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A predictive nomogram for a failed trial of labor after cesarean: A retrospective cohort study

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Abstract

Aim: To validate risk factors and a nomogram prediction model for the failure of a trial of labor after cesarean section (TOLAC) in a Chinese population.

Methods: We included women who tried TOLAC between January 2017 and May 2019, grouped according to the success/failure of TOLAC. The patients were randomized 3:1 into the development and validation sets. Multivariable logistic regression analyses were used to develop a nomogram prediction model for TOLAC failure.

Results: In total, 535 (86.3%) of the women ($n = 620$) aged 29–34 years had a successful vaginal birth after cesarean (VBAC). All women had a fully healed previous uterine incision. The univariable analyses showed that the cephalopelvic score ($p < 0.001$), BMI ($p = 0.001$), full engagement into the pelvis ($p < 0.001$), Bishop cervical maturity score ($p < 0.001$), and estimated fetal weight at admission ($p < 0.001$) could enter the multivariable model. Furthermore, the multivariable analysis showed that the cephalopelvic score (OR = 0.42, 95%CI: 0.23–0.77, $p = 0.005$), full engagement in the pelvis (OR = 0.16, 95%CI: 0.08–0.33, $p < 0.001$), and Bishop cervical maturity score (OR = 0.46, 95%CI: 0.35–0.59, $p < 0.001$) were independent predictors of the failure of TOLAC.

Conclusion: This study proposes a nomogram that can assess the risk of failure of TOLAC in Chinese pregnant women. The statistical model could help clinicians know the likelihood of successful TOLAC in the clinical setting.

Key words: cesarean section, nomogram, prediction, trial of labor after a cesarean, vaginal birth.

INTRODUCTION

The rate of cesarean section in China is increasing rapidly, from 28.8% in 2008 to 34.9% in 2014,[1] which is far over the rate recommended by the World Health Organization (WHO) (10%–15%).[2] In addition, the one-child policy has been adjusted to a two-child policy in China recently.[3] This alteration greatly boosted the demand for having a second child for multitudes of women who have already undergone a cesarean section, which increases the risk of the next childbirth.[4] Historically, a previous cesarean would automatically result in a repeat cesarean in a subsequent pregnancy. Nevertheless, in 1982, the American College of Obstetrics and Gynecology (ACOG) revealed that vaginal birth after cesarean (VBAC) was relatively safe and acceptable.[5] Later, in 1985, it was shown by the Canadian National Conference on Aspects of Cesarean Birth that women without indications for a cesarean section could receive a trial of labor after cesarean (TOLAC).[6] Nowadays,

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TOLAC is recommended in many countries to reduce the cesarean section rates and associated maternal morbidity.[7] Under strict indications for TOLAC, the success rate can reach 60–80%.[7,8]

Previous studies compared the risks and benefits between VBAC and elective repeat cesarean. It demonstrated that women with a successful VBAC showed shorter recovery and lower rates of infection, transfusion, unplanned hysterectomy, hemorrhage, and intensive care unit admissions than women with an elective repeat cesarean.[9–11] When an emergency cesarean section is required after labor fails, the potential risks of TOLAC increase.[12] The ACOG bulletin on VBAC demonstrates that TOLAC can be practical for most pregnant women with a prior cesarean birth.[10] Therefore, VBAC may bring more benefits to both the child and the mother.

A study showed that the VBAC rate decreased from 28% in 1996 to 8% in 2010,[13] which might be due to the fear of failure and legal issues when offering TOLAC. The risk of uterine rupture associated with TOLAC exists, and emerging evidence indicates that secondary cesarean section is associated with increased short- and long-term complications.[14] Therefore, one important factor in this decision-making process is the likelihood that a TOLAC will result in an actual VBAC.[15]

Although models predicting a woman's likelihood of successful VBAC have been suggested,[12,15–17] these studies were only for western populations. Whether these models could be practical for Chinese women remains unknown. Therefore, it is urgent to find a statistically powered predictive model, especially for China.

Therefore, the present study aimed to identify the risk factors associated with the failure of TOLAC and develop a nomogram prediction of failed TOLAC based on a retrospective cohort study in China, which could benefit the practices of TOLAC in China.

METHODS

Study design and patients

This retrospective study included women who tried TOLAC between January 2017 and May 2019 at Changsha Hospital for Maternal & Child Health Care. The study complied with the Helsinki Declaration and was approved by the Ethics Committee of Changsha Hospital for Maternal & Child Health Care. The requirement for individual consent was waived due to the retrospective nature of the study.

