NIH Consensus Development Conference

Vaginal Birth After Cesarean: New Insights

Program and Abstracts

March 8–10, 2010

William H. Natcher Conference Center
National Institutes of Health
Bethesda, Maryland

Presented by

Eunice Kennedy Shriver National Institute of Child Health and Human Development, NIH
Office of Medical Applications of Research, NIH

Cosponsors

National Institute of Nursing Research, NIH
Office of Research on Women's Health, NIH

The Agency for Healthcare Research and Quality and the Centers for Disease Control and Prevention provided additional conference development support.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
National Institutes of Health

About the Program

The National Institutes of Health (NIH) Consensus Development Program has been organizing major conferences since 1977. The Program generates Evidence-based consensus statements addressing controversial issues important to healthcare providers, policymakers, patients, researchers, and the general public. The NIH Consensus Development Program holds an average of three conferences a year. The Program is administered by the Office of Medical Applications of Research within the NIH Office of the Director. Typically, the conferences have one major NIH Institute or Center sponsor, with multiple cosponsoring agencies.

Topic Selection

NIH Consensus Development and State-of-the-Science Conference topics must satisfy the following criteria:

- Broad public health importance. The severity of the problem and the feasibility of interventions are key considerations.
- Controversy or unresolved issues that can be clarified, or a gap between current knowledge and practice that can be narrowed.
- An adequately defined base of scientific information from which to answer conference questions such that the outcome does not depend primarily on subjective judgments of panelists.

Conference Type

Two types of conferences fall under the purview of the NIH Consensus Development Program: State-of-the-Science Conferences and Consensus Development Conferences. Both conference types utilize the same structure and methodology; they differ only in the strength of the evidence surrounding the topic under consideration. When it appears that there is very strong evidence about a particular medical topic, but that the information is not in widespread clinical practice, a Consensus Development Conference is typically chosen to consolidate, solidify, and broadly disseminate strong Evidence-based recommendations for general practice. Conversely, when the available evidence is weak or contradictory, or when a common practice is not supported by high-quality evidence, the State-of-the-Science label is chosen. This highlights what evidence about a topic is available and what directions future research should take, and alerts physicians that certain practices are not supported by good data.

Conference Process

Before the conference, a systematic evidence review on the chosen topic is performed by one of the Agency for Healthcare Research and Quality's Evidence-based Practice Centers. This report is provided to the panel members approximately 6 weeks prior to the conference, and posted to the Consensus Development Program Web site once the conference begins, to serve as a foundation of high-quality evidence upon which the conference will build.

The conferences are held over 2-1/2 days. The first day and a half of the conference consist of plenary sessions, in which invited expert speakers present information, followed by "town hall forums," in which open discussion occurs among the speakers, panelists, and the general public in attendance. The panel then develops its draft statement on the afternoon and evening of the second day, and presents it on the morning of the third day for audience commentary. The panel considers these comments in executive session and may revise its draft accordingly. The conference ends with a press briefing, during which reporters are invited to question the panelists about their findings.

Panelists

Each conference panel comprises 12 to 16 members, who can give balanced, objective, and informed attention to the topic. Panel members:

- Must not be employees of the U.S. Department of Health and Human Services.

- Must not hold financial or career (research) interests in the conference topic.
- May be knowledgeable about the general topic under consideration, but must not have published on or have a publicly stated opinion on the topic.
- Represent a variety of perspectives, to include:
  - Practicing and academic health professionals
  - Biostatisticians and epidemiologists
  - Clinical trialists and researchers
  - Nonhealth professionals with expertise in fields relevant to the specific topic (ethicists, economists, attorneys, etc.)
  - Individuals representing public-centered values and concerns

In addition, the panel as a whole should appropriately reflect racial and ethnic diversity. Panel members are not paid a fee or honorarium for their efforts. They are, however, reimbursed for travel expenses related to their participation in the conference.

Speakers

The conferences typically feature approximately 21 speakers: 3 present the information found in the Evidence-based Practice Center's systematic review of the literature; the other 18 are experts in the topic at hand, have likely published on the topic, and may have strong opinions or beliefs on the topic. Where multiple viewpoints on a topic exist, every effort is made to include speakers who address all sides of the issue.

Conference Statements

The panel's draft report is released online late in the conference's third and final day. The final report is released approximately 6 weeks later. During the intervening period, the panel may edit its statement for clarity and correct any factual errors that might be discovered. No substantive changes to the panel's findings are made during this period.

Each Consensus Development or State-of-the-Science Conference Statement reflects an independent panel's assessment of the medical knowledge available at the time the statement is written; as such, it provides a "snapshot in time" of the state of knowledge on the conference topic. It is not a policy statement of the NIH or the Federal Government.

Dissemination

Consensus Development and State-of-the-Science Conference Statements have robust dissemination:

- A press briefing is held on the last day of the conference to assist journalists in preparing news stories on the conference findings.
- The statement is published online at **consensus.nih.gov.**
- Print copies are mailed to a wide variety of targeted audiences and are available at no charge through a clearinghouse.
- The Conference Statement is published in a major peer-reviewed journal.

Contact Us

For conference schedules, past statements, and evidence reports, please contact us:

NIH Consensus Development Program
Information Center
P.O. Box 2577
Kensington, MD 20891

1–888–NIH–CONSENSUS (888–644–2667)
consensus.nih.gov

Upcoming Conferences

NIH State-of-the-Science Conference:	**Preventing Alzheimer's Disease and Cognitive Decline** *April 26–28, 2010*
NIH Consensus Development Conference:	**Inhaled Nitric Oxide Therapy for Premature Infants** *October 27–29, 2010*

To receive registration notifications and updates about conferences and other program activities, please join the NIH Consensus Development Program Information Network at **consensus.nih.gov/alerts.htm.**

Recent Conferences

NIH Consensus Development Conference:	**Lactose Intolerance and Health** *February 22–24, 2010*
NIH State-of-the-Science Conference:	**Enhancing Use and Quality of Colorectal Cancer Screening** *February 2–4, 2010*
NIH State-of-the-Science Conference:	**Diagnosis and Management of Ductal Carcinoma In Situ (DCIS)** *September 22–24, 2009*
NIH State-of-the-Science Conference:	**Family History and Improving Health** *August 24–26, 2009*
NIH Consensus Development Conference:	**Management of Hepatitis B** *October 20–22, 2008*
NIH Consensus Development Conference:	**Hydroxyurea Treatment for Sickle Cell Disease** *February 25–27, 2008*
NIH State-of-the-Science Conference:	**Prevention of Fecal and Urinary Incontinence in Adults** *December 10–12, 2007*
NIH State-of-the-Science Conference:	**Tobacco Use: Prevention, Cessation, and Control** *June 12–14, 2006*
NIH State-of-the-Science Conference:	**Multivitamin/Mineral Supplements and Chronic Disease Prevention** *May 15–17, 2006*
NIH State-of-the-Science Conference:	**Cesarean Delivery on Maternal Request** *March 27–29, 2006*
NIH State-of-the-Science Conference:	**Manifestations and Management of Chronic Insomnia in Adults** *June 13–15, 2005*
NIH State-of-the-Science Conference:	**Management of Menopause-Related Symptoms** *March 21–23, 2005*

To access previous conference statements, videocasts, evidence reports, and other conference materials, please visit **consensus.nih.gov.**

General Information

Continuing Education

The NIH Consensus Development Program aspires to offer continuing education credits to as many conference attendees as possible. If your preferred credit type is not listed, please check to see if your credentialing body will honor other credit types.

Please note that continuing education credits are not available for Webcast viewers.

Continuing Medical Education

This activity has been planned and implemented in accordance with the Essential Areas and policies of the Accreditation Council for Continuing Medical Education through the joint sponsorship of the Centers for Disease Control and Prevention (CDC) and the National Institutes of Health (NIH). The CDC is accredited by the Accreditation Council for Continuing Medical Education (ACCME®) to provide continuing medical education for physicians.

The Centers for Disease Control and Prevention designates this educational activity for a maximum of 12 *AMA PRA Category 1 Credits*™. Physicians should only claim credit commensurate with the extent of their participation in the activity.

Continuing Education Designated for Non-Physicians

Non-physicians will receive a certificate of participation.

Continuing Nursing Education

The Centers for Disease Control and Prevention is accredited as a provider of continuing nursing education by the American Nurses Credentialing Center's Commission on Accreditation.

This activity provides 12.1 contact hours.

Continuing Education Contact Hours

The Centers for Disease Control and Prevention is a designated provider of continuing education contact hours (CECH) in health education by the National Commission for Health Education Credentialing, Inc. This program is a designated event for certified health education specialists (CHES) to receive 12.5 Category I contact hours in health education, CDC provider number GA0082.

Financial Disclosures

CDC, our planners, and our presenters wish to disclose they have no financial interests or other relationships with the manufacturers of commercial products, suppliers of commercial services, or commercial supporters, with the exception of the following:

Planning committee members	Company	Financial relationship
	No conflicts identified	
Speakers	**Company**	**Financial Relationship**
Miriam Kuppermann	Boehringer Ingelheim Pharmaceuticals, Inc.	Honorarium, Advisory Board Member Consulting fees, Reviewer

Presentations will not include any discussion of the unlabeled use of a product or a product under investigational use with the exception of Drs. Jeanne-Marie Guise, Karen Eden, and Cathy Emeis' discussion on Misprostol. They will be discussing the results of using Misprostol for induction. This product is generally not labeled for this function.

Policy on Panel Disclosure

Panel members signed a confirmation that they have no financial or other conflicts of interest pertaining to the topic being addressed.

Videocast

Live and archived videocasts may be accessed at videocast.nih.gov. Archived videocasts will be available approximately 1 week after the conference.

Dining

The dining center in the Natcher Conference Center is located on the main level, one floor above the auditorium. It is open from 6:30 a.m. to 2:30 p.m., serving hot breakfasts and lunch, sandwiches and salads, and snack items. An additional cafeteria is available from 7:00 a.m. to 3:30 p.m., in Building 38A, Level B1, across the street from the main entrance to the Natcher Conference Center.

Online Content

All materials issuing from the NIH Consensus Development Program are available at **consensus.nih.gov**. In addition, remote participants will have the opportunity to provide comments on the panel statement by visiting **consensus.nih.gov/comments.htm** from 8:30 a.m. to 11:30 a.m. on Wednesday, March 10, 2010.

Contents

V. What Are the Nonmedical Factors That Influence the Patterns and Utilization of Trial of Labor After Prior Cesarean? *(continued)*

Background

Vaginal birth after cesarean (VBAC) is the delivery of a baby through the vagina after a previous cesarean delivery. For most of the 20th century, once a woman had undergone a cesarean (the delivery of a baby through an incision made in the abdominal wall and uterus), many clinicians believed that all of her future pregnancies would require delivery by cesarean as well. However, in 1980, a National Institutes of Health (NIH) Consensus Development Conference panel questioned the necessity of routine repeat cesarean deliveries and outlined situations in which VBAC could be considered. The option for a woman with a previous cesarean delivery to try to labor and deliver vaginally, rather than to plan a cesarean delivery, was therefore offered and exercised more often from the 1980s through the early 1990s. Since 1996, however, VBAC rates in the United States have consistently declined, while cesarean delivery rates have been steadily rising.

The exact causes of these shifts are not entirely understood. A frequently cited concern about VBAC is the possibility of uterine rupture during labor, because a cesarean delivery leaves a scar in the wall of the uterus at the incision site, which is weaker than other uterine tissue. Attempted VBAC may also be associated with endometritis (infection of the lining of the uterus), the need for a hysterectomy (removal of the uterus), and blood transfusion, as well as neurologic injury to the baby. However, repeat cesarean delivery may also carry a risk of bleeding or the need for a hysterectomy, uterine infections, and respiratory problems for the newborn. In addition, multiple cesarean deliveries may be associated with placental problems in future pregnancies. Other important considerations that may influence the decision include the number of previous cesarean deliveries a woman has experienced; the surgical incision used during previous cesarean delivery; the reason for the previous surgical delivery; the woman's age; how far along the pregnancy is, relative to her due date; and the size and position of the baby. Given the complexity of this issue, a thorough examination of the relative balance of benefits and harms to mother and baby will be of immediate utility to practitioners and pregnant women in deciding on a planned mode of delivery.

A number of nonclinical factors are involved in this decision as well, and may be influencing the decline in VBAC rates. Some individual practitioners and hospitals in the United States have decreased or eliminated their use of VBAC. Professional society guidelines may influence utilization rates because some medical centers do not offer the recommended supporting services for a trial of labor after cesarean (e.g., immediate availability of a surgeon who can perform a cesarean delivery and onsite anesthesiologists). Information related to complications of an unsuccessful attempt at VBAC, medico-legal concerns, personal preferences of patients and clinicians, and insurance policies and economic considerations may all play a role in changing practice patterns. Improved understanding of the clinical risks and benefits, and how they interact with legal, ethical, and economic forces to shape provider and patient choices about VBAC, may have important implications for health services planning.

To advance understanding of these important issues, the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development and the NIH Office of Medical Applications of Research have convened a Consensus Development Conference, March 8–10, 2010. The conference will address the following key questions:

- What are the rates and patterns of utilization of trial of labor after prior cesarean, vaginal birth after cesarean, and repeat cesarean delivery in the United States?

- Among women who attempt a trial of labor after prior cesarean, what is the vaginal delivery rate, and the factors that influence it?

- What are the short- and long-term benefits and harms to the mother of attempting trial of labor after prior cesarean versus elective repeat cesarean delivery, and what factors influence benefits and harms?

- What are the short- and long-term benefits and harms to the baby of maternal attempt at trial of labor after prior cesarean versus elective repeat cesarean delivery, and what factors influence benefits and harms?

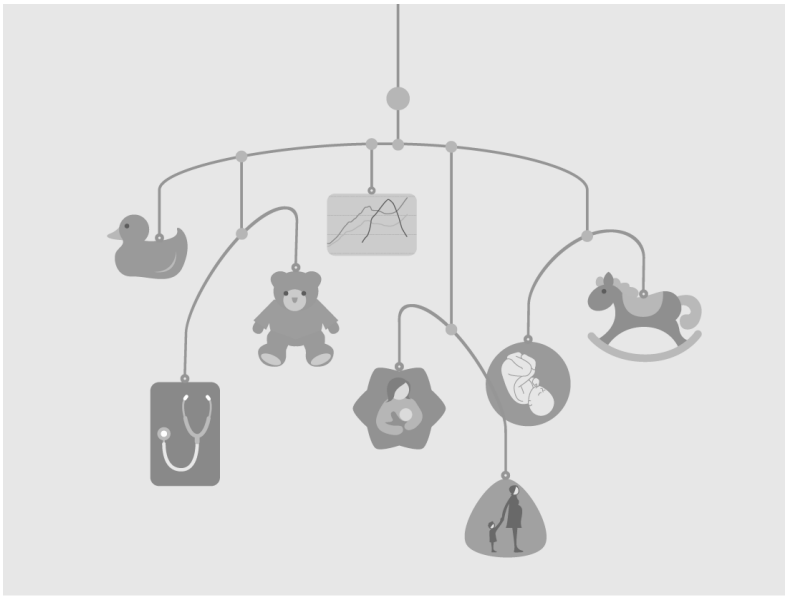
- What are the nonmedical factors that influence the patterns and utilization of trial of labor after prior cesarean?

- What are the critical gaps in the evidence for decision-making, and what are the priority investigations needed to address these gaps?

About the Artwork

The illustration on this volume's cover and used on a variety of materials associated with the conference depicts a mobile hanging over an infant's crib. In addition to some traditional playthings, this mobile's hanging elements hint at the delicate balance of issues to be considered by expectant parents and healthcare providers in whether to attempt a vaginal birth after a prior cesarean delivery.

The image was conceived and created by Bonnie Hamalainen of NIH's Division of Medical Arts and is in the public domain. No permission is required to use the image. Please credit "Bonnie Hamalainen/NIH Medical Arts."



vaginal birth after cesarean: new insights

Agenda

Monday, March 8, 2010

8:30 a.m. Introduction and Opening Remarks
Alan E. Guttmacher, M.D.
Acting Director
Eunice Kennedy Shriver National Institute of Child Health and Human Development
National Institutes of Health

8:40 a.m. Charge to the Panel
Jennifer M. Croswell, M.D., M.P.H.
Acting Director
Office of Medical Applications of Research
Office of the Director
National Institutes of Health

8:50 a.m. Conference Overview and Panel Activities
F. Gary Cunningham, M.D.
Panel and Conference Chairperson
Beatrice and Miguel Elias Distinguished Chair in Obstetrics and Gynecology
Professor
Department of Obstetrics and Gynecology
University of Texas Southwestern Medical Center at Dallas

9:00 a.m. Overview of the Topic
Caroline Signore, M.D., M.P.H.
Medical Officer
Pregnancy and Perinatology Branch
Eunice Kennedy Shriver National Institute of Child Health and Human Development

I. What Are the Rates and Patterns of Utilization of Trial of Labor After Prior Cesarean, Vaginal Birth After Cesarean, and Repeat Cesarean Delivery in the United States?

9:15 a.m. Trends and Patterns of Vaginal Birth After Cesarean Availability in the United States
Kimberly D. Gregory, M.D., M.P.H.
Vice Chairperson
Women's Healthcare Quality and Performance Improvement
Department of Obstetrics and Gynecology
Cedars-Sinai Medical Center

II. Among Women Who Attempt a Trial of Labor After Prior Cesarean, What Is the Vaginal Delivery Rate and the Factors That Influence It?

9:35 a.m. Evidence-based Practice Center Presentation I: Trial of Labor, Vaginal Delivery Rates, and Relevant Factors
Karen B. Eden, Ph.D.
Investigator/Associate Professor
Department of Medical Informatics and Clinical Epidemiology
School of Medicine
Oregon Health & Science University

9:55 a.m. Rates and Prediction of Successful Vaginal Birth After Cesarean
William A. Grobman, M.D., M.B.A.
Associate Professor
Division of Maternal Fetal Medicine
Department of Obstetrics and Gynecology
Feinberg School of Medicine
Northwestern University

10:15 a.m. **Discussion**
Participants with questions or comments for the speakers should proceed to the designated microphones and wait to be recognized by the panel chairperson. Please state your name and affiliation. Questions and comments not heard before the close of the discussion period may be submitted on the computers in the registration area. Please be aware that all statements made at the microphone or submitted later are in the public domain.

III. What Are the Short- and Long-Term Benefits and Harms to the Mother of Attempting Trial of Labor After Prior Cesarean Versus Elective Repeat Cesarean Delivery, and What Factors Influence Benefits and Harms?

10:45 a.m. Evidence-based Practice Center Presentation II: Maternal Benefits and Harms, and Relevant Factors
Jeanne-Marie Guise, M.D., M.P.H.
Principal Investigator/Associate Professor
Departments of Obstetrics and Gynecology, and Medical Informatics and Clinical Epidemiology
School of Medicine
Oregon Health & Science University

Monday, March 8, 2010 *(continued)*

III. What Are the Short- and Long-Term Benefits and Harms to the Mother of Attempting Trial of Labor After Prior Cesarean Versus Elective Repeat Cesarean Delivery, and What Factors Influence Benefits and Harms? *(continued)*

11:05 a.m. Birth After Prior Cesarean Delivery: Short-Term Maternal Outcomes
Mona T. Lydon-Rochelle, Ph.D., M.P.H., CNM
Perinatal Epidemiologist
National Perinatal Epidemiology Centre
Anu Research Centre
Cork University Maternity Hospital
Associate Professor
Department of Epidemiology and Public Health
University College Cork

11:25 a.m. **Discussion**

11:45 a.m. **Lunch**
Panel Executive Session

12:45 p.m. Delivery After Previous Cesarean: Long-Term Maternal Outcomes
Robert M. Silver, M.D.
Professor and Chief
Division of Maternal-Fetal Medicine
Department of Obstetrics and Gynecology
University of Utah Health Sciences Center

1:05 p.m. Predicting Uterine Rupture in Women Undergoing Trial of Labor After Prior Cesarean Delivery
Mark B. Landon, M.D.
Professor and Director
Division of Maternal-Fetal Medicine
Department of Obstetrics and Gynecology
The Ohio State University College of Medicine

1:25 p.m. **Discussion**

IV. What Are the Short- and Long-Term Benefits and Harms to the Baby of Maternal Attempt at Trial of Labor After Prior Cesarean Versus Elective Repeat Cesarean Delivery, and What Factors Influence Benefits and Harms?

1:45 p.m. Evidence-based Practice Center Presentation III: Infant Benefits and Harms, and Relevant Factors
Cathy Emeis, Ph.D., CNM
Investigator/Assistant Professor
Department of Primary Care
School of Nursing
Oregon Health & Science University

2:05 p.m. Delivery After Previous Cesarean: Short-Term Perinatal Outcomes
Lucky Jain, M.D., M.B.A.
Richard W. Blumberg Professor and Executive Vice Chairperson
Department of Pediatrics
Emory University School of Medicine

2:25 p.m. Delivery After Previous Cesarean: Long-Term Outcomes in the Child
T. Michael O'Shea, M.D., M.P.H.
Professor
Department of Pediatrics
Chief
Department of Neonatal and Perinatal Medicine
Neonatology Division of Pediatrics
School of Medicine
Wake Forest University

2:45 p.m. Vaginal Birth After Cesarean Synthesis: Overview of Efficacy and Safety of Vaginal Birth After Cesarean
George A. Macones, M.D., M.S.C.E.
Professor and Chairperson
Department of Obstetrics and Gynecology
Washington University School of Medicine

3:05 p.m. **Discussion**

V. What Are the Nonmedical Factors That Influence the Patterns and Utilization of Trial of Labor After Prior Cesarean?

3:45 p.m. Trial of Labor Versus Elective Repeat Cesarean: An Administrator's Perspective
Michael L. Socol, M.D.
Thomas J. Watkins Memorial Professor and Vice Chairperson
Department of Obstetrics and Gynecology
Division of Maternal-Fetal Medicine
Feinberg School of Medicine
Northwestern University

Monday, March 8, 2010 *(continued)*

V. What Are the Nonmedical Factors That Influence the Patterns and Utilization of Trial of Labor After Prior Cesarean? *(continued)*

4:15 p.m. Evaluating Professional Society Guidelines on Vaginal Birth After Cesarean
Emmanuel Bujold, M.D., M.Sc., FRCSC
Associate Professor
Maternal Fetal Medicine and Perinatal Epidemiology
Jeanne et Jean-Louis Lévesque Perinatal Research Chair
Department of Obstetrics and Gynaecology
Faculty of Medicine
Laval University
Québec City, Québec
Canada

4:35 p.m. **Discussion**

5:00 p.m. **Adjournment**

Tuesday, March 9, 2010

V. What Are the Nonmedical Factors That Influence the Patterns and Utilization of Trial of Labor After Prior Cesarean? *(continued)*

8:30 a.m. Impact of Anesthesiologists on the Incidence of Vaginal Birth After Cesarean in the United States: Role of Anesthesia Availability, Productivity, Guidelines, and Patient Safety
David J. Birnbach, M.D., M.P.H.
Professor
Departments of Anesthesiology, Obstetrics and Gynecology, and Public Health
Executive Vice Chairperson
Department of Anesthesiology
Director
Center for Patient Safety
Jackson Memorial Hospital
University of Miami
Associate Dean
Miller School of Medicine
University of Miami

8:50 a.m. The Immediately Available Physician Standard
Howard Minkoff, M.D.
Distinguished Professor of Obstetrics and Gynecology
State University of New York–Downstate Medical Center
Chairperson

Department of Obstetrics and Gynecology
Maimonides Medical Center

Tuesday, March 9, 2010 *(continued)*

V. What Are the Nonmedical Factors That Influence the Patterns and Utilization of Trial of Labor After Prior Cesarean? *(continued)*

9:10 a.m. Understanding Risk, Patient and Provider Preferences, and Obstetric Decision-Making: Approach to Delivery After Cesarean
Miriam Kuppermann, Ph.D., M.P.H.
Professor
Departments of Obstetrics, Gynecology, & Reproductive Sciences, and Epidemiology & Biostatistics
University of California, San Francisco

9:30 a.m. **Discussion**

10:00 a.m. The Ethics of Vaginal Birth After Cesarean
Anne Drapkin Lyerly, M.D., M.A.
Associate Professor
Department of Obstetrics and Gynecology
Core Faculty
Trent Center for Bioethics, Humanities, and History of Medicine
Duke University

10:20 a.m. Mothers' Stories
Rita Rubin
Medical Reporter
USA Today

10:40 a.m. Vaginal Birth After Cesarean Section: Views From the Private Practitioner
Chet Edward Wells, M.D.
Professor
Department of Obstetrics and Gynecology
University of Texas Southwestern Medical Center at Dallas

11:00 a.m. **Discussion**

11:30 a.m. **Adjournment**

Wednesday, March 10, 2010

9:00 a.m. **Presentation of the Draft Consensus Statement**
The panel chairperson will read the draft statement to the assembled audience.

Wednesday, March 10, 2010 *(continued)*

9:30 a.m. **Public Discussion**

The panel chairperson will call for questions and comments from the audience on the draft statement, beginning with the introduction and continuing through each subsequent section, in turn. Please confine your comments to the section under discussion. The chairperson will use discretion in proceeding to subsequent sections so that comments on the entire statement may be heard during the time allotted. Participants with comments should proceed to the designated microphones and wait to be recognized by the panel chairperson. Please state your name and affiliation. Questions and comments not heard before the close of the discussion period may be submitted on the computers in the registration area. For participants viewing the remote Webcast, comments may be submitted online at ***consensus.nih.gov/comments.htm****. Comments will not be accepted after 11:30 a.m. Please be aware that all statements made at the microphone or submitted later are in the public domain.*

11:00 a.m. **Adjournment**

Panel Meets in Executive Session

The public portion of the conference ends at 11:00 a.m. The panel meets in its last executive session to review public comments on the draft statement.

2:00 p.m. **Press Telebriefing**

The panel will provide a summary of its findings to the press and will answer questions from reporters via telebriefing. Only members of the press are permitted to ask questions of the panel during this time. Interested conference participants who are not members of the press may call in (from a remote location) to listen to the live telebriefing. Please go to ***consensus.nih.gov*** *for instructions on joining the call.*

The panel's draft statement will be posted to ***consensus.nih.gov*** *as soon as possible after the close of proceedings, and the final statement will be posted 4 to 6 weeks later.*

Panel

Panel Chairperson: **F. Gary Cunningham, M.D.**
Panel and Conference Chairperson
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Sheila Cohen Zimmet, B.S.N., J.D.
Senior Associate Vice President for Regulatory Affairs
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Chicago, Illinois

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Abstracts

The abstracts are designed to inform the panel and conference participants, as well as to serve as a reference document for any other interested parties. We would like to thank the speakers for preparing and presenting their findings on this important topic.

The organizers would also like to thank the planning committee, the panel, the Oregon Evidence-based Practice Center, and the Agency for Healthcare Research and Quality. We would also like to thank the National Institute of Nursing Research and the Office of Research on Women's Health. We appreciate your continued interest in both the NIH Consensus Development Program and the area of vaginal birth after cesarean delivery.

Please note that where multiple authors are listed on an abstract, the underline denotes the presenting author.

