

Trial of Labor after Cesarean (TOLAC) for Vaginal Birth after Previous Cesarean Section (VBAC) Versus Repeat Cesarean Section; A Review

Abstract

Background: Cesarean deliveries have been on the rise in recent decades, and as a result the question of how to manage subsequent deliveries becomes ever more important. Historically, repeat cesareans were thought to be the only option. However multiple studies have shown that successful vaginal birth after cesarean (VBAC) has the lowest rate of maternal morbidity and mortality compared to elective repeat cesarean delivery (ERCD). The controversy lies in the risk associated with unsuccessful VBAC, which is associated with an increased risk of uterine rupture and maternal mortality.

Objective: To compare the risks and benefits of VBAC and ERCD, examine the characteristics of VBAC candidates to predict trial of labor after cesarean (TOLAC) success, and comment on current recommendations for delivery management after prior cesarean section.

Conclusion: Careful consideration on an individual basis is required to predict if VBAC will likely be successful. Multiple medical and nonmedical factors influence the outcome of TOLAC. However, current evidence suggests that successful VBAC should not be considered an exception to the rule, but with prudent physicians' guidance is a viable option for many women with prior cesarean delivery.

Keywords: Elective Repeat Cesarean Delivery (ERCD); Repeat Cesarean Section; Risk; Scar Dehiscence; Trial of Labor after Cesarean; (TOLAC); Uterine Rupture; Uterine Scar; Uterine Scar Dehiscence; Uterine Window after Cesarean; Vaginal Birth After C-Section (VBAC)

Commentary

Volume 4 Issue 6 - 2016

Shadi Rezaei^{1*}, Meghan Labine², Sri Gottimukkala¹, Steven Karp¹, Lesly Sainvil¹, Guy Isidore¹ and Cassandra E Henderson¹

¹Department of Obstetrics and Gynecology, Lincoln Medical and Mental Health Center, USA

²St. George's University, School of Medicine, West Indies

***Corresponding author:** Shadi Rezaei, Lincoln Medical and Mental Health Center, 234 East 149th Street, Bronx, NY, 10451, USA; Email:

Shadi.Rezaei@nychhc.org

Cassandra E Henderson, CDE, Director of Maternal Fetal Medicine, Lincoln Medical and Mental Health Center, 234 East 149th Street, Bronx, NY, 10451; Email:

Cassandra.henderson@nychhc.org

Received: July 05, 2016 | **Published:** July 20, 2016

Background

Despite cesarean being a major abdominal surgery, the number of cesarean deliveries has been increasing in recent decades in the United States [1-3]. The World Health Organization has stated that national cesarean rates greater than 10-15% indicate unnecessary maternal risk. Nevertheless the current cesarean rate in the US is 32.2% (CDC). With this high rate of cesarean delivery the question of the route of delivery for subsequent pregnancies becomes ever more important.

Famously, Edwin Bradford Cragin, an obstetrician in 1916, is quoted as saying "once a cesarean, always a cesarean" and historically this had been true [1,4]. However, in 1980 the National Institute of Health (NIH) and the American Congress of Obstetricians and Gynecologists (ACOG) endorsed trial of labor after cesarean delivery (TOLAC) leading to an increase in vaginal birth after cesarean (VBAC) in the US [1]. This increase in TOLAC also revealed an increase in TOLAC related complications, such as uterine rupture-related maternal and fetal morbidity [3]. "Uterine rupture is associated with an increased risk of severe maternal complications, such as hysterectomy, hemorrhage, as well as severe fetal complications, such as hypoxic ischemic encephalopathy and perinatal death" [5]. The corresponding rise in TOLAC related complications prompted a 1998 ACOG recommendation that TOLAC should only be considered in

institutions equipped for emergency care should complications occur [3]. A few months after releasing this recommendation, ACOG revised the wording from "readily available physicians" to "immediately available physicians" to provide emergency care. This had a significant impact on hospital policy and caused a rapid decline in the number of institutions willing to consider TOLAC as an option for patients, as well as introduced concerns about medical liability claims [3].

The American College of Obstetricians and Gynecologists notes that women who desire several children are not good candidates for elective primary cesarean delivery on maternal request [6]. The International Federation of Gynecology and Obstetrics and the Society of Obstetricians and Gynaecologists of Canada, among others, state that cesarean delivery on maternal request cannot be justified and should not be offered [7].

The 2006, National Institutes of Health State of the Science conference concluded, "Cesarean delivery upon maternal request may be a reasonable alternative to planned vaginal delivery. When a health care provider cannot support this request, it is appropriate to refer the woman to another health care provider" [8].

