Original articles

Predictors of successful trial of labor after cesarean: a cross-sectional study

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Abstract

Background: The rate of repeat cesarean delivery is increasing, and although trial of labor after cesarean (TOLAC) may reduce repeat surgeries, it carries inherent risks. In Vietnam, data on TOLAC success rates and their predictors are limited.

Methods: A cross-sectional descriptive study was conducted on 95 pregnant women at the Department of Obstetrics, Hue University of Medicine and Pharmacy Hospital, from May 2023 to July 2024. The subjects were grouped according to the mode of delivery (successful vaginal delivery vs. cesarean delivery). Univariate and multivariate analyses were performed to identify the factors associated with the mode of delivery.

Results: The success rate of vaginal delivery after cesarean delivery was 25.3%. In the multivariable logistic regression analysis, three independent factors were associated with successful vaginal delivery: previous vaginal delivery (adjusted Odds ratio [aOR] = 9.913; 95% confidence interval [CI]: 2.167 - 45.350; p = 0.003), cervical effacement ≥ 75% (aOR = 19.672; 95% CI: 1.908 - 202.808; *p* = 0.012), and cervical dilation > 4 cm (aOR = 21.337; 95% CI: 1.210 - 376.124; *p* = 0.037).

Conclusion: The success rate of vaginal delivery among women with a prior cesarean scar was 25.3%. Previous vaginal delivery, cervical effacement ≥ 75%, and cervical dilation > 4 cm were independently associated with successful vaginal delivery.

Keywords: *TOLAC; previous cesarean delivery; VBAC; predictive factors.*

1. INTRODUCTION

The cesarean delivery (CD) rate is rapidly increasing worldwide. It was estimated that the global CD rate in 2018 reached 21.1% and is projected to rise to 28.5% by 2030, corresponding to more than 38 million cesarean deliveries by that time [1]. The World Health Organization (WHO) recommends an optimal cesarean delivery rate of 10 - 15%; rates above this threshold do not confer additional benefits in terms of maternal and neonatal mortality. The WHO also emphasizes that CD should only be performed for medical indications [2].

Although advances in anesthesia, surgical techniques, and infection prevention have improved the safety of CD, repeat CD remains associated with maternal and neonatal risks, including infection, hemorrhage, organ injury, postoperative adhesions, and a markedly increased risk of placenta previa and placenta accreta spectrum in subsequent pregnancies [3]. The cumulative burden of these complications leads many women with a uterine scar to choose between elective repeat cesarean section (ERCS) and trial of labor after cesarean (TOLAC).

TOLAC has garnered increasing attention over the years due to its potential to circumvent repeat surgical procedures and their associated complications, thereby conserving time and resources [4]. However, delivery after a prior cesarean section carries risks, such as uterine rupture, which can have serious consequences for both the mother and neonate. Therefore, careful selection of candidates for TOLAC is necessary to improve the success rate [5, 6].

According to the American College of Obstetricians and Gynecologists, the success rate of vaginal birth after Caesarean (VBAC) is approximately 60-80% and varies according to labor characteristics and individual obstetric history [4]. Factors influencing the decision to attempt TOLAC and the likelihood of successful TOLAC include previous vaginal birth, especially prior VBAC, which is the strongest predictor of success; high Bishop score on admission; nonrecurrence of the indication for the prior cesarean; younger

maternal age; lower Body Mass Index (BMI); adequate interdelivery interval; spontaneous onset of labor (i.e., not induced); and absence of need for strong induction/augmentation [7].

In Vietnam, studies on TOLAC rates and predictors in women with prior cesarean scars remain limited. This gap hinders the standardization of selection criteria and optimization of safety when implementing TOLAC in routine practice. Therefore, we conducted this study to characterize pregnancies in singleton women with a previous cesarean scar and identify factors associated with successful vaginal delivery (VD) in this population.