The inclusion criteria were (1) pregnant women offered TOLAC and (2) complete available data. The indications for TOLAC during the study period were (1) pregnant woman and her family had a desire for a vaginal birth, (2) a previous history (only once) of cesarean section with a transverse incision of the lower uterus, and the previous cesarean section went smoothly, without complications, (3) there was no objective pathological reason for the previous cesarean section, (4) the time of the present pregnancy was ≥18 months from the last cesarean section, (5) the pregnancy was a singleton, (6) B-mode ultrasound indicated that the muscular layer of the lower anterior uterine wall was continuous, and (7) no severe pregnancy complications and comorbidities. The contraindications were (1) history of two or more cesarean sections, (2) the previous cesarean section was a classical cesarean section, or a longitudinal incision or T-shaped incision in the lower uterus, (3) history of uterine rupture or a penetrating uterus cavity due to uterine fibroids removal, (4) uterine incision complications of the previous cesarean section, (5) the ultrasound examination showed that the placenta was attached to the uterine scar, and (6) the estimated fetus weight was >4000 g.

Grouping

The patients were grouped into two groups according to failed or successful TOLAC. Failed TOLAC, or emergency cesarean section, was defined as any unplanned cesarean birth after the onset of labor, most probably due to fetal distress, threatened uterine rupture, scalp disproportion, cervical toughness, chorioamnionitis, or any other complication that could endanger the life of the women and/or her baby.

Data collection

Maternal age, height, weight, gestational weeks, Bishop cervical maturity score,[18] postpartum hemorrhage, weight gain during pregnancy, lower uterine segment thickness (the lower uterine segment thickness was measured by ultrasound within 1 week before admission; if no ultrasound was performed within 1 week before admission, ultrasound was performed immediately after admission), engagement into the pelvis (if the lowest point of the fetal skull was 3 cm [−3] or above the ischial spine, the fetal head was not inserted into the pelvis; −2 was half

inserted into the pelvis; −1 or 0 below was inserted into the pelvis[19]), cephalopelvic score (Table S1),[19] and labor induction were collected from the charts. Fetal sex, 1- and 5-min Apgar scores, and estimated fetal weight (from ultrasound examination) on admission were also collected. The body mass index (BMI) was calculated according to kilograms per square meter.

Statistical analysis

Continuous variables were tested for normal distribution using the Kolmogorov–Smirnov test. Those with a normal distribution were presented as means ± SD and analyzed using the Student *t* test. Those with a skewed distribution were expressed as median (P25, P75) and analyzed using the Mann–Whitney *U* test. Categorical variables were presented as *n* (%) and analyzed using the chi-square test or Fisher's exact test, as appropriate. The prediction model for failed TOLAC was based on the univariable and multivariable logistic regression analyses; the results were presented as odds ratios (ORs) and 95% confidence intervals (CIs). Before developing this prediction model, a random 75%-to-25% split of the original dataset was performed. The prediction models were first developed in the 75% dataset (development set), and the final model was subsequently validated in the 25% dataset (validation set). The final model selection for the nomogram was performed by a backward step-down selection process using a threshold of $p < 0.05$, and some factors without significance were excluded from the full model. A nomogram was generated using R (version 4.0.2). The receiver operating characteristic (ROC) curve was used to evaluate the discriminatory ability of the model. Thirty patients were randomly selected from the success ($n = 15$) and failure ($n = 15$) groups of the validation set. The probability values for VBAC were calculated using the MFMU VBAC calculator (https://mfmunetwork.bsc.gwu.edu/web/mfmunetwork/vaginal-birth-after-cesarean-calculator) and our new nomogram. The areas under the ROC curves (AUCs) were compared using the DeLong test using the pROC package in R. All analyses (except the nomogram) were performed with SPSS 22.0 (IBM, Armonk, NY). *p* values <0.05 (two-sided) were considered statistically significant.