Now the question becomes, is previous cesarean a medical indication for a repeat cesarean [1]? And if the answer is "no",

then what is the standard of care for subsequent deliveries after cesarean? Multiple studies have been done to answer this question, assessing the risks and benefits of VBAC versus elective repeat cesarean delivery (ERCD) in order to better guide patient and practice decisions. Several investigators have found that “among women with prior cesarean delivery, the rates of maternal complications are highest among women who attempted vaginal birth and failed (14.1%), intermediate among women who have a planned cesarean delivery (3.6%), and the lowest among women who attempt vaginal birth and succeed (2.4%)” [5,9]. Guise et al. [10] reviewed 568 publications on VBAC vs. ERCD and reported that successful VBAC is more effective, less expensive, and had the lowest mortality compared to ERCD. However failed TOLAC carried the highest morbidity [1,3,5,9,10]. It was concluded that the additional risk of perinatal death from attempted VBAC was 1.4 per 10,000 (95% CI 0-9.8), and in only 5% of uterine ruptures did the baby die. This means that 7,142 ERCD would have to be performed to prevent one baby death [10].

Ultimately it comes down to the physician’s ability to predict whether emergent cesarean will be required after TOLAC, as this is the real danger in attempted VBAC [2,5]. It follows that if women could be classified as either low-risk or high-risk for failure of attempted VBAC, the decision of whether to offer TOLAC would be much clearer [1,2,5]. Multiple tools have been developed meant to predict the likelihood of cesarean and uterine rupture after prior cesarean [11]. However because of the extensive number of factors to consider when evaluating maternal risk, none of the current tools have been able to definitively predict patient outcomes [1,5]. Factors that have been found to have a significant influence on the risk of failed attempted VBAC include characteristics of a woman’s obstetric history, such as type of uterine scar, single-layer versus double-layer uterine closure, number of prior cesarean births and the indication for cesarean, number of prior vaginal births, inter-delivery interval, and maternal age, in addition to factors related to current labor management, including induction or augmentation with prostaglandins or oxytocin [4,12,13]. Research has continued to examine the influence of each of the listed factors on the risk of adverse outcomes with TOLAC, and will be discussed further in the body of this review.

Objective

Current data suggest that more studies should be done to evaluate the risks and benefits of both VBAC and ERCD, and to identify potential predictors of successful VBAC. In this paper we will examine and compare the advantages and disadvantages of VBAC versus ERCD, provide an evidence base for the safe practice of VBAC based on patient selection, discuss preparation of patients, and summarize current guidelines for intrapartum care.

Risks and benefits by delivery method

Benefits Of VBAC: Women who have chosen VBAC when compared to ERCD report greater satisfaction with their delivery, often attributed to feelings of selflessness [14]. They regularly have a quicker recovery time from VBAC as compared to ERCD since there is no surgical wound. VBAC can also be cheaper than ERCD. However the costs are variable and in the event of an emergent cesarean after TOLAC they can actually be more expensive. There is also a lower rate of maternal morbidity and

mortality associated with VBAC, though these are rare even with ERCD. A successful VBAC also means it is more likely the woman would be able to have another vaginal birth in the future [15]. All vaginal deliveries are anecdotally associated with less maternal depression [14]. Additionally, breastfeeding is more likely to succeed with VBAC because it is easier for mothers without wound pain and can occur in the delivery room immediately after birth. It goes without saying that VBAC would also inherently avoid the risks that are unique to ERCD [3].

Benefits of ERCD: There are several advantages of ERCD, including more convenient timing, certainty of outcome, and a less painful delivery. Cesarean deliveries are scheduled, which can allow for families to better plan for the arrival of the baby. If an extended family member is planning on assisting with the new child but lives far away, a known delivery date and time makes planning for their arrival much easier. It also allows the parents to schedule days off from work [3,14]. With VBAC there is always the 30-50% chance that a repeat cesarean will be required if trial of labor fails. Many expectant mothers and obstetricians prefer to just have ERCD rather than risk an emergent cesarean, as they are more dangerous than planned cesareans. Also, with an elective cesarean there is no need to suffer the pain of contractions as the procedure itself is done under anesthesia, so it is relatively painless during the actual delivery [3].

For women ERCD is theorized to be protective for the pelvic floor. However this is controversial, because some of the risk of pelvic floor weakness is due to the pregnancy itself and not the method of delivery. It has been found to be slightly safer for babies, though the absolute risk to the fetus in VBAC is also quite small. But the most important advantage of ERCD is that it avoids the risk of scar rupture. It is uncertain what the true risk of scar rupture is with VBAC, as there are many factors that affect this risk. Several studies have been done to examine risk factors and predictors of uterine scar rupture in pregnancies following prior cesarean deliveries, however clear correlations have proven elusive [16].

