

Imaging Guided Interventions: Fulfilling the Promise

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Imaging Guided Interventions: Fulfilling the Promise

- Working Definition of IGI for the Purposes of this Workshop
- Clinical IGI: Current Status, Opportunities, Barriers (**"Begin with the End in Mind"**)
- Purpose for This Workshop

IGI Working Definition

- Clinical service in which:
 - Images are obtained during and/or immediately prior
 - Used for guidance, navigation, orientation, monitoring in “real-time”
 - To reach specified target lesion(s) under direct or indirect operator control
- Common IGI requirements include:
 - Imaging source or modality (modalities)
 - Real time interaction linked to the intervention (maybe through the operator)
 - Target defined in context of real 3-D space
 - Therapy minimally invasive or less invasive

IGI Services: True or False?

- Treatment of Uterine Fibroids:
 - TAH / TVH or laparoscopic surgery following diagnostic US and/or MRI
 - UAE / UFE or FUS / HIFU therapy
- Treatment of CAD:
 - CABG following cardiac catheterization
 - PTCA (lysis, stent, etc.)
- Hepatic metastases from colorectal cancer
 - Resection based on preoperative imaging
 - Percutaneous RFA / laser / MW / cryo under US / CT/ MRI
 - Open RFA / laser / MW / cryo under US
 - Resection under real-time US guidance
- Other “fuzzy” examples exist (e.g., brain, combo Rx)

IGI Utility

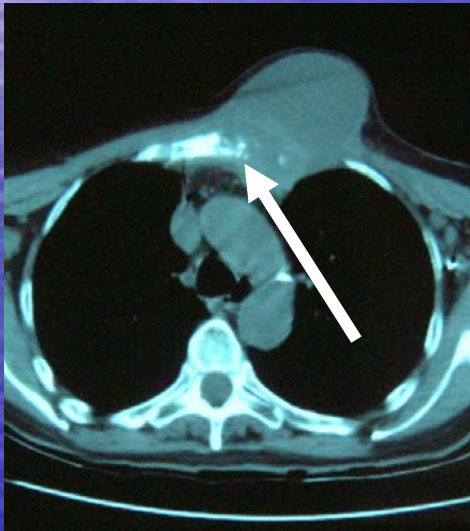
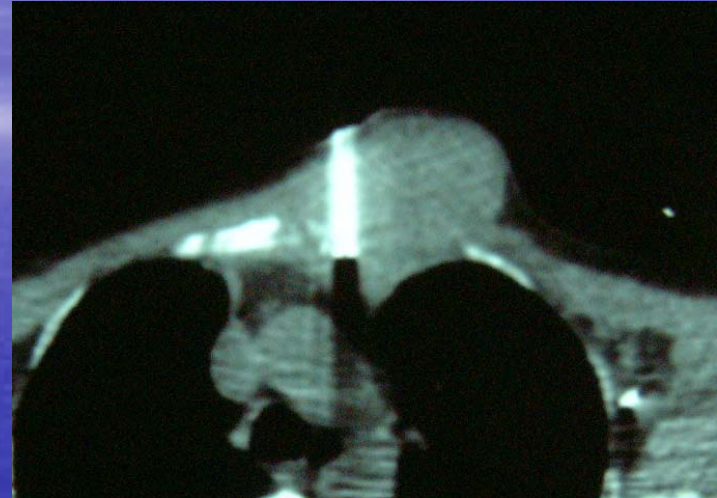
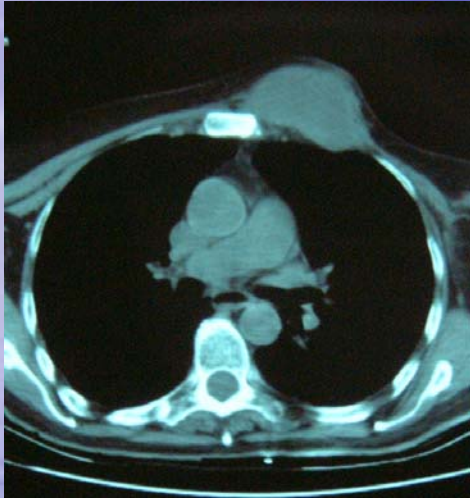
- Minimize trauma and/or cost as compared with “traditional” more invasive treatments
 - Treatment targeted (anatomic / functional)
 - “Pathway” trauma limited
- Allow regional or local therapies otherwise impossible
 - Non-surface lesions
 - Patient condition
 - Novel approach to lesion location or characterization
- More immediate feedback loop between therapy and local outcome

IGI Oncology Representative Cases

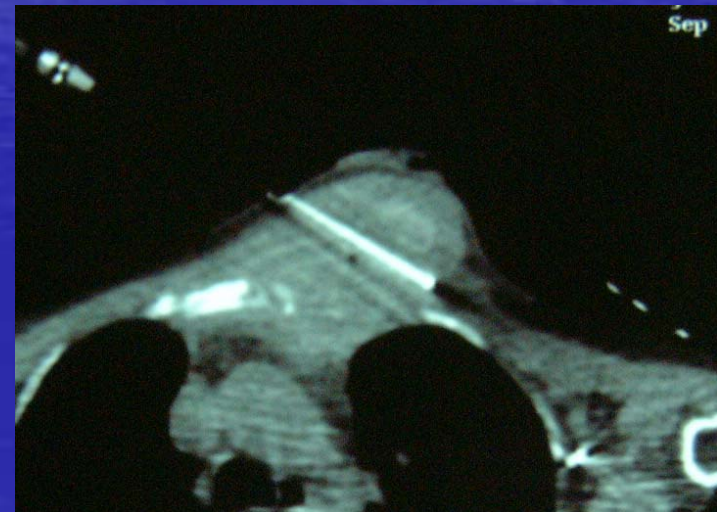
Radiofrequency Ablation of Painful
Bone Metastases

