
Vaginal Birth After Cesarean: An Effective Method to Reduce Cesarean

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Abstract: Cesarean deliveries represent almost one third of US births. Given that repeat cesarean is the most common single indication for cesarean, trial of labor after cesarean (TOLAC) with subsequent vaginal birth after cesarean (VBAC) is an important mechanism to reduce the overall cesarean rate. The 2010 National Institutes of Health Conference found that one of the biggest barriers to VBAC is the lack of patient access to TOLAC. Many women who currently deliver by repeat cesarean would be candidates for a TOLAC. This manuscript will summarize the evidence on VBAC to help clinicians identify candidates, provide evidence-based counseling, and guide management of TOLAC.

Key words: pregnancy, vaginal birth after cesarean, cesarean, evidence-based medicine

Introduction

Cesarean deliveries are the most commonly performed surgical procedure in the United States with just over 1.3

million cesareans performed annually.¹ Although cesarean delivery is a safe procedure, it poses both immediate and long-term risks including implications for future pregnancies. As cesarean delivery rates remain high and continue to climb, the impact of multiple cesarean deliveries is becoming increasingly evident. Increasing the appropriate use of vaginal birth after cesarean (VBAC) is an important mechanism to reducing the overall cesarean delivery rate.

VBAC was first recommended by the National Institutes of Health (NIH) Consensus Conference in 1980 as a means to safely reduce the cesarean delivery rate.² As shown in Figure 1, although it took almost a decade following the NIH Consensus Conference for VBAC to gain popularity, once it did, VBAC was effective at decreasing the overall cesarean delivery rate. In fact just looking at the impact of VBAC and not considering the primary cesarean rate, for every 1% increase in VBAC there is a 0.58% decrease in total cesarean, demonstrating

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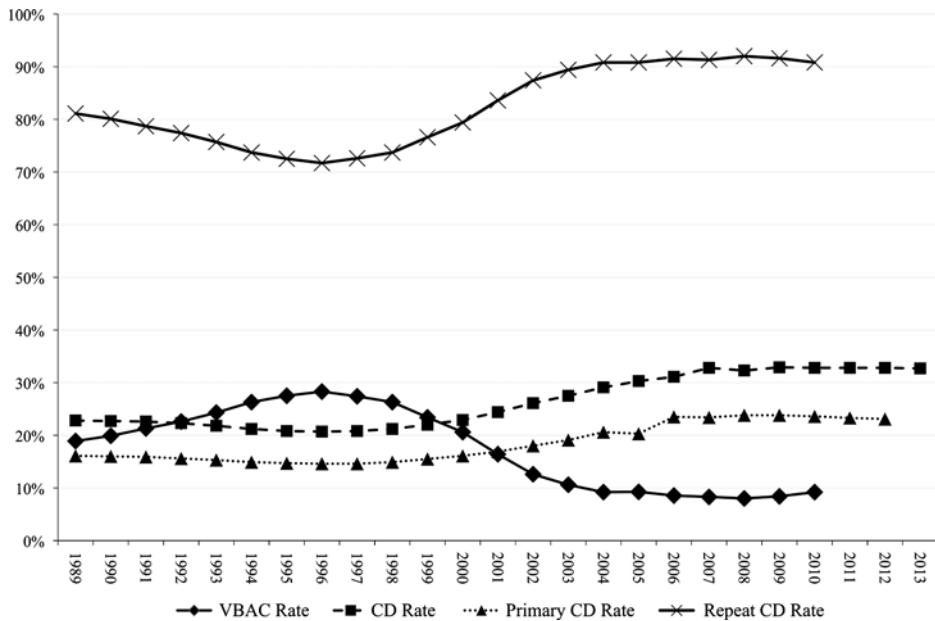


FIGURE 1. Rates of vaginal birth after cesarean [vaginal birth after cesarean (VBAC)], total, repeat, and primary cesarean deliveries.^{3–5}

the direct and important effect VBAC has on US cesarean delivery rates.