VBAC Risks to Fetus: The rate of perinatal death is 11 times higher in VBAC than for ERCD, but this risk is shown to be equivalent to that of a fetus of a primigravida mother [17]. There is also equal risk of adverse neonatal outcomes for small-for-gestational-age neonates whether delivered by VBAC or ERCD [18]. The absolute risk is only 4.5 per 10,000 births and the confidence limits are wide. Other sources found that the risk of perinatal death was 0.2% for VBAC and 0.1% for ERCD. These statistics suggest that ERCD does decrease the risk of perinatal death, but VBAC is not proven to be more dangerous to the fetus than a woman’s first delivery [17]. There is an increased risk of neonatal birth trauma and postpartum hemorrhage if operative vaginal delivery, such as vacuum or forceps assisted delivery is required. Although, these deliveries have been shown to have lower rates of wet lung syndrome and neonatal convulsions [19].

Maternal Risk from VBAC: A meta-analysis published in American Family Physician found that trial of labor after cesarean is relatively safe. Smith et al. [5] found that although their model could not definitively predict patient outcomes, data gathered while studying its effectiveness supported the relative safety of TOLAC if spontaneous labor occurs before 40 weeks [1,5].

They found that the risk of death was 2.8 per 10,000 with trial of labor and 2.4 per 10,000 with elective cesarean. Significantly, no maternal deaths in their study were attributed to scar rupture [1,5,20]. There is a significant amount of confusion in the literature over the definition of uterine scar rupture, which contributes to the difficulty in determining its risk during VBAC. The rate of asymptomatic scar rupture has been shown to be the same for VBAC or ERCD in some studies. Overall the rate of uterine scar rupture is approximately 0.5% or 1 in 200, although, some sources have reported it as low as 0.3% or as high as 1.5% [20,21]. The largest combined study reported 0.35% risk of uterine scar rupture.

Occasionally hysterectomy is required after trial of labor, with a reported risk of 3.4 per 10,000. Statistically, this means that 2941 ERCD would need to be performed to prevent one hysterectomy after trial of labor [10,20]. Delivery is never without risk of potential complications. Through careful records analysis of these risks, obstetricians and mothers can make thoughtful decisions regarding methods of delivery and standards of care. The maternal death rate with all vaginal births is 1 per 10,000, compared to 4 per 10,000 for cesarean section. The maternal death rate with elective cesarean is 2 per 10,000 versus the maternal death rate with a normal vaginal birth of 0.5 per 10,000 [3]. This means that normal vaginal births are associated with the least maternal deaths, and overall cesarean sections are associated with the most. This does not however take into account the indication for the cesarean section, and includes those performed due to obstetric emergencies.

Patient selection for VBAC

It has been shown that women with a 60-70% chance of TOLAC success have no greater morbidity if they undergo TOLAC than if they undergo an ERCD [22-24]. This fact emphasizes the importance of evaluating candidates for VBAC. Patient selection should be based on several factors, both medical and nonmedical. Medical considerations include indication, incision type, and number of previous cesarean sections, physical factors such as advanced cervical opening, effacement, and labor progression, along with obstetric history like gravidity, parity, and prior vaginal delivery [5,21,23,25-39]. Several studies have also shown that maternal demographic factors such as age, weight, height, and ethnicity play a role in predicting VBAC success as well [4,5,11,40-44]. Some nonmedical factors to consider include, patient preference, provider comfort with the method of delivery, and delivery unit rates of successful VBAC [22].

The indication for previous cesarean is important in determining the risk of complications in following deliveries. If the reason for prior cesarean was cephalopelvic disproportion, for example, there is a 50-75% chance of successful VBAC, since this is dependent on the size of the child, which varies for each pregnancy. The size of the mother's pelvis and the fetus may have a significant influence on a successful VBAC, which supports the importance of accuracy of fetal size estimates [19,22,23].

Records indicate that VBAC has a >90% success rate if there have been prior vaginal births [7,21,25]. One study showed that out of 938 successful VBAC patients, 33.8% had a previous successful VBAC and 6.5% of those who failed VBAC had a

previously successful VBAC ($p < 0.001$). The authors found that women with a history of previous VBAC were 7 times more likely to have subsequent VBAC success [15].