D. Dupuy, M.D.

Breast Recurrence

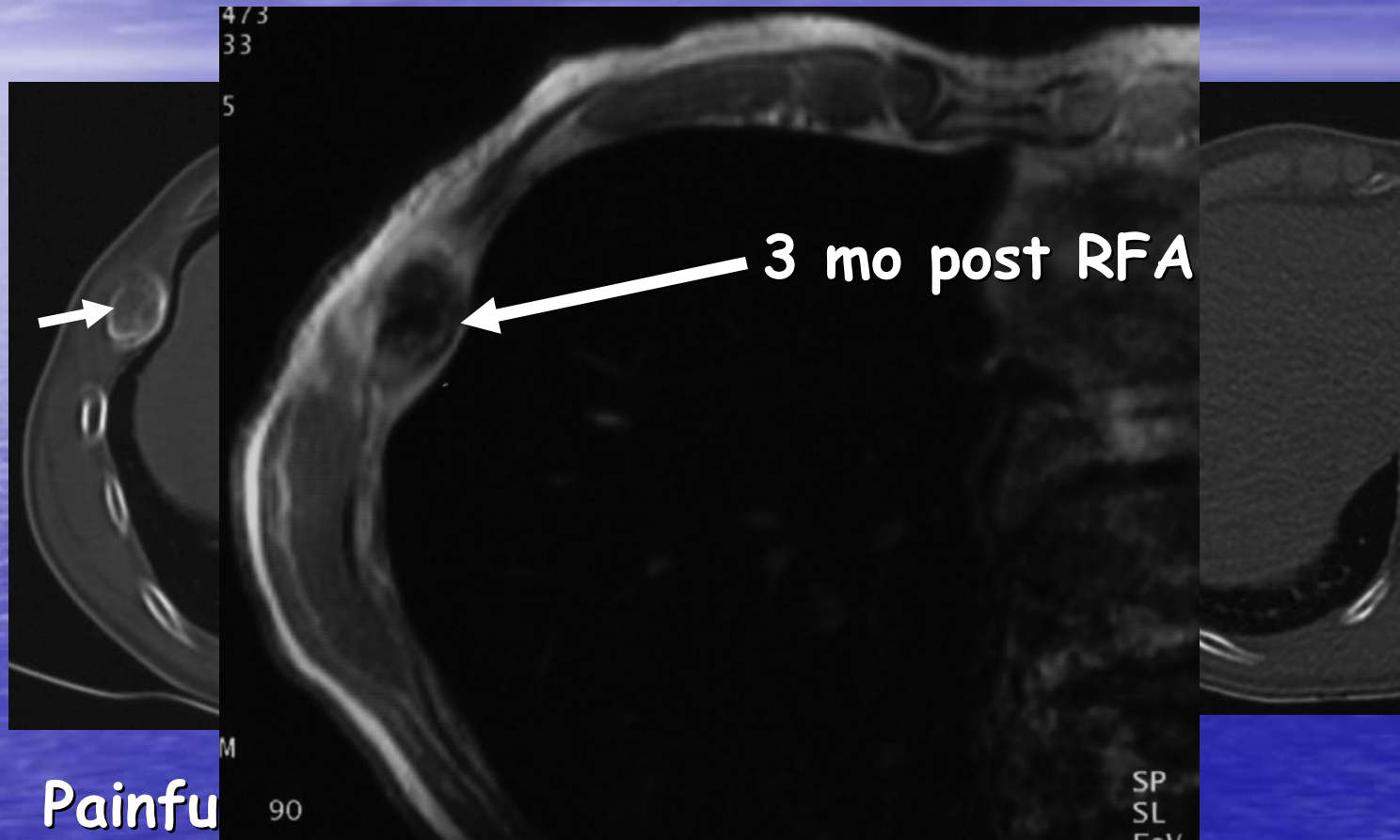


Bone destruction



Pain 10-1 at 1 mo

Metastatic Lung CA



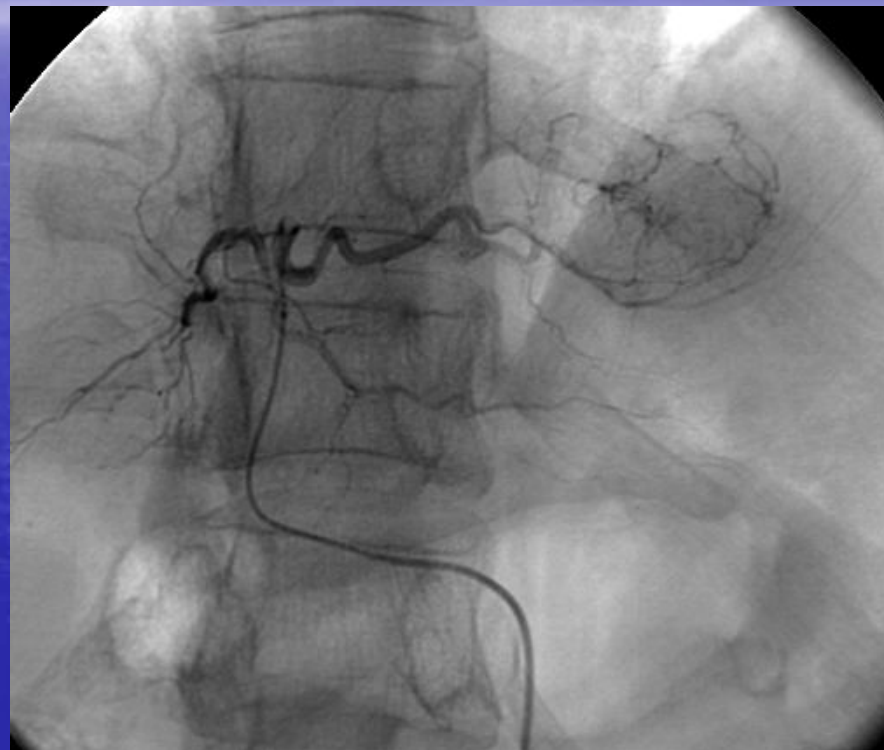
Pain scale 8-3-3 at pre-1mo-3mo

IGI Oncology Representative Cases

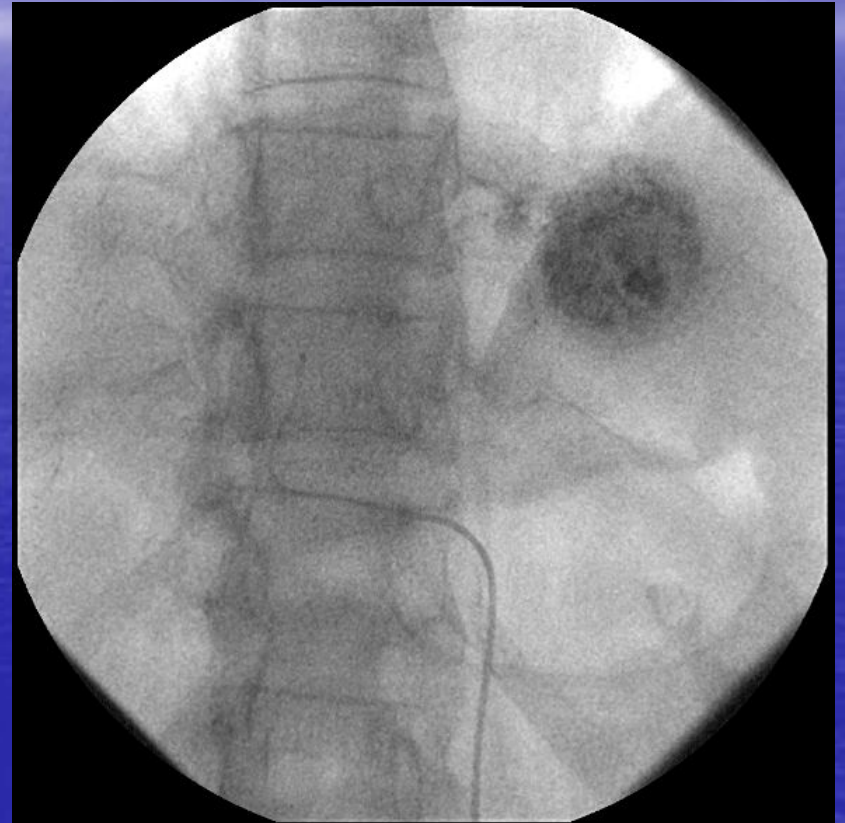
Chemoembolotherapy of Hepatic
Colorectal Adenocarcinoma
Metastases