Trends and Patterns of Vaginal Birth After Cesarean Availability in the United States

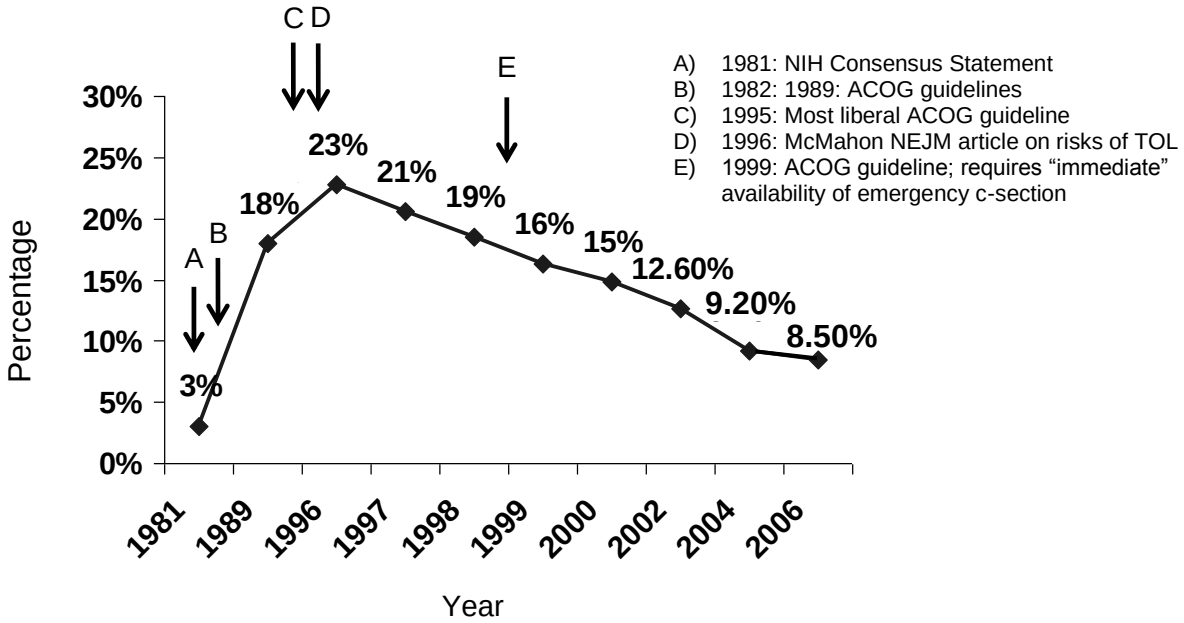
Kimberly D. Gregory, M.D., M.P.H.; Moshe Fridman, Ph.D.; Lisa Korst, M.D., Ph.D.

National Trends in Vaginal Birth After Cesarean (VBAC)

Since the advent of cesarean birth and the survival of the first patient, the question of what to do with subsequent pregnancy has been a topic of debate with case series publications dating back as early as 1959 establishing what is widely known and accepted today—VBAC is possible, is successful approximately 70% of the time, and is associated with uterine rupture approximately 1% of the time.[1]

Three overlapping series of events or phenomena led to the widespread uptake of VBAC across the country. The first event was the National Institutes of Health Consensus Conference on Cesarean Childbirth in 1981.[2] The meeting ended with a series of recommendations to decrease the overall national cesarean rate, most prominent of which was to increase the utilization of VBAC. Second, in recognition of the growing body of literature supporting VBAC, and concurrent with the evolution of practice guideline development, the American College of Obstetricians and Gynecologists (ACOG) published a series of guidelines that were successively less restrictive.[3–7] The 1995 guideline was perhaps the most liberal and strongest endorsement, stating that "…all women 'should' undergo VBAC unless medical or obstetrical contraindications."[8] The third phenomenon contributing to the increase in VBAC utilization was interest by policymakers and third-party payers. The net effect of these phenomenal events led to the highest VBAC rate ever reported in the United States at 28.3% in 1996[9,10] (see Figure 1).

Figure 1. Rates of VBAC in the United States, 1981–2006



Martin et al., 2004.[9]
Martin et al., 2006.[10]

Since 1996, the national rate has plummeted to as low as 8.5%.[10] The decline appears to have started around 1997, shortly after a publication by McMahon et al.[11] The publicity surrounding McMahon's study solidified in the public's eye the risks of adverse outcomes associated with failed trial of labor. Notably, adverse outcomes (uterine rupture, hysterectomy, transfusion, "major operative injury," maternal or newborn death) are more likely with failed VBAC. Further decline in the national VBAC rate was noted after the release of an updated ACOG practice bulletin released in 1999.[12] In response to both ongoing patient safety concerns emphasized by the McMahon paper, as well as clinician concerns about malpractice liability, the language of ACOG's recommendation was altered such that instead of "encouraging" VBAC, women should be "offered" VBAC if no contraindications, in settings where a physician capable of performing a cesarean is "immediately" available throughout active labor, in institutions equipped to respond to emergencies.[7,12] In the current medico-legal climate, the health system personnel requirements became burdensome for both physicians and hospitals and directly contributed to the abolition of VBAC at some facilities.[13,14]

Factors Associated With Variation in VBAC Utilization

Regional Variation

In all states, across all hospital types, and for most women independent of age, race, or clinical conditions, the cesarean rate is going up and the VBAC rate is going down.[9,10] As shown in Table 1, using data from the Nationwide Inpatient Sample for the years 2000, 2003, and 2005 to calculate national cesarean and VBAC rates, the elective repeat cesarean rate increased during this time period (from 59% to 83%), while the VBAC process measures (VBAC attempt rate and VBAC success rate) as well as the overall VBAC rate declined.[15]

Table 1. Method of Delivery for Women With Prior Cesareans, Nationwide Inpatient Sample, 2000, 2003, 2005

	2000 N (%)	2003 N (%)	2006 N (%)
Total Deliveries	3,975,574	3,964,514	4,100,779
Total Prior Cesarean	482,913 (12.1%)	540,038 (13.6%)	596,725 (14.6%)
Elective Repeat (% Total Prior Cesarean)	285,636 (59.1%)	423,786 (78.5%)	495,151 (83.0%)
Attempted VBAC	197,276 (40.9%)	116,251 (21.5%)	101,574 (17.0%)
Successful VBAC	136,334	74,397	6,1210
% Success = Success/Attempt	69.1%	64.0%	60.3%
VBAC Rate = Success VBAC/All Priors	28.2	13.8	10.3

Patient Variation

Since 1996, VBAC utilization has decreased across all age groups.[9,10] Likewise, the VBAC rate has declined for all racial/ethnic groups.[10] Several recent studies suggest that black women

were more likely to attempt and fail VBAC, when compared to other ethnic groups.[16,17] Cesarean and VBAC rates vary by insurance status, and patient-specific clinical characteristics impact VBAC success.[2,18–28] Gregory et al. stratified patients into high risk (one or more maternal, fetal, or placental condition) and low risk (no conditions) and found attempted and successful VBAC rates varied widely by these conditions, ranging from 10–73%.[28] Similar findings by other investigators suggest that there may be promise in the development of models to predict ideal VBAC candidates or patients at increased risk for adverse events.[29–34] Several models have been proposed, but none has been integrated into standard obstetrical practice.

International Data

Publications from Europe consistently demonstrate that the majority of women with prior cesarean attempt VBAC (attempted VBAC rates approach 50–70%) with success rates ranging from 70–75%.[35–41] It is noteworthy that, unlike the United States, the model of care in these countries relies heavily on nurse midwives.

Access to VBAC

Decline in VBAC utilization is due, in part, to decreased access.[13,14,42,43] Physicians practicing in rural and suburban areas reported the largest decline in the use of VBAC/trial of labor.[43] In surveys of hospital administrators, approximately 30% of hospitals stated they stopped allowing VBAC services.[13,14] Of the hospitals that still allow VBAC, more than half had to change their policies to be compliant with ACOG recommendations.

Gaps in Knowledge About VBAC

Since the risks of VBAC and elective repeat cesarean delivery are not directly comparable, how do clinicians communicate these risks to women so that they can make informed decisions?[44] Who should communicate these risks? Clearly physicians are stakeholders in the outcome, and what they say and how they say it influences patient choices. Attitudes about childbirth, fear of labor, and perceptions about womanhood and vaginal birth are cultural phenomenon influenced by society, spouse, family, friends, and personal values. Women need to have access to non-biased, evidence-based information to engage in a collaborative partnership of equals with midwives and obstetricians.[45,46] What are the incentives and resources for the medical profession to develop this nonbiased evidence base? How and whether to use decision tools, and what type is the most meaningful/helpful for the patient? How and when do patient preferences get integrated into the decision-making process for VBAC?[45] Hierarchically, randomized trials are considered the gold standard for evaluating outcome and effectiveness. Are patients and obstetricians ready to subject the “natural” process of vaginal birth to a trial? Dodd et al. offer justification for a randomized trial and a patient preference study of planned VBAC versus planned repeat cesarean.[47] In conclusion, in addition to a better knowledge base about how to communicate risks and benefits to patients in a meaningful manner, clinicians need a better set of tools to bring about more rapid dissemination and change in provider practices. In the United States, where choice and autonomy are perceived as a basic human right, it is unlikely that a blanket universal VBAC policy will ever be possible. At best, one can hope for refined prediction tools that maximize success and minimize failure, and a healthcare system that maintains and perhaps even improves access so that those women who want to choose VBAC will be able to do so.

References

1. Cohen B, Atkins M. Brief history of vaginal birth after cesarean section. *Clin Obstet Gynecol*. 2001;44:604–608.

2. National Institutes of Health: Consensus Development Conference on Cesarean Childbirth. Pub. No. 82:2067. Washington, DC: NIH; 1981.

3. American College of Obstetricians and Gynecologists (ACOG). Committee Statement. Guidelines for Vaginal Delivery After a Cesarean Childbirth. Washington, DC: ACOG; January 1982.

4. American College of Obstetricians and Gynecologists (ACOG). Committee Statement. Guidelines for Vaginal Delivery After a Cesarean Birth. Washington, DC: ACOG; November 1984.

5. American College of Obstetricians and Gynecologists (ACOG). Guidelines for Vaginal Delivery After a Cesarean Birth. Committee Opinion No. 64. Washington, DC: ACOG; October 1988.

6. American College of Obstetricians and Gynecologists (ACOG). Vaginal Delivery After a Cesarean Birth. Washington, DC: ACOG; October 1994.

7. Zinberg S. Vaginal delivery after previous cesarean delivery: a continuing controversy. *Clin Obstet Gynecol*. 2001;44:561–570.

8. American College of Obstetricians and Gynecologists (ACOG). Vaginal Delivery After a Cesarean Birth. Practice Patterns No. 1. Washington, DC: ACOG; August 1995.

9. Martin JA, Hamilton BE, Sutton PD, et al. Births: final data for 2004. *Natl Vital Stat Rep*. 2006;55(1).

10. Martin JA, Hamilton BE, Sutton PD, et al. Births: final data for 2006. *Natl Vital Stat Rep*. 2009;57(7).

11. McMahon MJ, Luther ER, Bowes WA, et al. Comparison of a trial of labor with an elective second cesarean section. *N Engl J Med*. 1996;335:689–695.

12. American College of Obstetricians and Gynecologists. Vaginal Birth After Previous Cesarean Delivery. ACOG Practice Bulletin No. 5. 1999;1106–1112.

13. Shihady IR, Broussard P, Bolton LB, et al. Vaginal birth after cesarean: do California hospital policies follow national guidelines? *J Reprod Med*. 2007;52:349–358.

14. Roberts RG, Deutchman M, King VJ et al. Changing policies on vaginal birth after cesarean: impact on access. *Birth*. 2007;34:316–322.

15. Agency for Healthcare Research and Quality (AHRQ). Healthcare Cost and Utilization Project–Nationwide Inpatient Sample. Rockville, MD: AHRQ; 2005. (Unpublished data.)

16. Cahill AG, Samilio DM, Odibo AO, et al. Racial disparity in the success and complications of vaginal birth after cesarean delivery. *Obstet Gynecol*. 2008;111:654–658.

17. Hollard AL, Wing DA, Chung J. Ethnic disparity in the success of vaginal birth after cesarean delivery. *J Matern Fetal Neonatal Med*. 2006;19:483–487.

18. Mercer BM, Gilbert S, Landon MB, et al.; National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network. Labor outcomes with increasing number of prior vaginal births after cesarean delivery. *Obstet Gynecol*. 2008;111:285–291.

19. Macones GA, Cahill A, Pare E, et al. Obstetric outcomes in women with two prior cesarean deliveries: is vaginal birth after cesarean delivery a viable option? *Am J Obstet Gynecol*. 2005;192:1223–1228.

20. Ford AA, Bateman BT, Simpson LL. Vaginal birth after cesarean delivery in twin gestations: a large nationwide sample of deliveries. *Am J Obstet Gynecol*. 2006;195:1138–1142.

21. Cahill A, Stamilio DM, Pare E, et al. Vaginal birth after cesarean (VBAC) attempt in twin pregnancies: is it safe? *Am J Obstet Gynecol*. 2005;193:1050–1055.

22. Varner MW, Leindecker S, Spong CY, et al.; National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network. The Maternal-Fetal Medicine Unit Cesarean Registry: trial of labor with a twin gestation. Am J *Obstet Gynecol*. 2005;193:135–140.

23. Bujord E, Hammoud A, Schild C, Krapp M, Bauman P. The role of maternal body mass index in outcomes of vaginal births after cesarean. *Am J Obstet Gynecol*. 2005:193:1517–1521.

24. Hibbard JU, Gilbert S, Landon MB, et al.; National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network. Trial of labor or repeat cesarean delivery in women with morbid obesity and previous cesarean delivery. *Obstet Gynecol*. 2006;108:125–133.

25. Quinones JN, Stamilio DM, Pare E, et al. The effect of prematurity on vaginal birth after cesarean delivery: success and maternal morbidity. *Obstet Gynecol*. 2005;105:519–524.

26. Durnwal CP, Rouse DJ, Leveno KJ, et al.; National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network. The Maternal-Fetal Medicine Units Cesarean Registry: safety and efficacy of a trial of labor in preterm pregnancy after a prior cesarean delivery. *Am J Obstet Gynecol*. 2006;195:1119–1126.

27. Srinivas SK, Stamilio DM, Stevens EJ, et al. Safety and success of vaginal birth after cesarean delivery in patients with preeclampsia. *Am J Perinat*. 2006;23:145–152.

28. Gregory KD, Korst LM, Fridman M, et al. Vaginal birth after cesarean: clinical risk factors associated with adverse outcome. *Am J Obstet Gynecol*. 2008;198(452):e1–e10.

29. Grobman WA, Lai Y, Landon MB, et al. Development of a nomogram for prediction of vaginal birth after cesarean delivery. *Obstet Gynecol*. 2007;109:796–797.

30. Grobman WA, Lai Y, Landon MB, et al. Can a prediction model for vaginal birth after cesarean also predict the probability of morbidity related to a trial of labor? *Am J Obstet Gynecol*. 2009;200(56):e1–e6.

31. Grobman WA, Lai Y, Landon MB, et al. Prediction of uterine rupture associated with attempted vaginal birth after cesarean delivery. *Am J Obstet Gynecol*. 2008;199(30):31–35.

32. Hashima JN, Guise JM. Vaginal birth after cesarean: a prenatal scoring tool. *Am J Obstet Gynecol*. 2007;196:e22–e23.

33. Macones GA, Cahill AG, Samilio DM. Can uterine rupture in patients attempting vaginal birth after cesarean delivery be predicted? *Am J Obstet Gynecol*. 2007;195:1148–1152.

34. Harper LM, Macones GA. Predicting success and reducing the risks when attempting vaginal birth after cesarean. *Obstet Gynecol Survey*. 2008;63:538–545.

35. Case BD, Corcoran R, Jeffcoate N, et al. Cesarean section and its place in modern obstetric practice. *J Obstet Gynaecol Br Commonw*. 1971;78:203–214.

36. Selo-Ojeme D, Abulhassan N, Mandal R, et al. Preferred and actual delivery mode after a cesarean in London, UK. *Int J Gynaecol Obstet*. 2008;102(2):156–159.

37. Zwart JJ, Richters JM, Ory F, et al. Uterine rupture in the Netherlands: a nationwide population-based cohort study. *BJOG*. 2009;116(8):1069–1678.

38. Turner MJ, Agnew G, Langan H. Uterine rupture and labour after a previous low transverse caesarean section. *BJOG.* 2006;113:729–732.

39. Udayasankar V, Padmagirison R, Majoko F. National survey of obstetricians in Wales regarding induction of labour in women with a previous caesarean section. *J Obstet Gynaecol*. 2008;28(1):48–50.

40. Kwee A, Bots ML, Visser GH, et al. Obstetric management and outcome of pregnancy in women with a history of caesarean section in the Netherlands. *Eur J Obstet Gynecol Reprod Biol*. 2007;132(2):171–176.

41. Grossetti E, Vardon D, Creveuil C, et al. Rupture of the scarred uterus. *Acta Obstet Gynecol Scand*. 2007;86:572–578.

42. Coleman VH, Erickson K, Shulkin J, et al. Vaginal birth after cesarean delivery: practice patterns of obstetrician-gynecologists. *J Reprod Med*. 2005;50:261–266.

43. Gochnour G, Ratcliffe S, Stone MB. The Utah VBAC Study. *Matern Child Health J*. 2005;9(2):181–188.

44. Lyerly AD, Mitchel LM, Armstrong EM, et al. Risks, values, and decision making surrounding pregnancy. *Obstet Gynecol*. 2007;109:979–984.

45. Meddings F, Phipps FM, Haith-Cooper M, et al. Vaginal birth after caesarean section (VBAC): exploring women's perceptions. *J Clin Nurs*. 2007;16:160–167.

46. Emmett CL, Shaw ARG, Montgomery AA, et al.; DIAMOND Study Group. Women's experience of decision making about mode of delivery after a previous caesarean section: the role of health professionals and information about health risks. *BJOG*. 2006;113:1438–1445.

47. Dodd JM, Crowther CA, Hiller JE. Birth after cesarean study—planned vaginal birth or planned elective repeat cesarean for women at term with a single previous cesarean birth: protocol for a patient preference study and randomized trial. *BMC Pregnancy Childbirth*. 2007;7:17.

Evidence-based Practice Center Presentation I: Trial of Labor, Vaginal Delivery Rates, and Relevant Factors

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Introduction

Nearly one in three women (32.8%) were delivered by cesarean in 2007, the highest rate ever reported in the United States.[1] A major reason for the increase in cesareans is the rapid decline in vaginal birth after cesarean (VBAC) deliveries witnessed over the last decade. We undertook a systematic review to understand the incidence of trial of labor (TOL), VBAC, and the factors that influence it.

Methods

We searched MEDLINE®, the Database of Abstracts of Reviews of Effectiveness, and the Cochrane databases (from 1980 through September 2009) for studies to estimate the trial of labor (TOL) and VBAC rates. To be included, studies had to be at least fair quality using U.S. Preventive Services Task Force quality criteria[2] and clearly define eligibility for TOL, as well as provide the number of women eligible for TOL, the number of women who had a TOL, and the number of women who had a VBAC. The overall strength of the body of evidence was rated (graded) using the methods described in the Methods Reference Guide for Effectiveness and Comparative Effectiveness Reviews used by the Evidence-based Practice Centers.[1,3] Studies of factors that influence TOL or VBAC (e.g., induction) also were reviewed to understand how those factors related to the reported rates.

Results and Discussion

Trial of Labor Rates

Thirty-five observational studies provided data on TOL. The overall TOL rate in studies conducted in the United States was 58%, with a range of 28% to 70%, compared with 64% among women in studies conducted outside the United States. Fewer women in studies conducted exclusively in term populations—both inside and outside the United States—had a TOL, 53% compared with 66% for studies that included any gestational age.

Factors That Predict Trial of Labor

Nine observational studies looked for factors known in the prenatal setting that may predict TOL. Three themes emerged from these studies: site of delivery, history of prior vaginal delivery, and race affected TOL. TOL was more likely in hospitals with higher delivery volumes, tertiary care centers, and teaching hospitals. Women with a prior vaginal delivery had more than double the likelihood of a TOL. Finally, nonwhite women were more likely to have a TOL than were white women.

Vaginal Birth After Cesarean

As the TOL rate is decreasing, it is important to examine what effect, if any, this has on the VBAC rate and what factors are contributing to vaginal delivery. Sixty-seven studies provided moderate strength of evidence for an overall summary estimate for VBAC of 74%. The rates of VBAC are highly variable in these studies. Most evidence of VBAC rates is from studies based in large tertiary care centers. While TOL rates have dropped over time, VBAC rates reported in observational studies have remained constant for women who have a TOL.

Induction of Labor and VBAC

Overall, the evidence regarding the rate of VBAC among women with induction of labor was low to moderate strength, indicating that 54–63% of these women will have a VBAC depending on the method of induction. Most studies were conducted in tertiary care settings. Less than half of these studies were conducted in the United States. The results were not stratified by age, race, ethnicity, or baseline obstetric or medical factors.

Factors That Predict Vaginal Birth After Cesarean

There is particular interest in whether demographic factors, nonclinical factors, and past obstetric factors may predict VBAC, since these factors are known prenatally and would allow clinicians to provide information on prognosis early in pregnancy. Twenty-three studies addressed predictive factors for VBAC.

Hispanic and African American women were more likely to have a TOL but less likely to have a VBAC compared with non-Hispanic and white women, respectively. Women at rural and private hospitals had a decreased likelihood of TOL and a decreased likelihood of VBAC. A prior history of vaginal delivery was consistently reported to increase likelihood of VBAC. Women delivering infants over 4 kilograms had a reduced likelihood of VBAC. Maximizing favorable clinical conditions such as waiting for a favorable cervical examination, if possible, improved the likelihood of VBAC.

Screening Tools for Predicting Vaginal Birth After Cesarean

The purpose of a screening tool is to help providers and patients better identify who will have a VBAC (and who is more likely to have a repeat cesarean delivery). Sophisticated mathematical models provide reasonable ability to identify women who are good candidates for VBAC, but none has discriminating ability to consistently identify women who are at risk for cesarean delivery.

References

1. Agency for Healthcare Research and Quality (AHRQ). *Methods Reference Guide for Effectiveness and Comparative Effectiveness Reviews, Version 1.0.* Rockville, MD: AHRQ; 2007.

2. Harris RS, Helfand M, Woolf S, et al. Current methods of the U.S. Preventive Services Task Force: a review of the process. *Am J Prev Med*. 2001;20(3 Suppl):21–35.

3. Deeks JJ, Dinnes J, D'Amico R, et al. Evaluating non-randomised intervention studies. *Health Technol Assess*. 2003;7(27):iii–x, 1–173.

Rates and Prediction of Successful Vaginal Birth After Cesarean

William A. Grobman, M.D., M.B.A.

There have been multiple observational studies that have assessed the probability that a woman who undertakes a trial of labor (TOL) after a previous cesarean will have a vaginal birth. These studies have demonstrated a population-level probability of a successful vaginal birth after cesarean (VBAC) that ranges between 60–80%.[1–3] However, within a population, the chances for an individual woman's success may vary significantly on the basis of her particular characteristics and history.

Several demographic factors, including younger maternal age, lower maternal body mass index, and Caucasian race, have been consistently associated with a higher chance that a TOL results in a VBAC.[4–6] Women who are without medical illnesses that predate pregnancy, who have had a prior vaginal delivery, and whose prior cesarean was for an indication not related to arrest of labor also have higher chances of successful TOL.[4,7] Data regarding the number of prior cesareans have not consistently demonstrated marked differences in the chance of achieving VBAC.[8,9]

Events that occur during the antepartum course of the current pregnancy of women who are considering a TOL also have been associated with the probability of achieving a VBAC. For example, a woman who develops preeclampsia appears to have a lower chance of successful TOL.[10] Presenting for delivery at a lower gestational age with a more advanced (e.g., more dilated) cervical exam or with a fetus with a lower birth weight has been associated with a greater chance of VBAC.[4] Spontaneous labor, in comparison to induction of labor, has been consistently associated with a greater chance of VBAC as well.[11]

Lastly, several intrapartum factors may influence the probability that a TOL is successful. Women who receive augmentation or have a nonreassuring fetal status have been reported to have a lower chance of VBAC, as do women who have received epidural analgesia.[4,12] It should be noted, however, that these factors are not equivalent to factors such as maternal age, given that intrapartum variables such as these may not be merely risk factors, but reflective of labor events that are directly related to or responsible for the failed TOL and corresponding cesarean.

Although the identification of these factors allows physicians to provide patients with some general guidance regarding the likelihood of achieving a VBAC, knowledge of these factors does not necessarily allow physicians to predict VBAC effectively. Even a strong association of a factor with an outcome does not guarantee that this factor predicts the outcome accurately.

Several investigators have attempted to develop models that could accurately predict whether a TOL would result in a VBAC.[12–21] Table 1 presents these studies as well as the different factors that have been incorporated into these models. As can be seen, many models have incorporated factors that are present at the start of prenatal care as well as factors that are not apparent until admission for delivery. Such models may be less useful for counseling women during their antepartum course, when they may start planning for their intended route of delivery. Other methodologic issues (e.g., no multivariable analysis, no formal evaluation of discriminatory accuracy) and limitations (e.g., scoring systems that result in a limited number of predictive categories, such that patients of very different risk may still appear to have an equivalent probability of VBAC) also have hampered the clinical usefulness of these predictive models.

Table 1. Models Predicting Whether a TOL Will Result in a VBAC

	Known Prior to Admission for TOL										Known at Admission for TOL						Known After TOL
	Age	BMI	Ethno-racial status	Ht	Prior CS #	Prior CS indication	Any prior VD	VD after prior CS	Prior macro-somia	Anemia	EGA	NRF	PE	Cervical exam	IOL	LA	Fetal gender
Weinstein et al.[13]	-	-	-	-	NA	+	+	-	-	-	-	-	-	+	-	-	-
Pickhardt et al.[14]	-	-	-	•	+	-	-	-	-	-	+	-	-	+	-	-	-
Troyer et al.[12]	-	-	-	-	-	+	+	-	-	-	-	+	-	-	+	-	-
Flamm et al.[15]	+	-	-	-	-	+	+	+	-	-	-	-	-	+	-	-	-
Gonen et al.[16]	-	-	-	-	NA	+	-	+	-	-	+	-	-	+	-	-	-
Smith et al.[17]	+	-	-	+	NA	-	+	-	-	-	+	-	-	-	+	-	+
Hashima et al.[18]	-	-	-	-	NA	+	-	-	+	+	-	-	-	-	-	-	-
Srinivas et al.[19]	+	-	+	-	-	+	+	-	-	-	+	-	-	-	+	+	-
Grobman et al.[20]	+	+	+	-	NA	+	+	+	-	-	-	-	-	-	-	-	-
Grobman et al.[21]	+	+	+	-	NA	+	+	+	-	-	+	-	+	+	+	-	-

(+) = factor present in prediction model; (-) = factor not present in prediction model; NA = not applicable as only women with one prior cesarean included in analysis; TOL = trial of labor; BMI = body mass index; Ht = height; CS = cesarean section; VD = vaginal delivery; EGA = estimated gestational age; NRF = nonreassuring fetal heart tracing; PE = preeclampsia; IOL = induction of labor; LA= labor augmentation

One recently proposed approach to VBAC prediction has incorporated only variables known in the early antepartum period to generate a predictive model that could provide a woman's individual-specific probability of achieving a VBAC.[20] An extension of this model that includes factors also known at the time of admission to labor and delivery enables the determination of a predicted probability of VBAC that reflects relevant factors that have occurred as gestation progresses.[21] These models appear well calibrated and have reasonable discriminatory capability. Furthermore, the "early antepartum factor" model has been evaluated and considered valid in a population other than that in which it was developed and tested.[22] Further validation of these models in additional populations remains to be done.

