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## Original Article

## Vaginal birth after cesarean section: 10 years of experience in a tertiary medical center in Taiwan

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## ABSTRACT

**Objective:** Because of the increased risk of uterine rupture and other morbidities, instances of trial of labor after cesarean (TOLAC) have decreased in number each year. Nevertheless, under careful assessment and advanced medical care, TOLAC is still a safe option for delivery. The objective of this study is to find the factors that impact the success rate for TOLAC and to compare the results with Taiwan national registry data.

**Materials and Methods:** A longitudinal cohort study that includes a total of 254 cases of women receiving TOLAC in a tertiary medical center over a period of 10 years.

**Results:** A total of 254 participants who underwent TOLAC, which accounts for 1.67% of total labor instances (254/15,166), were enrolled for analysis. The success rate of TOLAC was found to be 80.70% (205/254), including 146 (57.5%) normal deliveries, 45 (17.7%) vacuum-assisted deliveries, and 14 (5.5%) forceps-assisted deliveries. The conversion rate to cesarean section was 19.3%. There were no uterine rupture cases in our study, and there were only two suspected cases, which turned out to have no actual rupture. When analyzing the factors affecting the results of TOLAC, we found that a successfully spontaneously delivered baby had a lower birth weight than the failed TOLAC cases that were converted to cesarean delivery (mean, 2989 g vs. 3379 g;  $p < 0.001$ ). Among the patients who were converted to cesarean section, the most common reason was dysfunctional labor (79.6%), followed by fetal distress (14.3%).

**Conclusion:** Under intensive care and observation, TOLAC section may still be a feasible choice. Nevertheless, the body weight of the baby has been shown to be a factor that can influence the success rate. Copyright © 2016, Taiwan Association of Obstetrics & Gynecology. Published by Elsevier Taiwan LLC. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## Introduction

The cesarean delivery rate has increased worldwide. In the United States, the cesarean delivery rate was measured at 4.5% in 1965, but this figure increased to 32.8% in 2007. In most cases, the indication for elective cesarean section (CS) is previous CS. Many have tried trial of labor after cesarean (TOLAC) instead of elective repeat cesarean delivery (ERCD) as an attempt to reduce CS rates [1,2]. Generally speaking, TOLAC is relatively safe when compared with ERCD. Several large observational studies looking at TOLAC

have provided information that generally has been reassuring [3–8]. In 2000, however, a meta-analysis reported a higher rate of uterine rupture and perinatal death following a trial of labor than following elective CS [9]. For this reason, the American College of Obstetricians and Gynecologists (ACOG) has recommended cautious use of TOLAC. Thus, the TOLAC rate around the world has decreased since that time [10,11]. During the same period, the incidence rates of abnormal placental implantations and ectopic pregnancy on CS scar increased significantly [12,13]. The increasing CS rate as well as decreasing TOLAC could be significantly correlated with complicated placental and abnormal embryonic implantation. Hence, reducing repetitive CS rate might be the most important way to prevent pregnancy complications. Here, we present the experience of TOLAC over a period of 10 years in a single tertiary medical center, while assessing the primary outcomes; morbidities, such as uterine

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rupture; and neonatal outcomes. Also, there is emphasis on the birth weight and the success rate of vaginal birth [vaginal delivery after previous cesarean section (VBAC)].

## Materials and methods

Between January 2001 and April 2011, there were total of 15,166 deliveries registered in Taipei Veterans General Hospital, a tertiary medical center and teaching center in Taiwan. The study was approved by the Ethics Committee of the Department of Obstetrics and Gynecology at Taipei Veterans General Hospital and was conducted with the consent of each participant. We collected data from patients receiving TOLAC as an option after CS, with a total of 254 patients enrolled. The data were collected from individual medical records and entered into an electronic database. The collected information included the participant's age, pregnancy weeks at delivery, the method of delivery [normal vaginal delivery (NVD), low forceps- or vacuum-assisted vaginal birth, or conversion to CS], and the potential obstetric complication of uterine rupture. Fetal status included the fetal birth weight, and the Apgar scores rated at 1 minute and 5 minutes after delivery were all collected. Statistical analysis was done by individual *t* test. We also compared the total cesarean delivery rate and the TOLAC rate with the national data. A *p* value of  $< 0.05$  was considered statistically significant.