Patients with multiple previous cesareans are reported to be more at risk for surgical complications, abnormal placenta implantation (placenta previa, placenta accreta), and scar rupture than women with only one prior cesarean [26,45]. Tahseen & Griffith [26] conducted a systematic analysis of available data and meta-analysis, and found that overall success for VBAC was 71.1%. They reported the risk of scar rupture to be 1.36% and perinatal risk to be 0.09% for VBAC after more than one previous cesarean, both of which are 3 times greater than VBAC after once prior cesarean. They also found that the overall maternal mortality was the same as that for ERCD [26]. Another study done by Cahill et al. [33] of 89 women in a retrospective cohort, concluded that VBAC success after >2 prior cesareans was 79.2%, with no cases of uterine rupture, and equal rates of overall maternal morbidity when compared to ERCD [33,34].

Other factors, such as dilation and gestation at previous cesarean delivery play a role in likelihood of successful outcomes of VBAC. Engagement and cervical ripening are best assessed at the onset of labor, and can guide decisions regarding attempting VBAC. If during trial of labor progress in dilatation and descent are not observed, VBAC may not be the right choice for that patient. When counseling a mother, it is important to make the distinction between attempting VBAC when labor onset is spontaneous versus when labor needs to be induced [5,12].

Many vaginal deliveries require induction of labor with either oxytocin or prostaglandin E2 (PGE2), and it is essential to understand the safety of these methods of induction before using them on women with prior cesarean sections. Overall, the risk of uterine rupture after induction of labor in women with previous cesarean delivery is low. It is noted though, that studies have shown that the risk of uterine rupture, however small, is about 1.6 times higher in women whose labor is induced compared to those who enter labor spontaneously [13,46,47]. Miller et al. [23] found that women who undergo induction with 2 prior CS have a 65% chance of achieving VBAC, which is similar to the 69% success rate of women with only 1 prior CS [23]. In a study evaluating the rates of successful VBAC and uterine rupture rates among women whose labor was induced and women who entered labor spontaneously, it was determined that induction of labor with PGE2 resulted in significantly higher rates of uterine scar rupture [25,28-30,37]. The study was conducted by Ravasia et al. [30] who reported scar rupture rate after spontaneous labor as 0.45% versus induced labor 1.4%. Prostaglandin E2 (PGE2) induction was associated with scar rupture rate that was 6 times higher than the rate in women with spontaneous labor. Women who had Foley catheter induction due to unripe cervixes had the lowest rate of rupture, 0.7% [30]. There is no significant difference in the rate of scar rupture between oxytocin and misoprostol in the literature [36]. Therefore, it can be deduced that should labor require induction, oxytocin or misoprostol are the more prudent methods to be chosen by providers to achieve the best outcomes.

Additionally, Grantz et al. [39] studied labor patterns in women attempting vaginal birth after cesarean with normal outcomes and found that labor duration for TOLAC was slower compared

to nulliparous labor, particularly for induced labor [39]. This data is significant for decision making by obstetricians when TOLAC becomes prolonged, and it must be decided whether to induce labor or perform emergent cesarean delivery.

Timing is an important consideration for predicting successful VBAC. A study done by Bujold et al. [35] recorded that in VBAC attempted <12 months after previous cesarean 4.8% resulted in scar rupture, 2.7% ruptured for those between 13-24 months status post cesarean, and 0.9% ruptured for those attempted after 25 months [35]. Bujold et al. [31] repeated their study 8 years later to better pinpoint the minimal amount of time between prior cesarean and successful VBAC. They found that the risk for uterine scar rupture is 2-3 times higher if VBAC attempted <18 months since prior cesarean. However, the risk of rupture between 18-24 months and >24 months was comparable, 1.9% and 1.3% respectively. It was also noted there is a 7-fold increased rate of rupture if the previous cesarean was a single layer closure [31].

Studies indicate that the surgical details of the previous cesarean are significant when considering a woman for VBAC. Blumenfeld et al. [32] concluded in their 2010 study that women who had single layer closure at their previous cesarean had a 7-fold increased risk of bladder adhesions regardless of any other variation in surgical techniques [32]. Classical and T incisions from prior cesarean sections are associated with a 10% risk of rupture [14].

These findings suggested that increased risk of uterine scar rupture in women with multiple previous cesareans or recent cesareans could be attributed to uterine tissue weakness or adhesions. To investigate this theory, Rozenberg et al. [27] studied 642 women with ultrasound, measuring the thinnest portion of the lower segment against a filled bladder, before attempting VBAC. Their study found that uterine thickness >4.5mm had no events of uterine rupture or dehiscence, 3.6mm-4.5mm had 2% rate of scar rupture, 2.6mm-3.5mm had 10% rate of scar rupture, and <2.6mm had a 16% rate of scar rupture. These results suggested that uterine wall thickness should be assessed prior to deciding to attempt VBAC. However this can be difficult to ascertain especially in obese women [27,45].

