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Maternal and Fetal Factors Associated with the Outcome of Trial of Labor after Cesarean in Four Reference Hospitals in Cameroon

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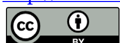
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Abstract

Introduction: Trial of Labor After Cesarean (TOLAC) is an alternative to iterative cesarean section. This study aimed to identify maternal-fetal factors associated with the outcome of TOLAC in four referral hospitals in Cameroon. **Methodology**: This was a retrospective case-control study conducted from January 2016 to December 2018 at the Yaoundé Central Hospital, the Yaoundé Teaching Hospital, the Douala Gyneco-Obstetric and Pediatric Hospital, and the Douala General Hospital. Cases (VBAC success) and controls (TOLAC failure) were matched according to maternal age and delivery site. Multivariate analysis identified factors independently associated with a favourable outcome. **Results**: Out of 468 women with unicatricial uterine who attempted vaginal delivery, 156 were successful and 312 were unsuccessful. Factors independently associated with a favorable outcome were: a favorable Bishop score (aOR = 42.24; 95% CI: 22.04 - 84.12), dilation ≥ 5 cm at admission (aOR = 7.63; 95% CI: 4.73 - 12.36), an estimated fetal weight between 2500 - 3500 g (aOR = 2.13; 95% CI: 1.44 - 3.17), clear amniotic fluid (aOR = 3.18; 95% CI: 1.73 - 6.16), and the absence of major obstetric comorbidities (aOR = 5.09; 95% CI: 2.1 - 14.73). **Conclusion**: Both maternal and fetal characteristics influence TOLAC outcomes. These results support the development of appropriate protocols to reduce unnecessary cesarean sections in resource-limited settings like Cameroonian hospitals.

Keywords

Trial of Labor After Cesarean Outcome, Iterative Cesarean Section, Associated Factors, Hospital, Cameroon

1. Introduction

The use of cesarean section has increased significantly in recent decades, raising concerns about maternal and perinatal health. Globally, the prevalence of cesarean deliveries increased from 7% in 1990 to 21% in 2021, and projections suggest that it could reach 29% by 2030 if current trends continue [1]. Although this intervention can be lifesaving when medically indicated, its overuse is associated with increased risks in subsequent pregnancies, including uterine rupture, placental complications, and preterm delivery [2].

In sub-Saharan Africa, caesarean section rates are generally low, often below 10%, but vary considerably across regions and levels of care. A study in 26 African countries found caesarean section rates ranged from 2% to 18%, with a higher concentration in urban areas and tertiary health facilities [3]. In Cameroon, a systematic review by Njim *et al.* (2020) estimated the national average caesarean section rate at 9.9%, with a progressive increase: 3.4% before 2000, 9.8% between 2000 and 2009, and 14.7% between 2010 and 2019 [4]. In some referral facilities, such as Yaoundé or Douala, this rate can exceed 17% [5].

Faced with this trend, Trial of labor after cesarean delivery or vaginal birth after cesarean (TOLAC/VBAC), is emerging as a relevant alternative to reduce complications associated with repeated cesarean sections. When properly conducted in carefully selected patients, VBAC has a success rate of 60 to 80% [6]. However, this decision remains delicate because failure of TOLAC exposes the patient to major risks such as uterine rupture, postpartum hemorrhage, acute fetal distress or even perinatal death [7].

Many factors influence the outcome of TOLAC, including the indication for the previous cesarean section, the type of uterine incision, the labor induction at the previous delivery, parity, maternal age, Bishop score, and estimated fetal weight [6] [8]. In resource-limited settings, such as in several Cameroonian hospitals, VBAC management often relies on clinical judgment, in the absence of locally validated prediction tools, making decision-making even more complex [9]. The present multicenter study, conducted in four referral hospitals, aimed to identify maternal-fetal factors associated with the outcome of TOLAC, to contribute to better patient selection, improve delivery safety, and guide obstetric practices toward a reasoned reduction in the use of repeated cesareans.

2. Methodology

2.1. Type of Study

We conducted a retrospective case-control analytical study aiming at identifying

maternal-fetal factors associated with the outcome of TOLAC.