Regardless of the accuracy of any of these models, there has yet to be a demonstration that their use can enhance the care of women who are considering a VBAC. It remains uncertain whether the provision of a VBAC probability, even an accurate one, to a woman considering a TOL can help her to optimize her decision-making and improve her satisfaction with her choices and outcomes. In addition, it has yet to be demonstrated whether the use of a prediction model in a given population can reduce the chance of adverse outcomes (e.g., major maternal morbidity) related to VBAC.

References

1. Lavin JP, Stephens RJ, Miodovnik M, Barden TP. Vaginal delivery in patients with a prior cesarean section. *Obstet Gynecol*. 1982;59(2):135–148.

2. Flamm BL, Newman LA, Thomas SJ, Fallon D, Yoshida MM. Vaginal birth after cesarean delivery: results of a 5-year multicenter collaborative study. *Obstet Gynecol*. 1990;76(5 Pt 1):750–754.

3. Miller DA, Diaz FG, Paul RH. Vaginal birth after cesarean: a 10-year experience. *Obstet Gynecol*. 1994;84(2):255–258.

4. Landon MB, Leindecker S, Spong CY, et al. National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network. The MFMU Cesarean Registry: factors affecting the success of TOL after previous cesarean delivery. *Am J Obstet Gynecol*. 2005;193(3 Pt 2):1016–1023.

5. Srinivas SK, Stamilio DM, Sammel MD, et al. Vaginal birth after cesarean delivery: does maternal age affect safety and success? *Paediatr Perinat Epidemiol*. 2007;21(2):114–120.

6. Juhasz G, Gyamfi C, Gyamfi P, Tocce K, Stone JL. Effect of body mass index and excessive weight gain on success of VBAC. *Obstet Gynecol*. 2005;106(4):741–746.

7. Caughey AB, Shipp TD, Repke JT, Zelop C, Cohen A, Lieberman E. Trial of labor after cesarean delivery: the effect of previous vaginal delivery. *Am J Obstet Gynecol*. 1998;179(4):938–941.

8. Landon MB, Spong CY, Thom E, et al.; National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network. Risk of uterine rupture with a trial of labor in women with multiple and single prior cesarean delivery. *Obstet Gynecol*. 2006;108(1):12–20.

9. Macones GA, Cahill A, Pare E, et al. Obstetric outcomes in women with two prior cesarean deliveries: is vaginal birth after cesarean delivery a viable option? *Am J Obstet Gynecol*. 2005;192(4):1223–1228.

10. Srinivas SK, Stamilio DM, Stevens EJ, Peipert JF, Odibo AO, Macones GA. Safety and success of VBAC in patients with preeclampsia. *Am J Perinatol*. 2006;23(3):145–152. Epub 2006 Feb 22.

11. Grobman WA, Gilbert S, Landon MB, et al. Outcomes of induction of labor after one prior cesarean. *Obstet Gynecol*. 2007;109(2 Pt 1):262–269.

12. Troyer LR, Parisi VM. Obstetric parameters affecting success in a trial of labor: designation of a scoring system. *Am J Obstet Gynecol*. 1992;167(4 Pt 1):1099–1104.

13. Weinstein D, Benshushan A, Tanos V, Zilberstein R, Rojansky N. Predictive score for vaginal birth after cesarean section. *Am J Obstet Gynecol*. 1996;174(1 Pt 1):192–198.

14. Pickhardt MG, Martin JN Jr, Meydrech EF, et al. Vaginal birth after cesarean delivery: are there useful and valid predictors of success or failure? *Am J Obstet Gynecol*. 1992;166(6 Pt 1):1811–1815; discussion 1815–1819.

15. Flamm BL, Geiger AM. Vaginal birth after cesarean delivery: an admission scoring system. *Obstet Gynecol*. 1997;90(6):907–910.

16. Gonen R, Tamir A, Degani S, Ohel G. Variables associated with successful vaginal birth after one cesarean section: a proposed vaginal birth after cesarean section score. *Am J Perinatol*. 2004;21(8):447–453.

17. Smith GC, White IR, Pell JP, Dobbie R. Predicting cesarean section and uterine rupture among women attempting vaginal birth after prior cesarean section. *PLoS Med*. 2005;2(9):e252. Epub 2005 Sep 13.

18. Hashima JN, Guise JM. Vaginal birth after cesarean: a prenatal scoring tool. *Am J Obstet Gynecol*. 2007;196(5):e22–e23.

19. Srinivas SK, Stamilio DM, Stevens EJ, Odibo AO, Peipert JF, Macones GA. Predicting failure of a vaginal birth attempt after cesarean delivery. *Obstet Gynecol*. 2007;109(4):800–805.

20. Grobman WA, Lai Y, Landon MB; National Institute of Child Health and Human Development (NICHD) Maternal-Fetal Medicine Units (MFMU) Network. Development of a nomogram for prediction of vaginal birth after cesarean delivery. *Obstet Gynecol*. 2007;109(4):806–812.

21. Grobman WA, Lai Y, Landon MB, et al. Does information available at admission for delivery improve prediction of vaginal birth after cesarean? *Am J Perinatol*. 2009;26(10):693–701. Epub 2009 Oct 7.

22. Costantine MM, Fox K, Byers B, et al. Validation of the prediction model for success of vaginal birth after cesarean delivery. *Obstet Gynecol*. 2009;114:1029–1033.

Evidence-based Practice Center Presentation II: Maternal Benefits and Harms, and Relevant Factors

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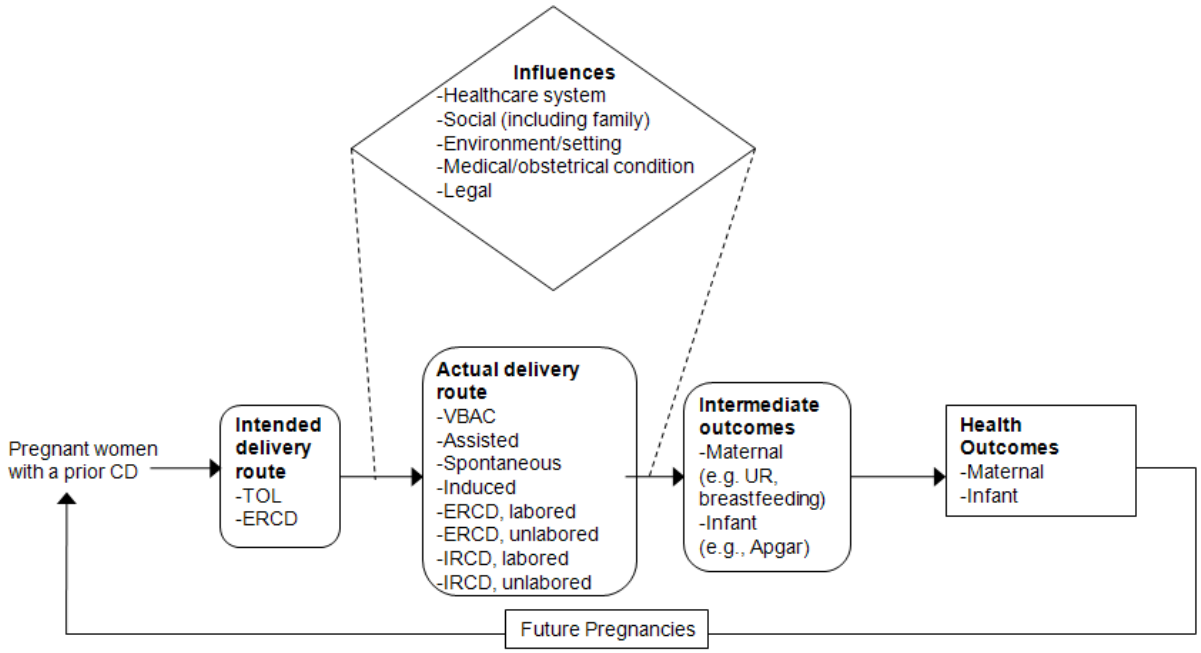
Introduction

The evidence on the benefits and harms of trial of labor (TOL) versus elective repeat cesarean delivery (ERCD) is unclear. This systematic review was conducted to examine maternal outcomes associated with vaginal birth after cesarean—one of the key questions specified by the Planning Committee for the 2010 NIH Consensus Development Conference: Vaginal Birth After Cesarean (VBAC): New Insights.[1]

Methods

An analytic framework (Figure 1) was constructed to illustrate the clinical logic and contextual factors that underlie the key questions relating to birth after previous cesarean delivery (CD). It explicitly aims to understand a woman's initial intended route of delivery and the factors that influence that initial intention. The framework then clarifies the relationship among the route of actual delivery, intermediate outcome measures, and maternal and infant health outcomes.

Figure 1. Analytic Framework



Abbreviations
CD=cesarean delivery, ERCD=elective repeat cesarean delivery, IRCD=indicated repeat cesarean delivery, TOL=trial of labor, UR=uterine rupture, VBAC=vaginal birth after cesarean

Relevant studies were identified from multiple searches of MEDLINE®, the Database of Abstracts of Reviews of Effectiveness, and the Cochrane databases (1980 to September 2009) and from recent systematic reviews, reference lists, reviews, editorials, Web sites, and experts. Inclusion criteria limited studies to the English language and human studies conducted in the United States and developed countries specifically evaluating birth after previous cesarean delivery. Studies focusing on high-risk maternal or neonatal conditions—including breech vaginal delivery—or including less than 10 subjects were excluded. Poor-quality studies were not included in the analyses. The overall strength of the body of evidence was rated (graded) using the Grading of Recommendations Assessment Development and Evaluation Working Group guidelines as adapted in the Methods Reference Guide for Effectiveness and Comparative Effectiveness Reviews.[2,3] Meta-analyses were conducted, when appropriate, to summarize rates and compare differences.

Results

Of the 3,134 citations reviewed from the searches, 963 full-text papers were retrieved and reviewed for inclusion. After applying inclusion/exclusion criteria, a total of 203 full-text papers were included.

Short-Term Maternal Outcomes of TOL Versus ERCD

Maternal death: Twelve studies, involving 402,883 patients, provide high strength of evidence that the risk of maternal mortality, while rare for both TOL and ERCD, is statistically significantly increased with ERCD (3.8 deaths per 100,000 for TOL [95% confidence interval (CI): 0.9 to 15.5 per 100,000] compared with 13.4 per 100,000 for ERCD [95% CI: 4.3 to 41.6 per 100,000]).

Hysterectomy: Eight studies found no significant difference in the rate of hysterectomy between TOL and ERCD.

Hemorrhage/transfusion: Among all studies, there is no significant difference in transfusions for TOL versus ERCD. However, among studies that focused exclusively on term patients, TOL is associated with increased risk of transfusion.

Infection: Twenty-two studies provide weak evidence that there is no significant difference between TOL and ERCD in infection. The body of evidence is low in strength due to inconsistent definitions, high risk of bias, and indirect evidence.

Surgical injury: There is insufficient evidence to evaluate the impact of route of delivery on surgical injury.

Length of stay: ERCD is associated with a longer hospital stay (pooled mean estimate 3.92 days [95% CI: 3.56 to 4.29]) than is TOL (2.55 days [95% CI: 2.34 to 2.76]).

Uterine rupture: There is moderate strength evidence that the risk of uterine rupture is higher for women undergoing a TOL (0.47%) than for those undergoing ERCD (0.03%). Women with prior low vertical CD or with an unknown scar are not at a statistically significant increased risk. The risk of rupture increased with induction of labor and was highest at >40 weeks gestational age.

Long-Term Benefits and Harms to the Mother of TOL Versus ERCD

Adhesions: Prior CD was associated with a statistically significant increase in adhesions at subsequent CD and hysterectomy, increased perioperative complications, time to delivery, and total operative time. It is unclear whether adhesions and complications increase with increasing number of prior cesareans.

General health: No studies evaluated TOL and/or RCD with respect to pelvic pain, risk of ectopic pregnancy, and general health risks. Two studies have suggested impaired fertility following CD.

Multiple cesareans: Women with multiple cesareans have increased risk of hemorrhage/transfusion, surgical injury, and hysterectomy. The risk of postoperative infection remains unclear. The risk of wound complications does not appear to increase.

Abnormal placentation: Women with a prior cesarean had a statistically significant increased risk of placenta previa and accreta. Risks increased with increasing number of prior cesareans, as did the risk for maternal transfusion, hysterectomy, and composite maternal morbidity.

Discussion

A major contributor to the increase in cesareans is the rapid decline in VBACs witnessed over the last decade. One of the major findings of this report is that the best evidence suggests that VBAC is a reasonable and safe choice for the majority of women with prior cesarean. However, there is a minority of women who will suffer serious adverse consequences of both TOL and ERCD. Models have not been able to predict who will do well and who will be harmed. Serious deficiencies were found in the existing literature, however, and the evidence report provides a list of research priorities to advance the field and provide important information to patients, clinicians, and policymakers.

References

1. Guise J-M, Denman MA, Eden K, et al. *Vaginal Birth After Cesarean: New Insights.* Evidence Report/Technology Assessment (Prepared by the Oregon Health & Science University Evidence-based Practice Center under Contract No. HHSA 290-2007-10057-I). AHRQ Publication. Rockville, MD: Agency for Healthcare Research and Quality; March 2010 (in press).

2. Atkins D, Eccles M, Flottorp S, et al. Systems for grading the quality of evidence and the strength of recommendations I: critical appraisal of existing approaches The GRADE Working Group. *BMC Health Serv Res.* 2004;4(1):38.

3. Agency for Healthcare Research and Quality (AHRQ). *Methods Reference Guide for Effectiveness and Comparative Effectiveness Reviews, Version 1.0*. Rockville, MD; AHRQ; 2007.

Birth After Prior Cesarean Delivery: Short-Term Maternal Outcomes

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An estimated 40% of the 1.3 million caesarean deliveries performed each year in the United States are repeat procedures. Understanding the competing short-term maternal risks of adverse outcomes associated with trial of labor after cesarean (TOLAC), elective repeat cesarean delivery (ERCD) with labor, and ERCD without labor is especially challenging given the complexity of factors influencing childbirth. If a trial of labor among some of these women were to be safe and effective,[1–12] early screening, careful candidate selection, and accurate counseling would be important to inform women of the favorable and unfavorable outcomes that present during and after childbirth.

Central to making progress in the care of women with a prior cesarean delivery is the ability to distinguish benefits from harms. The National Institute of Health's Consensus Development guidelines for the management of birth after a previous cesarean delivery were last published in 1985.[13,14] These guidelines recommended that a trial of labor should be attempted for women with previous cesareans because it was safe.[15] We discuss the available published scientific data on (1) the short-term maternal outcomes of TOLAC and ERCD, (2) the important factors that influence these outcomes, (3) the differences between outcomes for TOLAC compared with ERCD, and (4) successful VBAC compared with unsuccessful VBAC.

In the absence of randomized controlled trials, we consider observational studies conducted in North America to allow for comparison of competing short-term maternal outcomes across a range of study designs, data sources, dates, study populations, and settings. Severe short-term maternal outcomes reported in the literature include uterine rupture, uterine rupture or dehiscence, hysterectomy, bladder injury, thromboembolic disease, and death.[16–30] Less serious postdelivery outcomes have been reported on blood transfusion, postpartum hemorrhage, endometritis, infection, and prolonged hospital length of stay.[17,18,20,21,23,24,26–31]

Many factors can influence the short-term maternal outcomes associated with TOLAC and ERCD, and the relationships of these factors can be complex. Such factors may be patient related, provider related, or the environment in which the birth occurs. When deciding to undergo a TOLAC or an ERCD, providers and women want to know the benefits and risks of factors that impact the outcomes. However, except for uterine rupture, data on factors that impact short-term maternal outcomes associated with TOLAC and ERCD are relatively sparse (Table 1). On the basis of the results of the National Institute of Child Health and Human Development (NICHD) Maternal-Fetal Medicine Units (MFMU) Network Cesarean Registry study, morbidly obese women undergoing a TOLAC were more likely to have a uterine rupture relative to women with ERCD; however, absolute risk was small.[32] In women who undertake a TOLAC, the risk of uterine rupture is significantly higher among women who have either a short interpregancy or interdelivery time than among women with longer intervals.[10,29,33–35] Factors attenuating the rate of uterine rupture during TOLAC include a woman having a history of more than two previous caesarean deliveries,[36,37] a prior vaginal delivery,[26,36,38,39] and a successful previous VBAC.[40] Despite the frequent exposure of women to induction during a TOLAC, induction is known to increase the risk of uterine rupture.[5,11,12,23,25,41–44] Still, discrepancies between reported risks of uterine rupture associated with induction of labor may be attributed in part to different methods of induction, dosage, and timing.

Table 1. Factors Impacting Short-Term Outcomes Among Women With a TOLAC Compared With ERCD

Outcome	Factor	Evidence
Uterine rupture	Morbid obesity[a]	In TOLAC vs. ERCD, morbidly obese women have an increased risk of uterine rupture (2.1% vs. 0.4%).[32]
	Interpregnancy and interval delivery time[b]	Among women undergoing TOLAC, *short* interpregnancy and interdelivery interval increases uterine rupture risk,[10,29,33–35] particularly when the delivery interval is <6 months[10]; there are no data to suggest that longer intervals increase the risk for uterine rupture.
	Number of prior CS	For TOLAC vs. ERCD, women with ≥2 prior cesarean deliveries are more likely to have a uterine rupture.[36,37]
	History of prior vaginal delivery	Women who have had a vaginal birth prior to a TOLAC are at less risk for uterine rupture.[26,36,38,39]
	Prior VBAC	The likelihood of uterine rupture decreases among women undergoing a TOLAC who have had a prior VBAC.[40]
	Induction of labor	The method of induction, dosage, and timing must be taken into consideration. Overall, induction of labor increases the risk of uterine rupture.[5,11,12,23,25,41–44] Among women with a TOLAC, there is an evident dose response[11]; oxytocin ranges above 20 mU/min increases risk fourfold[12]; augmentation odds ratio [OR]=2.4; induction with any prostaglandin OR=4.0; oxytocin alone OR=3.0.[23]
Blood transfusion	Interpregnancy interval	Among women undergoing a TOLAC, an interpregnancy interval of <6 months increases the likelihood of blood transfusion, particularly when the delivery interval is <6 months.[10]
	Morbid obesity	Morbidly obese women with TOLAC vs. ERCD have similar risk of blood transfusion (1.5% vs. 1.3%).[32]
Endometritis	Morbid obesity	Morbidly obese women with TOLAC vs. ERCD are more likely to have endometritis (4.6% vs. 1.9%).[32]
Death		No data
Length of hospital stay ≥4 days	Morbid obesity	Morbidly obese women with TOLAC vs. ERCD are more likely to have longer hospital stays (30.3% vs. 26.0%).[32]

NOTE: TOLAC = trial of labor after caesarean; ERCD = elective repeat cesarean delivery.
[a] Morbidly obese defined as 40.0 kg/m^2 or greater.
[b] Interpregnancy interval defined as number of months between immediate prior delivery and subsequent conception, and interval delivery time defined as time between delivery dates.

Data identifying factors that adversely impact blood transfusion, endometritis, and prolonged hospital stay among women with ERCD or TOLAC are scarce. Among women attempting TOLAC, an interpregnancy interval of <6 months increases the likelihood of blood transfusion.[10] Based on data from the NICHD MFMU study, women with TOLAC relative to ERCD had a similar risk of blood transfusion, but morbid obesity was associated with an increased risk of blood transfusion.[32] Morbid obesity also adversely impacted other short-term maternal outcomes, including endometritis and length of hospital stay ≥4 days.

Adverse short-term maternal outcomes associated with management of childbirth among women with prior caesarean delivery can be severe. Because this area contains misperceptions, we review the medical evidence pertaining to these outcomes (Table 2). Uterine rupture is as uncommon as other major short-term maternal outcomes for which preventive strategies are debated. Almost no uterine rupture accompanies ERCD and, in the rare event that uterine rupture does occur, it is with TOLAC or ERCD with labor. Although morbidity associated with emergency hysterectomy can be very severe, hysterectomy is not significantly associated with a TOLAC compared with ERCD.[18,20,23,27,28,30,45] With regard to blood transfusion, reported rates were inconsistent between studies, particularly for TOLAC and ERCD groups.[21,23,29,31] Thromboembolic disease and maternal death rates among these women were extremely low, with no difference in the risk of either from a TOLAC versus ERCD.[18,23,28] Women with ERCD were more likely to stay longer in the hospital than women with TOLAC.[20,21]

Most adverse short-term maternal outcomes occur among women with a failed TOLAC. Uterine rupture was almost exclusively confined to unsuccessful VBAC compared with successful VBAC.[21,23,24,26,27,29,46] Overall, the rate of hysterectomy was similar for successful VBAC and unsuccessful VBAC.[17,23,27,28] Findings on blood transfusion among women with successful and unsuccessful VBAC were inconsistent, with reported rates either the same between groups[17,18,28,29] or higher among women with an unsuccessful VBAC.[21,23,24,26,27] Women with unsuccessful VBAC were more likely to have endometritis and stay longer in the hospital than women with VBAC.[20,21] Thromboembolic disease and maternal death were rarely reported and were indistinguishable between groups.

In summary, for women with a previous caesarean delivery, a successful TOLAC offers several distinct, consistently reproducible advantages compared with ERCD, including fewer hysterectomies, fewer thromboembolic events, lower blood transfusion rates, and shorter hospital stay. However, when TOLAC fails, emergency caesarean is associated with increased uterine rupture, hysterectomy, operative injury, blood transfusion, endometritis, and longer hospital stay.

Table 2. Frequency of Short-Term Maternal Outcomes for TOLAC Compared With ERCD

TOLAC	ERCD	ERCD With Labor	ERCD Without Labor	Reference
Uterine rupture (%)[a]				
–	–	0.15	0.0	Landon et al.[23,46]
0.9	0.004	–	–	Macones et al.[26]
0.3	0.0	–	–	McMahon et al.[27]
0.8	0.0	–	–	Hibbard et al.[21]
–	0.0	–	–	Blanchette et al.[29]
0.4	0.0	–	–	Loebel et al.[24]
Hysterectomy (%)				
0.2	0.3	0.3	0.0	Landon et al.[23,46]
0.2	0.2	–	–	McMahon et al.[27]
–	–	0.4	0.0	Quiroz et al.[30]
0.1–0.2[b]	0.1–0.4[b]	–	–	Gregory et al.[20]
0.3	0.5	–	–	Ford et al.[18]
0.1	0.1	–	–	Wen et al.[28]
Thromboembolic disease (%)				
0.04	0.1	-	-	Landon et al.[23]
0.0	0.1	-	-	Ford et al.[18]
0.6	0.5	-	-	Wen et al.[28]
Blood transfusion (%)				
1.7	1.0	1.7	0.9	Landon et al.[23,46]
0.7	1.2	–	–	Macones et al.[26]
1.1	1.3	–	–	McMahon et al.[27]
0.8	1.4	–	–	Hibbard et al.[21]
–	0.3	–	–	Blanchette et al.[29]
1.3	0.6	–	–	Loebel et al.[24]
–	–	0.4	0.2	Quiroz et al.[30]
0.5–0.8[b]	0.3–0.9[b]	–	–	Gregory et al.[20]
1.2	1.6	–	–	Ford et al.[18]
0.2	0.2	–	–	Wen et al.[28]
Endometritis (%)				
2.9	1.8	–	–	Landon et al.[23]
8.2	8.8	–	–	Hibbard et al.[21]
–	1.2	–	–	Blanchette et al.[29]
1.0	–	–	–	Upadhyaya et al.[31]
Maternal death (%)				
0.02	0.04	–	–	Landon et al.[23,46]
0.001	0.005	–	–	Wen et al.[28]
Length of hospital stay (days, mean)				
3.3	5.0	–	–	Hibbard et al.[21]
2.3–2.9[b]	3.0–3.3[b]	–	–	Gregory et al.[20]

NOTE: TOLAC = trial of labor after caesarean; ERCD = elective repeat cesarean delivery
[a] Based on medical record abstraction studies.
[b] Range includes women of low to high medical risk.

References

1. Cahill AG, Stamilio DM, Odibo AO, Peipert J, Stevens E, Macones GA. Racial disparity in the success and complications of vaginal birth after cesarean delivery. *Obstet Gynecol.* 2008;111:654–658.

2. Cahill AG, Stamilio DM, Odibo AO, et al. Is vaginal birth after cesarean (VBAC) or elective repeat cesarean safer in women with a prior vaginal delivery? *Am J Obstet Gynecol.* 2006;195:1143–1147.

3. Coassolo KM, Stamilio DM, Pare E, et al. Safety and efficacy of vaginal birth after cesarean attempts at or beyond 40 weeks of gestation. *Obstet Gynecol.* 2005;106:700–706.

4. Harper LM, Cahill AG, Stamilio DM, Odibo AO, Peipert JF, Macones GA. Effect of gestational age at the prior cesarean delivery on maternal morbidity in subsequent VBAC attempt. *Am J Obstet Gynecol.* 2009;200(3):276.e1–276.e6. Epub 2009 Jan 24.

5. Landon MB, Leindecker S, Spong CY, et al. The MFMU Cesarean Registry: factors affecting the success of trial of labor after previous cesarean delivery. *Am J Obstet Gynecol.* 2005;193:1016–1023.

6. Macones GA, Cahill A, Pare E, et al. Obstetric outcomes in women with two prior cesarean deliveries: is vaginal birth after cesarean delivery a viable option? *Am J Obstet Gynecol.* 2005;192:1223–1229.

7. Quinones JN, Stamilio DM, Pare E, Peipert JF, Stevens E, Macones GA. The effect of prematurity on vaginal birth after cesarean delivery: success and maternal morbidity. *Obstet Gynecol.* 2005;105:519–524.

8. Srinivas SK, Stamilio DM, Sammel MD, et al. Vaginal birth after caesarean delivery: does maternal age affect safety and success? *Paediatr Perinat Epidemiol.* 2007;21:114–120.

9. Srinivas SK, Stamilio DM, Stevens EJ, Odibo AO, Peipert JF, Macones GA. Predicting failure of a vaginal birth attempt after cesarean delivery. *Obstet Gynecol.* 2007;109:800–805.

10. Stamilio DM, DeFranco E, Pare E, et al. Short interpregnancy interval: risk of uterine rupture and complications of vaginal birth after cesarean delivery. *Obstet Gynecol.* 2007;110:1075–1082.

11. Cahill AG, Stamilio DM, Odibo AO, Peipert JF, Stevens EJ, Macones GA. Does a maximum dose of oxytocin affect risk for uterine rupture in candidates for vaginal birth after cesarean delivery? *Am J Obstet Gynecol.* 2007;197(5):495.e1–495.e5.

12. Cahill AG, Waterman BM, Stamilio DM, et al. Higher maximum doses of oxytocin are associated with an unacceptably high risk for uterine rupture in patients attempting vaginal birth after cesarean delivery. *Am J Obstet Gynecol.* 2008;199:32.e1–32.e5.

13. Cesarean childbirth. *Consens Dev Conf Summ Natl Inst Health*. 1980;3:39–53.

14. NIH Consensus Development Task Force statement on cesarean childbirth. *Am J Obstet Gynecol*. 1981;139:902–909.

15. Cragin EB. Conservatism in obstetrics. *NY Med.* 1916;104:1–3.

16. Bodelon C, Bernabe-Ortiz A, Schiff MA, Reed SD. Factors associated with peripartum hysterectomy. *Obstet Gynecol.* 2009;114:115–123.

17. El-Sayed YY, Watkins MM, Fix M, Druzin ML, Pullen KM, Caughey AB. Perinatal outcomes after successful and failed trials of labor after cesarean delivery. *Am J Obstet Gynecol.* 2007;196:583.e1–583.e5.