TABLE 1 Characteristics of the mothers

Characteristics	Total ($n = 620$)
Gestational age (weeks)	39 (38, 39.4)
Weight gain during pregnancy (kg)	14 (11, 15)
Maternal age (years)	31 (29, 34)
Lower uterine segment thickness (mm)	2.5 (2.2, 2.9)
Cephalopelvic score	7 (7, 8)
Body mass index (kg/m^2)	26.6 (24.95, 28.52)
Induced labor	12 (1.9%)
Forceps delivery	6 (1.0%)
Lateral incision	305 (49.2%)
TOLAC	
Failed	85 (13.7%)
Success	535 (86.3%)
Engagement into the pelvis	
−3	32 (5.2%)
−2	157 (25.3%)
−1 or 0	431 (69.5%)
The woman was in labor at the time of the previous cesarean	
Yes	174 (28.1%)
No	441 (71.1%)
Unknown	5 (0.8%)
Gravidity	3 (2, 4)
Parity	1 (1, 1)
Once	577 (93.1%)
Twice	41 (6.6%)
Bishop cervical maturity score	6 (5, 8)
Estimated fetal weight on admission (g)	3300 (3200, 3500)
Postpartum blood loss (ml)	200 (200, 300)

RESULTS

Characteristics of the patients

During the study period, 620 women met the eligibility criteria. Table 1 presents their characteristics. They were 31 (29–34) years of age. Of these women, 535 (86.3%) had a successful VBAC. All women had a fully healed previous uterine incision. Table 2 presents the characteristics of the infants.

The comparison of the characteristics between the TOLAC success and failure groups in the development dataset is shown in Tables 3 and 4. Compared with the failed TOLAC group, those who achieved a VBAC had a higher cephalopelvic score (7 [7, 8] vs. 7 [7], $p = 0.001$), a lower BMI (26.5 [25.0–28.4] vs. 27.8 [253.7–29.6] kg/m^2, $p = 0.002$), a higher rate of lateral incision (55.1% vs. 0, $p < 0.001$), a higher rate of engagement into the pelvis (100% vs. 69.2%, $p < 0.001$), higher Bishop cervical maturity score (7 [6–8] vs. 4 [3–5], $p < 0.001$), smaller estimated fetal weight (3300 [3200–3500] vs. 3400 [3300–3600] g, $p < 0.001$), smaller postpartum blood loss (200 [150–250]

TABLE 2 Characteristics of the infants

Characteristics	Total ($n = 620$)
Fetal sex	
Male	307 (49.5%)
Female	313 (50.5%)
Birth weight (g)	3281 ± 361
1 min Apgar score	9 (9, 9)
Score 9	609 (98.2%)
Score 6–8	11 (1.8%)
5 min Apgar score	10 (10, 10)
Score 10	610 (98.4%)
Score 0–9	10 (1.6%)

vs. 300 [200–300] ml, $p < 0.001$), and smaller actual birth weight (3261 ± 357 vs. 3498 ± 331 g, $p < 0.001$).

Univariable and multivariable analyses

As shown in Table 5, the univariable analyses showed that the cephalopelvic score ($p < 0.001$), BMI ($p = 0.001$), full engagement into the pelvis ($p < 0.001$), Bishop cervical maturity score ($p < 0.001$), and estimated fetal weight at admission ($p < 0.001$) could enter the multivariable model. The multivariable analysis showed that the cephalopelvic score

TABLE 3 Characteristics of two groups in the development dataset (mothers)

Characteristics	Successful TOLAC ($n = 405$)	Failed TOLAC ($n = 65$)	p
Gestational age (weeks)	39 (38, 39.5)	39 (39, 39)	0.393
Weight gain during pregnancy (kg)	14 (11, 15)	15 (10, 15)	0.969
Maternal age (years)	31 (29, 34)	32 (27, 35)	0.976
Lower uterine segment thickness (mm)	2.6 (2.3, 2.9)	2.5 (2.2, 2.9)	0.319
Cephalopelvic score	7 (7, 8)	7 (7, 7)	0.001
Body mass index (kg/m^2)	26.5 (25.0, 28.4)	27.8 (25.7, 29.6)	0.002
Induced labor			>0.99
Yes	9 (2.2%)	2 (3.1%)	
No	396 (97.8%)	63 (96.9%)	
Forceps delivery			>0.99*
Yes	6 (1.5%)	0	
No	399 (98.5%)	65 (100%)	
Lateral incision			<0.001
Yes	223 (55.1%)	0	
No	182 (44.9%)	65 (100%)	
Engagement into the pelvis			<0.001*
−3	0	20 (30.8%)	
−2	87 (21.5%)	33 (50.8%)	
−1 or 0	318 (78.5%)	12 (18.5%)	
The woman was in labor at the time of the previous cesarean			0.086*
Yes	117 (28.9%)	15 (23.1%)	
No	286 (70.6%)	48 (73.8%)	
Unknown	2 (0.5%)	2 (3.1%)	
Gravidity	3 (2, 4)	3 (2, 4)	0.219
Parity	1 (1, 1)	1 (1, 1)	0.386
Bishop cervical maturity score	7 (6, 8)	4 (3, 5)	<0.001
Estimated fetal weight on admission (g)	3300 (3200, 3500)	3400 (3300, 3600)	<0.001
Postpartum blood loss (ml)	200 (150, 250)	300 (200, 300)	<0.001

Note: *Compared using Fisher exact test. and Abbreviation: TOLAC, trial of labor after cesarean section.