Women with BMI >35 or who weigh >135Kg are less likely to have a successful VBAC and more likely to suffer infectious morbidities [4,11,40,43,44]. Carroll et al. [44] studied 70 women and found that VBAC was most successful for women <200lbs (81.8%), and least successful for women >300lbs (13.3%) [42]. They also found that women weighing >300lbs had a 39% infection rate, compared to the 5.7% infection rate in women <200lbs [44].

Similarly, there is evidence of declining uterine performance with increased age at first labor. In a study of 1750 women without prior vaginal delivery, Bujold et al. [41] found that patient who were 35 years or older are more prone to have a failed TOLAC after prior cesarean delivery [11,41]. [paper 2] suggests that the influence of maternal age on the risk of emergent cesarean after TOLAC may be overcome by the protective benefit of prior vaginal birth [5,15]. Interestingly, there have not been any studies about the relationship between family history and labor performance.

It is important not to overlook the influence of psychological factors on the patient also. A successful VBAC is more likely when the patient shows willingness and drive to deliver vaginally, and has adequate psychosocial support. In a study by Bernstein et al. it was shown that women were poorly educated about the risks and benefits of TOL and ERCD, and ultimately choose the mode most preferred by their care-provider [22,35]. For this reason it has been suggested by Fargerberg et al. [22] in their 2015 study that delivery unit specific rates of VBAC and ERCD should be taken into account when counseling a woman about delivery options, as the experiences of their obstetrician and the traditions of the specific delivery ward carry great influence on delivery success [22].

Uterine Rupture and TOLAC

A prior uterine incision is a risk factor for uterine rupture or uterine dehiscence. Incisions are from myomectomies or Hysterotomy at the time of Cesarean delivery Location of the prior uterine incision is a factor that markedly affects the chance of uterine rupture. Most cases of uterine rupture occur in patients who are attempting a trial of labor after Cesarean (TOLAC). It is important to select the right patient for a TOLAC based on her individual risk factors [48] (Tables 1 & 2).

Most women with a history of one previous low transverse Cesarean are candidates for a Trial of Labor after Previous Cesarean section (TOLAC). Women with 2 prior Cesarean, low vertical incision, and twin gestation, are candidates as well. Those with high risk for complications, such as history of prior classical or T-incision, prior uterine rupture, and extensive trans-fundal surgery, and other conditions that prohibit vaginal delivery such as placenta previa, are not. Another important factor to consider is whether or not the hospital has appropriate facilities/resources in place in order to perform emergency Cesarean if needed (and to care for the neonate) [49].

If suspected, uterine rupture requires immediate abdominal exploration. Repair of the uterine defect and achieving hemostasis is goal, but hysterectomy may be necessary for uncontrolled bleeding. Risks of rupture differ by incision types. Low transverse incisions have the best prognosis, with scar separation rates of 0.2 to 1.5 percent. Classical and T-shaped incisions carry a significantly higher risk of up to 9%. Low vertical incisions not involving the fundus have a risk of rupture between 1 and 7%. Other factors that increase the risk of uterine rupture include two or more prior cesarean deliveries, induced or augmented labor, and delivery at 37 or more weeks' gestation [49].

Discussion

The ACOG practice bulletin states 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 trial of labor" [21] based on good and consistent scientific evidence. It is also acknowledged that epidural analgesia for labor is acceptable during TOLAC, and misoprostol is not to be used for third trimester cervical ripening or labor induction in women with previous cesarean delivery or major uterine surgery [49].

Table 1: Selected Clinical Factors Associated with Trial of Labor After Previous Cesarean Delivery (TOLAC) Success [12].

Increased Probability of Success for TOLAC/VBAC (Strong Predictors)
<ol style="list-style-type: none"> 1. Prior Vaginal Birth 2. Spontaneous Labor 3. Factors that increase the chance of successful Vaginal Birth After Cesarean (VBAC) include previous vaginal delivery, previous VBAC, previous cesarean delivery for non-vertex presentation, and spontaneous onset of labor.
Decreased Probability of Successful Vaginal Birth After Cesarean (VBAC) (Other Predictors)
<ol style="list-style-type: none"> 1. Recurrent Indication for Initial Cesarean Delivery (labor dystocia) 2. Increased Maternal Age /Advanced Maternal Age (AMA) 3. Non-white Ethnicity 4. Gestational Age greater than 40 weeks 5. Maternal Obesity 6. Preeclampsia 7. Short interpregnancy Interval 8. Increased Neonatal Birth Weight

Table 2: Contraindication to Trial of Labor After Cesarean Section (TOLAC) include, but not limited to the following situations.