From 1990 to 1996 the VBAC rate increased from 19.9% to 28.3% with a mirrored decrease in the cesarean delivery rate from 22.7% to 20.7% over that same time period.^{3,6} This trend, however, was short lived. An amalgam of complex factors including concern that uterine rupture occurred at higher rates than initially expected,^{7,8} medical-legal pressures, patient and provider preferences, and organizational changes resulted in a rapid reduction in trials of labor after cesarean (TOLAC) and VBAC and a subsequent increase in cesarean delivery rates; soaring to the highest ever recorded in 2009 at 32.9%. All of this occurred despite the national goal outlined by Healthy People 2010 to reduce the cesarean delivery rate to 15% of births.⁹ Since 2007 the cesarean delivery rate has plateaued and remained essentially unchanged at 32.7% to 32.9% for the last 6 years.⁴

To renew the effort once again to decrease the cesarean delivery rate, the NIH

reconvened a NIH Consensus Conference in 2010 on VBAC. Their conclusions and recommendations again found that TOLAC is a reasonable option for many pregnant women with 1 prior low transverse uterine incision, yet many women in the United States lack access to clinicians and facilities willing and able to offer a trial of labor.¹⁰

This paper aims to summarize the evidence regarding TOLAC, outlining an evidence-based approach in identifying appropriate candidates, counseling patients on risks and benefits of TOLAC/VBAC, managing TOLAC, and finally summarizing the potential impact that could be achieved by increasing the availability and use of VBAC.

Professional Society Guidelines

Professional society guidelines are often used to define a reasonable scope of practice. For this reason it is helpful to

compare professional society’s guidance regarding cesarean and VBAC. The American College of Obstetrics and Gynecology (ACOG),¹¹ the Society of Obstetricians and Gynecology of Canada (SOGC),¹² and the Royal College of Obstetricians and Gynecologists (RCOG)¹³ all have issued statements on VBAC. Table 1 highlights comparisons from each society regarding candidates, counseling, and management of TOLAC. All 3 societies agree that women with 1 or 2 prior low transverse cesareans should be

offered TOLAC and that antenatal counseling should be documented and include both maternal and perinatal risks involved with both elective repeat cesarean delivery and trial of labor. Specifically, the RCOG recommends women to be counseled that planned VBAC carries an 8/10,000 risk of their infant developing hypoxic-ischemic encephalopathy.¹³

It is inevitable that some women with a prior cesarean delivery will require induction of labor for one indication or another. All 3 societies consider induction of labor an

TABLE 1. Comparison of ACOG, SOGC, and RCOG Statements on VBAC¹¹⁻¹³

	ACOG (August 2010)	SOGC (February 2005)	RCOG (February 2007)
No. references cited	136	119	116
Delivery resources and facilities	TOLAC in facilities with staff immediately available to provide emergency care	TOLAC can be performed in hospitals able to perform a cesarean section. Recommend a timeframe of 30 min to assemble a team for emergent surgery.	TOLAC in facilities with resources equipped for immediate cesarean delivery and advanced neonatal resuscitation
Candidates by no. prior cesareans	Most women with 1 low transverse incision should be offered TOLAC Women with 2 previous low transverse may be considered for TOLAC	1 prior transverse low-segment cesarean should be offered TOLAC Trail of labor with > 1 previous cesarean is likely to be successful but with higher risk of uterine rupture	Women with 1 prior low-segment cesarean delivery should be able to discuss options of VBAC Women with a history of 2 uncomplicated low transverse sections may be considered suitable for planned VBAC
Risks of uterine rupture	0.5%-1.0%	0.2%-1.5%	22-74/10,000 (0.2%-0.7%)
Fetal heart rate	monitoring	Recommends continuous fetal monitoring during labor	Recommends continuous fetal monitoring during labor
Recommends continuous fetal monitoring after onset of	contractions		
Vaginal delivery rate	60%-80%	No specific success rate mentioned	72%-76%
Anesthesia	Epidural not contraindicated	Epidural not contraindicated	Epidural not contraindicated

ACOG indicates American College of Obstetrics and Gynecology; RCOG, Royal College of Obstetricians and Gynecologists; SOGC, Society of Obstetricians and Gynecology of Canada; TOLAC, trial of labor after cesarean; VBAC, vaginal birth after cesarean.

option for women undergoing TOLAC with ACOG and SOGC recommending the use of mechanical dilation in women with an unfavorable cervix. They similarly all approve of the use of oxytocin for augmentation and ACOG and SOGC specifically recommend against misoprostol in women with a prior uterine scar due to the increased risk of uterine rupture. RCOG recommends women be quoted a 1.5-fold increased risk of cesarean delivery if undergoing induction/augmentation compared with spontaneous labor. With the exception of differences in wording, ACOG, SOGC, and RCOG are consistent in their message that the majority of women with 1 prior cesarean delivery should be counseled and offered a TOLAC.