TABLE 4 Characteristics of two groups in the development dataset (infants)

Characteristics	Successful TOLAC (n = 405)	Failed TOLAC (n = 65)	p
Fetal sex			0.603
Male	201 (49.6%)	30 (46.2%)	
Female	204 (50.4%)	35 (53.8%)	
Birth weight (g)	3261 ± 357	3498 ± 331	<0.001
1 min Apgar score	9 (9, 9)	9 (9, 9)	0.201
5 min Apgar score	10 (10, 10)	10 (10, 10)	0.225

TABLE 5 Univariable and multivariable analysis of factors related to failed TOLAC

Characteristics	Univariable analysis		Multivariable analysis	
	OR (95% CI)	*p*	OR (95% CI)	*p*
Gestational weeks (weeks)	1.181 (0.889–1.569)	0.251		
Weight gain during pregnancy (kg)	1.027 (0.959–1.101)	0.446		
Maternal age (years)	1.003 (0.936–1.074)	0.935		
Lower uterine segment thickness (mm)	0.817 (0.461–1.448)	0.490		
Cephalopelvic score	0.400 (0.244–0.656)	<0.001	0.420 (0.230–0.765)	0.005
Body mass index (kg/m^2)	1.181 (1.069–1.305)	0.001		
Induced labor				
Yes	1.397 (0.295–6.615)	0.674		
No	Reference			
Forceps delivery				
Yes	0.000 (0.000-NA)	0.999		
No	Reference			
Engagement into the pelvis				
−3	Reference			
−2	0.062 (0.032–0.121)	<0.001	0.157 (0.075–0.328)	<0.001
The woman was in labor at the time of the previous cesarean				
Yes	0.764 (0.412–1.418)	0.393		
No	Reference			
Gravidity	1.073 (0.861–1.336)	0.532		
Parity	0.527 (0.121–2.292)	0.393		
Bishop cervical maturity score	0.365 (0.287–0.465)	<0.001	0.455 (0.352–0.588)	<0.001
Estimated fetal weight on admission (g)	1.002 (1.001–1.004)	<0.001		

Abbreviations: CI, confidence interval; OR, odds ratio; TOLAC, trial of labor after cesarean section.

(OR = 0.42, 95%CI: 0.23–0.77, $p = 0.005$), full engagement in the pelvis (OR = 0.16, 95%CI: 0.08–0.33, $p < 0.001$), and Bishop cervical maturity score (OR = 0.46, 95%CI: 0.35–0.59, $p < 0.001$) were independent factors for the failure of TOLAC.

Nomogram

Figure 1 presents the nomogram that was developed based on the results of the multivariable analysis. In the development set, the ROC analysis showed that the area under the curve (AUC) was 0.902 (95%CI: 0.863–0.941, $p < 0.001$). In the validation set, the AUC was 0.898 (95%CI: 0.845–0.951, $p < 0.001$) (Figure 2). In the subset of 30 patients, the AUC of the MFMU VBAC calculator was 0.818, and the AUC of the new nomogram was 0.929, $p = 0.207$, indicating no statistically significant difference between the two models (Figure 3).

DISCUSSION

Models predicting a woman's likelihood of successful VBAC have been published,[12,15–17] but they are all from Western populations. Therefore, this study aimed to identify the independent risk factors for the failure of TOLAC in Chinese women. Moreover, this study proposes a nomogram that can assess the risk of failure of TOLAC in pregnant women.