2.2. Framework of the Study

This was a multicenter study conducted in four reference hospitals in Cameroon: the Yaoundé Central Hospital (HCY), the Yaoundé Teaching Hospital (CHUY), the Douala Gyneco-Obstetric and Pediatric Hospital (HGOPED) and the Douala General Hospital (HGD). These tertiary-level institutions have well-structured gynecology-obstetrics departments and technical platforms adapted to the management of high-risk deliveries.

2.3. Study Period

The data were collected over a three-year period from January 1, 2016 to December 31, 2018, and analysed from January 1st to May 31st, 2019.

2.4. Study Population

It concerned the files of pregnant women with a single-scarred uterus admitted in labor to the study sites and who had undergone an attempted vaginal delivery after a cesarean section.

- **Case**: women who had a successful vaginal birth after cesarean (VBAC), meaning they delivered vaginally after an attempted trial of labor after cesarean (TOLAC).
- **Control**: women who had a failed TOLAC, defined as those who underwent an secondary cesarean section following an attempted vaginal delivery after a prior cesarean.

2.5. Inclusion Criteria

- **Cases:** Complete records of women with a single-scarred uterus (SSU) who underwent TOLAC and successfully delivered vaginally (VBAC).
- **Controls:** Complete records of women with a single-scarred uterus who underwent TOLAC but required a cesarean section during labor (*i.e.*, failed TOLAC).

2.6. Exclusion Criteria

- Elective cesareans from the outset;
- Incomplete or unusable records (missing sociodemographic, obstetric, clinical, or neonatal outcome data).
- TOLAC cases with intrauterine fetal death at admission were excluded (because clinicians may be more likely to pursue vaginal delivery in these cases, potentially biasing TOLAC success estimates.

2.7. Sampling and Matching Method

We employed non-probabilistic consecutive sampling. Cases and controls were matched based on maternal age and delivery site, using a 1:2 ratio of cases to con-

trols.

2.8. Sample Size

The minimum size required was estimated from data from the study of Momat *et al*. (2017), conducted in DRC (Democratic Republic of Congo) [10]. Taking into account a case/control ratio of 1:2, and a difference in prevalence of dystocic presentation (the main factor associated with TOLAC failure) [10], a total of 127 cases and 254 controls was required, for a minimum size of 381 records.

2.9. Data Collection Procedure

Data were collected from delivery room registers, obstetric records, and surgical archives. A pre-established questionnaire was used to extract the following variables:

- Maternal factors: age, parity, obstetric history, interbirth interval, number of Antenatal Care visits, type of associated maternal pathologies (pre-eclampsia, hypertension, diabetes, etc.);
- Obstetric factors: mode of onset of labor, state of membranes, fetal presentation, use of oxytocics and Bishop score on admission. A favourable Bishop score was defined as a score of ≥6, indicating that the cervix was considered favorable for induction of labor. Amniotic fluid appearance was graded as clear, yellowish, meconium-stained , meconium-stained thick, pea soup–like or greenish, based on visual inspection at the time of rupture of membranes. This grading system allowed categorization of the fluid to assess any association with labor outcomes.
- Fetal factors: birth weight, sex of the newborn, amniotic fluid, Apgar score, fetal outcome.

2.10. Statistical Analysis

The data were analysed using Epi Info software version 3.5.4.

- Qualitative variables were expressed as percentages and compared using the Chi-square test or Fisher's exact test.
- Quantitative variables were presented as means ± standard deviation and compared by the Student's t test.
- Multivariate logistic regression analysis identified factors independently associated with the outcome of TOLAC. Results were expressed as adjusted odds ratios (aOR) with their 95% confidence intervals, with the significance threshold set at $p < 0.05$.

2.11. Ethical Considerations

Approval to conduct this study was granted by the Institutional Ethics Committee of the University of Douala and the management of the four participating hospitals. Data were handled with strict confidentiality.

3. Results

We selected 468 files comprising 156 cases and 312 controls distributed across the four recruitment sites.