18. Ford AA, Bateman BT, Simpson LL. Vaginal birth after cesarean delivery in twin gestations: a large, nationwide sample of deliveries. *Am J Obstet Gynecol.* 2006;195:1138–1142.

19. Gregory KD, Korst LM, Cane P, Platt LD, Kahn K. Vaginal birth after cesarean and uterine rupture rates in California. *Obstet Gynecol.* 1999;94:985–989.

20. Gregory KD, Korst LM, Fridman M, et al. Vaginal birth after cesarean: clinical risk factors associated with adverse outcome. *Am J Obstet Gynecol.* 2008;198:452.e1–452.e12.

21. Hibbard JU, Ismail MA, Wang Y, Te C, Karrison T. Failed vaginal birth after a cesarean section: how risky is it? I. Maternal morbidity. *Am J Obstet Gynecol.* 2001;184:1365–1373.

22. Kieser KE, Baskett TF. A 10-year population-based study of uterine rupture. *Obstet Gynecol.* 2002;100:749–753.

23. Landon MB, Hauth JC, Leveno KJ, et al. Maternal and perinatal outcomes associated with a trial of labor after prior cesarean delivery. *N Engl J Med.* 2004;351:2581–2589.

24. Loebel G, Zelop CM, Egan JF, Wax J. Maternal and neonatal morbidity after elective repeat cesarean delivery versus a trial of labor after previous cesarean delivery in a community teaching hospital. *J Matern Fetal Neonatal Med*. 2004;15:243–246.

25. Lydon-Rochelle M, Holt VL, Easterling TR, Martin DP. Risk of uterine rupture during labor among women with a prior cesarean delivery. *N Engl J Med.* 2001;345:3–8.

26. Macones GA, Peipert J, Nelson DB, et al. Maternal complications with vaginal birth after cesarean delivery: a multicenter study. *Am J Obstet Gynecol.* 2005;193:1656–1662.

27. McMahon MJ, Luther ER, Bowes WA, Jr, Olshan AF. Comparison of a trial of labor with an elective second cesarean section. *N Engl J Med.* 1996;335:689–695.

28. Wen SW, Rusen ID, Walker M, et al. Comparison of maternal mortality and morbidity between trial of labor and elective cesarean section among women with previous cesarean delivery. *Am J Obstet Gynecol.* 2004;191:1263–1269.

29. Blanchette H, Blanchette M, McCabe J, Vincent S. Is vaginal birth after cesarean safe? Experience at a community hospital. *Am J Obstet Gynecol.* 2001;184:1478–1484; discussion 1484–1487.

30. Quiroz LH, Chang H, Blomquist JL, Okoh YK, Handa VL. Scheduled cesarean delivery: maternal and neonatal risks in primiparous women in a community hospital setting. *Am J Perinatol.* 2009;26:271–277.

31. Upadhyaya CD, Upadhyaya DM, Carlan SJ. Vaginal birth after cesarean delivery in a small rural community with a solo practice. *Am J Perinatol.* 2003;20:63–67.

32. Hibbard JU, Gilbert S, Landon MB, et al. Trial of labor or repeat cesarean delivery in women with morbid obesity and previous cesarean delivery. *Obstet Gynecol.* 2006;108:125–133.

33. Esposito MA, Menihan CA, Malee MP. Association of interpregnancy interval with uterine scar failure in labor: a case-control study. *Am J Obstet Gynecol.* 2000;183:1180–1183.

34. Shipp TD, Zelop CM, Repke JT, Cohen A, Lieberman E. Interdelivery interval and risk of symptomatic uterine rupture. *Obstet Gynecol.* 2001;97:175–177.

35. Bujold E, Mehta SH, Bujold C, Gauthier RJ. Interdelivery interval and uterine rupture. *Am J Obstet Gynecol.* 2002;187:1199–1202.

36. Caughey AB, Shipp TD, Repke JT, Zelop CM, Cohen A, Lieberman E. Rate of uterine rupture during a trial of labor in women with one or two prior cesarean deliveries. *Am J Obstet Gynecol.* 1999;181:872–876.

37. Miller DA, Diaz FG, Paul RH. Vaginal birth after cesarean: a 10-year experience. *Obstet Gynecol.* 1994;84:255–258.

38. Caughey AB, Shipp TD, Repke JT, Zelop C, Cohen A, Lieherman E. Trial of labor after cesarean delivery: the effect of previous vaginal delivery. *Am J Obstet Gynecol.* 1998;179:938–941.

39. Zelop CM, Shipp TD, Repke JT, Cohen A, Lieberman E. Effect of previous vaginal delivery on the risk of uterine rupture during a subsequent trial of labor. *Am J Obstet Gynecol.* 2000;183:1184–1186.

40. Mercer BM, Gilbert S, Landon MB, et al. Labor outcomes with increasing number of prior vaginal births after cesarean delivery. *Obstet Gynecol.* 2008;111:285–291.

41. Goetzl L, Shipp TD, Cohen A, Zelop CM, Repke JT, Lieberman E. Oxytocin dose and the risk of uterine rupture in trial of labor after cesarean. *Obstet Gynecol.* 2001;97:381–384.

42. Lin C, Raynor BD. Risk of uterine rupture in labor induction of patients with prior cesarean section: an inner city hospital experience. *Am J Obstet Gynecol.* 2004;190:1476–1478.

43. Ravasia DJ, Wood SL, Pollard JK. Uterine rupture during induced trial of labor among women with previous cesarean delivery. *Am J Obstet Gynecol.* 2000;183:1176–1179.

44. Zelop CM, Shipp TD, Repke JT, Cohen A, Caughey AB, Lieberman E. Uterine rupture during induced or augmented labor in gravid women with one prior cesarean delivery. *Am J Obstet Gynecol.* 1999;181:882–886.

45. Landon MB, Spong CY, Thom E, et al. Risk of uterine rupture with a trial of labor in women with multiple and single prior cesarean delivery. *Obstet Gynecol.* 2006;108:12–20.

46. Spong CY, Landon MB, Gilbert S, et al. Risk of uterine rupture and adverse perinatal outcome at term after cesarean delivery. *Obstet Gynecol.* 2007;110:801–807.

Delivery After Previous Cesarean: Long-Term Maternal Outcomes

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Most studies of cesarean morbidity focus on short-term rather than long-term complications. However, women undergoing cesarean delivery are at increased risk for a variety of chronic problems including pain and surgical adhesions. In addition, they may be at increased risk for infertility or subfertility as well as perinatal complications in subsequent pregnancies. Most importantly, women undergoing multiple repeat cesarean deliveries are at substantially increased risk for life-threatening hemorrhage and morbidity in the setting of placenta accreta. These long-term maternal complications must be factored into the risk:benefit ratio for women considering vaginal birth after cesarean (VBAC) delivery.

There are few studies that have assessed chronic pain after cesarean delivery. In a study from Denmark, 18.6% of patients still had pain months after cesarean and 12.3% still had pain at follow-up (median 10.5 months).[1] Chronic pain may be associated with entrapment of the iliohypogastric or ilioinguinal nerves after Pfannensteil incision.[2–5] The risk of pain increases with increasing numbers of cesareans, and about 1 in 12 women seek medical attention for their pain.[5] In a case-control study of women undergoing laprascopy, prior cesarean delivery had an odds ratio of 3.7 (95% confidence interval [CI]:1.7–7.7) for chronic pain.[6] Another potential source of chronic pelvic pain[7] as well as abnormal vaginal bleeding[8] is cesarean scar defects. These involve myometrial discontinuity at the site of a previous cesarean scar and may be identified by a transvaginal sonogram. Almost 7% of women with a prior cesarean had cesarean scar dehiscences detected on sonogram.[9] There was an association between multiple cesareans and the size of the defect, dysmenorrhea, and pelvic pain.[9] Pain also may be due to pelvic adhesions, which increase with increasing numbers of cesarean deliveries.[10,11]

Another source of hidden morbidity from cesarean delivery is the effect on fertility and subsequent pregnancies. In theory, surgery involving the uterus and other pelvic organs may compromise local vasculature that could potentially decrease fertility and adversely affect placental development and perinatal outcomes. In addition, surgical adhesions might obstruct tubal patency, further compromising fertility. Although it is difficult to study without bias, decreased fertility in women with prior cesarean deliveries has been reported by several groups.[12–15] Cesarean is associated with an increased risk of ectopic pregnancy and spontaneous abortion in some[12,13] but not all studies.[16] It is clearly associated with cesarean scar ectopics, a life-threatening condition that is increasingly common.[17]

Numerous studies have established a clear increase in the risk for abnormal placentation in subsequent pregnancies in women with cesarean deliveries.[18–22] The most clinically significant long-term maternal morbidity after cesarean delivery occurs in subsequent pregnancies in women with placenta accreta. The morbidity from placenta accreta is substantial and includes problems associated with massive bleeding such as disseminated intravsacular coagulation, multi-organ failure, and death, as well as the need for often-complicated hysterectomies.[23–28]

The rate of accreta is rising, almost assuredly as a direct result of the increasing rate of cesarean delivery. The incidence is now reported to be 1 in 533,[29] considerably more than the 1 in 2,510 noted in a large center between 1985–1994.[30] There is a direct correlation between an increasing number of cesarean deliveries and an increased risk of placenta accreta. In a large

multicenter cohort of 30,132 women in the Maternal-Fetal Medicine Units (MFMU) Network who had cesarean delivery without labor, placenta accreta was present in 0.24% of women having their first cesarean.[27] However, accreta occurred in 2.13%, 2.33%, and 6.74% of women having their fourth, fifth, and sixth or greater cesarean deliveries, respectively (Table 1).

The combination of placenta previa and prior cesarean delivery dramatically increases the risk for placenta accreta. In the 723 women in the cohort with placenta previa, accreta occurred in 3%, 11%, 40%, 61%, and 67% in those having their first, second, third, fourth, and fifth or greater cesarean deliveries, respectively.[27] Others also have noted a dose response between the number of prior cesareans and the risk of accreta in women with previas.[31]

Women with multiple repeat cesarean deliveries are at increased risk for a variety of complications, even if they do not have placenta accreta (Table 1).[10,11,27] There does not seem to be a clear absolute threshold for the number of cesarean deliveries beyond which patients should be counseled to forgo future pregnancies. However, the risk of several rare but serious morbidities including cystotomy, need for hysterectomy, or intensive care unit admission is substantially increased with the fourth or greater cesarean delivery.[27]

Table 1. Maternal Morbidity of Women Who Had Cesarean Deliveries Without Labor

Morbidity	First CD*		Second CD		Third CD		Fourth CD		Fifth CD		≥6 CD		*P*†
No.	**6,201**		**15,808**		**6,324**		**1,452**		**258**		**89**		**–**
Placenta accreta	15	(0.24)	49	(0.31)	36	(0.57)	31	(2.13)	6	(2.33)	6	(6.74)	<0.001
Hysterectomy	40	(0.65)	67	(0.42)	57	(0.90)	35	(2.41)	9	(3.49)	8	(8.99)	<0.001
Any blood transfusion	251	(4.05)	242	(1.53)	143	(2.26)	53	(3.65)	11	(4.26)	14	(15.73)	0.61
Blood transfusion ≥4 units	65	(1.05)	76	(0.48)	49	(0.77)	23	(1.59)	6	(2.33)	9	(10.11)	<0.001
Cystotomy	8	(0.13)	15	(0.09)	18	(0.28)	17	(1.17)	5	(1.94)	4	(4.49)	<0.001
Bowel injury	7	(0.11)	9	(0.06)	8	(0.13)	5	(0.34)	0	(0.00)	1	(1.12)	0.02
Ureteral injury	2	(0.03)	2	(0.01)	1	(0.02)	1	(0.07)	1	(0.39)	1	(1.12)	0.008
Placenta previa	398	(6.42)	211	(1.33)	72	(1.14)	33	(2.27)	6	(2.33)	3	(3.37)	<0.001
Ileus	41	(0.66)	71	(0.45)	43	(0.68)	13	(0.90)	4	(1.55)	3	(3.37)	0.01
Postoperative ventilator	62	(1.0)	33	(0.21)	15	(0.24)	10	(0.69)	2	(0.78)	1	(1.12)	<0.001
Intensive care admission	115	(1.85)	90	(0.57)	34	(0.54)	23	(1.58)	5	(1.94)	5	(5.62)	0.007
Operative time (min)	50.6	(24.0)	54.9	(23.2)	60.7	(25.6)	64.5	(32.7)	67.9	(32.6)	79.9	(53.4)	<0.001‡
Hospital days	5.6	(7.2)	3.9	(4.2)	3.8	(4.0)	4.2	(5.2)	4.1	(5.0)	5.5	(7.8)	<0.001‡
Wound infection	95	(1.53)	148	(0.94)	97	(1.53)	19	(1.31)	9	(3.45)	3	(3.37)	0.09
Endometritis	371	(5.98)	404	(2.56)	178	(2.81)	43	(2.96)	4	(1.55)	6	(6.74)	<0.001
Wound dehiscence	23	(0.37)	17	(0.11)	10	(0.16)	3	(0.21)	2	(0.78)	0		0.18
Deep venous thrombosis	17	(0.27)	24	(0.15)	9	(0.14)	3	(0.21)	0		1	(1.12)	0.42
Pulmonary embolus	13	(0.21)	18	(0.11)	5	(0.08)	4	(0.28)	1	(0.39)	1	(1.12)	0.85
Reoperation	26	(0.42)	35	(0.22)	16	(0.25)	6	(0.41)	1	(0.39)	3	(3.37)	0.57
Maternal death	12	(0.19)	11	(0.07)	3	(0.05)	1	(0.07)	0		0		0.02

NOTE: CD, cesarean delivery. Data are presented as n (%).
*Primary cesarean delivery.
† *P* values are from Cochran-Armitage test for trend unless otherwise indicated.
‡ These *P* values are from Spearman rank correlation test.
Reprinted with permission. Silver et al., 2006.[27]

Complications such as stillbirth, small for gestational age fetus, preterm birth, perinatal death, birth asphyxia, and need for neonatal resuscitation and special neonatal care all have been reported to be increased in women with prior cesarean deliveries.[32–36] In a landmark study of antepartum stillbirth in Scotland, the risk of stillbirth attributable to prior cesarean was 0.88 per 1,000 births.[32] However, several studies found no association between prior cesarean and stillbirth.[35,37–39] Different results among studies are likely due to variation in study design, definitions, and populations.

References

1. Nikolajsen L, Sorensen HC, Jensen TS, Kehlet H. Chronic pain following cesarean section. *Acta Anaesthesiol Scand.* 2004;48:111–116.

2. Sippo WC, Burghardt A, Gomez AC. Nerve entrapment after Pfannensteil incision. *Am J Obstet Gynecol.* 1987;157:420–421.

3. Melville K, Schultz EA, Dougherty JM. Ilioinguinal-iliohypogastric nerve entrapment. *Ann Emerg Med.* 1990;19:925–929.

4. Tosun K, Schafer G, Leonhartsberger N, et al. Treatment of severe bilateral nerve pain after Pfannensteil incision. *Urology.* 2006;67:623.e5–623.e6.

5. Loos MJ, Schelinga MR, Mukders LG, Roumen RM. The Pfannensteil incision as a source of chronic pain. *Obstet Gynecol.* 2008;111:839–846.

6. Almeida ECS, Nogueira AA, Candido dos Reis FJ, Rosa e Silva JC. Cesarean section as a cause of chronic pelvic pain. *Int J Gynecol Obstet.* 2002;79:101–104.

7. Klemm P, Koehler C, Mangler M, Schneider U, Schneider A. Laparoscopic and vaginal repair of uterine scar dehiscence following cesarean section as detected by ultrasound. *J Perinat Med.* 2005;33:324–331.

8. Thurman AS, Harvey WJ, Smith SS. Cesarean section scar as a cause of abnormal vaginal bleeding: diagnosis by sonohysterography. *J Ultrasound Med.* 1999;18:13–16.

9. Wang CB, Chiu WWC, Lee CY, Sun YL, Lin YH, Tseng CJ. Cesarean scar defect: correlation between cesarean section number, defect size, clinical symptoms and uterine position. *Ultrasound Obstet Gynecol.* 2009;34:85–89.

10. Nisenblat V, Barak S, Barnett Griness O, Degani S, Ohel G, Gonen R. Maternal complications associated with multiple cesarean deliveries. *Obstet Gynecol.* 2006;108:21–26.

11. Makoha FW, Felimban HM, Fathuddien MA, Roomi F, Ghabra T. Multiple cesarean section morbidity. *Int J Gynaecol Obstet.* 2004;87:227–232.

12. Hemminki E. Impact of caesarean section on future pregnancy—a review of cohort studies. *Paediatr Perinat Epidemiol.* 1996;10:366–379.

13. Mollison J, Porter M, Campbell D, Bhattacharya S. Primary mode of delivery and subsequent pregnancy. *BJOG*. 2005:112:1061–1065.

14. Murphy DJ, Stirrat GM, Heron J, and the ALSPAC Study Team. The relationship between cesarean section and subfertility in a population based sample of 14,541 pregnancies. *Human Reprod.* 2002;17:1914–1917.

15. Collin SM, Marshall T, Filippi V. Caesarean section and subsequent fertility in sub-Saharan Africa. *BJOG*. 2006;113:276–283.

16. Tower L, Strachan BK, Strachan P, Baker C. Long term implications of caesarean section. *J Obstet Gynaecol*. 2000;20:365–367.

17. Rotas MA, Haberman S, Levgur M. Cesarean scar ectopic pregnancies: etiology, diagnosis, and management. *Obstet Gynecol.* 2006;107:1373–1381.

18. Ananth CV, Smulian JC, Vintzileos AM. The association of placenta previa with history of cesarean delivery and abortion: a metaanalysis. *Am J Obstet Gynecol.* 1997;177:1072–1077.

19. Lydon-Rochelle M, Holt VL, Easterling TR, Martin DP. First-birth cesarean and placental abruption or previa at second birth. *Obstet Gynecol.* 2001;97:765–769.

20. Gilliam M, Rosenberg D, Davis F. The likelihood of placenta previa with greater numbers of cesarean deliveries and higher parity. *Obstet Gynecol.* 2002;99:976–980.

21. Getahun D, Oyelese Y, Salihu HM, Ananth CV. Previous cesarean delivery and risks of placenta previa and placental abruption. *Obstet Gynecol.* 2006;107:771–778.

22. Pallasmaa N, Ekblad U, Gissler M. Severe maternal morbidity and the mode of delivery. *Acta Obstet Gynecol Scand.* 2008;87:662–668.

23. Rosen T. Placenta accreta and cesarean scar pregnancy: overlooked cost of the rising cesarean section rate. *Clin Perinatol.* 2008;35:519–529.

24. Oyelese Y, Smulian JC. Placenta previa, placenta accreta, and vasa previa. *Obstet Gynecol.* 2005;192:1458–1461.

25. Eller AG, Porter TF, Soisson P, Silver RM. Optimal management strategies for placenta accreta. *BJOG*. 2009;116:648–654.

26. Hudon L, Belfort MA, Broome DR. Diagnosis and management of placenta percreta: a review. *Obstet Gynecol Surv.* 1998;53:509–517.

27. Silver RM, Landon MB, Rouse DJ, et al. Maternal morbidity associated with multiple cesarean deliveries. *Obstet Gynecol.* 2006;107:1226–1232.

28. Bauer ST, Bonanno C. Abnormal placentation. *Semin Perinatol.* 2009;33:88–96.

29. Wu S, Kocherginsky M, Hibbard JU. Abnormal placentation: 20 year analysis. *Am J Obstet Gynecol.* 2005;192:1458–1461.

30. Miller DA, Chollet JA, Goodwin TM. Clinical risk factors for placenta previa-placenta accreta. *Am J Obstet Gynecol.* 1997;177:210–214.

31. Clark SL, Koonings PP, Phelan JP. Placenta previa/accreta and prior cesarean section. *Obstet Gynecol.* 1985;66:89–92.

32. Smith G, Pell JP, Dobbie R. Caesarean section and risk of unexplained stillbirth in subsequent pregnancy. *Lancet.* 2003;362:1779–1784.

33. Gray R, Quigley MA, Hockley C, Kurinczuk JJ, Goldacre M, Brocklehurst P. Caesarean delivery and risk of stillbirth in subsequent pregnancy: a retrospective cohort study in an English population. *BJOG*. 2007;114:264–270.

34. Kennare R, Tucker G, Heard A, Chan A. Risks of adverse pregnancy outcomes in the next birth after a first cesarean delivery. *Obstet Gynecol.* 2007;109:270–276.

35. Salihu HM, Sharma PP, Kristensen S, et al. Risk of stillbirth following a cesarean delivery: black-white disparity. *Obstet Gynecol*. 2006;107:383–390.

36. Hemminki E, Shelley J, Gissler M. Mode of delivery and problems in subsequent births: a register-based study from Finland. *Am J Obstet Gynecol.* 2005;193:169–177.

37. Bahtiyar MO, Julien S, Robinson JN, et al. Prior cesarean delivery is not associated with an increased risk of stillbirth in a subsequent pregnancy: analysis of U.S. perinatal mortality data,1995–1997. *Am J Obstet Gynecol*. 2006;195:1373–1378.

38. Taylor LK, Simpson JM, Roberts CL, Olive EC, Henderson-Smart DJ. Risk of complications in a second pregnancy following cesarean section in the first pregnancy: a population based study. *Med J Aust*. 2005;183:515–519.

39. Wood SL, Chen S, Ross S, Suave R. The risk of unexplained antepartum stillbirth in second pregnancies following caesarean section in the first pregnancy. *BJOG*. 2008;115:726–731.

Predicting Uterine Rupture in Women Undergoing Trial of Labor After Prior Cesarean Delivery

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Catastrophic uterine rupture is the most dreaded complication for women attempting vaginal delivery after prior cesarean section (VBAC). Varying terminology and definitions employed as well as ascertainment bias all have contributed to difficulty estimating risks of uterine rupture from the VBAC literature.[1] A review of 10 observational studies providing the best evidence on the rate of symptomatic rupture in women undergoing trial of labor (TOL) revealed rates ranging from 0/1,000 in a small study to 7.8/1,000 in the largest study cited.[1] The National Institute of Child Health and Human Development Maternal-Fetal Medicine Units (MFMU) Network study reported a 0.69% incidence with 124 symptomatic ruptures occurring in nearly 18,000 women undergoing TOL.[2]

Risk Factors for Uterine Rupture

Rates of uterine rupture have been reported to vary significantly according to a variety of associated risk factors[3] (Table 1).

Table 1. Risk Factors for Uterine Rupture

	Odds Ratios	(95% CI)	References
Prior Vaginal Delivery	0.2	(0.04 – 0.8)	4
	0.38	(0.23 – 0.62)	5
	0.66	(0.45 – 0.95)	3
Multiple Prior Cesareans	3.06	(1.95 – 4.79)	6
	4.5	(1.18 – 11.5)	7
	2.3	(1.37 – 3.85)	9
	1.46	(0.87 – 2.44)	5
	1.36	(0.69 – 2.69)	3
Short Interpregnancy Interval	3.0	(1.2 – 7.2)	10
	2.65	(1.08 – 6.46)	11
	2.05	(1.41 – 2.96)	3
	2.66	(1.21 – 5.82)	12
One-Layer Uterine Closure	no ruptures		14
	3.95	(1.35 – 11.49)	15
Prior Preterm Cesarean	1.6	(1.01 – 2.50)	16
	1.5	(0.7 – 3.5)	17
Labor Induction	2.86	(1.75 – 4.67)	3
	1.01	(0.43 – 2.34)	22
Oxytocin Augmentation	2.40	(1.45 – 4.07)	3
	1.72	(0.80 – 3.64)	22

Prior Vaginal Delivery

Prior vaginal delivery has been consistently reported to be protective against uterine rupture in women undergoing TOL. A single-center study revealed a rupture rate of 0.2% (2/1,021) in women with a prior vaginal birth attempting VBAC compared with 1.1% (30/2,762) among

women with no prior vaginal deliveries.[4] Both the large multicenter studies of Macones and colleagues (odds ratio [OR]=0.38, 95% confidence interval [CI] 0.23–0.62) and Landon (OR=0.66, 95% CI 0.45–0.95) have confirmed the protective effect of prior vaginal birth on the risk for subsequent uterine rupture.[2,5]

Number of Prior Cesarean Deliveries

Miller et al. reported a uterine rupture rate of 1.7% in women with two or more prior cesareans compared to 0.6% in those with a single prior operation (OR=3.06. 95% CI 1.95–4.79).[6] A smaller study of 134 women with two prior cesareans reported a uterine rupture rate of 3.7% in these women compared to 0.8 percent in women with a single prior cesarean (OR=4.5, 95% CI 1.18–11.5).[7] In 2004, the American College of Gynecologists and Obstetricians (ACOG) followed with a recommendation that a TOL for women with two prior cesarean deliveries be limited to those with a history of a successful VBAC or prior vaginal delivery.[8] Following these recommendations, Macones and colleagues reported a uterine rupture rate of 20/1,082 (1.8%) in women with two prior cesareans compared to 113/12,535 (0.9%) in women with one prior operation (adjusted OR=2.3, 95% CI=1.37–3.85).[9] The MFMU Cesarean Registry found no difference in rupture rates in women with multiple prior cesareans (9/975, 0.9%) compared to women with a single prior cesarean (115/16,916, 0.7%).[3]

Interpregnancy Interval

Shipp and co-workers reported a rupture rate of 2.3% (7/311) in women with an interdelivery interval of less than 18 months compared with 1.1% (22/2,098) with a longer interdelivery interval.[10] Bujold and colleagues noted an interdelivery interval of less than 24 months to be associated with a 2.8% rupture rate compared to 0.9% in women undergoing TOL more than 24 months since their prior cesarean section.[11] Secondary analyses from two large multicenter reports both support an increased risk for rupture with shorter interpregnancy intervals.[3,12]

Uterine Closure Technique

In a retrospective study of 292 women undergoing TOL, similar rates of uterine rupture were found for women regardless of the prior uterine closure technique employed.[13] A small randomized trial of 145 women who received one- or two-layer closure at the time of primary cesarean revealed no cases of rupture in the subsequent delivery.[14] In contrast, a large observational cohort study in which detailed operative report review was performed, a nearly fourfold increased risk for uterine rupture following single-layer closure was evident compared to a double-layer closure.[15] It remains unclear whether single-layer closure increases the risk for uterine rupture.

Prior Preterm Cesarean Delivery

The MFMU Network reported a risk of rupture of 1.0% in women undergoing TOL with a prior preterm cesarean compared to 0.68% in those with prior term cesarean delivery.[16] In contrast, Harper's analysis revealed similar risks of uterine rupture when patients were stratified according to prior cesarean before or after 34 weeks' gestation.[17] The risk for uterine rupture was 6/508 (1.2%) with prior preterm cesarean compared to 103/12,027 (0.9%) in women with prior term operations.