2. METHODS

2.1. Study Design and Setting

This cross-sectional descriptive study was conducted at the Department of Obstetrics, Hue University of Medicine and Pharmacy Hospital, from May 2023 to July 2024.

2.2. Study population

Pregnant women in labor with previous cesarean scars.

2.2.1. Inclusion criteria

- Previous low transverse uterine cesarean scar.
- Interval from the prior cesarean > 18 months.
- Singleton pregnancy with a cephalic presentation.
- Gestational age of ≥ 34 weeks.
- Had normal cardiotocography (CTG) at the time of admission.
- Eligible for and consented to a trial of labor after cesarean.
- Provided written, informed consent.

2.2.2. Exclusion criteria

- Intrauterine fetal death and major fetal anomalies.
- Patients with severe psychiatric disorders.
- Irreversible indication for a prior cesarean.
- History of myomectomy or uterine reconstruction.
- Contraindications to VD (e.g., anterior fibroid obstructing the pelvis, transverse lie, placenta previa).
- Severe maternal comorbidities.

2.3. Study Sample

The sample size was determined using the single proportion estimation formula: $n \geq \frac{Z^2_{1-\alpha/2}\, p(1-p)}{d^2}$ [8]. With a confidence level of 95% (Z = 1.96), an expected proportion of p = 0.747 [9], and a margin of error of d = 0.10, the minimum required sample size was 73 participants. Accordingly, at least 73 women with a previous low transverse cesarean scar and eligible for a trial of labor were needed. Ultimately, the study successfully enrolled 95 women, exceeding the minimum sample size.

A consecutive sampling method was employed to enroll all eligible women with a previous cesarean section who presented at our department and met the inclusion criteria during the study period. We collected sociodemographic, clinical, and paraclinical data, including maternal age; obstetric history (gravidity, number of prior births, history of pregnancy loss, history of VD, interval since prior cesarean section, and indication for prior cesarean section); pregnancy comorbidities (e.g., gestational hypertension, thyroid disease); gestational age; fundal height; abdominal circumference; estimated fetal weight (EFW) by ultrasound; amniotic fluid status; and cervical examination (effacement and dilation).

Labor was monitored clinically, combined with cardiotocography (CTG). We recorded the mode of labor onset, use of augmentation (if any), serial cervical progression, and intrapartum complications. If scar dehiscence or rupture was suspected, a persistent abnormal fetal heart rate (CTG category III or persistent category II) was observed (10), or arrest of labor occurred, TOLAC was terminated and CD was considered. The primary outcome was defined as successful vaginal delivery (VD), which included both spontaneous and operative vaginal births. Conversely, failed trial of labor after cesarean (TOLAC) was defined as the requirement for an emergency repeat cesarean delivery due to obstetric indications such as labor arrest or fetal distress.

2.5. Data analysis

Data were entered and analyzed using R version 4.3.1 and Microsoft Excel (2016). Categorical variables are presented as frequencies and percentages (n, %). Continuous variables are expressed as mean ± standard deviation for normally distributed data or median [25th interquartile - 75th interquartile] for non-normal distributions. The normality of continuous variables was examined using the Shapiro–Wilk test. Associations between categorical variables were assessed using Pearson's chi-square or Fisher's exact test, as appropriate. Multivariable logistic regression was used to identify independent factors associated with the outcome; results are reported as adjusted odds ratios (aOR) with 95% confidence intervals (CIs).

2.6. Ethical approval

The study was approved by the Institutional Review Board for Biomedical Research, University

of Medicine and Pharmacy, Hue (approval no. H2023/264, dated 26 May 2023). All participants were informed of the study's purpose, potential benefits, and risks, and provided written informed consent. Patient information was kept confidential, and the data were anonymized for analysis. This study adhered to the principles of the Declaration of Helsinki and the applicable regulations for protecting research participants.

3. RESULTS

Among the 95 women with a prior cesarean, the mean maternal age was 30.7 ± 4.9 years (range, 20 - 44). Over two-thirds were primiparous (one previous pregnancy). The majority of patients had no prior pregnancy loss. The median interval since the previous cesarean delivery was 4 years. Only 18.9% of the patients had a history of VD. Details are presented in Table 1.