In this study, 86.3% of the patients had a successful VBAC, which is higher than in previous studies (60%–80%),[7,8,20] but similar to an Australian study.[21] In addition, the risk of TOLAC failure was associated with lower cephalopelvic score, higher BMI, no engagement into the pelvis, lower Bishop cervical maturity score, and larger estimated fetal weight at admission in the univariable analyses, which was consistent with previous studies.[12,15,16] The multivariable analysis showed that the cephalopelvic score, no engagement into the pelvis, and Bishop cervical maturity score were independently associated with the failure of TOLAC. The maternal pelvis shape and the fetal weight are important factors associated with TOLAC success.[22,23] Of course, the fetus's full engagement in the pelvis is conducive to a successful vaginal birth.[24]

Although TOLAC might benefit the woman and her child,[9–11] risks exist because of the complications.[12] In order to avoid risks brought by TOLAC, the standard of selecting suitable parturients for TOLAC is essential. In the present study, a nomogram was constructed based on the multivariable

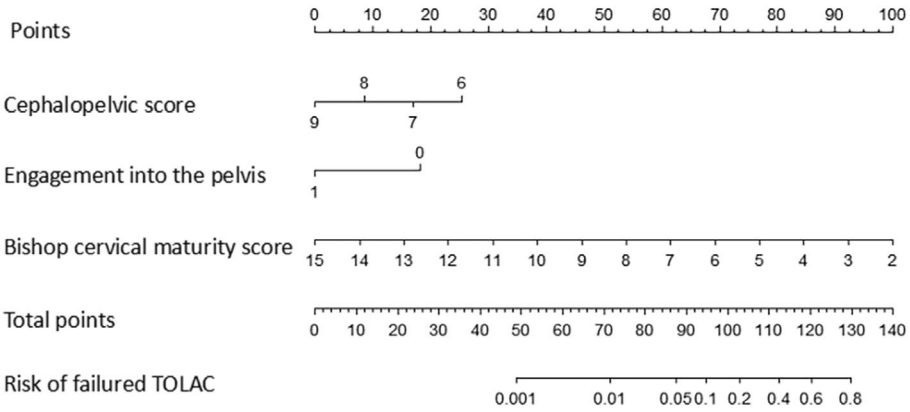

FIGURE 1 Nomogram to estimate the failure rate of trial of labor after cesarean section (TOLAC) in pregnant women. To use the nomogram for a specific patient, the score of each of the three variables (cephalopelvic score, engagement into the pelvis, and Bishop cervical maturity score) is marked on the corresponding axis. Then, a vertical line is drawn from each of the three scores to the "points" axis to determine the score of each three variables. The three scores are added together, and the total is indicated on the "Total points" axis. Finally, a vertical line is drawn from the "Total points" to the "Risk of failed TOLAC", and the risk is read directly from the axis (×100%). The formula for the risk of failed TOLAC was TOLAC = $e^{\text{Logit}(P)}/[1 + e^{\text{Logit}(P)}]$, where Logit(P) = 9.57–0.869 × cephalopelvic score-1.854 × engagement into the pelvis-0.787 × Bishop cervical maturity score.