<ol style="list-style-type: none"> 1. Vasa previa or complete placenta previa 2. Transverse fetal lie 3. Umbilical cord prolapse 4. Previous classical cesarean delivery 5. Active genital herpes infection 6. Previous myomectomy entering the endometrial cavity
--

Women with vertical or lower segment incisions that do not extend into the fundus are also candidates for VBAC, however the data supporting this is limited and inconsistent. ACOG practice bulletin does not cite support for use of prostaglandins for cervical ripening or labor induction in women with a previous cesarean.

As per general consensus, VBAC should be attempted in institutions equipped to respond to emergencies with physicians immediately available to provide emergency care, due to the catastrophic nature of uterine rupture [21]. Ultimately the decision to attempt VBAC or undergo an ERCD should be made by the patient and her physician after thorough counseling of the risks and benefits of VBAC, many of which have been outlined in this paper. Of course the patient’s medical records should reflect the counseling received by the patient and the patient’s wishes. ACOG supported guidelines reflect a relative contraindication of VBAC in women with a previous classical uterine incision or extensive trans-fundal uterine surgery.

Conclusion

Trial of labor should be recommended to all women who have had only one previous cesarean section, except for: previous classical or T uterine incision, more than one cesareans has been performed, previous hysterotomy or full thickness myomectomy, previous uterine rupture, any contraindications to labor in this pregnancy (e.g. placenta previa, transverse lie, etc.), or if previous cesarean was performed for failure to progress in the active phase of labor. These guidelines are suggested by evidence gathered from the literature and recommendations by experts in the field. However decisions should be made by physicians and patients on a case-by-case basis. Twins, suspected fetal macrosomia, and diabetes are not contraindications for VBAC.

Parents who are planning VBAC require one-on-one preparation, and should be presented with individualized evaluation of the maternal and fetal risks for that pregnancy specifically. Once the parents have been presented with detailed

risks and benefits of VBAC versus ERCD, their decision should be respected and documented. Should induction of labor be necessary in VBAC, membrane sweeping, AROM, and oxytocin can be offered during working hours at 39-41 weeks gestation, along with cervical ripening with Foley, but not PGE2. If the patient is admitted in spontaneous labor, she should be evaluated by an obstetrician within 2 hours and be on continuous maternal and fetal monitoring. Cesarean delivery is recommended if there is failure to progress, indicated by <1 cm per hour dilatation over >4 hours or no head descent with >60 minutes active pushing in the 2nd stage. Alternatively, assisted delivery may be attempted as obstetrically warranted.

Acknowledgment

The authors would like to thank Ms. Judith Wilkinson, Medical Librarian at Lincoln Medical and Mental Health Center Science Library for providing the reference articles.