Labor Induction

Induction of labor appears to be associated with an increased risk of uterine rupture in women undergoing TOL. In the MFMU Network analysis, a nearly threefold (OR=2.86, 95% CI=1.75–4.67) risk was evident as rupture occurred in 48/4,708 (1.0%) women undergoing induction and TOL compared with 24/6,685 (0.4%) accompanying spontaneous labor.[2] Although a systematic review[18] failed to find a higher rate of uterine scar disruption with labor induction, additional analyses suggest that oxytocin should be used with caution in women undergoing induction attempting VBAC.[19,20]

It is unclear whether other induction methods such as prostaglandins significantly increase the risk for uterine rupture.[2,21,22] In Macones' analysis, an increased risk for rupture was evident only in women receiving a combination of oxytocin and prostaglandins. The MFMU Network study revealed no cases of uterine rupture when prostaglandins alone were used for induction.[2,22] ACOG currently advises against the use of misoprostol (prostaglandin E1) for labor induction in women with prior cesarean delivery.[23]

Oxytocin Augmentation

Excessive oxytocin use may be associated with uterine rupture such that the MFMU Network study documented a risk for rupture of 52/6,009 (0.9%) in women receiving oxytocin for augmentation compared to 24/6,685 (0.4%) in spontaneous labor, which was confirmed in multivariable analysis.[2] In contrast, Macones and colleagues found that labor augmentation was not associated with uterine rupture.[22]

Uterine Rupture Prediction Models

Macones and colleagues used multivariable methods to develop two separate predictive models relying on antepartum and intrapartum factors and then constructed a combined model.[5] The two clinical predictive indices for uterine rupture were neither sufficiently sensitive nor specific for clinical use.

Grobman and colleagues also attempted to develop a model that would predict individual specific risk for uterine rupture during an attempted VBAC.[24] The optimal final prediction model included the two variables: previous vaginal delivery (OR=0.44) and induction of labor (OR=1.73). Unfortunately, the model did not allow a clinically useful estimate of the probability of uterine rupture for an individual woman.

Conclusions

Counseling women with prior cesarean considering their options for delivery should ideally include an individualized discussion of the risk of uterine rupture and the likelihood of successful VBAC.

In contrast to the introduction of a useful nomogram to predict the likelihood of successful VBAC for a given woman, two well-conducted analyses have failed to develop a clinically useful individual prediction model for uterine rupture.[5,24] Nonetheless, obstetrical care providers will continue to be expected to provide information to women regarding the risk of uterine rupture. Understanding this event clearly cannot be predicted on an individual basis, but known risk factors representing population averages can be discussed. Absolute risks and relative risks should be presented to provide objective counseling regarding the risk for uterine rupture.

References

1. Guise JM, McDonagh MS, Osterweil P, et al. Systematic review of the incidence and consequences of uterine rupture in women with previous cesarean section. *BMJ.* 2004;329:19–25.

2. Landon MB, Hauth JC, Leveno KJ, et al.; National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network. Maternal and perinatal outcomes associated with a trial of labor after prior cesarean delivery. *New Engl J Med.* 2004;351:2581–2589.

3. Landon MB, Spong CY, Thom E, et al.; National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network: The MFMU Cesarean Registry: risk of uterine rupture with a trial of labor in women with multiple and single prior cesarean delivery. *Obstet Gynecol.* 2006;108:12–20.

4. Zelop CM, Shipp TD, Repke JT, et al. Uterine rupture during induced or augmented labor in gravid woman with one prior cesarean delivery. *Am J Obstet Gynecol.* 1999;181:882–886.

5. Macones GA, Cahill AG, Stamilio DM, et al. Can uterine rupture in patients attempting vaginal birth after cesarean delivery be predicted? *Am J of Obstet Gynecol.* 2006;195(4):1148–1152.

6. Miller DA, Diaz FG, Paul RH. Vaginal birth after cesarean section: a 10-year experience. *Obstet Gynecol.* 1994;84:255–258.

7. Caughey AB, Shipp TD, Repke JT, et al. Rate of uterine rupture during a trial of labor in women with one or two prior cesarean deliveries. *Am J Obstet Gynecol.* 1990;181:872–876.

8. Vaginal birth after previous cesarean delivery. ACOG Practice Bulletin No. 54. American College of Obstetricians and Gynecologists. *Obstet Gynecol*. 2004;104(1):203–212.

9. Macones GA, Cahill A, Pare E, et al. Obstetric outcomes in women with two prior cesarean deliveries: is vaginal birth after cesarean delivery a viable option? *Am J Obstet Gynecol.* 2005;192(4):1223–1229.

10. Shipp TD, Zelop CM, Repke JT, et al. Interdelivery interval and risk of symptomatic uterine rupture. *Obstet Gynecol.* 2001;97:175–177.

11. Bujold E, Mehta SH, Bujold C, et al. Interdelivery interval and uterine rupture. *Am J Obstet Gynecol.* 2002;187(5):1199–1202.

12. Stamilio D, DeFranco E, Para E, et al. Short interpregnancy interval: risk of uterine rupture and complications of vaginal birth after cesarean delivery. *Obstet Gynecol.* 2007;110(5):1075–1082.

13. Tucker JM, Hauth JC, Hodgkins P, et al. Trial of labor after one- to two-layer closure of a low transverse uterine incision. *Obstet Gynecol.* 1993;168(2):545–546.

14. Chapman SJ, Owen J, Hauth JC. One- versus two-layer closure of a low transverse cesarean: the next pregnancy. *Obstet Gynecol.* 1997;89:16–18.

15. Bujold E, Bujold C, Hamilton EF, et al. The impact of a single-layer or double-layer closure on uterine rupture. *Am J Obstet Gynecol.* 2002;186:1326–1330.

16. Sciscione A, Landon MB, Leveno KJ, et al.; National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network. Previous preterm cesarean delivery and risk of subsequent uterine rupture. *Obstet Gynecol.* 2008;111:648–653.

17. Harper LM, Cahill AG, Stamilio DM, et al. Effect of gestational diabetes at the prior cesarean delivery on maternal morbidity in subsequent VBAC attempt. *Am J Obstet Gynecol.* 2009;200:276.e1–276.e6.

18. McDonagh MS, Osterweil P, Guise JM. The benefits and risks of inducing labour in patients with prior cesarean delivery: a systematic review. *BJOG.* 2005;112:1007.

19. Cahill AG, Stimilio DM, Odibo AO, et al. Does a maximum dose of oxytocin affect risk for uterine rupture in candidates for vaginal birth after cesarean delivery? *Am J Obstet Gynecol.* 2007;197(5):495–496.

20. Cahill AG, Waterman BM, Stamilio DM, et al. Higher maximum doses of oxytocin are associated with an unacceptably high risk for uterine rupture in patients attempting vaginal birth after cesarean delivery. *Am J Obstet Gynecol.* 2008;199:32.e1–32.e5.

21. Lydon-Rochelle M, Holt VL, Easterling TR, Martin DP. Risk of uterine rupture during labor among women with a prior cesarean delivery. *N Engl J Med.* 2001;345:3–8.

22. Macones G, Peipert J, Nelson D, et al. Maternal complications with vaginal birth after cesarean delivery: a multicenter study. *Am J Obstet Gynecol.* 2005;193(5):1656–1662.

23. Induction of labor. American College of Obstetricians and Gynecologists. ACOG Practice Bulletin No. 107. *Obstet Gynecol.* 2009;114:386.

24. Grobman WA, Lai Y, Landon MB, et al.; National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network. Prediction of uterine rupture associated with attempted vaginal birth after cesarean delivery. *Am J Obstet Gynecol.* 2008;193(1):30.

Evidence-based Practice Center Presentation III: Infant Benefits and Harms, and Relevant Factors

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Introduction

The evidence on the benefits and harms of trial of labor (TOL) versus elective repeat cesarean delivery (ERCD) for the infant is unclear. This systematic review was conducted to examine infant outcomes associated with vaginal birth after cesarean (VBAC)—one of the key questions specified by the Planning Committee for the 2010 NIH Consensus Development Conference: Vaginal Birth After Cesarean New Insights.[1]

Methods

Relevant studies were identified from multiple searches of MEDLINE®, the Database of Abstracts of Reviews of Effectiveness, and the Cochrane databases (1980 to September 2009) and from recent systematic reviews, reference lists, reviews, editorials, Web sites, and experts. For most outcomes, studies were limited to term infants—greater than or equal to 37 weeks gestational age (GA)—to reduce the confounding introduced by complications of prematurity. Studies addressing the influence of fetal macrosomia used fetal weight (greater than or equal to 4,000 grams) for the inclusion criteria rather than GA. The definitions accepted by the National Center for Vital Statistics[2] were used to measure the frequency of perinatal mortality, and the corresponding subsets of perinatal mortality were limited to term infants (greater than or equal to 37 weeks GA) to reduce the confounding introduced by complications of prematurity.
The overall strength of the body of evidence was rated (graded) using the Grading of Recommendations Assessment Development and Evaluation Working Group guidelines as adapted in the Methods Reference Guide for Effectiveness and Comparative Effectiveness Reviews.[3,4] Meta-analyses were conducted, when appropriate, to summarize rates and compare differences.

Results

Short-Term Infant Outcomes of TOL Versus ERCD

Perinatal death: Overall, perinatal death was rare, regardless of mode of delivery. Eight studies provide low to moderate strength of evidence that the risk of perinatal and neonatal mortality is statistically increased with TOL (1.3 deaths per 1,000 births [95% confidence interval (CI): 0.6 to 3]) versus ERCD (0.5 per 1,000 [95% CI: 0.07 to 3.8]) for perinatal death.

Respiratory conditions: There is conflicting evidence regarding whether VBAC or ERCD results in more transient tachypnea of the newborn. Two studies found significantly more infants required intubation for meconium among those mothers undergoing TOL versus ERCD (moderate strength of evidence).

Hypoxic-ischemic encephalopathy (HIE): The strength of evidence on the HIE of the infant for VBAC versus ERCD was low due to lack of consistency in measurement and the low number of studies. While studies consistently report higher risk for HIE after TOL compared with ERCD, it is not possible to know the true relationship due to the low strength of overall evidence.

Sepsis: Three studies reported sepsis in the newborn with only one study reporting proven sepsis. The overall strength of evidence for the impact of route of delivery upon infant sepsis is low due to imprecise and inconsistent definitions and the low number of studies. While it appears that there is no significant difference between TOL and ERCD, serious limitations prevent a true understanding of the relationship between route of delivery and sepsis.

Birth trauma: The overall strength of evidence for the impact of route of delivery on birth trauma is low largely due to few studies. While existing studies suggest that there is a nonstatistically significant increase in birth trauma for TOL, serious limitations prevent a true understanding of the risk of birth trauma for VBAC compared with ERCD.

Apgar scores: Four studies found no differences in Apgar scores of less than 6 and 7 at 5 minutes in infants undergoing a TOL versus ERCD. One study found that a very low Apgar score (<4) was rare but occurred more frequently in infants whose mothers attempted a TOL versus ERCD.

Neonatal intensive care unit (NICU) admissions: No studies defined the criteria for admission to the NICU. The majority of the eight studies reviewed found no significant differences in frequency of NICU admissions between TOL and ERCD.

Relevant Factors Associated With Benefits and Harms to the Infant of TOL Versus ERCD

Impact of mode of delivery on subsequent pregnancy: Two studies reported the frequency of stillbirth in subsequent pregnancies among women with a prior cesarean delivery. These studies produced conflicting results, with one study showing that prior cesarean increases the risk for unexplained stillbirth in the next pregnancy and the other study showing no difference in risk for stillbirth in the next pregnancy.

Impact of induction on infant outcomes: Evidence for the impact of induction of labor on infant outcomes is inadequate to make conclusions.

Macrosomia: There is evidence for a decreased likelihood of VBAC in infants weighing 4,000 grams or greater.

Fetal presentation: No studies were found that measured the impact of fetal presentation on the benefits or harms of a TOL versus an ERCD.

GA: There are insufficient data to determine whether GA in term neonates influences benefits or harms to the neonate undergoing TOL versus ERCD.

Long-Term Benefits and Harms to the Infant of TOL Versus ERCD

Breastfeeding: No studies were found that explored the effect of a TOL versus an ERCD on breastfeeding initiation or continuation.

Neurological development: No studies were found that measured the impact of a TOL versus an ERCD on neonatal neurological development.

Discussion

Overall, the evidence on infant outcomes was assessed to be of low to moderate strength. Perinatal and neonatal mortality rates, while rare for both TOL and ERCD, were statistically significantly higher for TOL; however, the literature on other neonatal outcomes was insufficient. The majority of studies lacked definitions or consistency of definitions for infant outcome. Outcomes of interest were generally classified by delivery mode regardless of exposure to labor. Future studies could be strengthened with closer attention to consistent definitions of infant outcomes and efforts to reduce classification bias.

References

1. Guise J-M, Denman MA, Eden K, et al. *Vaginal Birth After Cesarean: New Insights.* Evidence Report/Technology Assessment (Prepared by the Oregon Health & Science University Evidence-based Practice Center under Contract No. HHSA 290-2007-10057-I). AHRQ Publication. Rockville, MD: Agency for Healthcare Research and Quality; March 2010 (in press).

2. MacDorman MF, Kirmeyer S. Fetal and perinatal mortality, United States, 2005. *Natl Vital Stat Rep.* 2009;57(8):1–19.

3. Agency for Healthcare Research and Quality (AHRQ). *Methods Reference Guide for Effectiveness and Comparative Effectiveness Reviews, Version 1.0.* Rockville, MD: AHRQ; 2007.

4. Atkins D, Eccles M, Flottorp S, et al. Systems for grading the quality of evidence and the strength of recommendations I: critical appraisal of existing approaches The GRADE Working Group. *BMC Health Serv Res.* 2004;4(1):38.

Delivery After Previous Cesarean: Short-Term Perinatal Outcomes

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In many centers across the United States, women with a prior cesarean delivery are offered a trial of labor. Frequently, *maternal* risks of a failed trial of labor, with uterine rupture recognized as an uncommon but catastrophic complication, and cesarean delivery with its associated operative morbidity are presented to the mother. More difficult to ascertain, however, are the comparative risks and benefits of vaginal birth after cesarean delivery (VBAC) and elective repeat cesarean delivery (ERCD) to the *fetus* and *neonate.* Evaluating these risks is particularly problematic since no randomized controlled trial has compared outcomes between these two modes of delivery.[1] However, given that such a trial is unlikely to occur in the near future, we must guide our discussions with women who plan to undertake either VBAC or ERCD with the currently available observational data. Here we aim to briefly review and compare the short-term perinatal outcomes of VBAC and ERCD with a particular emphasis on problems encountered during neonatal transition.

Perinatal Mortality

Perinatal mortality is of obvious concern when considering the risks of VBAC and ERCD, although accurate evaluation is limited by data that involve heterogeneous observational studies. Although we aim to delineate the characteristics of the various studies, we emphasize that methodological limitations may prevent accurate comparisons. Several studies have compared the perinatal risk of death in infants born by ERCD and those who underwent a trial of labor (TOL) following previous cesarean delivery with essentially similar results: the rates of delivery-related perinatal death were significantly higher in the TOL group than in the ERCD group. In addition, the risk of delivery-related perinatal death in TOL was significantly higher than planned ERCD, although the overall perinatal death rate was low. Further complicating the evaluation of the relative risks of VBAC and ERCD on perinatal mortality is the prospect that ERCD may have additional benefits in the reduction of stillbirths. Indeed, the significant decrease in perinatal mortality over the last two decades has been due, in part, to the continued decline of stillbirths.[2] It is helpful to view this information against the backdrop of mortality data from studies comparing elective cesarean delivery (ECD) and planned vaginal delivery (PVD). These studies suggest a significantly higher mortality in ECD when compared to infants delivered by PVD.

Short-Term Morbidity

Respiratory morbidity following cesarean delivery is well recognized. Neonates delivered by cesarean, particularly without the onset of labor, have increased risks of transient tachypnea of the newborn, respiratory distress syndrome, and persistent pulmonary hypertension of the newborn (Table 1).[3] These infants are deprived of the maturational benefits of labor mediated by changes in endogenous steroids and catecholamines, as well as the decreased active clearance of fetal lung fluid by amiloride-sensitive sodium channels.[3–5] Several studies have reported increased incidence of oxygen requirement after admission to the neonatal intensive care unit (NICU) in infants born by ERCD when compared to those with intended VBAC.[6] Of concern, however, was the finding that neonates born by failed VBAC required the greatest amount of resuscitation and respiratory support. In addition, when respiratory outcomes are

stratified by gestational age, early term neonates, regardless of their mode of delivery, had the highest rates of oxygen required in the delivery room and admissions to the NICU (Figure 1).

Table 1. Neonatal Morbidity After ERCD Compared With VBAC

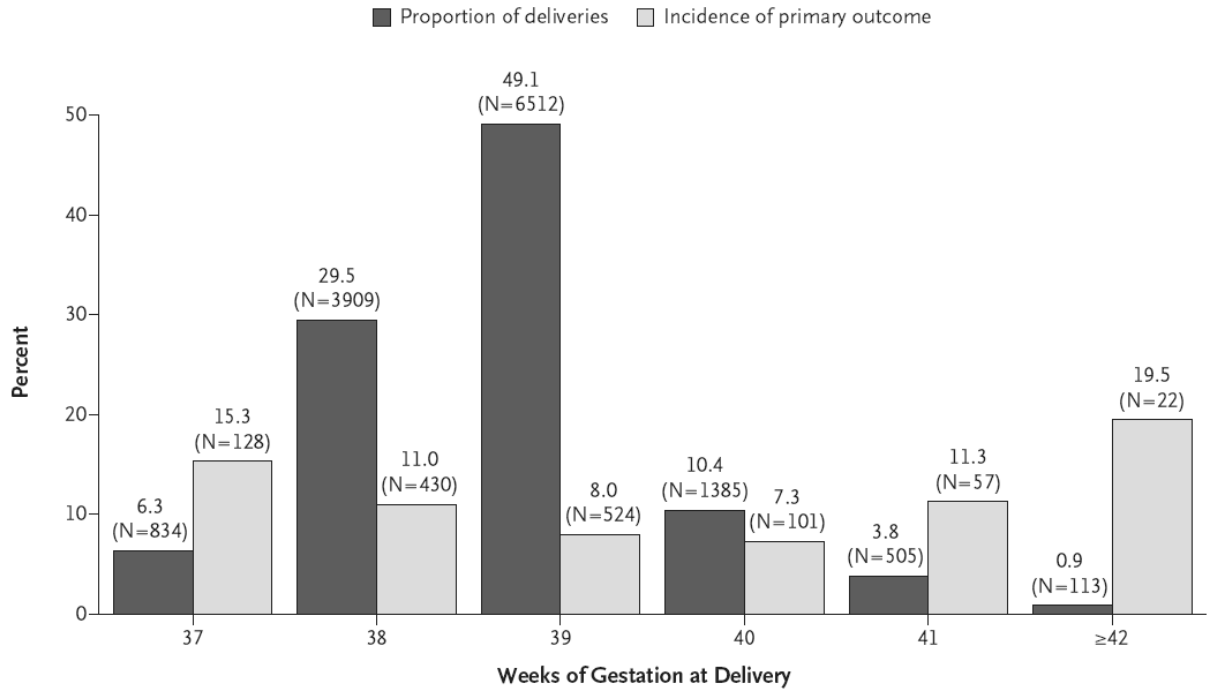
Morbidity	ERCD (n=15,212)	VBAC (n=8,336)	*P*
RDS	318 (2.1%)	119 (1.4%)	0.0003
TTN	630 (4.1%)	156 (1.9%)	0.0001
NICU Admission	1,682 (11.1%)	626 (7.5%)	0.0001
Oxygen	673 (4.4%)	212 (2.5%)	0.0001
Ventilator	192 (1.3%)	63 (0.8%)	0.0003

Data from the the National Institute of Child Health and Human Development Maternal-Fetal Medicine Units (MFMU) Network registry. ERCD, elective repeat cesarean delivery. VBAC, vaginal birth after cesarean. RDS, respiratory distress syndrome. TTN, transient tachypnea of newborn. NICU, neonatal intensive care unit. Source: Jain and Dudell, 2006.[3]

Asphyxia-related injury attributable to VBAC typically occurs following uterine rupture. The incidence ranges from 1/2,500 to 1/5,000 trials of labor.[7–9] However, the absolute risks of perinatal asphyxia are small. Birth trauma is a commonly recognized complication of both vaginal and cesarean delivery. Types of birth trauma are specific to the mode of delivery, although it is unclear if either mode confers a protection to all types of birth trauma. It has been suggested that overall reductions in birth trauma may be related to increases in cesarean delivery, although this effect appears partially due to improvements in surgical technique.[10] Common to cesarean deliveries are fetal lacerations, which have been reported as high as 3%.[11,12] However, when comparing the risks of fetal laceration due to ERCD, the effect of a failed TOL resulting in cesarean delivery must be accounted for. Studies have reported that vaginal deliveries, particularly those requiring operative assistance, were predisposing risk factors of birth trauma specific to the head and neck. Head and neck trauma, including intracranial hemorrhage and nervous injury to the face and brachial plexus, are likely influenced by both the need for operative vaginal delivery as well as an underlying abnormal course of labor.

Intracranial hemorrhage is an uncommon but serious complication in term infants and one that is feared in operative vaginal birth.[13] The incidence of intracranial hemorrhage is severalfold higher after a failed attempt to delivery vaginally with forceps or vacuum extraction when compared to cesarean prior to onset of labor. Although subdural and cerebral hemorrhage were the most common types of intracranial hemorrhage in term infants, intraventricular and subarachnoid hemorrhage also were seen in both vaginal and cesarean deliveries. Similar trends were seen with brachial plexus injury, where the incidence was highest in infants delivered with the use of both vacuum and forceps (incidence 0.46%). Although the incidence of brachial plexus injury was much lower in spontaneous vaginal delivery (0.077%), it remained higher than either cesarean delivery during labor (0.016%) or without labor (0.041%).

Figure 1. Timing of ERCD and the Incidence of the Primary Outcome According to the Number of Completed Weeks of Gestation



Primary outcome composite of neonatal death and any of several adverse events, including respiratory complications, treated hypoglycemia, newborn sepsis, and admission to the NICU. Reprinted with permission.[14]

NICU Admissions and Hospital Costs

Recent studies have shown that infants delivered by ERCD are more likely to be admitted to the NICU than those delivered by VBAC.[6] This is likely explained by the increased need for delivery room oxygen and continuous positive airway pressure in neonates born by intended cesarean.[15] Both length of stay and hospital costs are significantly higher in infants with intended cesarean delivery compared to those with intended VBAC. However, total costs due to failed VBAC are higher than those of both successful VBAC and intended cesarean delivery. Despite this, infants born with intended ERCD maintain higher median facility, physician, and total costs for both the mother and neonate than the intended VBAC group.

Conclusions

When presenting the option of a TOL to women, the uncommon but increased risk of perinatal death and birth asphyxia in women who undergo a TOL needs to be evaluated with consideration of the more frequent but less serious neonatal risks associated with ERCD. These include increased respiratory morbidity, hospital costs, and length of stay in neonates who undergo ERCD. While the majority of women who undergo a TOL will be successful, women who fail VBAC are at high risk of birth injury, need for resuscitation, and sepsis. Better prediction of those women who will fail VBAC may lead to more careful selection of candidates for a TOL and improved perinatal outcomes. Further studies are needed to help clarify the short-term risks of VBAC and better guide physicians and patients who are presented with the choice of a VBAC or ERCD. Future studies also will need to assess interventions with the promise of improving neonatal outcome after ERCD. Meanwhile, since normal spontaneous vaginal birth in women

with no prior history of cesarean delivery continues to have the best overall outcome, efforts continue to bring back the rates of primary cesarean delivery to a level that would yield the best outcomes for the mother and her baby.

References

1. Vaginal birth after previous cesarean. ACOG Practice Bulletin No. 54. American College of Obstetricians and Gynecologists. *Obstet Gynecol.* 2004;104(1):203–212.

2. Ananth CV, Gyamfi C, Jain L. Characterizing risk profiles of infants who are delivered at late preterm gestations: does it matter? *Am J Obstet Gynecol.* 2008;199(4):329–331.

3. Jain L, Dudell GG. Respiratory transition in infants delivered by cesarean section. *Semin Perinatol.* 2006;30(5):296–304.

4. Jain L. Alveolar fluid clearance in developing lungs and its role in neonatal transition. *Clin Perinatol.* 1999;26(3):585–599.

5. Jain L, Eaton DC. Physiology of fetal lung fluid clearance and the effect of labor. *Semin Perinatol.* 2006;30(1):34–43.

6. Kamath BD, Todd, JK, Spong CY, et al. Neonatal outcomes after elective cesarean delivery. *Obstet Gynecol.* 2009;113(6):1231–1238.

7. Flamm BL, Goings JR, Liu Y, et al. Elective repeat cesarean delivery versus trial of labor: a prospective multicenter study. *Obstet Gynecol.* 1994;83(6):927–932.

8. Flamm BL, Newman LA, Thomas SJ, et al. Vaginal birth after cesarean delivery: results of a 5-year multicenter collaborative study. *Obstet Gynecol.* 1990;76(5 Pt 1):750–754.

9. Miller DA, Diaz FG, Paul RH. Vaginal birth after cesarean: a 10-year experience. *Obstet Gynecol.* 1994;84(2):255–258.

10. Puza S, Roth N, Macones GA, Mennuti MT, Morgan MA. Does cesarean section decrease the incidence of major birth trauma? *J Perinatol.* 1998;18(1):9–12.

11. Dessole S, Cosmi E, Balata A, et al. Accidental fetal lacerations during cesarean delivery: experience in an Italian level III university hospital. *Am J Obstet Gynecol.* 2004;191(5):1673–1677.

12. Wiener JJ, Westwood, J. Fetal lacerations at caesarean section. *J Obstet Gynaecol.* 2002;22(1):23–24.

13. Harer WB Jr. Vaginal birth after cesarean delivery: current status. *JAMA.* 2002;287(20):2627–2630.

14. Tita AT, Landon MB, Spong CY, et al. Timing of elective repeat cesarean delivery at term and neonatal outcomes. *N Engl J Med.* 2009;360(2):111–120.

15. De Luca R, Boulvain M, Irion O, et al. Incidence of early neonatal mortality and morbidity after late-preterm and term cesarean delivery. *Pediatrics.* 2009;123(6):e1064–e1071.

Delivery After Previous Cesarean: Long-Term Outcomes in the Child

T. Michael O'Shea, M.D., M.P.H.; Mark A. Klebanoff, M.D., M.P.H.; Caroline Signore, M.D., M.P.H.

After a previous cesarean delivery (CD), the method of delivery (a trial of labor or a repeat CD) might have long-term consequences on the child, as summarized in Table 1.

Table 1. Mechanisms That Might Link Mode of Delivery and Long-Term Health and Development in the Child

Obstetric Event	Mechanism	Neonatal Manifestation	Childhood Outcome
Uterine rupture during labor	Perinatal asphyxia	Neonatal encephalopathy	Neurodevelopmental impairment
Shoulder dystocia	Nerve injury	Upper extremity palsy	Upper extremity motor impairment
Cesarean delivery	Retained fetal lung fluid; surfactant deficiency	Respiratory distress; hypoxic respiratory failure; persistent pulmonary hypertension	Neurodevelopmental impairment; asthma
Cesarean delivery	Altered gut floral	Altered immune function maturation	Asthma
Cesarean delivery	Lower rate of initiation of breastfeeding	Altered immune function maturation	Asthma

Based on two studies, Guise et al. estimated that the incremental risk associated with a trial of labor versus elective repeat CD is 2.7 (0.7 to 4.73) symptomatic ruptures per 1,000 trials of labor.[1] Data from the Maternal-Fetal Medicine Units (MFMU) Network lead to an estimate of 7.4 per 1,000 trials of labor versus elective repeat CD without labor, and 5.9 per 1,000 trials of labor versus elective repeat CD with labor.[2]

A study by the MFMU Network suggests that for every 10,000 elective repeat CDs performed after a previous CD, eight cases of hypoxic ischemic encephalopathy (HIE) would be prevented. Rates of mortality and morbidity after HIE can be estimated using data from recent trials of therapeutic hypothermia versus standard care.[3] For infants diagnosed with moderate or severe HIE who were randomized to hypothermia, the mortality rate was 16% for those with moderate HIE and 51% for those with severe HIE. Rates of major disability among survivors were 26% for moderate HIE and 41% for severe HIE.