## Results

### Demographics

All 254 women enrolled for TOLAC were grouped by age, and the results are shown in Figure 1. Women who were

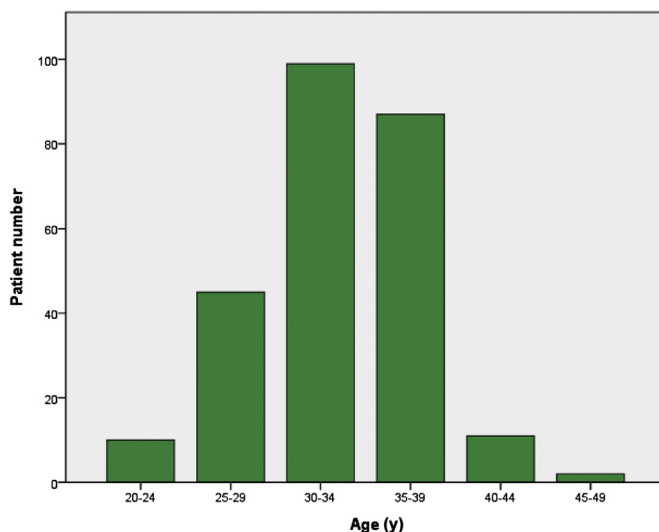


Figure 1. Age of patients, grouped.

approximately 31–35 years of age comprised the largest group. Demographic and other clinical characteristics are shown in Table 1. We defined a successful TOLAC (or defined as VBAC) as deliveries with NVD, vacuum-assisted delivery, or low forceps-assisted delivery. A failed TOLAC represented the cases that ended with receiving a CS for any reason.

### Induction of labor/augmentation

Induction of labor and augmentation using a single agent of oxytocin was applied for most of the patients after informed consent. The usage and dose were given individually by the patient's labor course and the frequency of uterine contractions.

### Method of delivery

We classified the method of delivery into NVD, low forceps- or vacuum-assisted vaginal birth, or CS. Patients who were put in to trial of labor first tried delivery spontaneously with or without the help of induction. If faced with difficulty while delivering, then either a low forceps- or a vacuum-assisted procedure would be used, according to the visiting staffs' decision. Conversion to cesarean delivery was indicated when the patient experienced either difficult labor or complications. Table 2 demonstrates the number of cases for each method. The proportion of each delivery method is shown in Figure 2. There were 146 (57.5%) normal vaginal deliveries, 45 (17.7%) vacuum-assisted deliveries, and 14 (5.5%) low forceps-assisted deliveries. There were 49 cases that were converted to CS, and the conversion rate was 19.3%.

### Previous vaginal delivery and repeated VBAC

In this study, there were 44 patients who have previous vaginal delivery before they underwent cesarean section. They have shown a higher successful VBAC rate than others—only two patients converted to cesarean section—given the success rate of 95.45% (42/44). Furthermore, 14 patients in our study group who had repeated VBAC all succeeded in a second VBAC.

The two patients (2/42) who had previous vaginal delivery but failed VBAC all transferred to CS because of dysfunctional labor. Both were term pregnancies: one was pregnancy 40 + 3/7 weeks and the other 40 + 1/7 weeks. Both were admitted for induction of labor, and oxytocin was used as a single induction agent.

### Correlation between birth weight and delivery method

Birth weight has failed to show an increase in uterine rupture rate [14,15]. Nevertheless, we were curious if it would relate to the success of VBAC. When comparing the body weight of the newborn between VBAC (normal vaginal deliveries with assisted deliveries) and failure of TOLAC (conversion to cesarean), failure of TOLAC was significantly associated with higher newborn weight (3068 g vs. 3379 g,  $p < 0.01$ ), as shown in Table 1. When we analyzed each method compared with CS, successful NVD (2989 g vs. 3379 g,  $p < 0.01$ ) and forceps-assisted

Table 1  
Clinical characteristics of the patients.