Counseling: Risks and Benefits of VBAC

Women desiring TOLAC should be counseled on both the risks and benefits of their desired route of delivery including risks of maternal and neonatal morbidity as well as implications for future deliveries.

MATERNAL OUTCOMES

Maternal risks associated with TOLAC include hysterectomy, hemorrhage, transfusion, uterine rupture, and death.¹⁴ Table 2 summarizes the maternal morbidity and mortality associated with VBAC and compares this with repeat cesarean.

Although rare, elective repeat cesarean carries a significantly higher risk of maternal mortality with an absolute risk of 0.013% [95% confidence interval (CI), 0.004%-0.0042%] versus 0.004% (95% CI, 0.001%-0.0015%) for TOLAC. The fact that TOLAC has now been found to have significantly less risk of maternal death is a compelling reason to increase the availability of TOLAC for women with prior cesarean. A review of the literature found no significant difference in hemorrhage, infection, or hysterectomy although the evidence was low in strength. However, the review did suggest that the risk of transfusion may be increased at term for TOLAC with 4 studies consistently reporting higher risk. Interestingly, one of the 4 studies suggests that this effect at term may be modified by medical comorbidities (0.22 for TOLAC compared with 0.41 for elective repeat cesarean delivery among women with medical comorbidities; 0.1 for trial of labor compared with 0.1 for elective repeat cesarean delivery in low-risk women).¹⁴ Further research is needed to understand the degree to which maternal morbidities are due to other medical complications.

UTERINE RUPTURE

Uterine rupture, defined as a complete separation of the uterine wall, is a serious and potentially catastrophic risk for women with a prior cesarean and has received substantial attention. The risk of uterine rupture in any woman with a

TABLE 2. Maternal Outcomes for Trial of Labor Compared With Elective Repeat Cesarean¹⁴

Maternal Outcomes	TOLAC	Elective Repeat Cesarean Delivery
Maternal death (95% CI)	0.004% (0.001%-0.0015%)	0.013%* (0.004%-0.0042%)
Uterine rupture (95% CI)	0.47%† (0.28%-0.77%)	0.026% (0.009%-0.082%)
Hysterectomy (95% CI)	0.17% (0.12%-0.26%)	0.28% (0.12%-0.67%)
Blood transfusion (%)	0.90	1.20
Infection (%)	0.8-30	1.2-18

*Relative risk 0.33 (CI 0.13-0.88, $P = 0.027$).

†Relative risk 20.7 (CI 9.77-44.02; $P < 0.0010$).

CI indicates confidence interval; TOLAC, trial of labor after cesarean.

prior cesarean scar is 0.3%.¹⁴ Although the absolute risk of uterine rupture is low for both TOLAC and elective repeat cesarean (0.47% vs. 0.03%), the risks are significantly increased for women attempting TOLAC (RR 20.74; 95% CI, 9.77-44.02; $P < 0.001$). Given the serious nature of uterine rupture, people have tried to develop algorithms to predict its occurrence. Although the prediction of uterine rupture remains elusive, individual factors have been identified to be associated with uterine rupture.

