	23
New as of FY 2000**		
Explant detail:		
No information		106
Apparent lead fracture		1
Damaged/cracked/cut insulation		1
Dislodgement		1
Elective replacement		1
Erosion/Necrosis		1
High resistance/impedance		1
High ventricular impedance/resistance		1
Infection		1
Removed/returned/reported due to associated device		1

* Other includes:
non device-related
non device-related patient complications
**Complies with 1-CARD requirements

MEDTRONIC, INC.
PMA Annual Postapproval Report
Model 6945, Sprint
Reporting Period from 01/01/07 through 09/30/07

Reported Experience

Implants		
Cumulative Registered Implants		42783
Explants		
Complication, Unresolvable by Programming		6
Other*		1491
Complication and Other		6
	Total Explants	1503
Patient Deaths		
Device Related		0
Non-Device Related		1302
	Total Patient Deaths	1302
Returned Product Analysis		
Units Returned for Cause		
Analysis in process		12
No anomalies found		35
Analysis unknown; not analyzed		0
Miscellaneous – Legal – No analysis performed		0
Failures:		
Defib conductor fractured		1
Defib conductor fracture (overstress)		1
Distal conductor fractured		4
Outer insulation abrasion (breached)		1
Proximal conductor other		1
	Total Returned Units	55

New as of FY 2000**

Explant detail:	
No information	189
Apparent lead fracture	6
Evaluation	4
Inappropriate therapy	3
Infection	3
High ventricular impedance/resistance	2
Credit/Warranty consideration	1
Disposal only	1
Helix blocked/unable to advance or retract	1
High resistance/impedance	1
Interference/noise	1
Medical judgment/system upgrade	1
Oversensing	1
Sensing difficulty	1
Threshold high/unstable/unmeasurable	1
Unwanted/unexpected shock	1

* Other includes:
non device-related
non device-related patient complications
**Complies with 1-CARD requirements

MEDTRONIC, INC.
PMA Annual Postapproval Report
Model 6944, Sprint Quattro
Reporting Period from 01/01/07 through 09/30/07

Reported Experience

Implants		
Cumulative Registered Implants		27749
Explants		
Complication, Unresolvable by Programming		6
Other*		1269
Complication and Other		2
	Total Explants	1277
Patient Deaths		
Device Related		0
Non-Device Related		1096
	Total Patient Deaths	1096
Returned Product Analysis		
Units Returned for Cause		
Analysis in process		5
No anomalies found		27
Analysis unknown; not analyzed		0
Miscellaneous – Legal – No analysis performed		0
Failures:		
Proximal conductor fractured		2
	Total Returned Units	34

New as of FY 2000**

Explant detail:	
No information	171
High resistance/impedance	4
Apparent lead fracture	2
Evaluation	1
Heart transplant	1
High ventricular impedance/resistance	1
Impedance/Resistance increase	1
Inappropriate therapy	1
Infection	1
Interference/noise	1
Medical judgment/system upgrade	1
Oversensing	1
Threshold high/unstable/unmeasurable	1

* Other includes:
non device-related
non device-related patient complications
**Complies with 1-CARD requirements

MEDTRONIC, INC.
PMA Annual Postapproval Report
Model 6947, Sprint Quattro Secure
Reporting Period from 01/01/07 through 09/30/07

Reported Experience

Implants		
Cumulative Registered Implants		132388
Explants		
Complication, Unresolvable by Programming		18
Other*		6130
Complication and Other		6
	Total Explants	6154
Patient Deaths		
Device Related		0
Non-Device Related		5644
	Total Patient Deaths	5644
Returned Product Analysis		
Units Returned for Cause		
Analysis in process		47
No anomalies found		160
Analysis unknown; not analyzed		0
Miscellaneous – Legal – No analysis performed		0
Failures:		
Defib conductor distorted		10
Defib conductor fractured		2
Defib conductor fracture (overstress)		2
Distal conductor blood/fluid obstruction		1
Distal conductor fractured		5
Helix/lobe distorted/bent		2
Inner insulation breached (clavicle-rib crush)		1
Outer insulation breached cut		1
Proximal conductor fractured		1
	Total Returned Units	232

New as of FY 2000**

Explant detail:	
No information	480
Apparent lead fracture	7
Inappropriate therapy	7
Infection	7
Credit/Warranty consideration	6
Oversensing	5
Evaluation	4
Heart transplant	4
Sensing difficulty	4
High resistance/impedance	3
Interference/noise	3

* Other includes:
non device-related
non device-related patient complications
**Complies with 1-CARD requirements

MEDTRONIC, INC.
PMA Annual Postapproval Report
Model 6930, Sprint Fidelis
Reporting Period from 01/01/07 through 09/30/07