Perinatal brachial plexus injury associated with shoulder dystocia occurs in about 0.36 to 2 per 1,000 vaginal deliveries.[4–6] The risk of permanent neurological impairment among neonates with perinatal brachial plexus injury is between 9% and 17%,[4,7,8] leading to an estimate of about 1 case of permanent upper extremity impairment due to perinatal brachial plexus injury per 10,000 vaginal deliveries. CD does not eliminate the risk of brachial plexus injury; in a study of

37,110 CDs, the incidence of perinatal brachial plexus injury was 0.3 per 1,000 among babies born by elective repeat CD.[9]

Most studies of the association of CD and neonatal respiratory disorders report odds ratios of 2–3 for transient tachypnea[10,11] and respiratory morbidity,[12–15] and even higher odds ratios for the respiratory distress syndrome[16] and persistent pulmonary hypertension.[11] In randomized trials of therapies for hypoxic respiratory failure, the mortality rate has been 9% and the rate of neurodevelopmental impairment among survivors has been 28%.[17] Neonates with persistent pulmonary hypertension who require extracorporeal membrane oxygenation have a mortality rate as high as 28%, and neurodevelopmental impairment occurs in as many as 20% of survivors.[18] Thus the higher rate of respiratory dysfunction among infants delivered by elective repeat CD can be expected to have long-term sequelae.

The higher risk of neonatal respiratory disorders, and possibly alterations in the intestinal flora after CD,[19] might explain the higher risk of asthma observed in children born by CD. In two meta-analyses of studies of the association of CD and asthma, the odds ratios for asthma after CD were 1.2 (95% confidence limits=1.14–1.26)[20] and 1.18 (95% confidence limits=1.05–1.32).[21]

Estimates of risk differences between neonatal outcomes after a trial of labor versus a planned CD are presented in Table 2. Risk differences for all of the outcomes except asthma are small, implying that at least several thousand elective CDs must be performed to prevent one adverse outcome associated with a trial of labor. This presumed benefit might be offset by the increased rate of death or neurodevelopmental impairment associated with hypoxic respiratory failure and the additional 10–20 cases of asthma for each 1,000 elective CDs performed.

Table 2. Risk Differences for Child Outcomes Comparing a Trial of Labor and Planned Cesarean Delivery (CD). (Positive numbers indicate higher rate of occurrence following a trial of labor, while negative numbers indicate a higher rate of occurrence with planned CD.)

Outcome	Estimated Risk Difference per 10,000 Deliveries
Neurodevelopmental impairment after uterine rupture	0.9 to 1.7
Death due to uterine rupture	0 to 9.8
Upper extremity neuromotor impairment after brachial plexus palsy	0.4 to 1
Neurodevelopmental impairment after hypoxic respiratory failure[a]	-20 to -40
Death due to hypoxic respiratory failure[a]	-6.6 to -13.2
Asthma[b]	-100 to -200

[a]Assumes risk difference for hypoxic respiratory failure of 14.8 per 1,000 based on a study by Liston et al.[16] that 5–10% of those with hypoxic respiratory failure are severe enough to require nitric oxide, and rates of death and impairment are similar to those observed among participants in randomized trials of nitric oxide.
[b]Assumes rates of asthma of 5–10%[22] among infants delivered after trial of labor.

Additional observational studies are needed to provide more precise estimates of these risk differences. Awaiting these data, there is no clear advantage to either a trial of labor or a planned CD. Thus randomized trials comparing these two approaches are appropriate and would provide the most valid basis for obstetric care.

References

1. Guise JM, McDonagh MS, Osterweil P, Nygren P, Chan BKS, Helfand M. Systematic review of the incidence and consequences of uterine rupture in women with previous caesarean section. *BMJ.* 2004;329:19–23.

2. Spong CY, Landon MB, Gilbert S, et al. Risk of uterine rupture and adverse perinatal outcome at term after cesarean delivery. *Obstet Gynecol.* 2007;110:801–807.

3. Jacobs SE, Hunt R, Tarnow-Mordi WO, Inder TE, Davis PG. Cooling for newborns with hypoxic ischaemic encephalopathy. *Cochrane Database Syst Rev.* 2007;4. Art. No.: CD003311-DOI: 10.1002/14651858.CD003311.pub2.

4. Rahman J, Bhattee G, Rahman MS. Shoulder dystocia in a 16-year experience in a teaching hospital. *J Reprod Med.* 2009;54:378–384.

5. MacKenzie IZ, Shah M, Lean K, Dutton S, Newdick H, Tucker DE. Management of shoulder dystocia—trends in incidence and maternal and neonatal morbidity. *Obstet Gynecol.* 2007;110:1059–1068.

6. Mehta SH, Blackwell SC, Bujold E, Sokol RJ. What factors are associated with neonatal injury following shoulder dystocia? *J Perinatol.* 2006;26:85–88.

7. Chauhan SP, Christian B, Gherman RB, Magann EF, Kaluser CK, Morrison JC. Shoulder dystocia without versus with brachial plexus injury: a case-control study. *J Matern Fetal Neonatal Med.* 2007;20:313–317.

8. Gherman RB, Ouzounian JG, Kwok L, Goodwin TM. Spontaneous vaginal delivery. A risk factor for Erb's palsy? *Am J Obstet Gynecol.* 1998;178:423–427.

9. Alexander JM, Leveno KJ, Hauth J, et al. Fetal injury associated with cesarean delivery. *Obstet Gynecol.* 2006;108:885–890.

10. Jain NJ, Kruse LK, Demissie K, Khandelwal M. Impact of mode of delivery on neonatal complications: trends between 1997 and 2005. *J Matern Fetal Neonat Med.* 2009;22:491–500.

11. Levine EM, Ghai V, Barton JJ, Strom CM. Mode of delivery and risk of respiratory diseases in newborns. *Obstet Gynecol.* 2001;97:439–442.

12. Zanardo V, Simbi AK, Franzoi M, Solda G, Salvadori A, Trevisanuto D. Neonatal respiratory morbidity risk and mode of delivery at term: influence of timing of elective caesarean delivery. *Acta Paediatr.* 2004;93:643–647.

13. Hook B, Kiwi R, Amini SB, Fanaroff A, Hack M. Neonatal morbidity after elective repeat cesarean section and trial of labor. *Pediatrics.* 1997;100:348–353.

14. Kolas T, Saugstad OD, Daltveit AK, Nilsen ST, Oian P. Planned cesarean versus planned vaginal delivery at term: comparison of newborn infant outcomes. *Am J Obstet Gynecol.* 2006;195:1538–1543.

15. De Luca R, Boulvain M, Irion O, Berner M, Pfister RE. Incidence of early neonatal mortality and morbidity after late-preterm and term cesarean delivery. *Pediatrics.* 2009;123:e1064–e1071.

16. Liston FA, Allen VM, O'Connell CM, Jangaard KA. Neonatal outcomes with caesarean delivery at term. *Arch Dis Child Fetal Neonat Ed.* 2008;93:F176–F182.

17. Finer N, Barrington KJ. Nitric oxide for respiratory failure in infants born at or near term. *Cochrane Database Syst Rev.* 2006;4. Art. No.: CD000399-DOI: 10.1002/14651858.

18. Mugford M, Elbourne D, Field D. Extracorporeal membrane oxygenation for severe respiratory failure in newborn infants. *Cochrane Database Syst Rev.* 2008;3. Art. No.: CD001340-DOI: 10.1002/14651858.

19. Gronlund MM, Salminen S, Mykkanen H, Kero P, Lehtonen OP. Development of intestinal bacterial enzymes in infants—relationship to mode of delivery and type of feeding. *Apmis.* 1999;107:655–660.

20. Thavagnanam S, Fleming J, Bromley A, Shields MD, Cardwell CR. A meta-analysis of the association between caesarean section and childhood asthma. *Clin Exp Allergy.* 2008;38:629–633.

21. Bager P, Wohlfahrt J, Westergaard T. Caesarean delivery and risk of atopy and allergic disesase: meta-analyses. *Clin Exp Allergy*. 2008;38:634–642.

22. Pearce N, Ait-Khaled N, Beasley R, et al. Worldwide trends in the prevalence of asthma symptoms: phase III of the International Study of Asthma and Allergies in Childhood (ISAAC). *Thorax.* 2007;62:758–766.

Vaginal Birth After Cesarean Synthesis: Overview of Efficacy and Safety of Vaginal Birth After Cesarean

George A. Macones, M.D., M.S.C.E.

Historical Perspective

Vaginal birth after cesarean (VBAC) was introduced in the 1980s and gained widespread acceptance to the point where some insurers were mandating VBAC attempts. After initial studies, physicians may have become overly aggressive with selection of candidates and intrapartum management, leading to an apparent increase in complications from VBAC. This, combined with medical-legal concerns and patient and physician factors, has led to a decline in VBAC. Two recent large U.S. observational studies have shed much light on the efficacy and safety of VBAC.[1,2]

What Are the Components of VBAC Safety?

A major recent concern with VBAC is safety. In this setting, there are three safety concerns: short-term maternal safety (success/failure, uterine rupture, infection/transfusion); neonatal safety (neurologic injury); and long-term maternal safety (consequences of multiple repeat cesareans).

Can Predicting Success Reduce Complications?

A commonly held myth is that the safety of VBAC can be enhanced by predicting success and failure. Attempts at prediction have been disappointing at best.[3] Even if accurate prediction were possible, the rate of uterine rupture, for example, may not be impacted, since rupture itself leads to failure. Future research should focus on predicting more important health outcomes than success/failure.[4]

How Safe Is Safe Enough?

Beauty, and risk, are in the eyes of the beholder. Short-term maternal complication rates (uterine rupture) are similar to other procedures in obstetrics and medicine overall. Short-term neonatal risks are possibly increased with VBAC, although close in magnitude to complications observed with *any* vaginal delivery. The effect of multiple repeat cesareans on maternal health can be profound, mainly due to complications of multiple surgeries and issues related to abnormal placentation.[5,6]

Can VBAC Be Offered Everywhere?

Current guidelines of the American College of Obstetricians and Gynecologists speak of “immediate availability,” thus limiting VBAC to larger hospitals with 24-hour obstetric physician and anesthesia coverage. The low risk of complications may not seem to justify this position.

What External Forces Will Drive VBAC Decisions?

There are a number of forces that may—appropriately and inappropriately—shape practice regarding VBAC. These include professional organizations, physicians, patients and advocacy groups, hospital administrators, insurers/cost, and lawyers. It is critical that we try to make a medically sound decision, rather than having such decisions be driven by nonmedical or patient-related forces.

Balancing Efficacy, Safety, and External Forces

The short-term safety evidence overall is in favor of VBAC as a standard part of practice, although research should focus on ways to further enhance safety. There is a significant downside to eliminating VBAC, specifically with impact on overall reproductive health. Insurers and concerns for professional liability should not influence best care for our patients.

How To Move Forward?

Physicians and patients need to be further educated about the efficacy and safety of VBAC. Selecting ideal candidates and conservatively managing the intrapartum period should lower major complication rates. Future research should focus on refinements in care to enhance safety.[7,8]

References

1. Landon MB, Hauth JC, Leveno KJ, et al.; National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network. Maternal and perinatal outcomes associated with a trial of labor after prior cesarean delivery. *N Engl J Med.* 2004;16;351(25):2581–2589.

2. Macones GA, Peipert J, Nelson DB, et al. Maternal complications with vaginal birth after cesarean delivery: a multicenter study. *Am J Obstet Gynecol.* 2005;193(5):1656–1662.

3. Srinivas SK, Stamilio DM, Stevens EJ, Odibo AO, Peipert JF, Macones GA. Predicting failure of a vaginal birth attempt after cesarean delivery. *Obstet Gynecol.* 2007;109(4):800–805.

4. Macones GA, Cahill AG, Stamilio DM, Odibo A, Peipert J, Stevens EJ. Can uterine rupture in patients attempting vaginal birth after cesarean delivery be predicted? *Am J Obstet Gynecol.* 2006;195(4):1148–1152.

5. Silver RM, Landon MB, Rouse DJ, et al.; National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network. Maternal morbidity associated with multiple repeat cesarean deliveries. *Obstet Gynecol.* 2006;107(6):1226–1232.

6. Paré E, Quiñones JN, Macones GA. Vaginal birth after caesarean section versus elective repeat caesarean section: assessment of maternal downstream health outcomes. *BJOG.* 2006;113(1):75–85.

7. Cahill AG, Waterman BM, Stamilio DM, et al. Higher maximum doses of oxytocin are associated with an unacceptably high risk for uterine rupture in patients attempting vaginal birth after cesarean delivery. *Am J Obstet Gynecol*. 2008;199(1):32.e1–32.e5. Epub 2008 May 2.

8. Cahill AG, Stamilio DM, Odibo AO, et al. Is vaginal birth after cesarean (VBAC) or elective repeat cesarean safer in women with a prior vaginal delivery? *Am J Obstet Gynecol.* 2006;195(4):1143–1147. Epub 2006 Jul 17.

Trial of Labor Versus Elective Repeat Cesarean: An Administrator's Perspective

Michael L. Socol, M.D.

Northwestern Memorial Hospital is a primarily private university hospital. Over my 30 years as a faculty member, the delivery volume has increased from approximately 3,500 births per year to nearly 12,000 births per year. Throughout this time period, 15–25% of the patients have come from the underserved community.

By 1986, the cesarean delivery rate at Northwestern had risen to 27.3%. Physician leaders implemented a number of initiatives in an attempt to safely curtail this trend. These initiatives included sharing with each obstetrician everyone's cesarean section rate, support for vaginal birth after cesarean (VBAC), and a prospective randomized trial of the active management of labor program for nulliparous parturients.[1] By 1996, we witnessed declines in the cesarean section rate for private patients to 16.5% and for medically indigent patients to 11.7%. For our entire population, the rate dropped to 15.4%.

As we have examined trends in our VBAC rate over the years, the denominator has included patients with one or more prior cesarean deliveries, regardless of the type of uterine incision. Consequently, our trial of labor rate appears lower than if the denominator included only patients with one prior low-transverse cesarean section. Nonetheless, in 1996, we observed that 64.7% of our private patients attempted a trial of labor with a vaginal birth rate of 80%. Similarly, 80% of our medically indigent patients labored and 77.9% delivered vaginally. As we fast forward to 2008, we continue to observe that 71.2% of our patients who attempt VBAC are successful but only 18.8% even try. Reasons for the national decline in VBAC from 28.3% in 1996 to 8.5% in 2006[2] include patient preferences, societal expectations, and risk aversion by both physicians and hospitals. Comparable to the rest of the country, we have seen an inverse relationship with our institutional cesarean delivery rate, which has risen to 29.4%.

An administrator's concerns are focused primarily on the quality of medical care, but patient satisfaction, perception by the community, and cost are also important. With regard to supporting VBAC, facility resources such as hospital beds, operating room availability, and nursing staffing are not the driving forces, although the availability of the personnel needed to respond in a timely manner to a possible uterine rupture is paramount. At Northwestern, we assign a unit attending to Labor and Delivery 24 hours a day, 7 days a week to teach medical students and residents, oversee our busy suite, and serve as a safety net. Smaller hospitals that cannot provide in-house surgical personnel and anesthesia when women desiring VBAC are in labor often decide it is not prudent to offer this service.[3]

Public perception and comparison to one's peer institutions are increasingly on the minds of administration. Internally, our obstetric quality-management committee performs peer review and also reviews a number of quality outcome measures including VBAC rate. Externally, there are opportunities such as the National Perinatal Information Center (www.npic.org) to voluntarily compare performance. Mandatory reporting occurs to the Joint Commission (www.jointcomission.org) and the Agency for Healthcare Research and Quality (www.ahrq.gov) and includes VBAC rate. And then, of course, there is the Leapfrog Group (www.leapfroggroup.org), which is an initiative by organizations/employers that buy healthcare and consequently may direct where patients are able to go for services. Whereas the Leapfrog

survey for 2009 does not include VBAC rates, transparency and easy access to healthcare information are encouraged as well as a proven record of high-quality care. Northwestern has recently developed a consumer Web site on which are posted a number of obstetric outcome measures including VBAC rate.

All hospitals are cognizant of charges and reimbursement. Hospital administrators are understandably preoccupied with budgets and balancing resources. The inherent inability to predict accurately patient volume on a daily basis in Labor and Delivery requires staffing flexibility that can contribute to fiscal inefficiency. But ebbs and tides occur on Labor and Delivery regardless of whether the medical staff and hospital are proponents of VBAC. In fact, bigger strains are placed on our delivery service by trying to accommodate all of the scheduled cases such as inductions of labor and planned cesarean deliveries. Whereas remuneration for patients attempting VBAC is most strongly influenced by the ultimate route of delivery,[4] it is hard to believe this will ever be a major determinant of hospital policy.

When analyzing the cost of providing services, specifically VBAC, the gorilla in the room is medicolegal liability. Studies have attempted to model the impact of tort reform on primary and repeat cesarean delivery rates and have shown that improvements in the medico-legal climate would be associated with reductions in cesarean sections.[5,6] These analyses strongly suggest that both caps on noneconomic damages and reductions in physician malpractice premiums would result in fewer operative deliveries. For those nonbelievers who do not think that this is a significant issue, one only has to look to south Florida where in many hospitals the cesarean delivery rate approaches, or exceeds, 50%.[7] A recent survey by the American College of Obstetricians and Gynecologists revealed that 25.9% of obstetricians stopped offering or performing vaginal birth after cesarean deliveries because of the risk or fear of professional liability claims or litigation.[8] This is compounded by 29.1% admitting to increasing their number of cesarean deliveries and 8% stopping the practice of obstetrics altogether. The average age at which physicians stopped practicing obstetrics was only 48 years.

The hospital is often viewed as the deep pocket in litigation. Since 1996, only 18% of malpractice claims against Northwestern Memorial Hospital have involved obstetric or gynecologic care, but these cases have accounted for 60% of the monetary awards. It should not be surprising that many hospitals might be able to provide the appropriate infrastructure and personnel to allow VBAC, but simply find the cost of doing business too high.

References

1. Socol ML, Garcia PM, Peaceman AM, Dooley SL. Reducing cesarean births at a primary private university hospital. *Am J Obstet Gynecol.* 1993;168(6 Pt 1):1748–1754; discussion 1754–1758.

2. Martin JA, Hamilton BE, Sutton PD, et al. Births: final data for 2006. *Natl Vital Stat Rep*. 2009;57(7). Hyattsville, MD: National Center for Health Statistics. cdc.gov/nchs/data/nvsr/nvsr57/nvsr57_07.pdf. Accessed December 31, 2009.

3. Roberts RG, Deutchman M, King VJ, Fryer GE, Miyoshi TJ. Changing policies on vaginal birth after cesarean: impact on access. *Birth*. 2007;34(4):316–322.

4. Traynor JD, Peaceman AM. Maternal hospital charges associated with trial of labor versus elective repeat cesarean section. *Birth*. 1998;25(2):81–84.

5. Murthy K, Grobman WA, Lee TA, Holl JL. Association between rising professional liability insurance premiums and primary cesarean delivery rates. *Obstet Gynecol*. 2007;110(6):1264–1269.

6. Yang YT, Mello MM, Subramanian SV, Studdert DM. Relationship between malpractice litigation pressure and rates of cesarean section and vaginal birth after cesarean section. *Med Care*. 2009;47(2):234–242.

7. Dorschner J. Births on cue: C-sections soar in S. Florida. *Miami Herald*. 2009 May 8. awombsview.com/files/Download/Birthoncue.pdf. Accessed December 31, 2009.

8. Klagholz BA, Strunk AL. Overview of the 2009 ACOG survey on professional liability. *ACOG Clin Rev*. 2009. acog.org/from_home/publications/press_releases/nr09-11-09.cfm. Accessed December 31, 2009.

Evaluating Professional Society Guidelines on Vaginal Birth After Cesarean

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Guidelines on vaginal birth after cesarean (VBAC) have changed over the last two decades. While the original main objective was to reassure healthcare professionals about the safety of VBAC in most cases, numerous reports of uterine rupture risk and complications led to the development of much more cautious guidelines.[1–3] The most recent recommendations target specific risk factors for failed trial of labor (TOL) and/or uterine rupture that should be considered in the management of women with prior cesarean. In the current report, the most recent guidelines from three national societies, the American College of Obstetricians and Gynecologists (ACOG), the Society of Obstetricians and Gynecologists of Canada (SOGC), and the Royal College of Obstetrics and Gynecology (RCOG), were reviewed and compared.[4–6]

The three societies classified their recommendations according to level of evidence based on specific criteria. While the American (2004) and Canadian (2005) guidelines are quite similar in most points, the English guidelines (2007), the most recent, represent significant differences in comparison to the first two. The differences are secondary to current data, mainly those from the study of the National Institute of Child Health and Human Development (NICHD) Maternal-Fetal Medicine Units Network.[1] Absolute and relative contraindications to VBAC (Table 1), as well as specific recommendations that were electively selected by each society, were compared. It was emphasized by the three societies that the data were limited by three factors: (1) there are no randomized trials of TOL versus elective repeat cesarean section (ERCS); (2) adverse maternal or perinatal outcomes are rare; and (3) a woman's choice to attempt TOL is heavily influenced by her healthcare provider and local resources that could lead to selection bias in published reports.[5]

Table 1. Selection Criteria for Identification of Candidates or Contraindications to VBAC

ACOG (2004)	SOGC (2005)	RCOG (2007)
Criteria useful in identifying candidates for VBAC:	Contraindications to TOL after cesarean:	Contraindications to VBAC:
1. One previous low, transverse cesarean delivery 2. Clinically adequate pelvis 3. No other uterine scars or previous rupture 4. Physician immediately available throughout active labor, capable of monitoring labor, and performing an emergency cesarean delivery 5. Availability of anesthesia and personnel for emergency	1. Previous classical or inverted "T" uterine scar 2. Previous hysterotomy or myomectomy to enter the uterine cavity 3. Previous uterine rupture 4. Presence of a contraindication to labor, such as placenta previa or malpresentation 5. Patient declines a TOL after cesarean and requests ERCS	1. Previous uterine rupture 2. Previous high, vertical, classical cesarean 3. Three or more previous cesareans

cesarean delivery

Antenatal Counseling

All three societies recommend that the option of VBAC and the alternative of an ERCS should be discussed with all women with one prior cesarean and documented in the notes. Women should be informed that, overall, the chances of successful, planned VBAC are 72–76% (RCOG), 60–80% (ACOG), or 50–85% (SOGC) and the risk of uterine rupture is between 0.2 to 0.7% (RCOG), 0.2 to 1.5% (SOGC), or generally less than 1% (ACOG). The RCOG guidelines, which were published after the NICHD study,[1] added that women considering a planned VBAC should be informed of the additional 8/10,000 (1/1,250) risk of the infant developing hypoxic ischemic encephalopathy, and the planned ERCS may increase the risk that their baby will have respiratory problems after birth, along with their own risk of serious complications in future pregnancies.

Factors Associated With Outcomes

The three societies agreed about the safety of epidural anesthesia, the safety of a TOL in women with multiple gestations, with an unknown uterine scar,[7,8] and on a recommendation of continuous fetal heart rate monitoring during labor. They all agreed about the increased risk of uterine rupture associated with labor induction, especially with prostaglandins,[2,9,10] and with a short interdelivery interval.[11–14] However, there are variances in the recommendations to women with multiple previous cesarean[15,16] and in the recommendations to women who required oxytocin augmentation. Finally, only the SOGC reported the two studies of Rozenberg et al. suggesting that evaluation of the lower uterine segment's thickness at 36–38 weeks' gestation could help in the prediction of uterine rupture,[17–19] but stated that these findings will need to be confirmed in further randomized studies.[18,20]

Facilities and Resources

Since 1999, the ACOG has recommended that a physician capable of monitoring labor and performing emergency cesarean should be immediately available throughout active labor, along with anesthesia and personnel for emergency cesarean.[21] The SOGC made the same recommendation in 2004 but changed it a few months later to specify that an approximate timeframe of 30 minutes should be considered adequate in the set-up of an urgent laparotomy. The RCOG stipulates giving advice to women that planned VBAC should be conducted in a suitably staffed and equipped delivery suite, with available resources for immediate cesarean and advanced neonatal resuscitation. A large retrospective study disclosed that planned VBAC in low-volume hospitals was associated with an increased risk of uterine rupture leading to perinatal death.[22] As suggested by Landon, the recommendation of having a physician ''immediately available'' and anesthesia service involvement for emergency cesarean around the clock can significantly limit access to VBAC in rural hospitals.[23] In my opinion, this guideline makes sense from a theoretical viewpoint but could be questioned ethically, mainly for women who are at low risk of uterine rupture and live in rural areas without such resources. Can we force them toward major surgery such as ERCS, with potential short- and long-term adverse outcomes? Like the RCOG, I believe that women should be appropriately informed of the pros and cons of a TOL and the ideal set-up, but the decision should remain their own, independently of the resources.

References

1. Landon MB, Hauth JC, Leveno KJ, et al. Maternal and perinatal outcomes associated with a trial of labor after prior cesarean delivery. *N Engl J Med.* 2004;351:2581–2589.

2. Lydon-Rochelle M, Holt VL, Easterling TR, Martin DP. Risk of uterine rupture during labor among women with a prior cesarean delivery. *N Engl J Med.* 2001;345:3–8.

3. Bujold E, Gauthier RJ. Neonatal morbidity associated with uterine rupture: what are the risk factors? *Am J Obstet Gynecol.* 2002;186:311–314.

4. Vaginal birth after previous cesarean. ACOG Practice Bulletin No. 54. American College of Obstetricians and Gynecologists. *Obstet Gynecol.* 2004;104(1):203–212.

5. SOGC Clinical Practice Guidelines. Guidelines for vaginal birth after previous caesarean birth. Number 155 (Replaces guideline Number 147), February 2005. *Int J Gynaecol Obstet.* 2005;89:319–331.

6. Royal College of Obstetricians and Gynecologists. Birth after previous caesarean birth. Green-Top Guideline No. 45. London, UK: RCOG; 2007.

7. Pruett KM, Kirshon B, Cotton DB. Unknown uterine scar and trial of labor. *Am J Obstet Gynecol.* 1988;159:807–810.

8. Beall M, Eglinton GS, Clark SL, Phelan JP. Vaginal delivery after cesarean section in women with unknown types of uterine scar. *J Reprod Med.* 1984;29:31–35.

9. Ravasia DJ, Wood SL, Pollard JK. Uterine rupture during induced trial of labor among women with previous cesarean delivery. *Am J Obstet Gynecol.* 2000;183:1176–1179.

10. Committee opinion. Induction of labor for vaginal birth after cesarean delivery. *Obstet Gynecol.* 2002;99:679–680.

11. Bujold E, Mehta SH, Bujold C, Gauthier RJ. Interdelivery interval and uterine rupture. *Am J Obstet Gynecol.* 2002;187:1199–1202.

12. Shipp TD, Zelop CM, Repke JT, Cohen A, Lieberman E. Interdelivery interval and risk of symptomatic uterine rupture. *Obstet Gynecol*. 2001;97:175–177.

13. Esposito MA, Menihan CA, Malee MP. Association of interpregnancy interval with uterine scar failure in labor: a case-control study. *Am J Obstet Gynecol.* 2000;183:1180–1183.

14. Stamilio DM, DeFranco E, Pare E, et al. Short interpregnancy interval: risk of uterine rupture and complications of vaginal birth after cesarean delivery. *Obstet Gynecol.* 2007;110:1075–1082.