DIRECTION OF SCAR AND RISK OF UTERINE RUPTURE

Table 3 presents the risk of uterine rupture by incision type. Women with prior incisions through the uterine corpus (eg, classic incision, myomectomy, uterine body extension) have a marked increase in the risk of uterine rupture and are not candidates for VBAC.¹⁴ There are less data surrounding low vertical incisions, but the limited studies that have looked at uterine rupture rates in this setting have found a rupture rate of 1.05% to 2.0%.^{14,15} The quandary for clinicians who are managing a patient with a previous vertical incision is feeling confident that the incision does not extend beyond the lower uterine segment. Finally, because most women with unknown scars at term are likely to have a low transverse uterine scar, there is general agreement that an unknown scar is not a contraindication to TOLAC.¹¹

TABLE 3. Type of Uterine Incision and Risk of Uterine Rupture¹⁴⁻¹⁷

Types of Uterine Incision	Risk of Uterine Rupture
Classical or T-shaped incision (%)	4.0-9.0 ¹⁴
Low vertical (%)	1.05-2.0 ^{14,15}
Low transverse (%)	0.4-0.7 ¹⁴
Unknown scar (%)	0.5 ¹⁴
2 prior cesarean deliveries (%)	0.9-1.8 ^{14,16,17}

TABLE 4. Factors Associated With Increased Risk of Uterine Rupture^{14,18}

Factors associated with increased risk of uterine rupture
Multiple fetal gestation
Obesity (body mass index > 30 kg/m ²)
Short interval pregnancy (less than 24 mo)
Gestational age > 40 wk
Estimated fetal weight > 4000 g
Prostaglandin administration

OTHER FACTORS ASSOCIATED WITH RISK OF UTERINE RUPTURE

Other factors that have been identified to increase a woman’s risk of uterine rupture are listed in Table 4 and briefly summarized below.

TWIN GESTATIONS

Two large population studies evaluated TOLAC in twin gestation and found no significant difference in uterine rupture risk (0.9% to 1.1% vs. 0.4% to 0.7%) when compared with singleton gestations.¹⁵ On the basis of these data, ACOG recommends that women with twin gestation who are otherwise candidates for vaginal delivery be considered candidates for TOLAC.¹¹

FETAL MACROSOMIA

Fetal macrosomia is a common obstetrical condition affecting almost 10% of pregnancies in the United States. Although there are inconsistencies in how fetal macrosomia is defined (estimated fetal weight > 4000 vs. 4500 g), studies do not show a statistically significant increased risk of uterine rupture but recognize that with increasing fetal weight there may be an associated increase in uterine rupture rates that is not yet proven due to the rarity of uterine rupture.¹⁴

MATERNAL OBESITY

Maternal obesity is a nationwide epidemic and carries its own risk for many obstetric complications including increased risk of cesarean section. The Maternal-

Fetal Medicine Units Network cohort of 28,446 subjects at term gestation found neither uterine dehiscence nor uterine rupture to be statistically different between obese and nonobese women when evaluated as separate events. However, when combined, they found a statistically significant increase in uterine events (dehiscence or rupture) with increasing body mass index (BMI), from an event prevalence of 0.9% in the normal (20 to 25) BMI group to 2.1% in the morbidly obese (BMI \geq 40) group ($P = 0.03$).¹⁸

ADVANCED MATERNAL AGE

The data are mixed regarding uterine rupture risk and advanced maternal age (age older than 35). Shipp et al¹⁹ examined a 12-year retrospective cohort and indicated that there was an associated increased risk of uterine rupture in women older than 35 compared with their younger counterparts [odds ratio (OR), 3.2; 95% CI, 1.2-8.4]. Another population study of 300,000 women showed a 2-fold increase in uterine rupture rates when compared with women aged 25 to 29 years. Whereas, a study by Bujold et al²⁰ failed to demonstrate any increased rate of uterine rupture when women aged older than 35 were compared with their younger cohort.¹⁴

INTERPREGNANCY INTERVAL

Multiple studies have examined the effect of interpregnancy interval and associated risk of uterine rupture. The majority of the data indicate that there is an increased risk of uterine rupture 2- to 3-fold (OR, 2.05-2.65) with an interpregnancy interval of < 24 months.¹⁴ Counseling should mention that women with a short interval pregnancy may have a risk of uterine rupture that is > 1%.

GESTATIONAL AGE > 40 WEEKS

Pregnancies beyond 40 weeks' gestation have not been significantly shown to increase rates of uterine rupture in women undergoing TOLAC (1.1% vs. 1.0%).¹⁴

It is important to remember that of the above-listed factors, previous classic cesarean section, > 2 previous cesarean deliveries, and misoprostol administration are the only factors that are found to substantially increase the risk of uterine rupture to where VBAC should not be offered. All of the other listed factors have either not been extensively studied, have conflicting evidence, or are not statistically significant. Although these factors often enter into the counseling of patients, in general they should not exclude a patient from being offered TOLAC.