References

1. Ugwumadu A (2005) Does the maxim "once a Caesarean, always a Caesarean" still hold true? *PLoS Med* 2(9): e305.
2. (2005) A Tool to Estimate the Risks of Repeat Cesarean Section. *PLoS Med* 2(9): e325
3. Wells CE, Cunningham FG (2015) Choosing The Route of Delivery After Cesarean Birth. Up to Date.
4. Hibbard JU, Gilbert S, Landon MB, Hauth JC, Leveno KJ, et al. (2006) Trial of labor or repeat cesarean delivery in women with morbid obesity and previous cesarean delivery. *Obstet Gynecol* 108(1): 125-133.
5. Smith GC, White IR, Pell JP, Dobbie R (2005) Predicting cesarean section and uterine rupture among women attempting vaginal birth after prior cesarean section. *PLoS Med* 2(9): e252.
6. American College of Obstetricians and Gynecologists (2013) ACOG committee opinion no. 559: Cesarean delivery on maternal request. *Obstet Gynecol* 121(4): 904-907.
7. International Federation of Gynecology and Obstetrics (FIGO) (2009) Committee for the Ethical Aspects of Human Reproduction and Women's Health. Ethical aspects regarding caesarean delivery for nonmedical reasons. Ethical issues in obstetrics and gynecology by the FIGO Committee for the Study of Ethical Aspects of Human Reproduction and Women's Health. London, FIGO, p. 72-73.
8. (2006) National Institutes of Health state-of-the-science conference statement: Cesarean delivery on maternal request March 27-29, 2006. *Obstet Gynecol* 107(6): 1386-1397.
9. Landon MB, Hauth JC, Leveno KJ, Spong CY, Leindecker S, et al. (2004) Maternal and perinatal outcomes associated with a trial of labor after prior cesarean delivery. *N Engl J Med* 351(25): 2581-2589.
10. Guise JM, McDonagh MS, Osterweil P, Nygren P, Chan BK, et al. (2004) Systematic review of the incidence and consequences of uterine rupture in women with previous caesarean section. *BMJ* 329(7456): 19-25.
11. Grobman WA, Lai Y, Landon MB, Spong CY, Leveno KJ, et al. (2007) Development of a nomogram for prediction of vaginal birth after cesarean delivery. *Obstet Gynecol* 109(4): 806-812.
12. O'brien-Abel N (2003) Uterine rupture during VBAC trial of labor: risk factors and fetal response. *J Midwifery Womens Health* 48(4): 249-257.
13. Scifres CM, Rohn A, Odibo A, Stamilio D, Macones GA (2011) Predicting significant maternal morbidity in women attempting vaginal birth after cesarean section. *Am J Perinatol* 28(3): 181-186.
14. Cox KJ (2014) Counseling women with a previous cesarean birth: toward a shared decision-making partnership. *J Midwifery Womens Health* 59(3): 237-245.
15. Gyamfi C, Juhasz G, Gyamfi P, Stone JL (2004) Increased success of trial of labor after previous vaginal birth after cesarean. *Obstet Gynecol* 104(4): 715-719.
16. Eden KB, McDonagh M, Denman MA, Marshall N, Emeis C, et al. (2010) New insights on vaginal birth after cesarean: can it be predicted? *Obstet Gynecol* 116(4): 967-981.
17. Smith GC, Pell JP, Cameron AD, Dobbie R (2002) Risk of perinatal death associated with labor after previous cesarean delivery in uncomplicated term pregnancies. *JAMA* 287(20): 2684-2690.
18. Turitz AL, Friedman AM, Gyamfi-Bannerman C (2016) Trial of labor after cesarean versus repeat cesarean in women with small-for-gestational age neonates: a secondary analysis. *J Maternity Fetal Neonatal Med* 29(18): 3051-3055.
19. Rietveld AL, Kok N, Kazemier BM, de Groot CJ, Teunissen PW (2015) Trial of labor after cesarean: attempted operative vaginal delivery versus emergency repeat cesarean, a prospective national cohort study. *J Perinatol* 35(4): 258-262.
20. French L (2004) Trial of Labor After Cesarean Section Is Relatively Safe. *Am Fam Physician* 70(9): 1761-1762.
21. Studsgaard A, Skorstengaard M, Glavind J, Hvidman L, Ulldbjerg N (2013) Trial of labor compared to repeat cesarean section in women with no other risk factors than a prior cesarean delivery. *Acta Obstet Gynecol Scand* 92(11): 1256-1263.
22. Fagerberg MC, Maršál K, Källén K (2015) Predicting the chance of vaginal delivery after one cesarean section: validation and elaboration of a published prediction model. *Eur J Obstet Gynecol Reprod Biol* 188: 88-94.
23. Miller ES, Grobman WA (2015) Obstetric outcomes associated with induction of labor after 2 prior cesarean deliveries. *Am J Obstet Gynecol* 213(1): 89.e1-89.e5.
24. Grobman WA, Lai Y, Landon MB, Spong CY, Leveno KJ, et al. (2009) 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* 200(1): 56.e1-56.e6.
25. Smith GC, Pell JP, Pasupathy D, Dobbie R (2004) Factors predisposing to perinatal death related to uterine rupture during attempted vaginal birth after caesarean section: retrospective cohort study. *BMJ* 329(7462): 375.
26. Tahseen S, Griffiths M (2010) Vaginal birth after two caesarean sections (VBAC-2)-a systematic review with meta-analysis of success rate and adverse outcomes of VBAC-2 versus VBAC-1 and repeat (third) caesarean sections. *BJOG* 117(1): 5-19.
27. Rozenberg P, Goffinet F, Phillippe HJ, Nisand I (1996) Ultrasonographic measurement of lower uterine segment to assess risk of defects of scarred uterus. *Lancet* 347(8997): 281-284.
28. Dekker GA, Chan A, Luke CG, Priest K, Riley M, et al. (2010) Risk