M. Soulen, M.D.

Chemoembolization

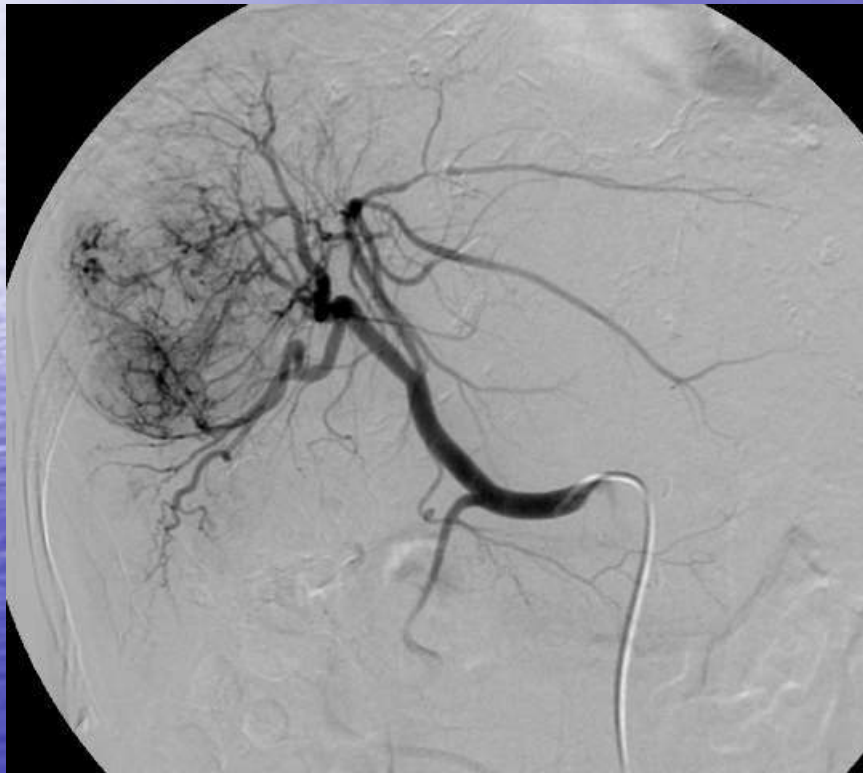


Final Angiography

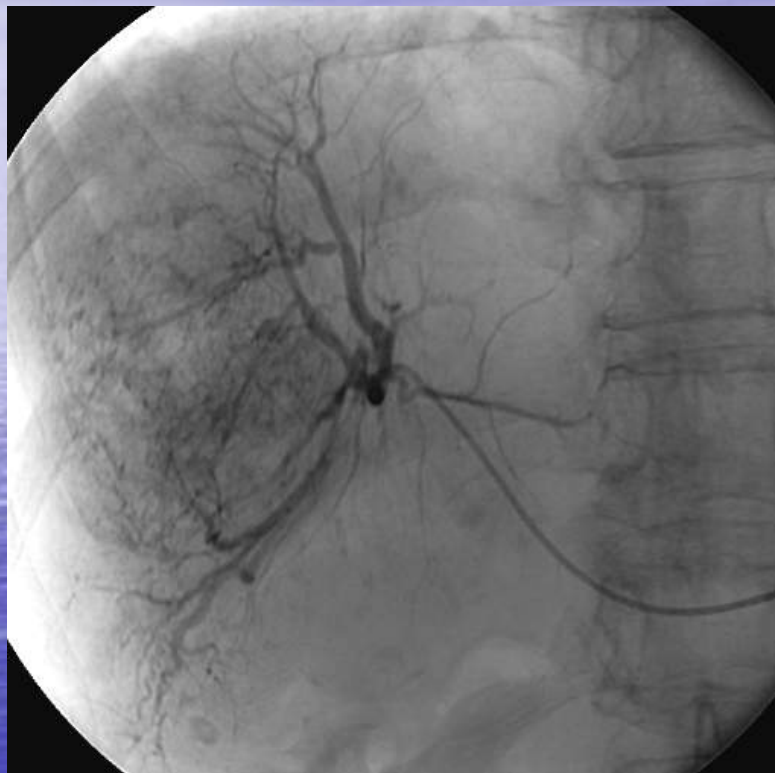


**Patient underwent surgery 4 weeks later
No viable tumor in specimen**

Ethiodol uptake



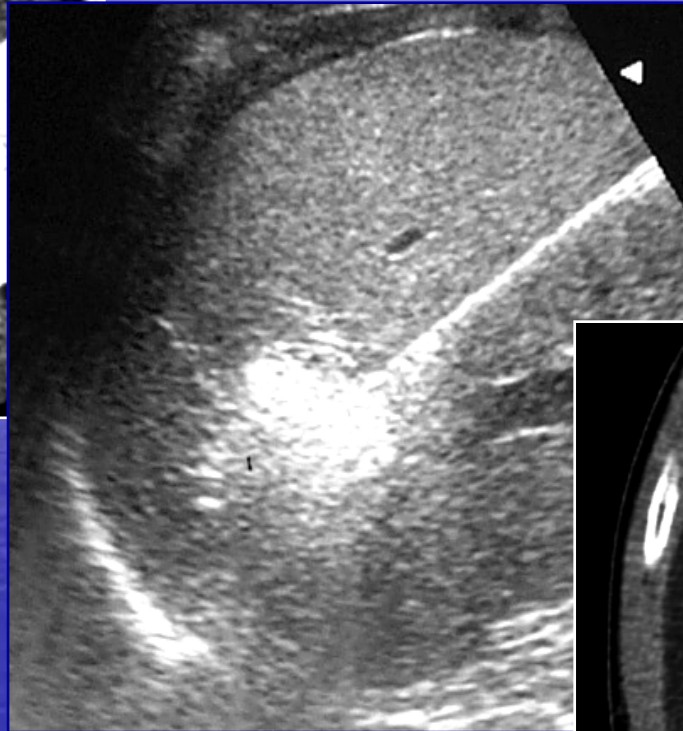
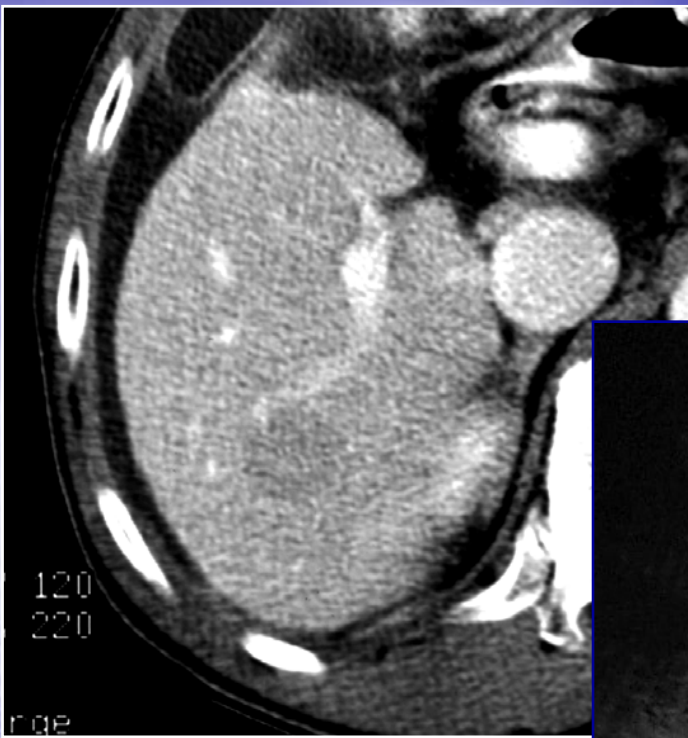
Final/Follow-up CT



IGI Oncology Representative Cases

Radiofrequency Ablation of
Hepatocellular Carcinoma

G. Dodd, M.D.



IGI Oncology Representative Cases

Radiofrequency Ablation of Non-Small Cell
Lung Cancer with / without Concomitant
Radiation Therapy

(Cases Contributed by D. Dupuy, M.D. &
T. DiPetrillo, M.D.)