Not only is it important to review factors that elevate a woman's risk of uterine rupture, it is also important to mention the factors that reduce her risk, making TOLAC an even more attractive option. Prior vaginal delivery and prior VBAC reduce a woman's risk for uterine rupture in subsequent TOLAC, overall cutting the risk in half. Women who TOLAC after a prior vaginal delivery have uterine rupture rates significantly lower than women without a prior vaginal delivery (OR, 0.26 to 0.62).¹⁴ Similarly, women with a prior VBAC have a reduced uterine rupture risk with an OR of 0.52 (CI, 0.34-0.82).¹⁷

NEONATAL OUTCOMES

Counseling in pregnancy always involves weighing maternal and neonatal risks and benefits. Table 5 summarizes the neonatal risks associated with TOLAC and repeat cesarean. Both perinatal mortality (death occurring between 20 wk gestation through 28 d of life) and neonatal mortality (death within the first 28 d of life) are significantly increased in TOLAC compared with elective repeat cesarean. Multiple studies have sought to understand the impact of TOLAC versus repeat cesarean on newborn respiratory conditions including transient tachypnea of the newborn and frequency of bag-and-mask ventilation. Neither of these conditions has been found to differ between TOLAC

TABLE 5. Neonatal Outcomes for Trial of Labor Compared With Elective Repeat Cesarean¹⁴

Neonatal Outcomes	TOLAC	Elective Repeat Cesarean
Perinatal mortality (95% CI)	0.13%* (0.006%-0.30%)	0.05% (0.007%-0.38%)
Neonatal mortality (95% CI)	0.11% (0.06%-0.2%)	0.06% (0.02%-0.15%)
Respiratory conditions (bag mask ventilation/transient tachypnea of the newborn) (95% CI)	5.4%/3.6% (3.5%-7.6%)/ (0.9%-8%)	2.5%/4.2% (1.6%-3.6%)/ (1.9%-7.3%)

*Relative risk 1.82 (95% CI, 1.24-2.67) *P* = 0.041.

CI indicates confidence interval; TOLAC, trial of labor after cesarean.

and elective repeat cesarean. Similarly, no difference has been found in hypoxic-ischemic encephalopathy or asphyxia, however, the number of studies and quality of studies is low for these outcomes.¹⁴

Counseling: Selecting Candidates for VBAC

One of the challenges in counseling patients with a prior cesarean delivery regarding TOLAC versus elective repeat cesarean is the inability to accurately predict those with a high likelihood of successful VBAC. This becomes important because the majority of the morbidity and mortality related to TOLAC is attributed to those who attempt TOLAC but do not deliver vaginally.

FACTORS INFLUENCING THE LIKELIHOOD OF VBAC

Several factors have been identified in the literature that either increase or decrease the likelihood of successful TOLAC (Table 6). One of the strongest predictors of VBAC is a previous vaginal delivery. The literature consistently shows that women who have delivered vaginally in the past go on to have successful VBACs at a much higher rate (almost a 3-fold difference)²¹ when compared with women without a prior vaginal delivery. Other favorable factors for VBAC include spontaneous labor and nonrecurrent indications for primary cesarean. Women who present with cervical dilation > 3 cm or in

spontaneous labor are more likely to go on to deliver vaginally compared with women who require induction, especially with a nonfavorable cervix. Primary cesareans performed for nonreassuring fetal status or fetal malpresentation carry an estimated repeat cesarean delivery (also known as “failed trail of labor”) risk similar to that of a nulliparous woman.²¹

FACTORS ASSOCIATED WITH DECREASED LIKELIHOOD OF VBAC

Studies indicate that racial and ethnic differences influence the likelihood of successful VBAC. When compared with whites, nonwhite Hispanics and African American’s were 20% to 52% and 29% to 50%, respectively, less likely to have a successful VBAC.¹⁴ The literature also