Table 1. General characteristics and obstetric history of the study population (n = 95)

Characteristic		n = 95
Age (years)		30.7 ± 4.9
Urban residence		59 (62.1)
Gravidity	1 pregnancy	69 (72.6)
	2 pregnancies	16 (16.8)
	≥ 3 pregnancies	10 (10.5)
History of pregnancy loss	Yes	12 (12.6)
	No	83 (87.4)
Parity	1 delivery	76 (80.0)
	≥ 2 deliveries	19 (20.0)
Interval since prior CD (years)		4 [3 - 6]
History of VD	VD before and after prior CD	1 (1.1)
	VD after prior CD	5 (5.3)
	VD before prior CD	12 (12.6)
	No prior VD	77 (81.1)

Values are presented as the mean ± standard deviation, median [25th interquartile - 75th interquartile], or number (%) as appropriate. CD: cesarean delivery; VD: vaginal delivery.

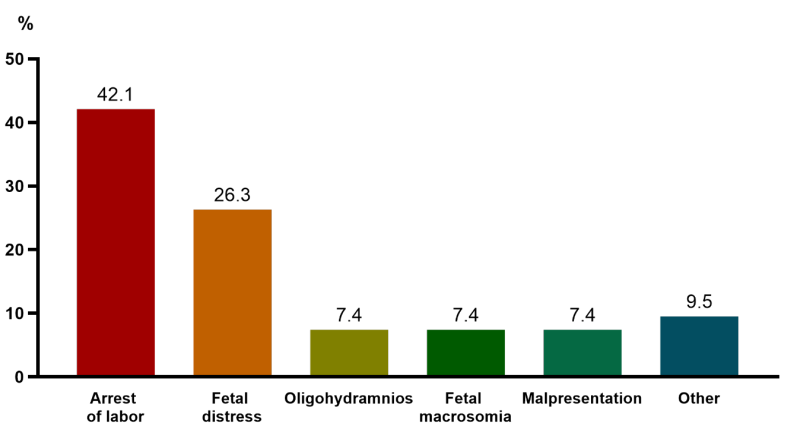

Figure 1. Indications for prior cesarean delivery

The main indications for prior CD were labor arrest (42.1%) and fetal distress (26.3%) (Figure 1).

Most pregnancies were at term (93.7%). The proportion of patients with EFW > 3500 g was low (16.8%) (Table 2).

Table 2. Characteristics of the current pregnancy (n = 95)

Characteristic		n = 95
Gestational age (weeks)	< 37 weeks	6 (6.3)
	≥ 37 weeks	89 (93.7)
Fundal height (cm)		31 [29 - 32]
Abdominal circumference (cm)		98 [94 - 102]
Pregnancy comorbidities	Gestational hypertension	8 (8.4)
	Thyroid disease	4 (4.2)
EFW (g)	< 2500 g	5 (5.3)
	2500g - 3500 g	74 (77.9)
	> 3500 g	16 (16.8)

Values are presented as the median [25th interquartile - 75th interquartile], or number (%) as appropriate. EFW: estimated fetal weight.

Table 3. Maternal complications and neonatal status (n = 95)

Variables		n = 95
Maternal complications	Uterine rupture	0 (0.0)
	Uterine atony	0 (0.0)
Neonatal status	Apgar score > 7 at 1 minute	95 (100.0)
	Apgar score > 7 at 5 minute	95 (100.0)
	Neonatal resuscitation	0 (0.0)

Values are presented as number (%).

Table 3 shows no cases of uterine rupture or atony. All neonates achieved Apgar scores >7 at 1 and 5 minutes, and none required resuscitation.

The success rate of VD was 25.3%. Statistically significant associations ($\alpha = 0.05$) were found between the mode of delivery and history of VD, gestational age < 37 weeks, cervical effacement ≥ 75%, and cervical dilation > 4 cm (Table 4).