NSC Lung CA

RIH/ Brown University RFA/XRT Trial

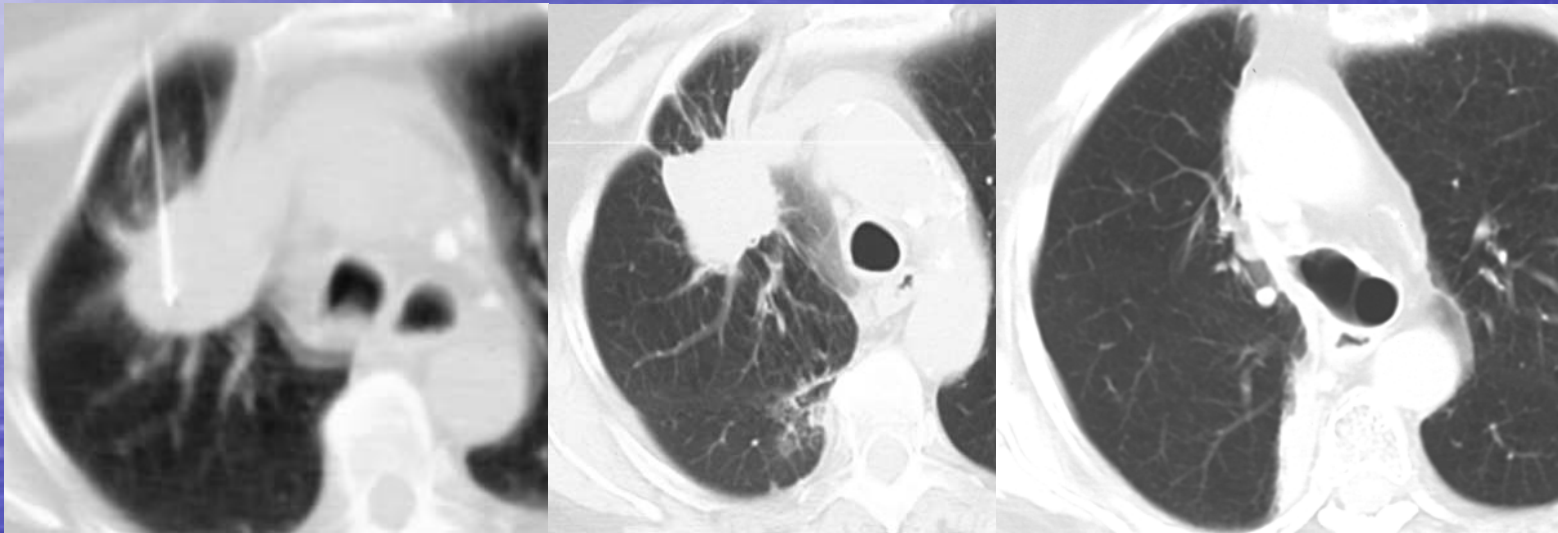


Pre-RFA



RFA

Radiofrequency ablation NSC Lung Cancer



3cm Cool-tip RFA

3mo S/P RFA/XRT

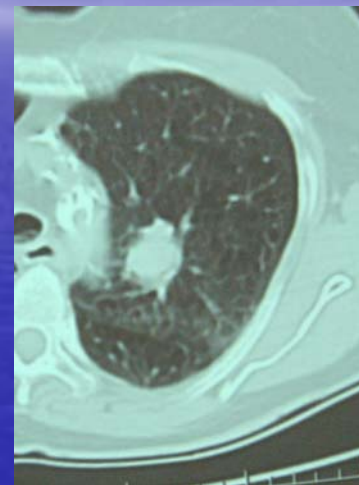
36mo S/P RFA/XRT

RFA/XRT

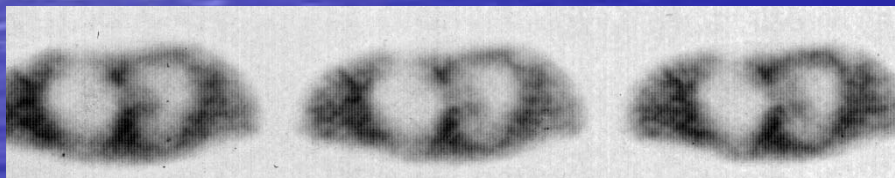
Squamous Cell CA



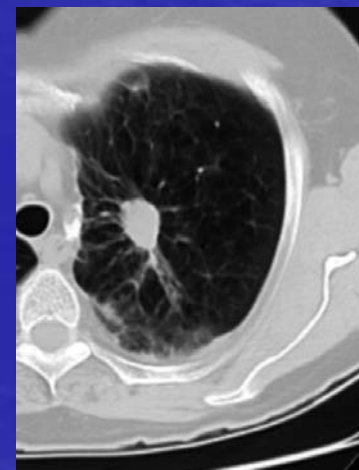
Pre-RFA PET



Pre-RFA
CT