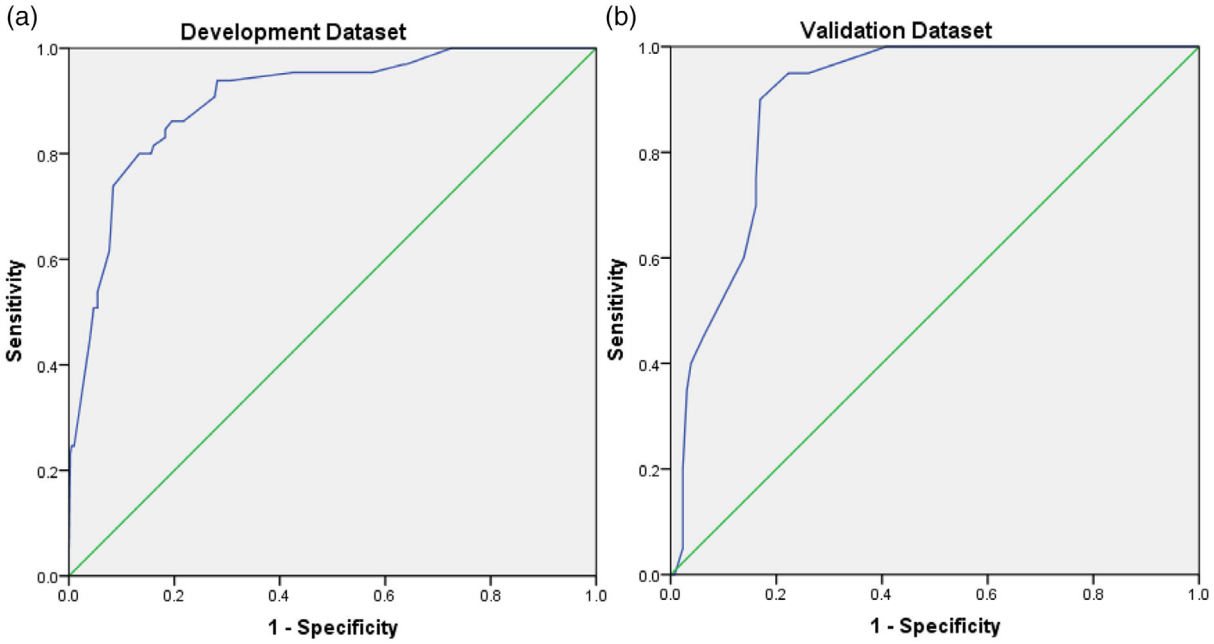

FIGURE 2 The receiver operating characteristics (ROC) curve for the nomogram. (a) The development set. Area under the curve (AUC) = 0.902, 95% confidence interval (CI) = 0.863–0.941, $p < 0.001$. (b) The validation set. AUC = 0.898, 95%CI = 0.845–0.951, $p < 0.001$.

analysis. This nomogram had a high AUC (0.902 and 0.898), indicating promising effects in predicting the failure of TOLAC. A nomogram is a practical model to evaluate the probability of a clinical outcome for specific patients.[25] Nomograms are of great value for risk-estimating, clinical decision-making, and better patient-physician communication. A previous nomogram in a Western population used six variables[15]

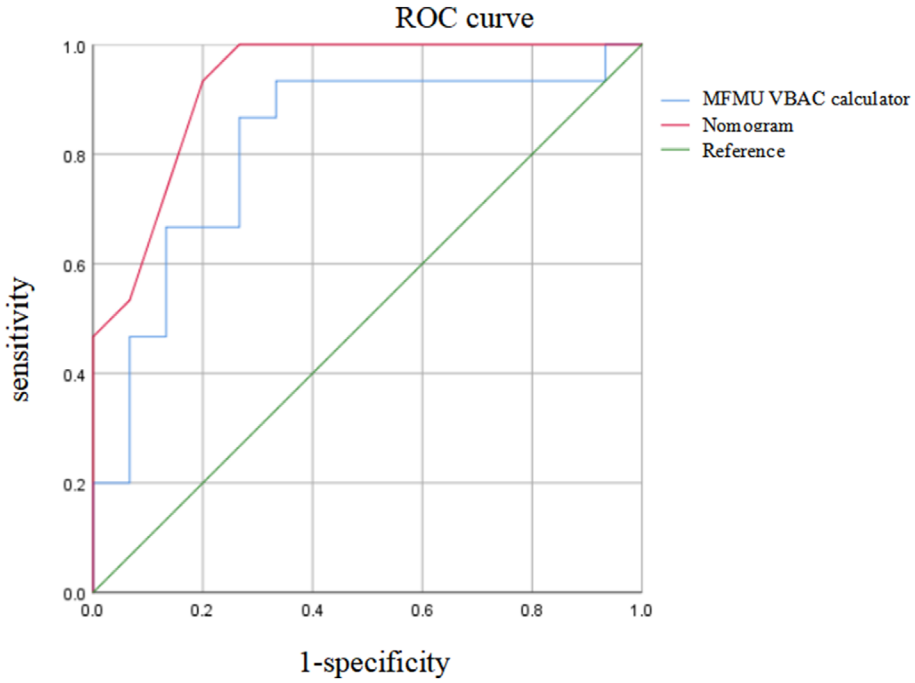

FIGURE 3 The receiver operating characteristics (ROC) curve for the nomogram and the MFMU VBAC prediction tool in a subset of 30 patients (15/group). The area under the curve (AUC) of the MFMU VBAC calculator was 0.818, and the AUC of the new nomogram was 0.929 (DeLong test, $p = 0.207$).

with no actual gain in AUC compared with the present nomogram. Another nomogram included five variables and showed an AUC of 0.723.[17] A study about a French adaptation of the Grobman nomogram showed AUCs of 0.650–0.690.[26] However, these standards might not be suitable for Chinese women. The only nomogram for a Chinese population included seven variables and showed a C-index of 0.89 for the internal validation,[27] which could not be practical because of too many indicators. Meanwhile, the present nomogram was developed for a Chinese population with only three variables and a relatively reliable AUC (0.898–0.902). The cephalopelvic score, Bishop cervical maturity score, and engagement into the pelvis are easily available without the need for laboratory or imaging tests, which can be more convenient for evaluation in the clinic.