TABLE 6. Factors Associated With VBAC Success^{14,21}

Factors associated with increased probability of VBAC
History of prior vaginal delivery/VBAC
Nonrecurring indication for prior cesarean (ex: malpresentation)
Spontaneous rupture of membranes or favorable cervix at time of presentation
Factors associated with decreased probability of VBAC
Obesity (BMI > 30 kg/m ²)
Advanced maternal age (> 35)
Maternal comorbid conditions (eg, hypertension, diabetes)
Gestational age > 40 wk
Estimated fetal weight > 4000 g
Hispanic ethnicity, African American race

BMI indicates body mass index; VBAC, vaginal birth after cesarean.

shows a decrease in the success rate of VBAC in the setting of macrosomia. Birth weight > 4000 g is associated with nearly half the likelihood of VBAC compared with those with birth weight < 4000 g (OR, 2.65) and this decreased likelihood becomes even more dramatic with increasing birth weight, (likelihood of VBAC success in infants > 4000 g is 11.6% vs. > 4500 g is 1.3%, $P < 0.001$).¹⁴ Of note, such studies have been done with actual birth weight, not estimated fetal weight so caution is needed before applying these findings directly to practice.

Elevated BMI (BMI > 30) significantly decreases likelihood for successful VBAC. The systematic review conducted for the NIH Consensus Conference¹⁴ found a dose-dependent decrease in vaginal delivery rates as BMI increases (Fig. 2). One of the best things maternal health providers can do to improve pregnancy outcomes is to help women retain normal body weight.

PREDICTIVE TOOLS

On average, 6 to 8 women of every 10 eligible women who attempt TOLAC

(60% to 80%) will have a VBAC.¹⁴ It would be ideal for clinicians to have a calculator that could predict likelihood of VBAC and risk for uterine rupture. This would make counseling much easier. Unfortunately, attempts to predict uterine rupture have not been successful. However, 2 predictive models developed by Grobman et al²² to predict likelihood of VBAC one in early pregnancy and the other at the onset of labor, have been independently validated retrospectively in the United States, Japan, and The Netherlands, and are in need of prospective trials to understand their use in practice. Their results are promising in that almost half of women would be predicted to receive additional information to discriminate whether they have higher or lower chances than average for VBAC (27% would score > 80% and almost 20% would score < 60%). The validation study from The Netherlands found that counseling alone without predicted numbers may also have an effect.²³ What is not known is whether telling a patient that she has “an 80% predicted success rate,” “a better than average success rate,” or “an

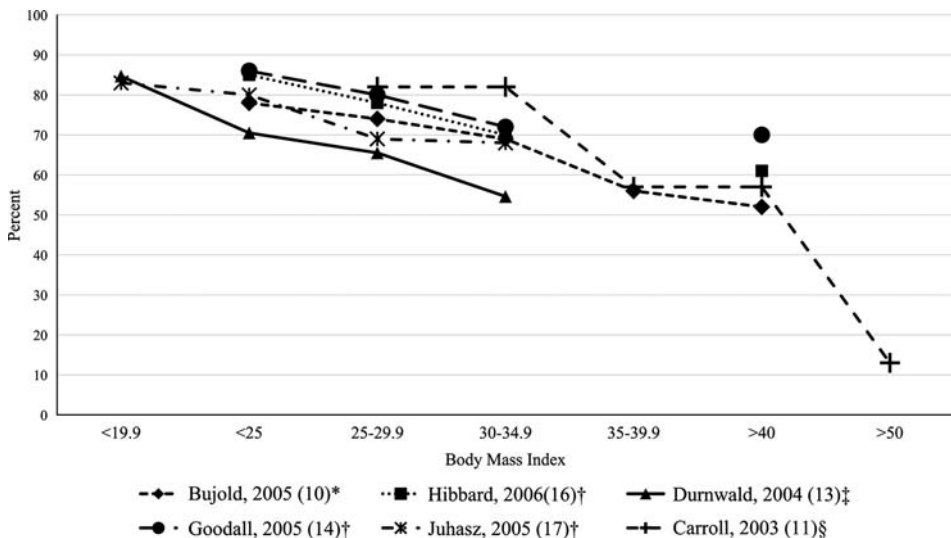


FIGURE 2. Percent vaginal birth after cesarean following trial of labor by body mass index.^{14,18}

80% success rate compared with an average of 70%” leads to different or better decisions. Prospective studies are needed to understand the impact on patient decision making and outcomes.