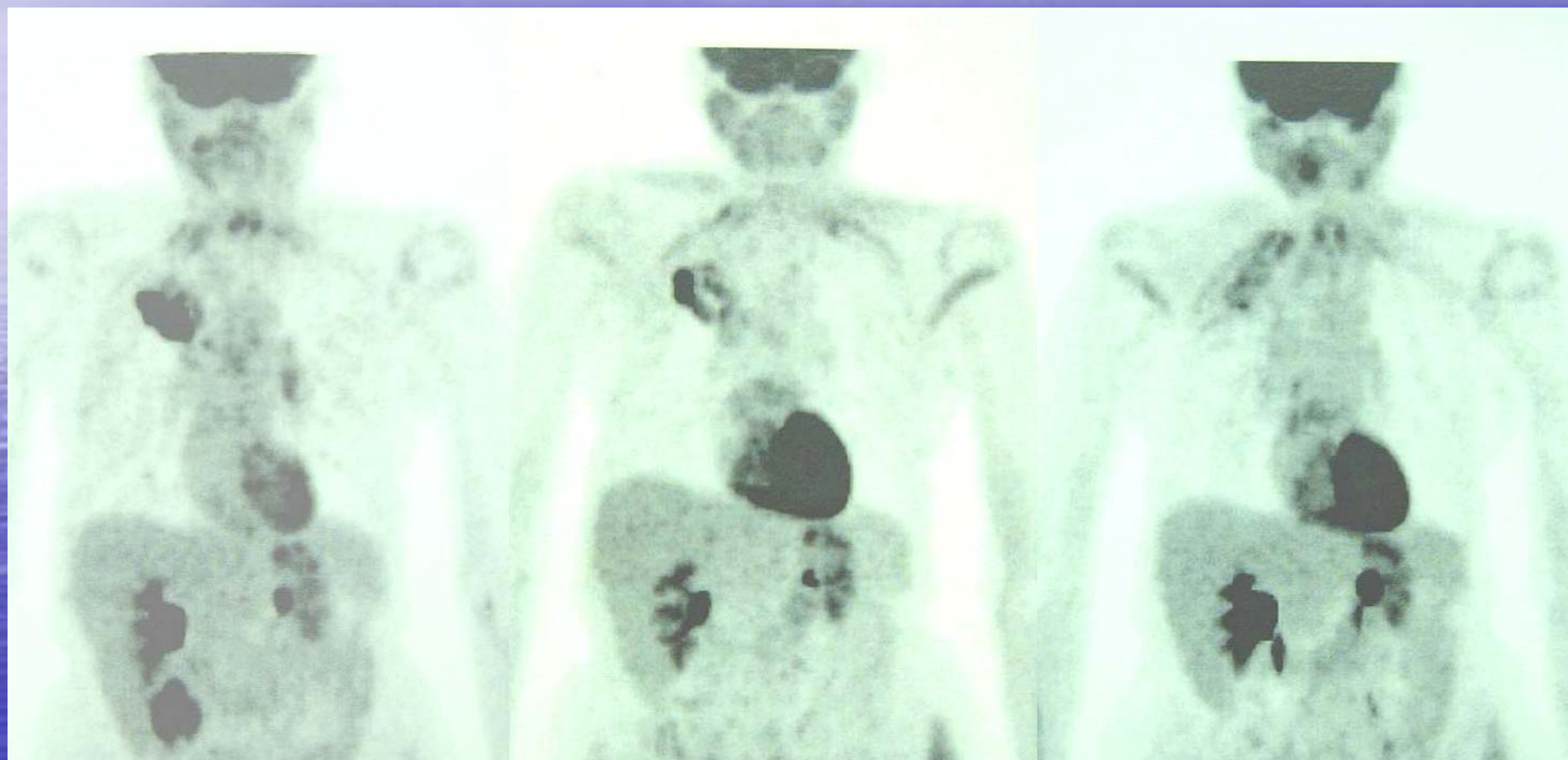


7 mo post-RFA PET



7mo
post-
RFA
CT

RFA/XRT NSC Lung CA

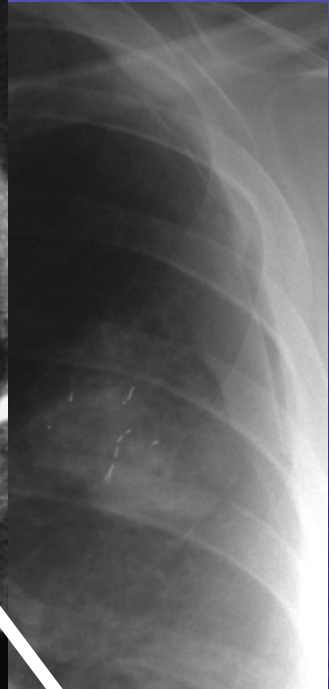
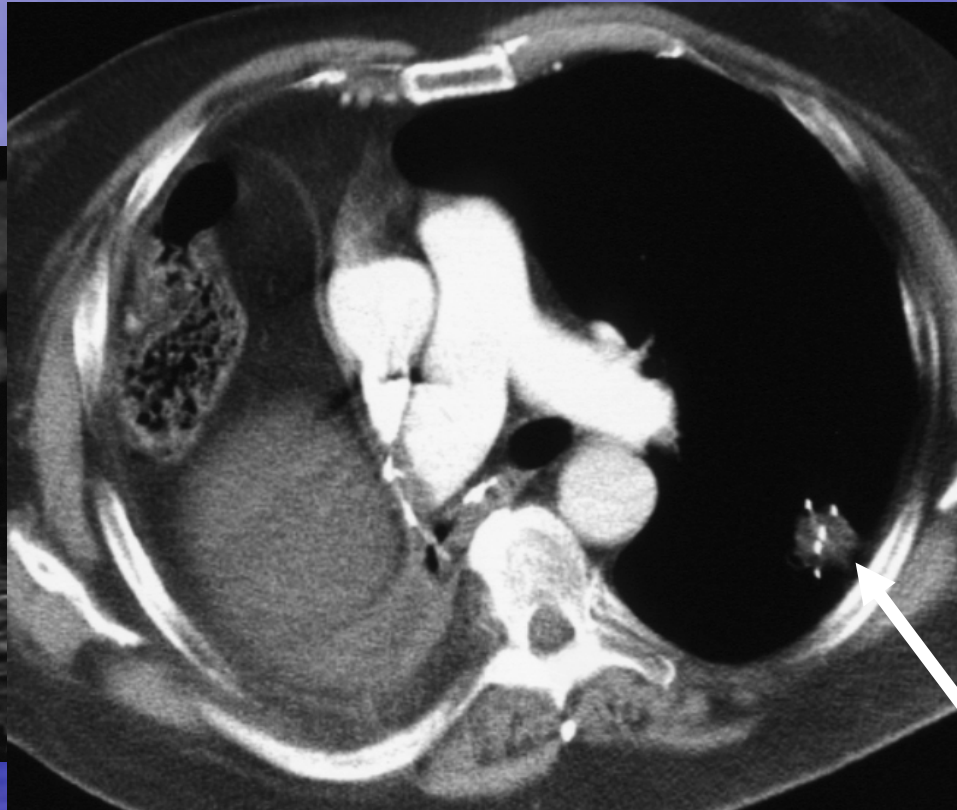
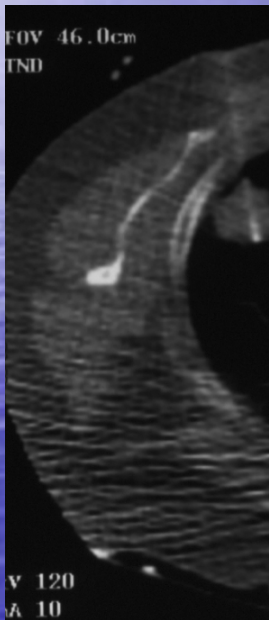


Pre RFA

2 weeks post RFA

6mo post RFA/XRT

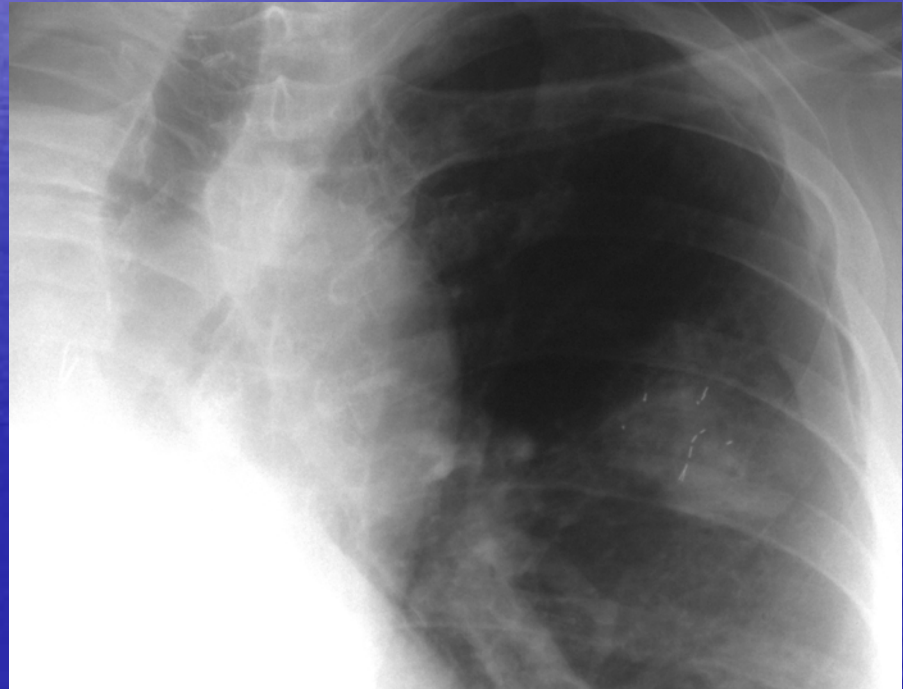
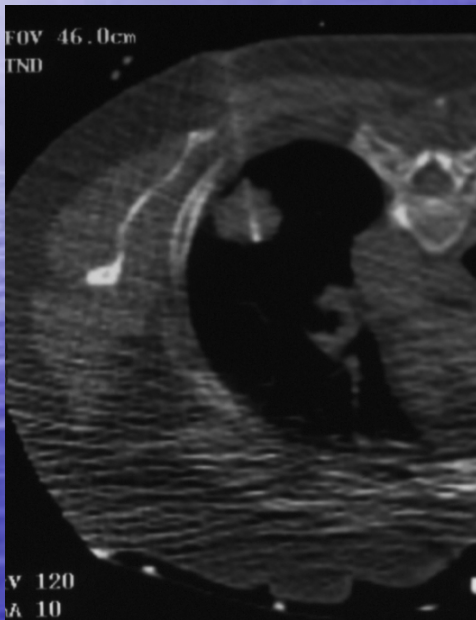
Combination RFA/Brachytherapy I¹²⁵