Reported Experience

Implants		
Cumulative Registered Implants		342
Explants		
Complication, Unresolvable by Programming		0
Other*		30
Complication and Other		0
	Total Explants	30
Patient Deaths		
Device Related		0
Non-Device Related		21
	Total Patient Deaths	21
Returned Product Analysis		
Units Returned for Cause		
Analysis in process		0
No anomalies found		4
Analysis unknown; not analyzed		0
Miscellaneous – Legal – No analysis performed		0
Failures:		
Proximal conductor fractured		2
	Total Returned Units	6
New as of FY 2000**		
Explant detail:		
No information		9

* Other includes:
non device-related
non device-related patient complications
**Complies with 1-CARD requirements

MEDTRONIC, INC.
PMA Annual Postapproval Report
Model 6931, Sprint Fidelis
Reporting Period from 01/01/07 through 09/30/07

Reported Experience

Implants		
Cumulative Registered Implants		7910
Explants		
Complication, Unresolvable by Programming		15
Other*		374
Complication and Other		12
	Total Explants	401
Patient Deaths		
Device Related		0
Non-Device Related		288
	Total Patient Deaths	288
Returned Product Analysis		
Units Returned for Cause		
Analysis in process		1
No anomalies found		54
Analysis unknown; not analyzed		1
Miscellaneous – Legal – No analysis performed		0
Failures:		
All conductors distorted		1
Defib conductor cut		1
Defib conductor distorted		1
Defib conductor fractured		1
Defib conductor fracture (overstress)		2
Distal conductor blood/fluid obstruction		1
Distal conductor fractured		8
Distal conductor fracture (overstress)		1
Helix/lobe distorted/bent		1
Outer insulation breached cut		1
Outer tubing overlay breached cut		1
Proximal conductor fractured		13
Proximal conductor fracture (overstress)		1
Several conductors distorted		1
	Total Returned Units	90

New as of FY 2000**
Explant detail:

No information	83
Apparent lead fracture	14
Oversensing	14
Evaluation	10
High resistance/impedance	9
Inappropriate therapy	9
Interference/noise	7
Infection	4
Sensing difficulty	4
Threshold high/unstable/unmeasurable	4

* Other includes:
non device-related
non device-related patient complications
**Complies with 1-CARD requirements

MEDTRONIC, INC.
PMA Annual Postapproval Report
Model 6948, Sprint Fidelis
Reporting Period from 01/01/07 through 09/30/07

Reported Experience

Implants		
Cumulative Registered Implants		10113
Explants		
Complication, Unresolvable by Programming		9
Other*		520
Complication and Other		5
	Total Explants	534
Patient Deaths		
Device Related		0
Non-Device Related		449
	Total Patient Deaths	449
Returned Product Analysis		
Units Returned for Cause		
Analysis in process		0
No anomalies found		42
Analysis unknown; not analyzed		0
Miscellaneous – Legal – No analysis performed		0
Failures:		
Defib conductor fractured		2
Defib conductor fracture (overstress)		3
Miscellaneous (non-electrical)		1
Outer tubing kinked/buckled		1
Outer tubing overlay breached cut		2
Proximal conductor fractured		4
	Total Returned Units	55

New as of FY 2000**

Explant detail:	
No information	69
Dislodgement	5
High resistance/impedance	5
Apparent lead fracture	4
Inappropriate therapy	3
Credit/Warranty consideration	2
Evaluation	2
Infection	2
Interference/noise	2
Oversensing	2
Patient Alert	2
Threshold high/unstable/unmeasurable	2

* Other includes:
non device-related
non device-related patient complications
**Complies with 1-CARD requirements

MEDTRONIC, INC.
PMA Annual Postapproval Report
Model 6949, Sprint Fidelis
Reporting Period from 01/01/07 through 09/30/07

Reported Experience

Implants		
Cumulative Registered Implants		181978
Explants		
Complication, Unresolvable by Programming		308
Other*		9734
Complication and Other		204
	Total Explants	10246
Patient Deaths		
Device Related		0
Non-Device Related		8225
	Total Patient Deaths	8225
Returned Product Analysis		
Units Returned for Cause		
Analysis in process		17
No anomalies found		686
Analysis unknown; not analyzed		8
Miscellaneous – Legal – No analysis performed		0
Failures:		
All conductors distorted		10
Defib conductor cut		1
Defib conductor distorted		3
Defib conductor fractured		41
Defib conductor fracture (overstress)		14
Distal conductor blood/body fluid (not obstructed)		1
Distal conductor blood/fluid obstruction		2
Distal conductor distorted		22
Distal conductor fractured		147
Distal conductor fracture (overstress)		23
Helix/lobe distorted/bent		4
Inner tubing kinked/buckled		2
Miscellaneous (non-electrical)		1
Outer insulation breached (clavicle-rib crush)		1
Outer insulation breached cut		8
Outer tubing kinked/buckled		1
Outer tubing overlay breached cut		5
Outer tubing overlay melted		1
Proximal conductor fractured		214
Several conductors distorted		4
	Total Returned Units	1216
New as of FY 2000**		
Explant detail:		
No information		1490
Inappropriate therapy		262
Apparent lead fracture		231
Oversensing		179