3.1. Description of the Study Population

By matching one case with two controls at each recruitment site, the study recruited 40 cases and 80 controls at CHUY, 30 cases and 60 controls at HCY, 29 cases and 58 controls at HGOPED, and 57 cases and 114 controls at HGD (Table 1).

The mean age was 30.82 ± 5.1 in cases and 30.81 ± 5.1 in controls.

Table 1. Representation of cases and controls by recruitment site.

Recruitment sites	Case	Control	Total
University Hospital	40	80	120
HCY	30	60	90
HGOPED	29	58	87
HGD	57	114	174
TOTAL	156	312	468

3.2. Maternal-Fetal Parameters Associated with the Outcome of TOLAC after Bivariate Analysis

3.2.1. Previous Delivery History and Type of Prior Cesarean

A history of vaginal delivery was significantly associated with successful TOLAC [OR 1.6, 95% CI 1.08 - 2.37; $p = 0.01$]. Similarly, a previous low-segment cesarean section and cesarean performed in a first-level hospital were strong predictors of success ($p = 0.001$). In contrast, a history of classical cesarean section, an undetermined type of prior cesarean, and cesarean performed in a third-level hospital were strongly associated with VBAC failure after TOLAC. Interestingly, when the indication for the prior cesarean was labor dystocia, this factor was associated with higher odds of VBAC success [OR 6.2, 95% CI 1.29 - 44.9; $p = 0.02$].

3.2.2. Estimated Fetal Weight

Comparison of estimated fetal weights (EFW) revealed that newborns with a weight between 2500 and 3500 g were significantly more frequent in the case group (63.5%) than in the control group (44.9%), with an odds ratio (OR) of 2.13 [1.44 - 3.17]; $p < 0.001$**,** showing a positive association with favorable outcome of TOLAC. In contrast, EWF < 2500 g or >3500 g was not significantly associated with this outcome (Table 2).

3.2.3. Cervical Dilation

Regarding cervical dilation at admission, advanced dilations were strongly linked to a positive outcome. Indeed, women with a dilation of ≥5 cm accounted for 47.4% of cases, compared to 10.6% of controls (OR = 7.63 [4.73 - 12.36]; p <

0.001). Similarly, a dilation between 3 and 4 cm was also significantly associated with a positive outcome (OR = 2.08 [1.37 - 3.16]; p < 0.001). Conversely, low dilations ([1 - 2] cm) and no dilation (0 cm) were significantly more common in controls and negatively linked to a positive outcome (OR = 0.13 [0.08 - 0.21] and OR = 0.05 [0 - 0.25] respectively; $p < 0.001$) (Table 2).

Table 2. Comparison of Estimated Fetal Weight (EFW), dilation between cases and controls.

Variables	Case n = 156 (%)	Control n = 312 (%)	Total N = 468 (%)	OR (95% CI)	*p*-Value
EFW					
<2500	2 (1.3)	4 (1.3)	6 (1.3)	1 (0.13 - 5.7)	0.650
[2500 - 3500]	99 (63.5)	140 (44.9)	239 (51.1)	2.13 (1.44 - 3.17)	0.000
[3501 - 4000]	40 (25.6)	85 (27.2)	125 (26.7)	0.92 (0.59 - 1.42)	0.400
			Dilation		
0	1 (0.6)	37 (11.9)	38 (8.1)	0.05 (0 - 0.25)	0.000
[1 - 2]	21 (13.5)	170 (54.5)	191 (40.8)	0.13 (0.08 - 0.21)	0.000
[3 - 4]	60 (38.5)	72 (23.1)	132 (28.2)	2.08 (1.37 - 3.16)	0.000
≥5	74 (47.4)	33 (10.6)	107 (22.9)	7.63 (4.73 - 12.36)	0.000

3.2.4. Bishop Score

The proportion of patients with a favorable cervix according to the Bishop score was significantly higher in cases (62.8%) compared to controls (3.8%), reflecting a strong association with favorable outcome (OR = 42.24; 95% CI: 22.04 - 84.12; $p < 0.001$) (Table 3).

Table 3. Comparison of BISHOP score between cases and controls.