- of uterine rupture in Australian women attempting vaginal birth after one prior caesarean section: a retrospective population-based cohort study. *BJOG* 117(11): 1358-1365.
29. Lydon-Rochelle M, Holt VL, Easterling TR, Martin DP (2001) Risk of uterine rupture during labor among women with a prior cesarean delivery. *N Engl J Med* 345(1): 3-8.
 30. Ravasia DJ, Wood SL, Pollard JK (2000) Uterine rupture during induced trial of labor among women with previous cesarean delivery. *Am J Obstet Gynecol* 183(5): 1176-1179.
 31. Bujold E, Gauthier RJ (2010) Risk of uterine rupture associated with an inter delivery interval between 18 and 24 months. *Obstet Gynecol* 115(5): 1003-1006.
 32. Blumenfeld YJ, Caughey AB, El-Sayed YY, Daniels K, Lyell DJ (2010) Single- versus double-layer hysterotomy closure at primary caesarean delivery and bladder adhesions. *BJOG* 117(6): 690-694.
 33. Cahill AG, Tuuli M, Odibo AO, Stamilio DM, Macones GA (2010) Vaginal birth after caesarean for women with three or more prior caesareans: assessing safety and success. *BJOG* 117(4): 422-427.
 34. Spencer C, Pakarian F (2010) Vaginal birth after caesarean for women with three or more prior caesareans: assessing safety and success. *BJOG* 117(8): 1034.
 35. Bujold E, Mehta SH, Bujold C, Gauthier RJ (2002) Inter delivery interval and uterine rupture. *Am J Obstet Gynecol* 187(5): 1199-1202.
 36. Lin C, Raynor BD (2004) Risk of uterine rupture in labor induction of patients with prior cesarean section: an inner city hospital experience. *Am J Obstet Gynecol* 190(5): 1476-1478.
 37. Hoffman MK, Grant GH (2015) Induction of labor in women with a prior cesarean delivery. *Semin Perinatol* 39(6): 471-474.
 38. Senturk MB, Cakmak Y, Atac H, Budak MS (2015) Factors associated with successful vaginal birth after cesarean section and outcomes in rural area of Anatolia. *Int J Womens Health* 7: 693-697.
 39. Grantz KL, Gonzalez-Quintero V, Troendle J, Reddy UM, Hinkle SN, et al. (2015) Labor patterns in women attempting vaginal birth after cesarean with normal neonatal outcomes. *Am J Obstet Gynecol* 213(2): 226.e1-226.e6.
 40. Edwards RK, Harnsberger DS, Johnson IM, Treloar RW, Cruz AC (2003) Deciding on route of delivery for obese women with a prior cesarean delivery. *Am J Obstet Gynecol* 189(2): 385-389.
 41. Bujold E, Hammoud AO, Hendler I, Berman S, Blackwell SC, et al. (2004) Trial of labor in patients with a previous cesarean section: does maternal age influence the outcome? *Am J Obstet Gynecol* 190(4): 1113-1118.
 42. Durnwald CP, Ehrenberg HM, Mercer BM (2004) The impact of maternal obesity and weight gain on vaginal birth after cesarean section success. *Am J Obstet Gynecol* 191(3): 954-957.
 43. Chauhan SP, Magann EF, Carroll CS, Barrilleaux PS, Scardo JA, et al. (2001) Mode of delivery for the morbidly obese with prior cesarean delivery: vaginal versus repeat cesarean section. *Am J Obstet Gynecol* 185(2): 349-354.
 44. Carroll CS Sr, Magann EF, Chauhan SP, Klauser CK, Morrison JC (2003) Vaginal birth after cesarean section versus elective repeat cesarean delivery: Weight-based outcomes. *Am J Obstet Gynecol* 188(6): 1516-1520.
 45. Jastrow N, Chaillet N, Roberge S, Morency AM, Lacasse Y, et al. (2010) Sonographic lower uterine segment thickness and risk of uterine scar defect: a systematic review. *J Obstet Gynaecol Can* 32(4): 321-327.
 46. Rossi AC, Prefumo F (2015) Pregnancy outcomes of induced labor in women with previous cesarean section: a systematic review and meta-analysis. *Arch Gynecol Obstet* 291(2): 273-280.
 47. Lappen JR, Hackney DN, Bailit JL (2015) Outcomes of Term Induction in Trial of Labor after Cesarean Delivery: Analysis of a Modern Obstetric Cohort. *Obstet Gynecol* 126(1):115-123.
 48. Landon MB (2010) Predicting uterine rupture in women undergoing trial of labor after prior cesarean delivery. *Semin Perinatol* 34(4): 267-271.
 49. American College of Obstetricians and Gynecologists (2010) ACOG Practice bulletin no. 115: Vaginal birth after previous cesarean delivery. *Obstet Gynecol* 116(2 Pt 1): 450-463.