A nomogram is a graphical representation of a complex mathematical formula to allow a clinician to calculate a score or a risk rapidly. The formula of the nomogram presented in Figure 1 represents the risk of failed TOLAC $= e^{\text{Logit}(P)}/[1 + e^{\text{Logit}(P)}]$, where Logit($P$) $= 9.57 - 0.869 \times$ cephalopelvic score $- 1.854 \times$ infiltration into basin-$0.787 \times$ Bishop cervical maturity score. For example, a lying-in woman has a cephalopelvic score of 8, engagement into the pelvis score of 0, and a Bishop cervical maturity score of 6. Therefore, Logit(P) $= 9.57 - 0.869 \times 8 - 1.854 \times 0 - 0.787 \times 6 = -2.104$, and the risk of failed TOLAC $= e^{-2.104}/[1 + e^{-2.104}] = 0.108$ (or 10.8%). In Figure 1, cephalopelvic score of 8, engagement into the pelvis of 0, and Bishop cervical maturity score of 6 correspond to about 9, 68, and 17.5 points. The total score is 94.5, which corresponds to about 0.108.

Women who have a history of cesarean section have an increased risk of childbirth complications at a second pregnancy, such as an increased risk of placenta previa, resulting in increased postpartum bleeding and pelvic and abdominal adhesion, and subsequent surgery might damage the bladder, bowel, and other adjacent organs.[24,28] More than 90% of pregnant women who have a history of cesarean section in China choose direct cesarean section again, and only about 10% of women are willing to try vaginal labor.[1,3,22] Therefore, this study proposes a nomogram that would help convince women to try TOLAC to decrease the high frequency of cesarean section observed in China.

The present study has several strengths. First, the research design can effectively avoid an observation bias. Second, the patients' information was complete and robust, including clinical history, patient demographics, and early factors, allowing for the investigation of the association of several factors with the outcome and adequately adjusting for potentially

confounding effects. Third, the population served by the hospital was entirely Chinese people from Hunan Province; there were no differences in anatomy and physiology. Nevertheless, there are also some limitations. First, it was a retrospective study in a single center. Hence, more prospective studies are needed to determine whether these results are widely applicable. Second, the data were obtained by reviewing medical records, and thus it could have compromised quality because of the accumulation of inappropriate data. A future large-scale prospective study is needed to validate this prediction model in the clinical setting.

We have proposed a nomogram that can assess the risk of failure of TOLAC in pregnant women. The statistical model could help clinicians know the likelihood of successful TOLAC in the clinical setting.

Author Contributions

Hua Li, Wenxia Li and Wen Sheng conceived and coordinated the study, designed, performed and analyzed the experiments, wrote the paper. Min Cai, Qiuling Chen, Beibei Lin and Weishe Zhang carried out the data collection, data analysis, and revised the paper. All authors reviewed the results and approved the final version of the manuscript.

Conflict of interest

The authors declare no conflict of interest.

Data availability statement

All data generated or analyzed during this study are included in this article and its supplementary material files. Further inquiries can be directed to the corresponding author.

Ethics statement

The study complied with the Helsinki Declaration and was approved by the Ethics Committee of Changsha Hospital for Maternal & Child Health Care. The requirement for individual consent was waived due to the retrospective nature of the study.