15. Landon MB, Spong CY, Thom E, et al. Risk of uterine rupture with a trial of labor in women with multiple and single prior cesarean delivery. *Obstet Gynecol.* 2006;108:12–20.

16. Caughey AB, Shipp TD, Repke JT, Zelop CM, Cohen A, Lieberman E. Rate of uterine rupture during a trial of labor in women with one or two prior cesarean deliveries. *Am J Obstet Gynecol.* 1999;181:872–876.

17. Bujold E, Jastrow N, Simoneau J, Brunet S, Gauthier RJ. Prediction of complete uterine rupture by sonographic evaluation of the lower uterine segment. *Am J Obstet Gynecol.* 2009;201:320.e1–320.e6.

18. Rozenberg P, Goffinet F, Phillippe HJ, Nisand I. Ultrasonographic measurement of lower uterine segment to assess risk of defects of scarred uterus. *Lancet.* 1996;347:281–284.

19. Jastrow N, Chaillet N, Roberge S, Morency AM, Lacasse Y, Bujold E. Sonographic lower uterine segment thickness and risk of uterine scar defect: a systematic review. *J Obstet Gynaecol Can.* 2010; in press.

20. Rozenberg P, Goffinet F, Philippe HJ, Nisand I. Thickness of the lower uterine segment: its influence in the management of patients with previous cesarean sections. *Eur J Obstet Gynecol Reprod Biol.* 1999;87:39–45.

21. Vaginal birth after previous cesarean delivery. ACOG Practice Bulletin No. 5. American College of Obstetricians and Gynecologists. *Int J Gyn Obstet.* 1999;66:197–204.

22. Smith GC, Pell JP, Pasupathy D, Dobbie R. Factors predisposing to perinatal death related to uterine rupture during attempted vaginal birth after caesarean section: retrospective cohort study. *BMJ.* 2004;329:375.

23. Landon MB. Vaginal birth after cesarean delivery. *Clin Perinatol.* 2008;35:ix–x, 491–504,

Impact of Anesthesiologists on the Incidence of Vaginal Birth After Cesarean in the United States: Role of Anesthesia Availability, Productivity, Guidelines, and Patient Safety

David J. Birnbach, M.D., M.P.H.

This talk will focus on the role of anesthesia services in the trend of the decreasing rates of vaginal birth after cesarean delivery (VBAC). One of the serious complications of attempted VBAC is uterine rupture, which can be associated with massive blood loss and a high incidence of fetal and maternal morbidity and mortality. In these cases, maintaining circulating intravascular volume often is not possible without surgical repair and thus usually requires the urgent administration of anesthesia.

A key concept in this discussion is “immediate availability” of an anesthesia provider for hospitals offering VBAC. Are there enough of them to ensure “immediate” anesthesia availability for all hospitals that offer obstetric services? Not currently. Can we increase the number of physician anesthesiologists and certified registered nurse anesthetists (CRNAs) so that every hospital in the United States has the ability to offer immediate access to anesthesia services? Unlikely. The future supply of anesthesiologists (those currently in residency training) is insufficient to expand the workforce of anesthesiologists adequately to achieve this goal. Some have suggested that current levels of trainees will barely allow the size of the workforce to stay steady, since many anesthesiologists are approaching retirement age and many others are considering working part time. In addition to these concerns, the surgical workload for anesthesiologists is likely to increase over the next few decades.

Regardless of future trends, there do not currently appear to be enough extra anesthesia personnel to radically shift staffing patterns throughout the United States to provide instant anesthesia availability at all hospitals with obstetric services. Nor is this an optimal utilization of their efforts. Hospitals report a nationwide vacancy rate of CRNAs,[1] as well as physician anesthesiologists[2]; if there is a shift of anesthesia personnel from other areas to obstetrics, there will be difficulty in completing necessary surgeries in the main operating room.

The availability of anesthesia providers varies considerably from state to state, city to city, and community to community. Availability is even more problematic in rural areas of the United States. A report from a federally funded center dedicated to the study of the provision of healthcare in rural Alaska, Idaho, Montana, Washington, and Wyoming stated that nine administrators reported that a shortage of anesthesia personnel affected their ability to deliver obstetric care and that three administrators specifically reported that lack of an epidural service limited obstetrics.[3]

The number of deliveries clearly impacts on the ability to provide 24/7 anesthesia coverage. The 2001 Obstetric Anesthesia Workforce Survey reported that in-house anesthesiology was available in only 4% of hospitals that were performing <500 deliveries annually.[4] Still, 68% of these small labor and delivery units allowed VBAC attempts; of these hospitals, only 33% reported that in-house anesthesia was required during VBAC without regional analgesia. Lavin and colleagues reported that an anesthesiologist was physically present in only 26% of level I hospitals (defined by their state as “uncomplicated pregnancies and unanticipated

complications") despite the fact that VBAC was performed in 93.7% of those hospitals. This number increased to approximately 62% when an obstetrician was present for the VBAC, which occurred in only 27.3% of the level I hospitals.[5]

Consolidation of services has been recommended in the past but is not always possible, especially in more rural locations. What is needed in order for small hospitals to continue to provide VBAC services? The American College of Obstetricians and Gynecologists and the American Society of Anesthesiologists issued a joint statement that was last amended in 2008 and stated, "Immediate availability of appropriate facilities and personnel, including obstetric anesthesia, nursing personnel, and a physician capable of monitoring labor and performing cesarean delivery, including an emergency cesarean delivery in cases of vaginal birth after cesarean delivery."[6] They did not differentiate based on location, size of the service, or risk of uterine rupture.

To increase VBAC availability and safety for patients and providers, some physicians and hospitals (for example, the Northern New England Perinatal Quality Improvement Network [NNEPQIN]) have come together to define parameters locally.[7] Specific guidelines have been developed by a collaborative effort between obstetricians, anesthesiologists, hospital administrators, medical malpractice attorneys, insurers, and public health departments. These efforts have resulted in protocols, patient education efforts, and specific consents for VBAC. Patients are stratified into high-, medium-, and low-risk categories. Such protocol guidelines can have an institutional component whereby cesarean delivery may be recommended if a woman's risk status increases and provider services cannot be increased and maintained until delivery. Further efforts by NNEPQIN have included work to improve local emergency cesarean delivery processes. This group used process mapping, identification of critical steps and resources, simulation exercises, and tracking of outcomes to create "toolkits" for hospitals to use to improve emergency cesarean delivery processes. These types of educational efforts should be useful where routine 24-hour in-house coverage is not possible.

There is no question that the rate of VBAC has been steadily decreasing in the United States. What is not clear, however, is what part the availability of anesthesia personnel has played in this reduction. Hospitals with large numbers of deliveries do not seem to be significantly impacted, because they typically have 24/7 anesthesia coverage. In smaller hospitals where anesthesiologists do call from home, quite often the obstetricians are similarly not immediately present. Lack of immediate availability of anesthesia may not always be a key factor in outcome, especially in cases where the obstetrician is not present. Many cases of uterine rupture can be stabilized while the anesthesiologist becomes available, and examples have been suggested of ways to reduce the risk associated with such a crisis. These include antepartum consultation of VBAC patients with the anesthesia department, development of cesarean delivery under local anesthesia protocols, finding methods of improving communication on labor and delivery suites, practice "fire-drills," and development of protocols matching resources to risk.

Would provision of an anesthesiologist standing by waiting for an emergency at every hospital that practices obstetric care increase patient safety? In truth, that person would need to be doing nothing else clinically, so even being in the hospital might not qualify for "immediately available." Looking at the numbers of anesthesia staff currently available, the minimum requirement to provide immediate anesthesia care for all deliveries would be to have all deliveries accomplished at facilities with greater than 1,500 deliveries annually. This would require that approximately three-quarters of all obstetric programs nationwide be closed.[4] For now, the solution to the "VBAC issue" is not to dramatically increase the number of anesthesia

personnel in the United States in order to be able to provide immediate availability of anesthesiology services in all labor and delivery suites.

What is next? Consolidation of obstetric services wherever possible, improved patient education, development of protocols and guidelines that allow stratification of risk and optimization of manpower, improved processes, use of team training and simulation for labor and delivery staff, and further patient safety research.

References

1. Merwin E, Stern S, Jordan LM, Bucci M. New estimates for CRNA vacancies. *AANA J.* 2009;77(2):121–129.

2. Kheterpal S, Tremper K, Shanks A, Morris M. Seventh and eighth year follow-up on workforce and finances of the United States anesthesiology training programs: 2007 and 2008. *Anesth Analg.* 2009;109(3):897–899.

3. Dunbar PJ, Mayer JD, Fordyce MA, et al. Availability of anesthesia personnel in rural Washington and Montana. *Anesthesiology.* 1998;88(3):800–808.

4. Bucklin BA, Hawkins JL, Anderson JR, Ullrich FA. Obstetric anesthesia workforce survey: twenty-year update. *Anesthesiology.* 2005;103(3):645–653.

5. Lavin JP Jr, DiPasquale L, Crane S, Stewart J Jr. A state-wide assessment of the obstetric, anesthesia, and operative team personnel who are available to manage the labors and deliveries and to treat the complications of women who attempt vaginal birth after cesarean delivery. *Am J Obstet Gynecol.* 2002;187(3):611–614.

6. Vaginal birth after previous caesarean. ACOG Practice Bulletin No. 54. American College of Obstetricians and Gynecologists. *Obstet Gynecol.* 2004;104(1):203–212.

7. Northern New England Perinatal Quality Improvement Network. www.nnepqin.org. Accessed November 25, 2009.

The Immediately Available Physician Standard

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The recent decline in the vaginal birth after cesarean (VBAC) rate in the United States is linked to a change in the standard for physician availability during a trial of labor. Before 1999, the standard ("readily available") was the same whether the parturient did or did not have a uterine scar.[1] Subsequently, the standard for women undergoing a VBAC trial changed to "immediately available."[2] The genesis of the change was concerns that were raised both about the danger posed by VBAC and the possibility that obstetrical complications linked to VBACs were particularly precipitous and disastrous.[3]

The focus of this presentation is the appropriateness of the new standard, discussing the underpinning characteristic of women undergoing VBAC that warrants the standard and considering whether there are other parturients who share that characteristic (i.e., are at similar risk from other obstetrical emergencies and could similarly benefit from the immediate availability of an obstetrician), and who should also be subject to that standard. Finally, comments will be made about how to move forward should it be felt that immediately available physicians do in fact lower risks for women undergoing trials and/or other women in labor.

Obstetrical emergencies that create risk similar to those faced by women undergoing a trial of labor may well exist. Abruptio placenta, for example, has a 1% worldwide prevalence and has been reported to increase perinatal mortality 25-fold at term.[4,5] While a physician knows when a woman is going to have VBAC but not when a woman will abrupt, there are circumstances (e.g., hypertension, premature rupture of membranes) in which an elevated risk of abruption can be anticipated. It also is true that a woman undergoing VBAC may have a higher risk of an intrapartum or neonatal death (1/1,000)[6,7] than a hypertensive woman at term does of a perinatal death related to an abruption (approximately 1 per 2,000), but that difference in risk is not dramatic. Similarly, a woman with late premature rupture of membranes may face a risk as high as 130/1,000 of sustaining an abruption, a substantial percentage of which will be severe.[8] Other complications with a short timeline from diagnosis to damage, for which an immediately available team would potentially be salutary, include hemorrhage, prolapsed cord, and fetal bradycardia. In some, these events are much more common causes of emergent ("crash") cesarean sections[9] and hypoxia[10] than are ruptured uteri.

Given that women can be identified who face a peril similar to that of women undergoing a trial of labor, what evidence supports holding VBAC to a greater personnel requirement? For one thing, other obstetrical emergencies may differ in the manner in which risks can be avoided. The American College of Obstetricians and Gynecologists has stated, "In contrast to other obstetric emergencies, such as prolapsed cord or placenta accreta, VBAC is a completely elective procedure that allows for reasonable precautions in assuming this small but significant risk."[11] In other words, ruptured uteri could be largely avoided by disallowing VBACs. To have a similar impact on risks related to severe abruptions, a large number of women would be asked to undergo a prophylactic primary cesarean section, an intervention that is far from any current standard of care. However as noted above, the number of scheduled surgeries to prevent one adverse event would not be vastly different if all hypertensive women underwent a cesarean section at 39 weeks than if all women with a prior cesarean section underwent an elective repeat. More to the point though, having an immediately available physician would undoubtedly

also benefit women with hypertension, women with premature rupture of membranes, and many other groups of women as well.

Indeed it could be argued that the immediate availability standard should not be limited to any narrow subset of parturients. In fact, there are studies that have found adverse outcomes among all nulliparous women in labor that are similar to that of women undergoing a trial of labor.[12] Whenever the fetal condition deteriorates from a nonreversible event, whether it be a ruptured uterus, or an abruption or a prolapsed cord, there is a continuous drop in pH and inexorable rise in base excess. These have been estimated to be as rapid as a decline in pH of .011mml/L per minute[10] and a rise in base excess greater than 1mmol/L every 3 minutes.[13] The advantage of an immediately available team regardless of the triggering event is clear, and the Perinatal Care Guidelines manual explicitly cites examples of conditions for which delivery should be more expeditious than the generally allowed 30 minutes (e.g., previa, abruptio, prolapsed cord, in addition to uterine rupture).[14] Patient safety experts have already started to argue for an ability to respond to the type of untoward events that can happen in any labor.[15,16]

At some point, the minimal standard for an obstetrical service will have to be more broadly considered. Ultimately, if evidence is deemed sufficient to justify the immediately available standard, the challenge will be for the healthcare system to implement it more uniformly. Perhaps the thorniest fact is that all hospitals cannot provide the same standard of care. The relationship between volume and outcome has been clearly demonstrated by hundreds of papers focused on numerous procedures.[17] Similarly, some, but not all, authors have reported an inverse relationship between hospital size and perinatal injury linked to uterine rupture during a VBAC trial.[18–21] Instituting the “immediately available” standard might be seen as means to reduce disparate outcomes, but also may merely “pick low-hanging fruit,” leaving in place the excess morbidity related to not having an immediately available physician in other, more common, though equally perilous clinical circumstances. The urgency and public health importance of these questions relate directly to the fact that 39% of American hospitals deliver less than 500 infants a year,[22,23] and they would undoubtedly feel that their resources in many circumstances would be inadequate to allow an immediately available team of providers to be present for women requesting VBACs (or facing any other similar risk).

Finally, it is clear that data needed to provide answers to questions about maintaining, abandoning, or modifying the immediately available physician standard are lacking. Many hospitals already have stopped performing VBACs. It would be helpful to gauge their experience and to see if morbid outcomes have decreased. An inventory of resources across hospitals in the United States also would be instructive. At a more macro level, the question of whether standards for obstetrical service need to be updated or modified to reflect alternative approaches—for example, laborists who could provide immediate availability—remains unanswered.

In sum, while it reasonable to assume that having an immediately available obstetrician during a VBAC trial will reduce risk, it is less certain that similar advantage would not accrue to many other women were that standard more broadly applied. It also is unclear that the level of risk that would obtain in institutions holding to the old, “readily available” standard is a sufficient predicate for abrogating a woman’s right to choose to avoid surgery. Indeed, the degree of risk faced by the fetuses of these women, even in the setting of the older standard, is not substantially greater than those faced by pregnant women in a number of circumstances in which patient choice is generally accepted. That said, it is undoubtedly true that risks faced by parturients, such as sudden deteriorations in fetal status or shoulder dystocia, would be mitigated if the immediately available standard was the singular standard. The fact that a large

number of hospitals cannot staff up to that standard may not be an adequate justification for its selective application in the setting of VBAC, particularly since many other women's risk profiles would allow physicians to drop risk to a similar degree by implementing the same policy for them.

Accordingly, the following suggestions are made: set a goal of providing an immediately available team whenever possible for all women in labor. This might require consideration of merging obstetrical services if it is geographically feasible or establishing regional trial centers if only a single hospital in a given area can adequately staff-up to the standard. All women should have informed consent tailored to their unique risks; unique because of their own risk profile (e.g., previous scar, hypertension) or unique because of characteristics of the birthing site (e.g., a team is or is not available). In smaller hospitals, if an immediately available team cannot be routinely provided, consideration should be given to bringing in a team for the occasional patient requesting a trial, and to allowing labor for lower risk (higher likelihood of success) trials. Finally, standards for care should be based on medical evidence, not patterns of litigation. Reconciling the goal of optimal outcomes with the reality of disparate resources remains a challenge that looms more broadly than how to set policy for women desiring a trial of VBAC.

References

1. American College of Obstetricians and Gynecologists. Vaginal birth after previous cesarean delivery. ACOG Practice Bulletin No. 2. 1998;928–935.

2. American College of Obstetricians and Gynecologists (ACOG). Vaginal birth after previous cesarean delivery. ACOG Practice Bulletin No. 5. 1999;1106–1112.

3. McMahon MJ, Luther ER, Bowes WA Jr, Olsshan AF. Comparison of a trial of labor with an elective second cesarean section. *N Engl J Med*. 1996;335(10):689–695.

4. Ananth CV, Berkowitz GS, Savitz DA, Lapinski RH. Placental abruption and adverse perinatal outcomes. *JAMA*. 1999;282(17):1646–1651.

5. Oyelese Y, Ananth CV. Placental abruption. *Obstet Gynecol*. 2006;108(4):1005–1016.

6. Lydon-Rochelle M, Holt VL, Easterling TR, Martin DP. Risk of uterine rupture during labor among women with a prior cesarean delivery. *N Engl J Med*. 2001;345(1):3–8.

7. Landon MB, Hauth JC, Leveno KJ, et al.; National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network. Maternal and perinatal outcomes associated with a trial of labor after prior cesarean delivery. *N Engl J Med*. 2004;351(25):2581–2589. Epub 2004 Dec 14.

8. Holmgren PA, Olofsson JI. Preterm premature rupture of membranes and the associated risk for placental abruption. Inverse correlation to gestational length. *Acta Obstet Gynecol Scand*. 1997;76(8):743–747.

9. Lagrew DC, Bush MC, McKeown AM, Lagrew NG. Emergent (crash) cesarean delivery: indications and outcomes. *Am J Obstet Gynecol*. 2006;194(6):1638–1643.

10. Leung TY, Chung PW, Rogers MS, Sahota DS, Lao TT, Chung TKH. Urgent cesarean delivery for fetal bradycardia. *Obstet Gynecol*. 2009;114(5):1023–1028.

11. Zinberg S. Cesarean delivery resources need to be available during VBAC trial of labor. *ACOG Today*. 1999;43:1.

12. Smith GC, Pell JP, Cameron AD, Dobbie R. Risk of perinatal death associated with labor after previous cesarean delivery in uncomplicated term pregnancies. *JAMA*. 2002;287(20):2684–2690.

13. Ross MG, Gala R. Use of umbilical artery base excess: algorithm for the timing of hypoxic injury. *Am J Obstet Gynecol*. 2002;187(1):1–9.

14. American Academy of Pediatrics and American College of Obstetricians and Gynecologists. *Guidelines for Perinatal Care*. 6th ed. Atlanta, GA; 2007:159.

15. Institute for Healthcare Improvement. Elective Induction and Augmentation Bundles. 2009. ihi.org/IHI/Topics/PerinatalCare/PerinatalCareGeneral/EmergingContent/ElectiveInductionandAugmentationBundles.htm. Accessed November 15, 2009.

16. Minkoff H, Berkowitz R; Greater New York Hospital Association's Perinatal Safety Committee. Fetal monitoring bundle. *Obstet Gynecol*. 2009;114(6):1332–1335.

17. Kizer KW. The volume–outcome conundrum. *N Engl J Med*. 2003;349(22):2159–2161.

18. Shah PS. Outcomes associated with a trial of labor after prior cesarean delivery. *N Engl J Med*. 2005;352(16):1718–1720.

19. DeFranco EA, Rampersad R, Atkins KL, et al. Do vaginal birth after cesarean outcomes differ based on hospital setting? *Am J Obstet Gynecol*. 2007;197(4):400.e1–e6.

20. Smith GC, Pell JP, Pasupathy D, Dobbie R. Factors predisposing to perinatal death related to uterine rupture during attempted vaginal birth after caesarean section: retrospective cohort study. *BMJ*. 2004;329(7462):375. Epub 2004 Jul 19.

21. Chang JJ, Stamilio DM, Macones GA. Effect of hospital volume on maternal outcomes in women with prior cesarean delivery undergoing trial of labor. *Am J Epidemiol*. 2008;167(6):711–718. Epub 2008 Jan 11.

22. *AHA Annual Survey Database* – Fiscal Year 2007. Chicago, IL: American Hospital Association; 2008.

23. *AHA Hospital Statistics 2009 Edition: The Comprehensive Reference Source for Analysis and Comparison of Hospital Trends (Hospital Statistics)*. Chicago, IL: American Hospital Association; 2008.

Understanding Risk, Patient and Provider Preferences, and Obstetric Decision-Making: Approach to Delivery After Cesarean

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Introduction

Determining the optimal mode of delivery for women with a prior cesarean has traditionally been framed as a balancing of the clinical risks and benefits of elective repeat cesarean delivery (ERCD) with those of a trial of labor (TOL), with a focus on quantifying the likelihood of uterine rupture and the probability of successful vaginal birth. The risk-benefit calculus has increased in complexity with the growing recognition of the key role that maternal preferences and priorities should play in this decision.[1] In addition to interpreting the constantly evolving information from the medical literature, it now also falls to the practitioner to present this information in a way that allows the patient to understand the risks and benefits of each option, laying the groundwork for a shared decision that is concordant with the patient's preferences and values. In this talk, a summary will be presented of what is known about risk comprehension, patient and provider preferences, and obstetric decision-making in the context of prior cesarean, and suggestions will be offered on how to incorporate preferences into delivery approach decisions.

Risk

A foundational requirement in the shared decision-making process is accurate communication of risk. Psychological research aimed at exploring the mechanisms underlying patient-provider decision-making indicates that the cognitive processes involved are affected by a number of factors, including whether information has been described to or experienced by the decision-maker.[2] In addition, a number of biases in the way that humans conceptualize and interpret risk have been identified. For example, in general, people tend to be more influenced by "individuating information" such as anecdotes rather than statistical information.[3] Individuals with low numeracy tend to overweight risk as well as the protective effect of interventions, and they are more likely to be affected by mood.[4] In addition, reasoning about risk in pregnancy is sometimes compromised by the tendency to consider probabilities out of the context of patient values and to consider elimination of any fetal risk as paramount.[5]

Patient Preferences

Despite the research emphasis on quantifying rupture risk and the likelihood of having a vaginal birth after cesarean (VBAC) after TOL, evidence on how women view these outcomes is lacking. Instead, most investigations of patient preferences around VBAC have focused on documenting the number of women who undergo TOL. A review of six studies conducted in the 1980s and 1990s reported that the proportion of women choosing to attempt a VBAC ranged from 22% to 90%[6]; a more recent survey reported that over half (57%) of women interested in TOL were denied that option, primarily due to characteristics of their caregiver (45%), their delivering hospital (23%), or, less frequently, their pregnancy (20%).[7] A survey of women in the 6 months following a cesarean delivery found that 41% of women expressed a preference for vaginal delivery in the future, 23% preferred a cesarean for future deliveries, and 35% were unsure.[8]

Women often cite the practitioner as a strong external influence on their decision to undergo TOL or ERCD.[6,9] Other studies have demonstrated individual patient experience and risk assessment as important determinants of delivery preferences—women who have had a prior vaginal delivery, as well as those who predict that they would have a high likelihood of successful vaginal delivery, have been found to be more likely to report a preference for TOL.[9–11] Family obligations, desire for their partners' involvement, and the need for an easy recovery also have been identified as key factors underlying women's preference for attempting VBAC,[6,12] while desire for postpartum sterilization, convenience, desire to avoid labor pain, and fear of failed trial of labor have been identified as reasons for preferring ERCD.[9,10,12–15]

Provider Preferences

Even less is known about provider preferences regarding TOL and ERCD. A survey administered to fellows of the American College of Obstetricians and Gynecologists indicated an increasing number of cesarean deliveries; risk of liability and patient preference were the primary reasons cited.[16] A qualitative study of midwives and physicians in England found that clinical indications and medical evidence were important influences when making mode of delivery decisions after cesarean, but practitioners also felt that the overall quality of evidence was poor and that identifying women who were likely to have a successful VBAC was difficult.[17]

Obstetric Decision-Making After Cesarean Delivery

Most of the reports of decision-making regarding delivery approach after cesarean come from small qualitative studies. In one, participants agreed that a decision regarding approach to delivery was never considered final, as the medical and social circumstances surrounding delivery continued to evolve.[12] While during the study these women expressed a desire to be involved in decision-making, not all of them had actively done so. Several participants reported that they felt uncomfortable with the degree of choice they were given, voicing a desire for their providers to make the decision. Overall, these women reported a need for information specific to their situation, rather than just general information about delivery options, and a desire to have their preferences integrated into decision-making even if they did not want to take total responsibility for the choice of delivery approach. Another study found that some women had a great deal of uncertainty regarding the right decision, even after the delivery had occurred, while others were comfortable with their role in the process, reinforcing the idea that each woman's needs may be unique.[9] As for the providers' approach to the decision-making process, descriptions ranged from a consumerist approach, whereby the patient is presented with the information regarding risks and benefits and asked to choose, to a mutualistic or joint approach, to a paternalistic or directive style.[17] Providers also identified the consumerist approach as a way to transfer responsibility to the patient, potentially helping to avoid litigation if the outcome is not good.

The use of patient decision aids has been advocated to help patients participate in preference-sensitive clinical decisions, where the best choice depends on how patients value the benefits and harms.[18] Several decision aids for women who have had a cesarean delivery have been developed and evaluated. While earlier studies were aimed at encouraging women to choose TOL,[19,20] more recent interventions have focused on the shared decision-making model and balanced presentation of information.[21] A randomized trial of two computer-based decision aids in England and Scotland including more than 700 women found that viewing either computerized decision aid reduced decisional conflict, increased knowledge, and reduced anxiety and was associated with a higher rate of vaginal birth.[22] However, evidence from the medical decision-making literature suggests that use of decision aids outside of the trial setting

is challenging.[23,24] Further investigation into efficient dissemination and implementation methods is therefore needed if decision tools to help women share with their providers in making informed decisions regarding delivery approach are to be effectively used in clinical practice.

Incorporating Patient Preferences Into Clinical Care

Given the importance of the patient perspective in determining not only the optimal delivery approach but also the preferred decision-making process, how can we go about incorporating patient preferences into clinical practice? An important step toward integrating patient preference into delivery approach decisions after prior cesarean would be to remove the institutional barriers to TOL. If TOL is not available in all communities to all women, by definition shared decision-making cannot occur. Additional research regarding the clinical outcomes of TOL and ERCD as well as other obstetric procedures may be helpful in quantifying the risks and determining whether current criteria for hospitals offering VBAC are indeed necessary and adequate.