BISHOP score	Case n = 156 (%)	Control n = 312 (%)	Total N = 468 (%)	OR (95% CI)	*p*-Value
Favorable					
Yes	98 (62.8)	12 (3.8)	110 (23.5)	42.24 (22.04 - 84.12)	0.000
No	58 (37.2)	300 (96.2)	358 (76.5)		

3.2.5. Analysis of Comorbidities

It highlights a statistically significant association between the favorable outcome of TOLAC and the absence of certain obstetric pathologies. Cases were significantly less likely to present conditions such as severe malaria, placenta praevia, retroplacental hematoma (RPH), threatened preterm delivery (THREATENED PRETERM LABOR) or pyelonephritis compared to controls (OR = 0.2; 95% CI: 0.07 - 0.48; $p = 0.000$ for each of these pathologies).

This difference highlights that the presence of these comorbidities represents a significant risk factor for failure of TOLAC. Indeed, their impact on maternal-fetal stability and uterine dynamics could justify a VBAC failure. Conversely,

women who did not present any of these complications were more likely to have a successful VBAC, which is confirmed by the strong inverse association observed with the absence of placenta previa and threatened preterm delivery (OR = 5.09; 95% CI: 2.1 - 14.73; $p = 0.000$) (Table 4).

Table 4. Comparison of pregnancy-related comorbidities between cases and controls.

Variables	Case	Control	Total	OR (95% CI)	*p*-Value
Comorbidity	n = 156 (%)	n = 312 (%)	n = 468 (%)		
Severe malaria					
Yes	5 (3.2)	45 (14.4)	50 (10.7)	0.2 (0.07 - 0.48)	0.000
No	151 (96.8)	267 (85.6)	418 (89.3)		
Placenta praevia					
Yes	5 (3.2)	45 (14.4)	50 (10.7)	0.2 (0.07 - 0.48)	0.000
No	151 (96.8)	267 (85.6)	418 (89.3)		
Absence of the placenta praevia					
Yes	151 (96.8)	267 (85.6)	418 (89.3)	5.09 (2.1 - 14.73)	0.000
No	5 (3.2)	45 (14.4)	50 (10.7)		
Retroplacental hematoma					
Yes	5 (3.2)	45 (14.4)	50 (10.7)	0.2 (0.07 - 0.48)	0.000
No	151 (96.8)	267 (85.6)	418 (89.3)		
Threatened preterm labor					
Yes	5 (3.2)	45 (14.4)	50 (10.7)	0.2 (0.07 - 0.48)	0.000
No	151 (96.8)	267 (85.6)	418 (89.3)		
Absence of threatened preterm labor					
Yes	151 (96.8)	267 (85.6)	418 (89.3)	5.09 (2.1 - 14.73)	0.000
No	5 (3.2)	45 (14.4)	50 (10.7)		
Pyelonephritis					
Yes	5 (3.2)	45 (14.4)	50 (10.7)	0.2 (0.07 - 0.48)	0.000
No	151 (96.8)	267 (85.6)	418 (89.3)		

3.2.6. Fetal Factors

Fetal heart rate (FHR) abnormalities were significantly less frequent in cases (3.2% vs. 15.1%; OR = 0.19; 95% CI: 0.06 - 0.45; $p < 0.001$). Umbilical cord prolapse was observed only in controls (3.5%; $p = 0.010$). Regarding the appearance of amniotic fluid, clear fluid was more frequent in cases (91.7% vs. 77.6%; OR = 3.18; 95% CI: 1.73 - 6.16; $p < 0.001$), while meconium-stained fluid was more frequent in controls (19.6% vs. 5.1%; OR = 0.22; 95% CI: 0.1 - 0.46; $p < 0.001$). Other aspects of the liquid (yellowish, meconium-stained thick, pea soup-like, greenish) were not statistically associated with the outcome of TOLAC (Table 5).

Table 5. Comparison of fetal factors between cases and controls.