References

1. Li HT, Luo S, Trasande L, Hellerstein S, Kang C, Li JX, et al. Geographic variations and temporal trends in cesarean delivery rates in China, 2008-2014. *JAMA*. 2017;**317**:69–76.
2. Appropriate technology for birth. *Lancet*. 1985;**2**:436–7.
3. Zeng Y, Hesketh T. The effects of China's universal two-child policy. *Lancet*. 2016;**388**:1930–8.
4. Bi S, Zhang L, Chen J, Huang L, Zeng S, Jia J, et al. Development and validation of predictive models for vaginal birth after cesarean delivery in China. *Med Sci Monit*. 2020;**26**: e927681.
5. Fonseca JE, Rodriguez JL, Salazar DM. Validation of a predictive model for successful vaginal birth after cesarean section. *Colomb Med (Cali)*. 2019;**50**:13–21.
6. Indications for cesarean section: final statement of the panel of the National Consensus Conference on aspects of cesarean birth. *CMAJ*. 1986;**134**:1348–52.
7. Digestive Endoscopy Special Committee of Endoscopic Physicians Branch of Chinese Medical Association, Cancer Endoscopy Committee of China Anti-Cancer Association. Chinese guideline for bowel preparation for colonoscopy (2019, Shanghai). *Chin J Intern Med*. 2019;**58**:485–95.
8. Beckmann L, Dorin L, Metzing S, Hellmers C. Vaginal birth after caesarean section in out-of-hospital settings: a literature review. *Z Geburtshilfe Neonatol*. 2014;**218**:195–202.
9. Curtin SC, Gregory KD, Korst LM, Uddin SF. Maternal morbidity for vaginal and cesarean deliveries, according to previous cesarean history: new data from the birth certificate, 2013. *Natl Vital Stat Rep*. 2015;**64**:1–13.
10. ACOG Practice bulletin no. 115: vaginal birth after previous cesarean delivery. *Obstet Gynecol*. 2010;**116**:450–63.
11. McMahon MJ, Luther ER, Bowes WA Jr, Olshan AF. Comparison of a trial of labor with an elective second cesarean section. *N Engl J Med*. 1996;**335**:689–95.
12. Annessi E, del Giovane C, Magnani L, Carossino E, Baldoni G, Battagliarin G, et al. A modified prediction model for VBAC, in a European population. *J Matern Fetal Neonatal Med*. 2016;**29**:435–9.
13. Cox KJ. Providers' perspectives on the vaginal birth after cesarean guidelines in Florida, United States: a qualitative study. *BMC Pregnancy Childbirth*. 2011;**11**:72.
14. Xing YP, Qi XY, Wang XZ, Yang FZ. Development of a modified score system as prediction model for successful vaginal birth after cesarean delivery. *Clin Transl Sci*. 2019;**12**:53–7.
15. Grobman WA, Lai Y, Landon MB, Spong CY, Leveno KJ, Rouse DJ, et al. Development of a nomogram for prediction of vaginal birth after cesarean delivery. *Obstet Gynecol*. 2007; **109**:806–12.
16. Schoorel EN, van Kuijk SM, Melman S, Nijhuis JG, Smits LJM, Aardenburg R, et al. Vaginal birth after a caesarean section: the development of a Western European population-based prediction model for deliveries at term. *BJOG*. 2014;**121**:194–201. discussion.
17. Tessmer-Tuck JA, El-Nashar SA, Racek AR, Lohse CM, Famuyide AO, Wick MJ. Predicting vaginal birth after cesarean section: a cohort study. *Gynecol Obstet Invest*. 2014;**77**:121–6.
18. Wormer KC, Bauer A, Williford AE. *Bishop score*. Treasure Island (FL): StatPearls; 2022.
19. Ling L. Cephalic dystocia and cephalic delivery score. *Chin J Obst Gyn*. 1978;**13**:104–6.

20. Ha TK, Rao RR, Maykin MM, Mei JY, Havard AL, Gaw SL. Vaginal birth after cesarean: does accuracy of predicted success change from prenatal intake to admission? *Am J Obstet Gynecol MFM*. 2020;**2**:100094.
21. Mooney SS, Hiscock R, Clarke ID, Craig S. Estimating success of vaginal birth after caesarean section in a regional Australian population: validation of a prediction model. *Aust N Z J Obstet Gynaecol*. 2019;**59**:66–70.
22. Wen J, Song X, Ding H, Shen X, Shen R, Hu LQ, et al. Prediction of vaginal birth after cesarean delivery in Chinese parturients. *Sci Rep*. 2018;**8**:3084.
23. Manzanares S, Ruiz-Duran S, Pinto A, Pineda A, Puertas A. An integrated model with classification criteria to predict vaginal delivery success after cesarean section. *J Matern Fetal Neonatal Med*. 2020;**33**:236–42.
24. Habak PJ, Kole M. Vaginal birth after cesarean delivery. *StatPearls*. StatPearls Publishing; 2020.
25. Shariat SF, Capitanio U, Jeldres C, Karakiewicz PI. Can nomograms be superior to other prediction tools? *BJU Int*. 2009;**103**:492–5.
26. Haumonte JB, Raylet M, Christophe M, Mauviel F, Bertrand A, Desbriere R, et al. French validation and adaptation of the Grobman nomogram for prediction of vaginal birth after cesarean delivery. *J Gynecol Obstet Hum Reprod*. 2018;**47**:127–31.
27. Zhang HL, Zheng LH, Cheng LC, Liu ZD, Yu L, Han Q, et al. Prediction of vaginal birth after cesarean delivery in Southeast China: a retrospective cohort study. *BMC Pregnancy Childbirth*. 2020;**20**:538.
28. ACOG Practice Bulletin No. 205 summary: vaginal birth after cesarean delivery. *Obstet Gynecol*. 2019;**133**:393–5.

Supporting information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

TABLE S1. Calculation of the cephalopelvic score.