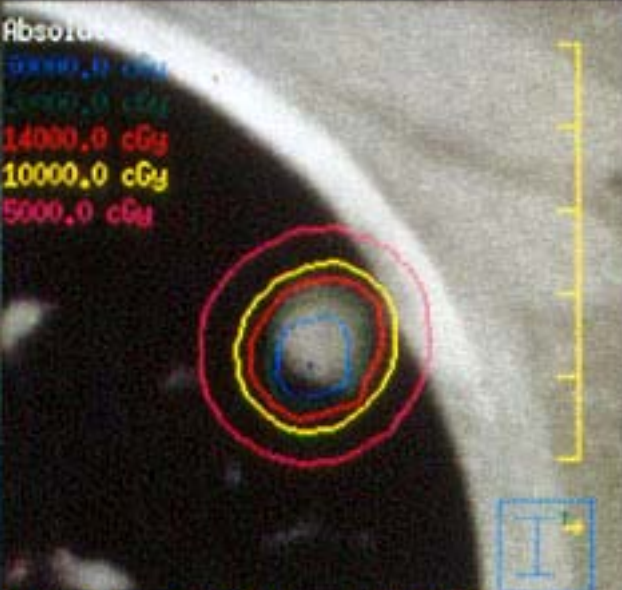
CT 9mo
Post-RFA/BrachyRx

Tumor
Shrinkage

Combination RFA/Brachytherapy

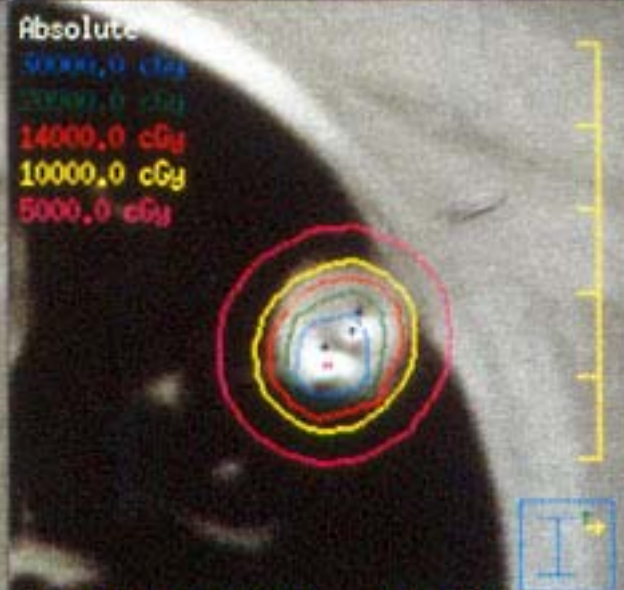


2D 3D



Slice 3: Z = -3.900 Manuel Martone

2D 3D



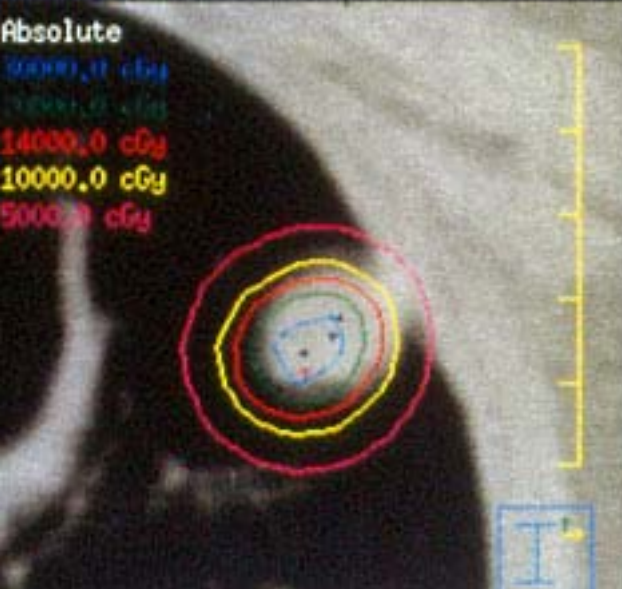
Slice 4: Z = -3.600 Manuel Martone

2D 3D



Slice 5: Z = -3.300 Manuel Martone

2D 3D



Slice 6: Z = -3.000 Manuel Martone

2D 3D



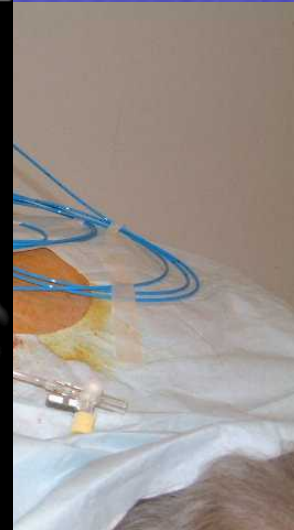
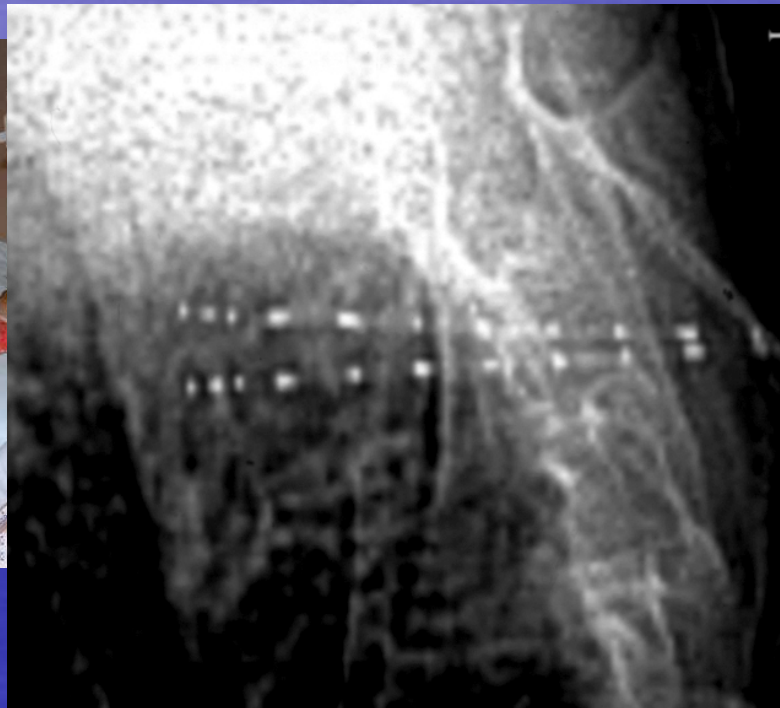
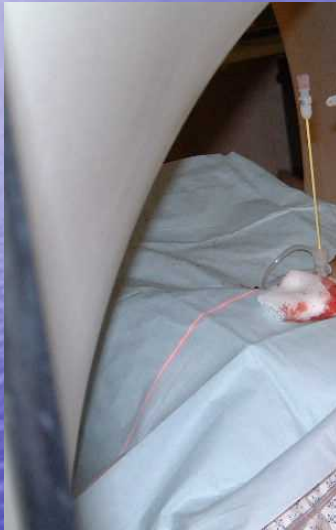
Slice 7: Z = -2.700 Manuel Martone