Variables	Case n = 156 (%)	Control n = 312 (%)	Total N = 468(%)	OR (95% CI)	*p*-Value
FHR Anomaly					
Yes	5 (3.2)	47 (15.1)	52 (11.1)	0.19 (0.06 - 0.45)	0.000
No	151 (96.8)	265 (84.9)	416 (88.9)		
Prolapse of the Cord					
Yes	0 (0)	11 (3.5)	11 (2.4)	0 (0 - 0.61)	0.010
No	156 (100)	301 (96.5)	457 (97.6)		
Appearance of the Amniotic fluid					
Yellowish					
Yes	1 (0.6)	1 (0.3)	2 (0.4)	2.01 (0.05 - 78.48)	0.560
No	155 (99.4)	311 (99.7)	466 (99.6)		
Meconium-stained					
Yes	8 (5.1)	61 (19.6)	69 (14.7)	0.22 (0.1 - 0.46)	0.000
No	148 (94.9)	251 (80.4)	399 (85.3)		
Clear					
Yes	143 (91.7)	242 (77.6)	385 (82.3)	3.18 (1.73 - 6.16)	0.000
No	13 (8.3)	70 (22.4)	83 (17.7)		
Meconium-stained thick, pea soup-like					
Yes	1 (0.6)	3 (1)	4 (0.9)	0.66 (0.03 - 6.29)	0.590
No	155 (99.4)	309 (99)	464 (99.1)		
Greenish					
Yes	3 (1.9)	3 (1)	6 (1.3)	2.02 (0.34 - 11.86)	0.320
No	153 (98.1)	309 (99)	462 (98.7)		

3.3. Maternal-Fetal Parameters Associated with Successful TOLAC after the Multivariable Logistic Regression

After adjustment, the following identified independent factors: were found: primary admission mode from home, past history of low segmental caesarean section, current pregnancy monitoring by an obstetrician-gynaecologist, an intergenetic interval of between 25 and 36 months inclusive, a birth weight of between 2500 and 3500g inclusive, ruptured membranes on admission, dilation greater than 3 cm, HU between 34 and 36 cm inclusive , drug-induced labour, and a favourable Bishop score on admission (Table 6).

Table 6. Maternal and fetal factors associated with successful TOLAC after multivariable logistic regression analysis.

Associated Factors	aOdds Ratio	95%	C.I.	*p*-Value
Favorable Bishop score	4.6252	1.4322	14.937	0.0105
Clear amniotic fluid	1.981	2.0994	11.8175	0.0653
Cervical dilatation ≥ 3 cm	16.8178	7.3333	38.569	0
Interpregnancy interval [25 - 36 months]	3.7187	1.9339	7.1506	0.0001
Obstetrician-gynecologist as care provider	2.8461	1.0274	7.8838	0.0442
Previous cesarean performed in a level-1 hospital	1.9065	0.9599	3.7864	0.0653
Uterine height [34 - 36 cm]	2.2814	1.2647	4.1153	0.0061
Mechanical induction of labor	0.425	0.1076	1.678	0.222
Pharmacological induction of labor	8.1358	1.3211	50.1041	0.0238
Married status	0.8451	0.4519	1.5807	0.5984
History of prior vaginal delivery	1.1166	0.6236	1.9995	0.7106
No history of abortion	1.0009	0.5583	1.7944	0.9975
Estimated fetal weight [2500 - 3500 g]	2.6267	1.4497	4.7592	0.0014
Ruptured membranes	3.1382	1.6444	5.9892	0.0005
Previous low transverse cesarean section	3.2136	1.6579	6.2289	0.0005
Admission from home (direct admission)	2.3903	1.3258	4.3095	0.0038

4. Discussion

The objective of this study was to identify obstetric factors associated with a favorable outcome of the uterine scar test in four university hospitals in Cameroon. The results obtained show that a favorable cervix (high Bishop score), advanced cervical dilation, an estimated fetal weight between 2500 and 3500 g, the absence of major obstetric comorbidities and clear amniotic fluid are significantly associated with a favorable outcome of the scar test.

4.1. Bishop Score and Cervical Dilation

The Bishop score is a major predictor of successful vaginal delivery, particularly in the context of Trial of labor after cesarean. In our study, a favorable Bishop score was strongly correlated with a favorable outcome of the scar test. This result is consistent with those reported by Landon *et al.* (2004) in the National Institute of Child Health and Human Development (NICHD) prospective study, which showed that the chances of successful TOLAC significantly increased with a mature cervix [6].