Another key step is increasing awareness of the variation in women's preferences regarding the process of decision-making, the course of labor (if undergone), and the ultimate delivery mode.[25] As a complimentary step, information regarding both TOL and ERCD should be made widely available to women, so that they have the opportunity to consider how they feel about the trade-offs inherent in making a decision regarding these two approaches. To engage in a shared decision-making process, both patients and providers must recognize that there is a decision to be made, be aware of and comprehend their roles, understand the choices with the accompanying benefits and harms, clarify and articulate their preferences, and implement these thoughts into action[24]; additional information is needed to inform and encourage each step in this process. Given the broad policy support for shared decision-making,[26] implementing guidelines for documentation of patients' knowledge and the concordance between their preferences and the care received also may incentivize providers to adopt this style of practice.[27]

Future Research

Despite the recognition of the importance of patient preferences in decision-making regarding approach to delivery after cesarean and endorsement of shared decision-making in this context, data from large prospective studies among sociodemographically diverse pregnant women are lacking. Likewise, more information is needed on how obstetric providers view offering both options, and the conditions under which they would feel comfortable engaging their patients in meaningful opportunities to share in decision-making regarding approach to delivery. Moreover, further development of a framework must be done to understand how these data should ethically guide the care of patients at the bedside and the practice guidelines that will shape, and sometimes limit, their choices. Finally, we need to continue to investigate the optimal ways to communicate risk and elicit preferences in the unique decision-making setting of pregnancy and childbirth, as better information in all of these areas is the key to ensuring that patient preferences are incorporated into clinical practice.

References

1. Vaginal birth after previous cesarean. ACOG Practice Bulletin No. 54. American College of Obstetricians and Gynecologists. *Obstet Gynecol.* 2004;104(1):203–212.

2. Hertwig R, Barron G, Weber EU, Erev I. Decisions from experience and the effect of rare events in risky choice. *Psychol Sci*. 2004;15(8):534–539.

3. Fagerlin A, Wang C, Ubel PA. Reducing the influence of anecdotal reasoning on people's health care decisions: is a picture worth a thousand statistics? *Med Decis Making*. 2005;25(4):398–405.

4. Fagerlin A, Ubel PA, Smith DM, Zikmund-Fisher BJ. Making numbers matter: present and future research in risk communication. *Am J Health Behav*. 2007;31(Suppl 1):S47–S56.

5. Lyerly AD, Mitchell LM, Armstrong EM, et al. Risks, values, and decision making surrounding pregnancy. *Obstet Gynecol*. 2007;109(4):979–984.

6. Eden KB, Hashima JN, Osterweil P, Nygren P, Guise JM. Childbirth preferences after cesarean birth: a review of the evidence. *Birth*. 2004;31(1):49–60.

7. Declercq E, Sakala C, Corry M, Applebaum S. *Listening to Mothers II: Report of the Second National Survey of Women's Childbearing Experiences.* New York: Childbirth Connection; 2006.

8. Dodd J, Pearce E, Crowther C. Women's experiences and preferences following caesarean birth. *Aust N Z J Obstet Gynaecol*. 2004;44(6):521–524.

9. Emmett C, Shaw A, Montgomery A, Murphy DG. Women's experience of decision making about mode of delivery after a previous caesarean section: the role of health professionals and information about health risks. *BJOG*. 2006;113:1438–1445.

10. Kirk EP, Doyle KA, Leigh J, Garrard ML. Vaginal birth after cesarean or repeat cesarean section: medical risks or social realities? *Am J Obstet Gynecol*. 1990;162(6):1398–1403; discussion 1403–1405.

11. Martin JN Jr, Harris BA Jr, Huddleston JF, et al. Vaginal delivery following previous cesarean birth. *Am J Obstet Gynecol*. 1983;146(3):255–263.

12. Moffat MA, Bell JS, Porter MA, et al. Decision making about mode of delivery among pregnant women who have previously had a caesarean section: a qualitative study. *BJOG*. 2007;114(1):86–93.

13. McClain CS. Why women choose trial of labor or repeat cesarean section. *J Fam Pract*. 1985;21(3):210–216.

14. McClain CS. Patient decision making: the case of delivery method after a previous cesarean section. *Cult Med Psychiatry*. 1987;11(4):495–508.

15. McClain CS. The making of a medical tradition: vaginal birth after cesarean. *Soc Sci Med*. 1990;31(2):203–210.

16. Coleman VH, Erickson K, Schulkin J, Zinberg S, Sachs BP. Vaginal birth after cesarean delivery: practice patterns of obstetrician-gynecologists. *J Reprod Med*. 2005;50(4):261–266.

17. Kamal P, Dixon-Woods M, Kurinczuk JJ, Oppenheimer C, Squire P, Waugh J. Factors influencing repeat caesarean section: qualitative exploratory study of obstetricians' and midwives' accounts. *BJOG*. 2005;112(8):1054–1060.

18. O'Connor AM, Wennberg JE, Legare F, et al. Toward the "tipping point": decision aids and informed patient choice. *Health Aff (Millwood)*. 2007;26(3):716–725.

19. Saisto T, Salmela-Aro K, Nurmi JE, Kononen T, Halmesmaki E. A randomized controlled trial of intervention in fear of childbirth. *Obstet Gynecol*. 2001;98(5 Pt 1):820–826.

20. Fraser W, Maunsell E, Hodnett E, Moutquin JM. Randomized controlled trial of a prenatal vaginal birth after cesarean section education and support program. Childbirth Alternatives Post-Cesarean Study Group. *Am J Obstet Gynecol*. 1997;176(2):419–425.

21. Shorten A, Shorten B, Keogh J, West S, Morris J. Making choices for childbirth: a randomized controlled trial of a decision-aid for informed birth after cesarean. *Birth*. 2005;32(4):252–261.

22. Montgomery AA, Emmett CL, Fahey T, et al. Two decision aids for mode of delivery among women with previous caesarean section: randomised controlled trial. *BMJ*. 2007;334(7607):1305.

23. O'Donnell S, Cranney A, Jacobsen MJ, Graham ID, O'Connor AM, Tugwell P. Understanding and overcoming the barriers of implementing patient decision aids in clinical practice. *J Eval Clin Pract*. 2006;12(2):174–181.

24. Sepucha K, Mulley AG Jr. A perspective on the patient's role in treatment decisions. *Med Care Res Rev*. 2009;66(1 Suppl):53S–74S.

25. Little MO, Lyerly AD, Mitchell LM, et al. Mode of delivery: toward responsible inclusion of patient preferences. *Obstet Gynecol*. 2008;112(4):913–918.

26. Institute of Medicine Committee on Quality Health Care in America. *Crossing the Quality Chasm: A New Health System for the 21st Century*. Washington, DC: Institute of Medicine; 2001.

27. Sepucha KR, Fowler FJ Jr, Mulley AG Jr. Policy support for patient-centered care: the need for measurable improvements in decision quality. *Health Aff (Millwood)*. 2004;Suppl Web Exclusives:VAR54–62.

The Ethics of Vaginal Birth After Cesarean

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For at least three decades, the appropriate approach to birth after previous cesarean has been characterized by dramatic shifts in practice patterns and considerable controversy.[1] A central concern has been how to approach ethically the decision between vaginal birth after cesarean (VBAC) and repeat cesarean delivery, from both the standpoint of clinical care and of public policy.

The controversy surrounding VBAC has been marked by three key issues. First are concerns about maternal and neonatal safety, with a particular focus on the rare but potentially devastating risk of uterine rupture during labor, and ongoing efforts to refine the evidence base for assessing and comparing risks of VBAC versus scheduled cesarean.[2,3] Second are concerns about the high rate of cesarean delivery—with VBAC cited as a means to "reduce the overall cesarean rate"[4] and its declining use a contributing factor to record cesarean rates.[5] And third are concerns about the degree to which guidelines may have limited patient access to their preferred delivery mode, be it cesarean, as was the case in the 1990s when access to repeat cesarean was limited, or vaginal, as is the case currently, in the context of institutional restrictions on access to VBAC.[6]

Each set of concerns is ethically complex. Judgments of safety, for instance, while sometimes straightforward, often run into fraught questions about which risks are reasonable—and by what measure of reasonability. Those issues emerge with particular importance in VBAC, given the need to reason about the potential trade-off between very small probabilities of very bad outcomes versus the benefits, both medical and extra-medical, that may accrue to each approach. Similarly, while the cesarean rate in the United States is alarmingly high, care must be taken to identify and disaggregate the different rationales for regarding it as alarming[7]—worries about resource allocation and cost containment, concern over externalities such rates may impose by influencing practice patterns and provider expertise,[8] social judgments about the "right" way to deliver—in order to know how much weight they should be given in guideline development, and whether those issues should translate into the clinical context as considerations physicians or women themselves should be concerned with. And limitations on access to preferred mode of delivery raise questions about both the meaning and importance of autonomy in the context of birth,[9] and how to think about the responsible inclusion of patient preferences for clinical decision-making and the development of practice guidelines and public policy.[10]

Addressing these complex concerns will require an ethically, scientifically, and socially responsible framework for developing guidelines for aggregate populations and individual clinical encounters. In my presentation, I will outline the considerations fundamental to such a framework, drawing on the work of the Obstetrics and Gynecology Risk Research Group.[9] Four factors interact in complex ways. First are considerations of safety and efficacy, which include the extent to which the provider has the tools and expertise to manage the specific approach. Second are considerations of cost effectiveness, which are especially important for options whose use would be prevalent, as is characteristic of VBAC. Third are externalities, or the broader clinical and social consequences of professional guidelines, that expand or restrict choice. These three factors circumscribe boundary conditions on what providers can

responsibly provide to individual patients and also provide comparative information key to informing choices within the range of broadly safe and cost-effective options.

Fourth are patient preferences, including the extent to which women would trade off one set of possible outcomes for another, how important differences in such outcomes are to them, and how robustly variable preferences are across the population. Because birth, like death, is an arena in which personal values are often strongly held and varied and process matters in addition to outcome, priority should be given to maintaining a range of options within which values can be responsibly honored.

In addition to these factors, an adequate framework will acknowledge the ethically salient difference between restrictive, prescriptive, presumptive, and fully nondirective guidelines. Certain levels of risk justify *restrictive* guidelines, outlining the limits of what the profession regards as responsible practice; whether social costs similarly justify these guidelines is more controversial. Other boundary conditions may justify only *prescriptive* guidelines—guidelines that use the authority of medicine to issue strong recommendations; still others will justify only *presumptions*, which set forth helpful defaults for structuring conversations, but which explicitly admit that what is ultimately medically recommended is dependent on clinical factors and individual preferences. Finally, an important form of guideline is *nondirective* guidelines, which set out a range of reasonable options rather than a univocal option—even one strongly contextually determined. I will argue that in the context of VBAC, restrictive, prescriptive, presumptive, and nondirective guidelines have been conflated, and that ethically sound policy and practice will require understanding and instituting such distinctions.

References

1. Flamm BL. Once a cesarean, always a controversy. *Obstet Gynecol*. 1997;90(2):312–315.

2. Greene MF. Vaginal birth after cesarean revisited. *N Engl J Med*. 2004;351(25):2467–2469.

3. Landon MB. Vaginal birth after cesarean delivery. *Clin Perinatol*. 2008;35(3):491–504.

4. Vaginal birth after previous cesarean delivery. ACOG Practice Bulletin No. 54. American College of Obstetricians and Gynecologists. *Obstet Gynecol*. 2004;104(1):203–212.

5. Martin JA, Hamilton BE, Sutton PD, et al. Births: final data for 2006. *Natl Vital Stat Rep.* 57(7). Hyattsville, MD: National Center for Health Statistics; 2009.

6. Roberts RG, Deutchman M, King VJ, Fryer GE, Miyoshi TJ. Changing policies on vaginal birth after cesarean: impact on access. *Birth*. 2007;34(4):316–322.

7. Sachs BP, Kobelin C, Castro MA, Frigoletto F. The risks of lowering the cesarean-delivery rate. *N Engl J Med.* 1999;340(1):54–57.

8. Behague DP, Victora CG, Barros FC. Consumer demand for caesarean sections in Brazil: informed decision making, patient choice, or social inequality? A population based birth cohort study linking ethnographic and epidemiological methods. *BMJ.* 2002;324(7343):942–945.

9. Obstetrics and Gynecology Risk Research Group, Kukla R, Kuppermann M, Little M, et al. Finding autonomy in birth. *Bioethics.* 2009;23(1):1–8.

10. Little MO, Lyerly AD, Mitchell LM, et al. Mode of delivery: toward responsible inclusion of patient preferences. *Obstet Gynecol*. 2008;112(4):913–918.

Mothers' Stories

Rita Rubin

Has birth become the latest battleground for reproductive rights?

Over the last few years, women around the country have walked the picket line at hospitals that will not allow them to deliver vaginally if they have previously had a cesarean. And they have circulated petitions calling for hospitals to end vaginal birth after cesarean (VBAC) bans. "My uterus, my choice," read one placard at a protest in front of a Tacoma, Washington, hospital.[1]

VBAC as a right is a common theme, as women struggle to understand why some doctors and hospitals support the right to choose a medically unnecessary C-section but not the right to choose to go into labor and deliver vaginally. "A woman has a right to bear her children in the way she deems fit," says Oklahoma mother Michelle English, who, against her ob-gyn's advice, wanted to try for a VBAC after delivering her first two babies by cesarean.[2]

Unlike first-timers, women who have previously had a C-section know firsthand what it is like to undergo and recover from one. Those who prefer a VBAC over a scheduled repeat C-section hope to avoid the stress of healing while caring for an infant as well as older children. They are familiar with the research showing that women who deliver vaginally may have an easier time initiating breastfeeding and that babies born via cesarean section are more likely to end up in the neonatal intensive care unit with breathing problems.

But in many cases, those issues do not fully explain women's desire to deliver vaginally after having had a C-section. Deny them the opportunity to deliver vaginally, they argue, and you deny them an empowering, primal experience. "Women are getting cheated by not being encouraged to believe both in their ability to birth and that birth can be a positive experience," says Christie Craigie-Carter, Hudson Valley coordinator for the International Cesarean Awareness Network.[3]

Women have gone to great lengths to have a VBAC. Faced with hours-long drives to hospitals that will allow such births, they have chosen to give birth at home, which even some VBAC proponents regard as risky.[4] Others have spent the last weeks of their pregnancy scrambling to find a new hospital for the delivery because their old one unexpectedly banned VBACs.[4] And one Arizona ob-gyn enlisted colleagues to attend her VBAC, which was performed where she delivered babies—a hospital that had banned such births.[5]

But other women would rather go with a sure thing: a planned C-section. In addition to concern about the small risk of a uterine rupture, they cite similar reasons as women who choose to deliver their firstborn via a medically unnecessary C-section. They would like to control the timing of their baby's birth so they can schedule maternity leave and grandparents' visits. They would prefer to skip labor, which does not necessarily end with a vaginal delivery. Unlike women preparing for their first delivery, many VBAC candidates have already experienced what they regard as the worst of both worlds—hours of labor capped with an unplanned C-section—and they would rather not go through that again.

References

1. Rubin R. Battle lines drawn over C-sections. *USA TODAY*. 2005 Aug 23. usatoday.com/news/health/2005-08-23-csection-battle_x.htm. Accessed December 31, 2009.

2. Simpson S. Oklahoma mom opts for traditional birth after C-sections. *The Oklahoman*. 2009 Sept 7.

3. Pfeiffer MB. Birth by surgery: the skyrocketing cesarean rate. *Poughkeepsie Journal*. 2009 March 29.

4. Rubin R. New data: cesarean birth likely followed by another. *USA TODAY*. 2004 Dec 15. mywire.com/a/USATODAY//684886?&pbl=27.

5. Rubin R. Battle lines drawn over C-sections. *USA TODAY*. 2005 Aug 23.

Vaginal Birth After Cesarean Section: Views From the Private Practitioner

Chet Edward Wells, M.D.

In obstetrics, few conditions have created as much controversy and debate as the management of the woman with prior cesarean delivery.[1] In 1951, Cosgrove observed, "The management of a patient who becomes pregnant subsequent to a cesarean section has been a matter of controversy for over a generation,"[2] and now 58 years later the ongoing debate persists.

Over the past 30 years, the rise and fall of cesarean section and vaginal birth after cesarean (VBAC) rates represents a fundamental shift in obstetrical care. Following the National Institutes of Health Consensus Development Conference on Cesarean Birth in 1980,[3] with the support of the American College of Obstetricians and Gynecologists (ACOG), the attempt to reduce overall cesarean section rates by utilizing VBAC was enthusiastically embraced and resulted in an increase in VBAC rates from 3.4% in 1980[4] to a peak rate of 28% in 1996.[5] As the frequency of VBAC increased, the number of reports of uterine rupture-related perinatal morbidity rose.[6] In response to those reports, ACOG released Practice Bulletin No. 5 on VBAC in 1999,[7] which recommended that "most women with one previous cesarean delivery with a low transverse incision are candidates for VBAC and should be counseled about VBAC and offered a trial of labor," and added, "because uterine rupture may be catastrophic, VBAC should be attempted in institutions equipped to respond to emergencies with physicians immediately available to provide emergency care."

In the years following, ACOG Practice Bulletin No. 5 began a decade-long decline in national VBAC rates to an all-time low of 8.5% in 2006[8] with a VBAC rate for the State of Texas of 6.6% and a rate of 4.1% among community hospitals in the Dallas–Ft. Worth region.[9] This decline in VBAC utilization occurred despite multiple well-designed studies documenting the safety and success of VBAC in selected clinical settings.[10,11]

How do we explain the rapid decline in VBAC rates since the late 1990s? Multiple factors have been reported to contribute including medicolegal burdens on providers and hospitals, increased patient awareness of VBAC complications, and patients along with their providers becoming more risk averse and losing their overall enthusiasm for VBAC. While several studies have suggested the more restrictive guidelines from ACOG Practice Bulletin No. 5 may have accelerated the decline in VBAC rates,[12,13] others propose that the risk of malpractice litigation has been an important influencing factor affecting both provision of obstetrical care[14] and discontinuation in the offering of VBAC services by private practitioners.[15] States with higher malpractice premiums have been found to have lower VBAC rates and higher cesarean section rates when compared with lower malpractice-premium states.[16]

Most research regarding VBAC has focused on the clinical outcomes of mother and infant associated with a trial of labor; however, it is apparent that nonclinical factors such as the "physician factor" appear to play an increasingly important role in both cesarean section and VBAC.[17,18] While physicians' practice patterns and bias regarding cesarean section and VBAC have been the subject of investigation,[18,19] there has been little research on how nonclinical factors influence private-practice obstetricians' decision to either offer VBAC or to discontinue the practice of VBAC.

In an effort to learn more about what factors influence a provider's decision to offer or not to offer VBAC services to patients, we designed a survey to investigate the practices and policies

of private obstetrical practitioners in the Dallas–Ft. Worth region. All private-practice obstetricians in the Dallas–Ft. Worth region were asked to participate in the survey and were mailed a questionnaire. The survey contained both open and close-ended questions about the physician and his or her hospital practices and policies surrounding VBAC. The questionnaire was divided into two sections: (1) physician and hospital practice demographics and characteristics, and (2) focused questions on the provider's policy to offer or not offer VBAC and what factors influenced those decisions.

Results

The survey was mailed October 1, 2009; data from respondents returning the questionnaire by November 1, 2009, are included in this report. Seven hundred and seventy-four questionnaires were mailed; 36 providers returned the questionnaire, indicating that they had discontinued (5%) practicing obstetrics. Three hundred seventy-two (51%) of the remaining 738 questionnaires were returned within the allotted 4 weeks.

Overall, 53% of practicing obstetrician respondents offered VBAC to their patients, 77% practiced in a group setting, 74% performed 100–200 deliveries per year, and 93% indicated that they would provide "elective primary cesarean section" for their patients.

The survey confirms a declining interest in VBAC among physicians and in particular physicians who have completed their training within the last 10 years. Physicians practicing less than 10 years were significantly less likely to perform VBAC compared to physicians in practice more than 10 years. Those physicians who did **not** have a history of a "cesarean-section-related malpractice lawsuit" were more likely to perform VBAC than those with a history of a "cesarean-section-related malpractice lawsuit."

Responses From Practitioners Who Perform VBAC

A. In the group performing VBACs, more than 90% performed 10 or fewer VBACs last year and more than 65% indicated that the number of VBACs in their practice was declining.

B. Physicians performing VBAC indicated the following reasons for a decline in VBAC:

    1. Provider and patient concern for maternal or fetal consequences of uterine rupture
    2. Medicolegal concerns associated with VBAC
    3. Patients' requests for repeat cesarean section
    4. ACOG requirement to be "immediately available."

C. Reasons given as to why patients are not choosing VBAC (as viewed by the provider):

    1. Not willing to accept fetal and maternal risks of uterine rupture
    2. Prior difficult labor/not willing to risk long labor followed by repeat cesarean
    3. Desire convenient date/time for delivery.

D. Other responses:

- 93% offer VBAC ONLY to one prior low-transverse cesarean section.
- 91% do not offer VBAC for patients with an unknown uterine scar.
- 95% do not offer VBAC for multiple gestation.
- 87% do not offer VBAC to patients with gestational or overt diabetes.
- 93% do not induce labor with oxytocin for VBAC patients.
- 53% do not augment labor with oxytocin for VBAC patients.
- 55% will induce labor with amniotomy for VBAC patients.

Responses From Practitioners Who Do Not Perform VBAC

A. In all, 95% of physicians who no longer offer VBAC indicated they have discontinued VBAC since 2001, and 88% indicated they would not reconsider their policy and return to providing VBAC for their patients.

B. Physicians no longer performing VBAC indicated their reasons for not offering VBAC were:

1. Unwilling to accept risk of adverse outcome/Do not feel VBAC safe
2. Medicolegal liability concerns
3. ACOG Practice Bulletin No. 5.

Comparing the group offering VBAC versus the group not offering VBAC:

1. The hospital requirement that the obstetrician be “in house” for a laboring VBAC patient (ACOG Practice Bulletin No. 5) was similar in both groups.
2. In both groups, 90% of physicians indicated that their hospital either “allowed” or “encouraged” VBACs in their hospital.
3. In all, 91% and 94% of physicians offering or not offering VBAC, respectively, would grant a patient’s request for an “elective primary cesarean section.”

Discussion

The results of our survey of private-practice obstetricians in the Dallas–Ft. Worth region suggest that those physicians who offer VBAC services to their patients do so with a narrow set of parameters limiting VBACs to patients with one previous low transverse incision, limited induction and augmentation of labor, and limitations of VBAC if other pregnancy-related complications are present such as multiple gestation or diabetes.

Although previous research suggests that recently trained physicians “favor VBAC over repeat cesarean section,”[20] our survey finds that many recently trained obstetricians are not offering VBAC and indicate that they likely will not reconsider that decision. Unless there is a reversal of this trend, the supply of obstetrical providers willing to provide VBAC will be destined to follow the fate of mid-forcep rotations and breech vaginal deliveries.

The most common reason stated for discontinuing or declining VBAC practice in this survey was either physician or patient concern for maternal or fetal outcomes associated with uterine rupture followed by the fear of medical liability concerns. Contrary to earlier research, ACOG

Practice Bulletin No. 5 does not appear to be a significant reason for the steady decline in VBAC rates.[12] A smaller number of younger physicians also indicated that they were unable to provide VBAC services due to joining an obstetrical group that prohibits the offering.

In 1916, when addressing the Congress of Surgeons of North America, Professor J. Whitridge Williams, author of *Williams Obstetrics,* observed the following:[21]

> *"Unfortunately, history shows that advances in the practice of medicine and surgery are rarely attained in a thoroughly rational manner, but that a period of undue enthusiasm, or even of almost reckless abuse, usually precedes the establishment of the actual value of a given procedure. . . . I believe that we are at present going through such a stage in connection with caesarean section."*

I believe the same could be said today regarding the practice of VBAC and suspect that the pendulum will gradually swing to greater acceptance of VBAC, albeit a more cautious approach. As noted by Katz in 2006, "The question in these times is not whether or not cesarean, but when and how best to use cesarean."[22]

References

1. Lagrew D. The future of vaginal birth after cesarean (VBAC). *Perinatal Care Matters: Regional Perinatal Programs of California.* 2007(Fall):1–2. cdph.ca.gov/HealthInfo/healthyliving/childfamily/Documents/MO-FinalSeptember2007Edition-OC-05-07.pdf. Accessed November 15, 2009.

2. Cosgrove RA. Management of pregnancy and delivery following cesarean section. *JAMA*. 1951;145(12):884–888.

3. National Institutes of Health: Consensus Development Conference of Cesarean Childbirth, September 1980, sponsored by the National Institute of Child Health and Human Development. NIH Pub. No. 82-2067. Bethesda, MD: NIH; 1981.

4. Placek PJ, Taffel SM. Vaginal birth after cesarean (VBAC) in the 1980s. *Am J Public Health*. 1988;78(5):512–515.

5. Martin JA, Hamilton BE, Sutton PD, et al. Births: final data for 2004. *Natl Vital Stat Rep*. 2006;55(1). Hyattsville, MD: National Center for Health Statistics.

6. Sachs BP, Kobelin C, Castro MA, Frigoletto F. The risks of lowering the cesarean-delivery rate. *N Engl J Med*. 1999;340(1):54–57.

7. American College of Obstetricians and Gynecologists. Vaginal Delivery After Previous Cesarean Section. Practice Bulletin No. 5. American College of Obstetricians and Gynecologists. 1999.

8. Martin JA, Hamilton BE, Sutton PD, Ventura SJ, Menacker F, Munson ML. Births: final data for 2006. *Natl Vital Stat Rep*. 2009;57(7). Hyattsville, MD: National Center for Health Statistics.

9. Texas Health Care Information Collection. Texas Hospital Inpatient Discharge Public Use Data File, 2006. dshs.state.tx.us/thcic/Hospitals/HospitalData.shtm. Accessed November 15, 2009.

10. Landon MB, Hauth JC, Leveno KJ, et al. Maternal and perinatal outcomes associated with a trial of labor after prior cesarean delivery. *N Engl J Med*. 2004;351(25):2581–2589.

11. Macones GA, Peipert J, Nelson DB, et al. Maternal complications with vaginal birth after cesarean delivery: a multicenter study. *Am J Obstet Gynecol*. 2005;193(5):1656–1662.

12. Gochnour G, Ratcliffe S, Stone MB. The Utah VBAC Study. *Matern Child Health J*. 2005;9(2):181–188.

13. Pinette MG, Kahn J, Gross KL, Wax JR, Blackstone J, Cartin A. Vaginal births after cesarean rates are declining rapidly in the rural state of Maine. *J Matern Fetal Neonatal Med*. 2004;16(1):37–43.

14. Xu X, Siefert KA, Jacobson PD, Lori JR, Ransom SB. The effects of medical liability on obstetric care supply in Michigan. *Am J Obstet Gynecol*. 2008;198(2):205.e1–205.e9.

15. Strunk A, Esser L. Overview of the 2003 ACOG Survey of Professional Liability. *ACOG Clin Rev* 2004;9:1,13–16.

16. Yang YT, Mello MM, Subramanian SV, Studdert DM. Relationship between malpractice litigation pressure and rates of cesarean section and vaginal birth after cesarean section. *Med Care*. 2009;47(2):234–242.

17. Stafford RS. The impact of nonclinical factors on repeat cesarean section. *JAMA*. 1991;265(1):59–63.

18. Goyert GL, Bottoms SF, Treadwill MC, Nehra PC. The physician factor in cesarean birth rates. *N Engl J Med*. 1989;320(11):706–709.

19. Phillips RN, Thornton J, Gleicher N. Physician bias in cesarean sections. *JAMA*. 1982;248(9):1082–1084.

20. Kenton K, Brincat C, Mutone M, Brubaker L. Repeat cesarean section and primary elective cesarean section: recently trained obstetrician-gynecologist practice patterns and opinions. *Am J Obstet Gynecol*. 2005;192(6):1872–1875.

21. Jellett H. The abuse of caesarean section. *BMJ*. 1927;2(3479):451–454.

22. Katz VL. Cesarean birth: guidelines, not rules. *Obstet Gynecol*. 2006;108(1):2–3.