* Other includes:
non device-related
non device-related patient complications

**Complies with 1-CARD requirements

Model 6949, Sprint Fidelis
Reporting Period from 01/01/07 through 09/30/07
Continued

Explant detail:

Interference/noise	133
Evaluation	129
High resistance/impedance	124
Sensing difficulty	110
High ventricular impedance/resistance	82
Credit/Warranty consideration	57
Threshold high/unstable/unmeasurable	56
Infection	48
No capture	44
Varying resistance/impedance	41
Impedance/resistance increase	30
Alleged malfunction/defective/bad/failure/abnormal/faulty	29
Damaged/cracked/cut insulation	26
Overdetection/Sensing	22

* Other includes:
non device-related
non device-related patient complications
**Complies with 1-CARD requirements

MEDTRONIC, INC.
PMA Annual Postapproval Report
Model 6707, Implantable Lead Adaptor
Reporting Period from 01/01/07 through 09/30/07

Reported Experience

Implants		
Cumulative Registered Implants		536
Explants		
Complication, Unresolvable by Programming		0
Other*		19
Complication and Other		0
	Total Explants	19
Patient Deaths		
Device Related		0
Non-Device Related		9
	Total Patient Deaths	9
Returned Product Analysis		
Units Returned for Cause		
Analysis in process		1
No anomalies found		2
Analysis unknown; not analyzed		0
Miscellaneous – Legal – No analysis performed		0
Failures		0
	Total Returned Units	3
New as of FY 2000**		
Explant detail:		
No information		10

* Other includes:
non device-related
non device-related patient complications
**Complies with 1-CARD requirements

MEDTRONIC, INC.
PMA Annual Postapproval Report
Model 6726, Implantable Lead Adaptor
Reporting Period from 01/01/07 through 09/30/07

Reported Experience

Implants		
Cumulative Registered Implants		365
Explants		
Complication, Unresolvable by Programming		0
Other*		24
Complication and Other		0
	Total Explants	24
Patient Deaths		
Device Related		0
Non-Device Related		15
	Total Patient Deaths	15
Returned Product Analysis		
Units Returned for Cause		
Analysis in process		0
No anomalies found		5
Analysis unknown; not analyzed		1
Miscellaneous – Legal – No analysis performed		0
Failures		0
	Total Returned Units	6
New as of FY 2000**		
Explant detail:		
No information		9

* Other includes:
non device-related
non device-related patient complications
**Complies with 1-CARD requirements

Attachment B - Product Performance Report

Pages removed for the following reason: Copywrite Material

P920015/R14/A1 C1

Medtronic

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08 July 2008

Office of Device Evaluation
Document Mail Center (HFZ-401)
Center for Devices and Radiological Health
Food and Drug Administration
9200 Corporate Blvd
Rockville, MD 20850

RE: Annual Report Deficiency Response – Amendment to P920015/R014/AX Annual Report for reporting period 01-01-2007 to 9-30-2007

To Whom It May Concern:

Medtronic has completed a request for additional information that was received from the FDA on March 18, 2008 and dated March 10, 2008. The following information was included in a PMA 30-day Notice, P920015/S043, dated March 31, 2008, and approved on May 1, 2008. Medtronic requests that the annual report P920015/R014 be closed at this time.

From FDA's letter of March 10, 2008:

This review has determined that the annual reported change of the post-cure time and temperature for the DF-1 connector insulation has been implemented without your submission, and receipt of FDA approval, of a PMA supplement required under 21 CFR 814.39 as these changes affect the safety or effectiveness of the device. The change is considered a curing process change for a critical component and should be submitted as a 30-day nice.

Accordingly, you must submit a PMA supplement within 15 working days of your receipt of this letter. Your supplements should provide the following:

1. *a detailed explanation of the change comparing the old and new curing process, and any example of the new process being used for other marketed leads;*
2. *a detailed explanation of the reason for the change (e.g., field observations, etc.);*
3. *the testing performed to evaluate the safety and effectiveness of the device following modification, and in production; and*
4. *an explanation for your decision not to submit a PMA supplement for the above listed modification.*

In accordance with 21 CFR 814.20(c), three (3) paper copies, 1 original and 2 copies of this request are being submitted for this PMA. This submission contains confidential commercial and trade secret information and we respectfully request the maximum protection provided by law.

If additional information is needed, please contact the undersigned.

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cc: Office of Compliance, Field Programs Branch