Intrapartum Management

Whether presenting in spontaneous labor or for induction there are certain steps that should be performed to maximize the safety of both mother and fetus in women undergoing a TOLAC. Given our inability to predict if and when uterine rupture will occur, it is recommended that women undergoing a TOLAC undergo continuous fetal monitoring, IV placement, complete blood count, and type and screen. There have been no data to show that internal monitoring with an intrauterine pressure catheter has been shown to detect uterine rupture.¹⁴

With almost 1 in 4 pregnant women being induced,⁵ understanding evidence around induction of labor for women with prior cesarean is important. Induction of labor often requires cervical ripening, typically performed with misoprostol, prostaglandin E2, mechanical dilation, or oxytocin. Women with a prior uterine scar who undergo induction of labor, especially with prostaglandins, have been shown to have an increased rate of uterine rupture.^{8,14} The use of misoprostol for induction of labor in women with a prior uterine incision carries a risk of uterine rupture close to 6% and it thus is not recommended.¹⁴

Prostaglandin E2 confers an increased rupture risk of 2% and oxytocin has the lowest rate of associated uterine rupture at 1.1%.¹⁴ There are no data to indicate that mechanical dilation with a balloon confers any increased risk of uterine rupture, however, the evidence is limited.¹⁴

Augmentation of labor with oxytocin, when studied separately from use in conjunction with cervical ripening agents again is varied. There is no clear association between the use of oxytocin for labor augmentation and increased risk of uterine rupture.¹⁴

Future Impact

In counseling patients about TOLAC or repeat cesarean, it is important to address the downstream ramifications of each. As the cesarean delivery rate continues to increase, it is becoming increasingly clear that multiple repeat cesareans carry substantial health risks. Table 7 summarizes the risks associated with increasing number of cesareans.

Cesarean deliveries increase the risk of abnormal placentation in future pregnancies including risk of placenta previa, placenta accreta, increta, and percreta. This spectrum of abnormal placentation holds significant maternal and neonatal morbidity including prolonged antepartum hospitalization, preterm delivery, need for emergent cesarean section, hysterectomy, blood transfusion, intensive care unit admission, and maternal and fetal death.¹⁴

TABLE 7. Complications in Proportion to Number of Cesarean Deliveries¹⁴

Complications	1 Prior CD	2 Prior CDs	3 Prior CDs	4 Prior CDs	5 Prior CDs
Hysterectomy (%)	0.42	0.9	2.41	3.49	8.99
Placenta previa	0.8%-1.5% (OR, 1.2-1.9)	1.1%-2.0% (OR, 1.9-2.0)	—	—	—
Placenta accreta (%)	0.3-0.6	1.4	—	—	6.74
Placenta previa + accreta (%)	3-4	11-14	23-40	35-61	50-67

CD indicates cesarean delivery.

Women with ≥ 1 prior cesarean deliveries are at significantly increased risk for placenta previa by a rate of 1.2% (95% CI, 0.8-1.5) compared with women without a prior cesarean. This risk increases with increasing number of prior cesarean deliveries. In women with ≥ 5 cesareans, the rate of placenta previa increases to close to 3.7%.¹⁴

Women who have both a placenta previa and a prior cesarean section are at increased risk of placenta accreta compared with women without a prior cesarean. The risk of placenta accreta increases significantly with each cesarean section and the composite maternal morbidity and risk of mortality rises in the same manner. Thus, repeat cesarean holds important and potentially catastrophic risks, and providers play an important role in helping the woman understand these risks on both sides and helping them to understand the best balance and choice for their situation.

Summary

The rate of cesarean delivery in the United States, although stable, is lingering at record highs. The implications of increasing cesareans have yet to be fully appreciated but are clearly concerning. VBAC is a safe and effective mode of delivery for the majority of women with 1 or 2 prior low transverse uterine incisions. Although our predictive powers to know who will experience poor outcomes and who will succeed are poor, the majority of women (60% to 80%) who have a TOLAC have a successful VBAC. With appropriate counseling and management, VBAC is an important mechanism to reduce the cesarean delivery rate in the United States.

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