Table 4. Association between mode of delivery and maternal characteristics

Characteristic		VD (n = 24)	CD (n = 71)	p
Age (years)	< 40 years	22 (91.7)	68 (95.8)	0.598*
	≥ 40 years	2 (8.3)	3 (4.2)	
Interval since prior CD (years)	≤ 2 years	5 (20.8)	9 (12.7)	0.334*
	> 2 years	19 (79.2)	62 (87.3)	
History of VD		12 (50.0)	6 (8.5)	**< 0.001***
Indication for prior CD	Arrest of labor	9 (37.5)	31 (43.7)	0.640**
	Other indications	15 (62.5)	40 (56.3)	
Gestational age (weeks)	< 37 weeks	4 (16.7)	2 (2.8)	**0.034***
	≥ 37 weeks	20 (83.3)	69 (97.2)	
Cervical effacement	≥ 75%	23 (95.8)	30 (42.3)	**< 0.001****
	<75%	1 (4.2)	41 (57.7)	

Cervical dilation (cm)	≤ 4cm	17 (70.8)	70 (98.6)	**< 0.001***
	> 4cm	7 (29.2)	1 (1.4)	
Rupture of membranes on admission		5 (20.8)	5 (70.4)	0.116*

Values are presented as the number (%). Bold values indicate statistical significance at the p < 0.05 level. CD: cesarean delivery; VD: vaginal delivery.

**Fisher's Exact Test*

***Pearson Chi-Square test*

Table 5. Factors associated with successful vaginal delivery in multivariable logistic regression

Factor	B	SE	aOR	95% CI	p
History of VD	2.294	0.776	9.913	2.167 - 45.350	**0.003**
Gestational age < 37 weeks	2.714	1.433	15.086	0.910 - 250.038	0.058
Estimated fetal weight ≥ 3500 g	-2.134	1.267	0.118	0.010 - 1.416	0.092
Cervical effacement ≥ 75%	2.979	1.190	19.672	1.908 - 202.808	**0.012**
Cervical dilation > 4cm	3.060	1.464	21.337	1.210 - 376.124	**0.037**

Bold values indicate statistical significance at the p < 0.05 level. aOR: adjusted Odds ratio; B: regression coefficient; CD: cesarean delivery; CI: Confidence interval; SE: Standard Error; VD: vaginal delivery.

In multivariable logistic regression, history of VD, cervical effacement ≥ 75%, and cervical dilation > 4 cm were independent predictors of successful VD, with aORs of 9.913, 19.672, and 21.337, respectively (α = 0.05) (Table 5).

4. DISCUSSION

In the present study, the success rate of VD after cesarean section was 25.3%. This figure is markedly lower than the success rates reported in international literature, such as those by Kalok (2017) and Lakra (2020), which reached 76.3% and 78.0%, respectively [11, 12] . Our results also fall below the intermediate rates of 40% to 50.95% observed in studies by Sahu (2018) and Mishra (2020) [13, 14]. Within the domestic context, this success rate is significantly lower than the 54.14% documented at Tu Du Hospital in 2018 [15]. The comparatively lower VBAC success rate observed in our cohort may reflect both population-specific clinical characteristics and institutional practices related to the selection of candidates for TOLAC and intrapartum management.

A key observation from our data is that only 8.4% of women presented with cervical dilation > 4 cm on admission, and only 18.9% had a history of VD. Both factors are well-established predictors of successful TOLAC, and their low prevalence in our cohort likely contributed substantially to the low success rate [16, 17]. To contextualize this domestically, the Tu Du cohort identified a favorable Bishop score on admission as a primary determinant of success and routinely utilized transcervical catheters for labor induction, which is a practice that may actively optimize cervical readiness [15]. Furthermore, while our multivariable model underscored prior vaginal delivery as a critical independent predictor, the Tu Du study did not establish a significant association for this variable, highlighting substantial heterogeneity in baseline obstetric characteristics between the cohorts [15]. Additionally, decision-making in settings with limited resources or concerns about immediate surgical availability may also lean toward early cesarean deliveries, which could lower the observed VBAC success rates. Patient preference, often influenced by fear of uterine rupture or prior negative obstetric experiences, may further contribute to higher repeat cesarean rates.