In addition, a dilation ≥ 3 cm at admission was an independent factor associated with the success of TOLAC. It multiplied by 16 the chance of success of the scar test, which confirms the importance of the stage of labor at the time of assessment. This result is consistent with that of Malede and Yirgu in Ethiopia (2013) who found that a dilation greater than or equal to 3 cm was an independent factor

associated with the success of TOLAC [11]. It multiplied by 5 the chance of success of VBAC. In addition, these results are consistent with those of Trojano *et al*. (2019) who reported that the progress of spontaneous labor was one of the best predictors of a successful vaginal delivery in patients with a scarred uterus [12].

4.2. Estimated Fetal Weight

Our study shows that EFWs between 2500 and 3500 g were significantly associated with a favorable outcome. These results are consistent with those of Tahseen and Griffiths (2010), and İzbudak *et al*. (2021); who showed that fetal weights > 4000 g were associated with an increased rate of failed TOLAC and maternal-fetal complications, while moderate weights increased the chances of success [13] [14]. Thus, an adequately weighted fetus appears to represent an optimal compromise between maternal and neonatal safety in the context of attempted vaginal delivery.

4.3. Pregnancy-Related Comorbidities

Analysis of comorbidities reveals that the presence of pathologies such as severe malaria, placenta praevia, retroplacental hematoma , threatened preterm labor or pyelonephritis is significantly more frequent in controls. These conditions, often associated with maternal-fetal instability, constitute relative or absolute contraindications to the scar test according to international recommendations [15] [16]. Conversely, the absence of these comorbidities was strongly associated with successful completion of TOLAC, highlighting the importance of rigorous selection of candidates for TOLAC, as also suggested by Guise *et al*. (2010) in their meta-analysis of the Agency for Healthcare Research and Quality (AHRQ) [17].

4.4. Fetal Factors

Fetal heart rate (FHR) abnormalities, cord prolapse, and abnormal amniotic fluid (meconium, pea-like, greenish) were significantly more common in controls. These factors often reflect acute fetal distress or suspected intrapartum complications, justifying immediate cesarean section. Conversely, clear amniotic fluid, indicative of good fetal well-being, was more common in women with successful vaginal deliveries. This is consistent with the data of Rosen *et al*. (2013), who emphasise that fetal integrity is a determining factor in the decision to continue labor in patients with scarred uteri [18].

In this study, after logistic regression, successful TOLAC was significantly associated with maternal and fetal factors including a favorable Bishop score, inter-delivery interval of 25 - 36 months, birth weight 2500 - 3500 g, ruptured membranes, cervical dilation >3 cm, and uterine height 34 - 36 cm. These findings align with recent studies in sub-Saharan Africa: Tegegne *et al*. (2024) identified prior vaginal delivery, cervical dilation, and maternal age as predictors of TOLAC success, while Gebremedhin *et al*. (2023) reported cervical dilation ≥4 cm and previous VBAC as independent predictors [19] [20]. Incorporating these factors into clinical assessment can optimize selection for TOLAC and improve maternal and

neonatal outcomes.

4.5. Limitations of the Study

Limitations include the bias related to the retrospective nature of the study. Also, fetal weight estimation remains subject to ultrasound variability, and amniotic fluid classification was based on a visual assessment, which is potentially subjective. Furthermore, the analysis did not incorporate certain psychosocial or logistical factors (transfer time, staff availability), which could influence clinical decisions and the outcome of TOLAC.

5. Conclusion

Trial of labor after cesarean, when properly supervised, constitutes a safe and rational obstetric strategy in resource-limited settings. It offers a realistic alternative to iterative cesarean section and allows for the optimization of obstetric care, provided that it is based on rigorous selection and adequate labor monitoring. This study reinforces the importance of formalising management protocols adapted to local realities, to promote vaginal delivery after cesarean section in optimal conditions of safety for the mother and child. Efforts must be continued to improve provider training and the monitoring of high-risk pregnancies.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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