2D 3D



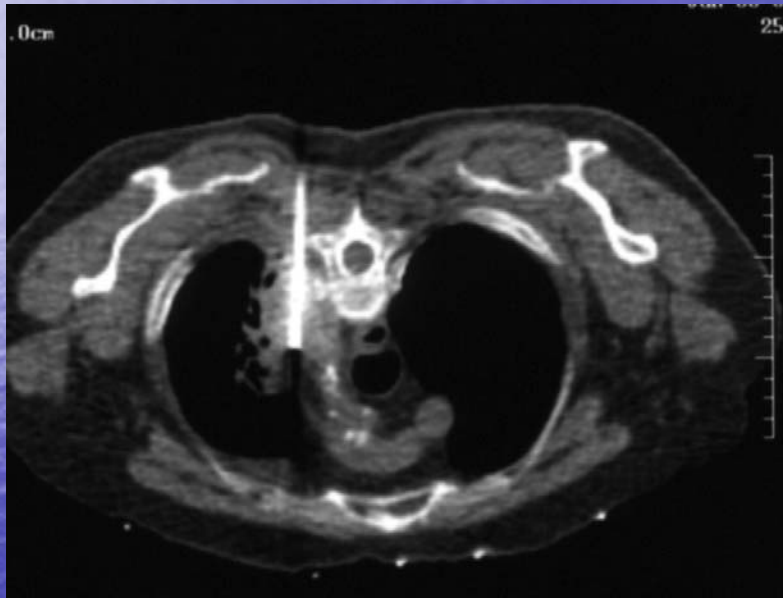
Slice 8: Z = -2.400 Manuel Martone

RFA/High Dose Rate Brachytherapy

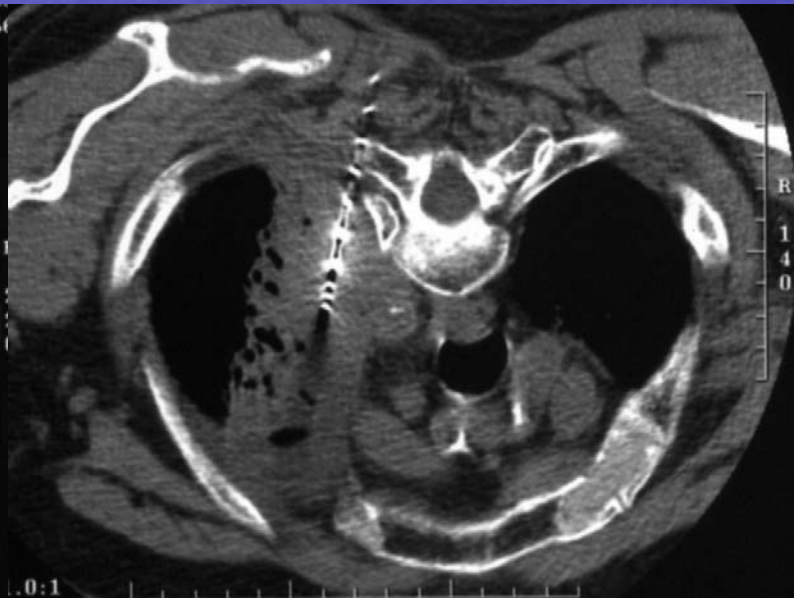


Iridium¹⁹² Brachytherapy

RFA/High Dose Rate Brachytherapy



RF Electrode Insertion



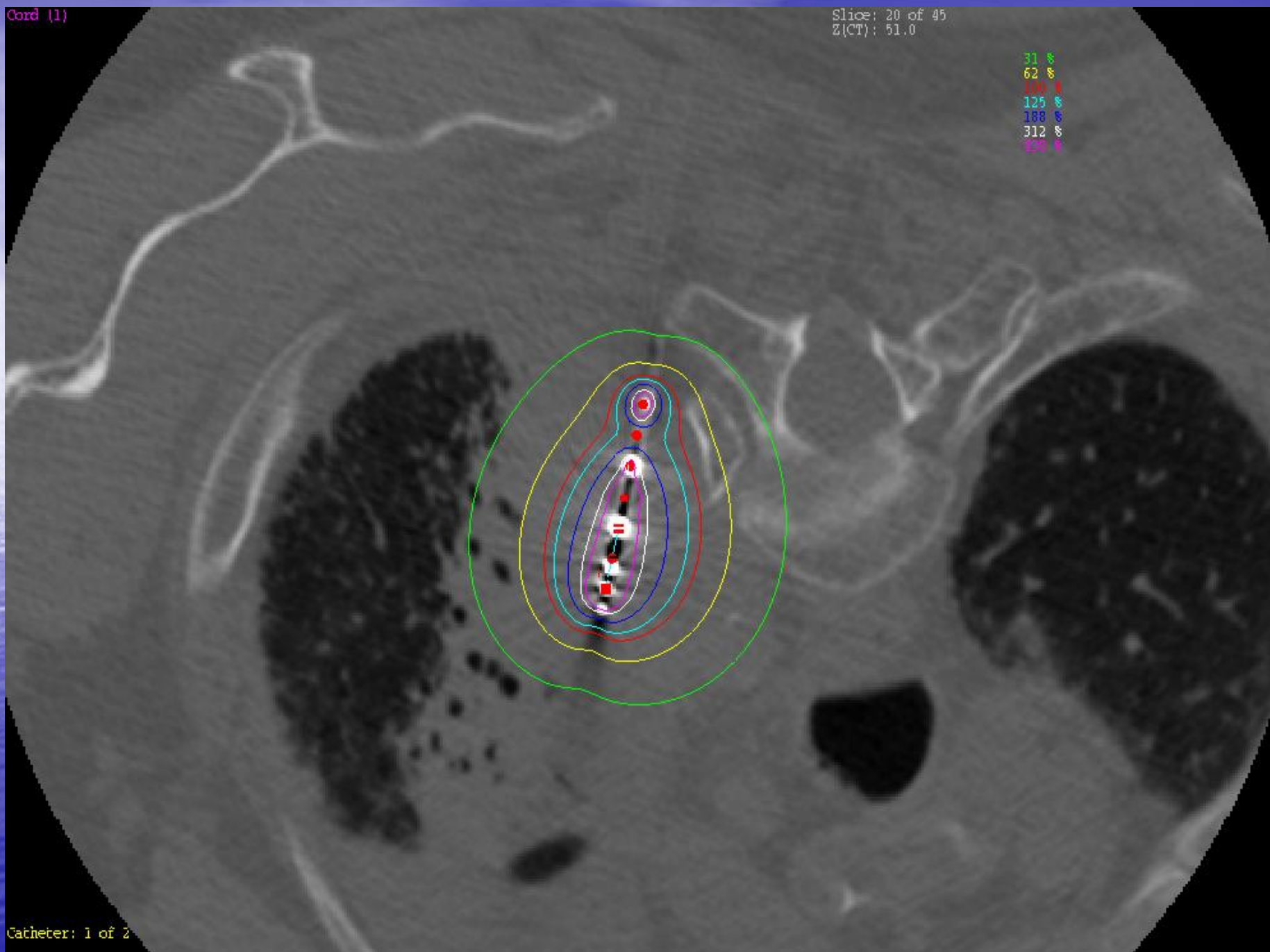
BrachyRx Insertion

Cord (1)

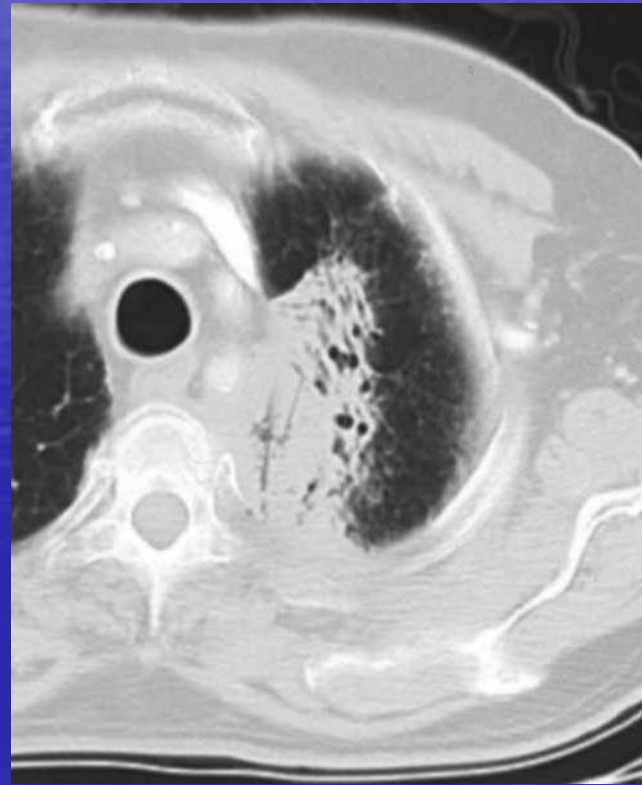
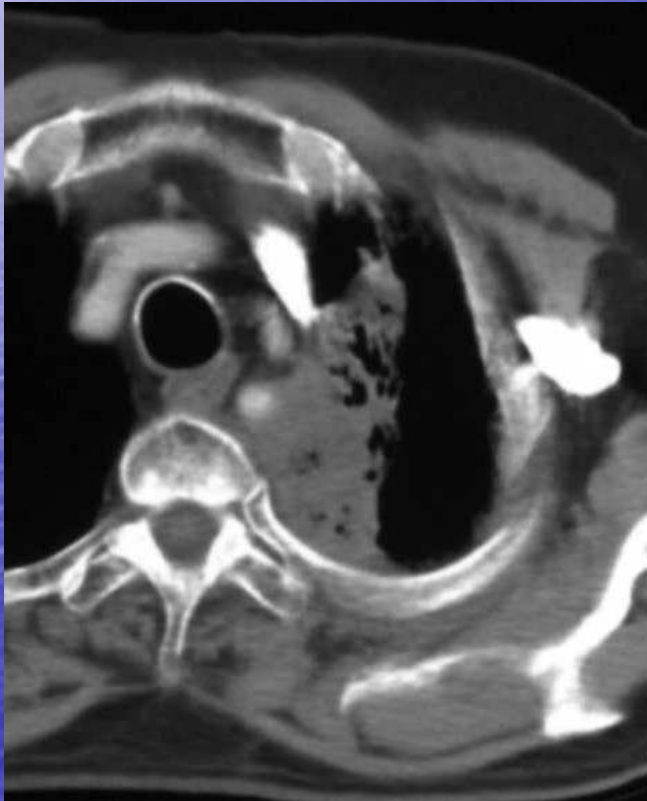
Slice: 20 of 45
Z(CT): 51.0