Crucially, our study observed no cases of both uterine rupture and uterine atony, which underscores the clinical safety of our trial of labor protocols despite the relatively lower success rate. This safety profile compares favorably to the 1% uterine rupture rate reported at Tu Du Hospital [15]. Furthermore, the neonatal outcomes were excellent, as all cases achieved Apgar scores above 7 at 1 and 5 minutes without any requirement for neonatal resuscitation. These findings suggest that our stringent selection criteria and intensive intrapartum monitoring effectively mitigated the major risks typically associated with TOLAC, thereby ensuring maternal and neonatal wellbeing throughout the trial.

Our multivariable logistic regression analysis identified three independent factors strongly associated with successful VD in women with a prior cesarean scar: history of VD (aOR = 9.913; p = 0.003), cervical effacement ≥ 75% (aOR = 19.672; p =

0.012), and cervical dilation > 4 cm (aOR = 21.337; p = 0.037). These findings underscore the pivotal role of obstetric history and cervical status in predicting the success. Prior VD has consistently been shown to be the strongest predictor of TOLAC success [16, 17]. Women who have delivered vaginally before, particularly after a prior cesarean section, demonstrate a more favorable pelvic architecture, cervical compliance, and more efficient uterine contractility. These elements, when combined, reduce the risk of dystocia and increase the likelihood of successful labor progression during TOLAC [16, 17]. Moreover, prior successful VBAC has been shown in meta-analyses to increase the odds of successful TOLAC by more than fourfold [16].

Cervical effacement and dilation at admission are also critical indicators of cervical readiness. A cervix that is ≥ 75% effaced and > 4 cm dilated reflects favorable conditions for progression to active labor. These parameters, which overlap with the components of the Bishop score [18], indicate that the cervix is already in a transitional state, which is associated with shorter labor, less need for augmentation, and reduced uterine stress on the previous cesarean scar. Several international studies and meta-analyses have confirmed cervical favorability as a strong predictor of TOLAC success, with higher effacement and greater dilation consistently associated with improved results [16].

The low percentage of women achieving these favorable cervical conditions on admission suggests that earlier admission during latent labor may be common in our study setting. Evidence shows that early admission is associated with increased cesarean rates due to slower cervical changes and longer monitoring times, both of which heighten the clinical suspicion for labor dystocia [19]. Future research should explore the timing of admission and the role of standardized admission criteria in optimizing TOLAC success in Vietnam.

Gestational age < 37 weeks showed a trend toward an association with successful VD (aOR = 15.086; p = 0.058), although this did not reach statistical significance. This trend aligns with the notion that preterm infants have smaller birth weights, thereby reducing the mechanical strain on the uterine scar. However, induction or augmentation of preterm labor may still carry risks; therefore, this finding should be interpreted with caution due to the small number of preterm births in the cohort.

Limitations: The findings of this study should be interpreted in light of certain caveats. First, the small sample size (n = 95) and the single center design limit the statistical power and generalizability of the findings. Second, the results reflect the specific clinical practices and patient selection criteria of a single institution, which may not be representative of other healthcare settings across Vietnam. Consequently, larger multicenter studies are required to further validate these findings.

5. CONCLUSION

The success rate of vaginal delivery after cesarean section in our cohort was 25.3%. The independent predictors of VBAC success were prior vaginal delivery, cervical effacement ≥ 75%, and cervical dilation > 4 cm. These findings highlight the importance of comprehensive clinical evaluation - particularly obstetric history and cervical readiness, including effacement and dilation - when selecting and counseling women with a prior cesarean section for TOLAC.

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