31 %
62 %
100 %
125 %
188 %
312 %
500 %

Catheter: 1 of 2



RFA/High Dose Rate Brachytherapy



1 mo s/p RFA and Iridium 192 Brachytherapy

Chemotherapy Response by MRI & MRS

1 wk
pre-Tx
76 cc

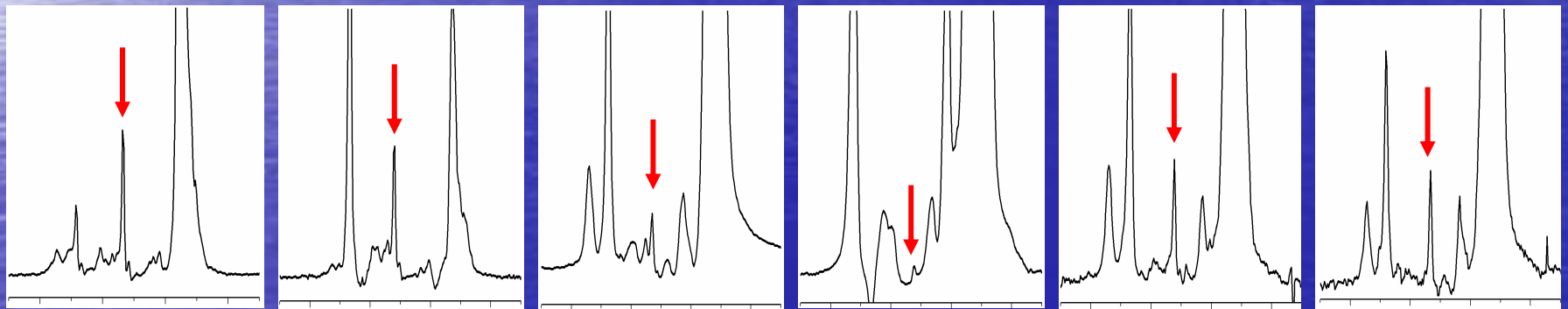
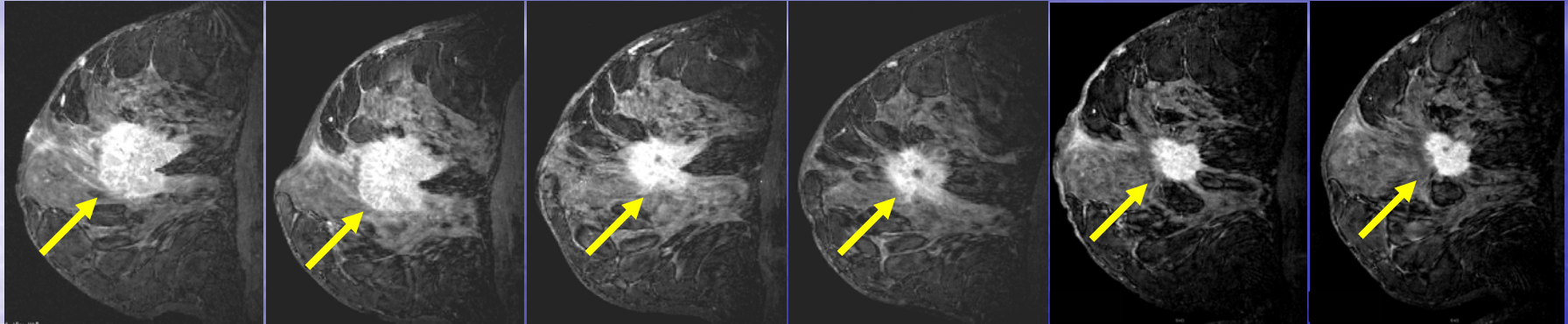
Day 1
AC x1
79 cc

Day 42
AC x3
26 cc

Day 70
AC x4
25 cc

Day 112
taxol x2
11 cc

Day 178
taxol x4
6 cc



593

486

267

79

481

595

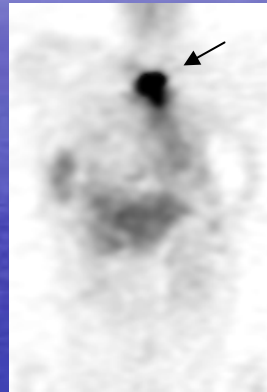
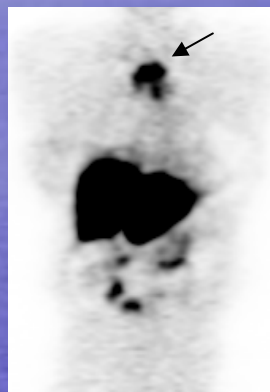
partial response to AC, regrowth on taxol
final pathology - viable IDC and extensive DCIS

FES Uptake Predicts Breast Cancer Response to Hormonal Therapy

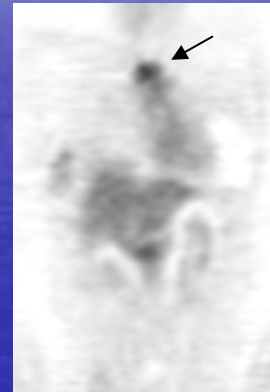
Example 1

- Recurrent sternal lesion
- ER+ primary
- Recurrent Dz strongly FES+

Pre-Rx



Post-Rx

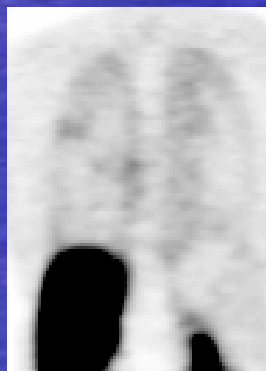


Excellent response
after 6 wks
Letrozole

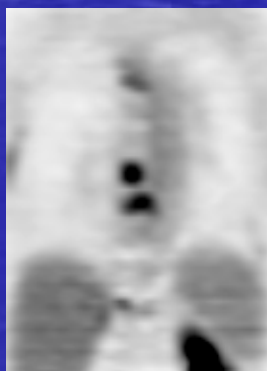
Example 2

- Newly Dx'd breast cancer
- ER+ primary
- FES- bone mets

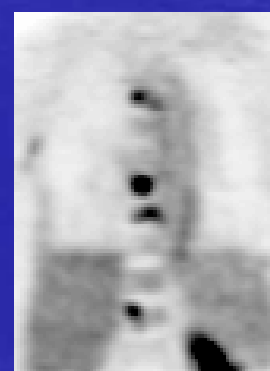
FES



FDG



FDG



No response
to several
different
hormonal
Rx's

IGI Opportunities / Barriers

- Physiologic versus anatomic targeting (combo)
- Imaging-pathologic correlation of local effect
- Patient level utility of local effect
- Systems optimization, standardization, QA
- Integration of the **I**maging and the **I**ntervention
- Robotic assistance and/or performance
- Complex targeting
- IGI-specific clinical trials methods (including imaging outcomes)
- Imaging with real-time updating of the “surgically altered field”
- Multi-modal imaging and/or intervention

IGI Workshop: Purpose

- Promote interdisciplinary TEAM SCIENCE
 - Facilitators / Barriers
 - Potential funding and collaboration potentials
- Provide an overview of ongoing research funded by NIH, NSF and NASA
- NEW IDEAS and recommendations to ensure important IGI needs and issues are addressed
- While enjoying the science remember the three key questions posed:
 1. How to facilitate collaborations
 2. What are the barriers to collaborations
 3. Significant advance in IGI over 5-10 years