Variable	Failure (N = 49)	Success (N = 206)	<i>p</i>
Maternal age (y)	32.7 ± 4.6	33.8 ± 4.0	0.11
Gravidity	2.6 ± 0.9	2.9 ± 1.3	0.09
Gestational age at delivery (wk)	38.7 ± 1.5	38.2 ± 2.0	0.06
Birth weight (g)	3379.55 ± 449.58	3068.57 ± 518.09	<0.01
Apgar score at 1 min	7.84 ± 0.51	7.66 ± 0.97	0.22
Apgar score at 5 min	8.98 ± 0.14	8.82 ± 0.60	0.07
Blood loss (mL)	726.94 ± 313.97	270.73 ± 206.67	<0.01

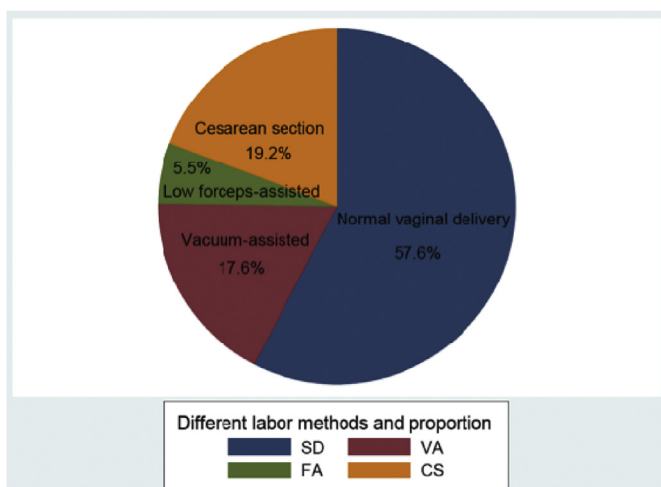
delivery (3058 g vs. 3379 g,  $p = 0.01$ ) were shown to have lower newborn weight and have statistical difference. Nevertheless, vacuum-assisted delivery failed to show a statistical difference (3329 g vs. 3379 g,  $p = 0.55$ ), as shown in Table 3.

### Neonatal outcome

We recorded the Apgar score at 1 minute and 5 minutes after delivery to evaluate the neonatal outcome. The Apgar scores of 1 minute and 5 minutes failed to show a difference between the VBAC group and the cesarean group, as shown in Table 1. Even when we analyzed each subgroup with the cesarean group, there was no significant difference in neonatal outcome (data shown in Table 4).

**Table 2**  
Patient numbers for each delivery method.

Delivery methods	Number of patients
Normal vaginal delivery	146 (57.5%)
Vacuum-assisted delivery	45 (17.7%)
Low forceps-assisted delivery	14 (5.5%)
Cesarean section	49 (19.3%)



**Figure 2.** Proportion of each delivery method. CS = cesarean section; FA = forceps-assisted; SD = spontaneous delivery; VA = vacuum-assisted.

**Table 3**  
Average newborn weight of each delivery method.

Delivery method	Newborn body weight (g)	$p^a$
Spontaneous delivery	2989.69 ± 552.09	<0.01
Vacuum-assisted delivery	3329.42 ± 361.49	0.55
Forceps-assisted delivery	3058.29 ± 247.67	0.01
Cesarean section	3379.55 ± 449.58	NA

<sup>a</sup> Compared with cesarean delivery.

**Table 4**  
Apgar score at 1 minute and 5 minutes for each delivery method.

Delivery method	Apgar score at 1 min	Apgar score at 5 min	$p^a$ (1 min/5 min)
Normal vaginal delivery	7.62 ± 1.07	8.80 ± 0.67	0.174/0.068
Vacuum-assisted delivery	7.71 ± 0.69	8.84 ± 0.42	0.319/0.038
Low forceps-assisted delivery	7.93 ± 0.26	9.00 ± 0.00	0.524/0.597
Cesarean section	7.84 ± 0.51	8.98 ± 0.14	NA/NA

NA = not available.

<sup>a</sup> Compared with cesarean section.

### Complications

#### Conversion to cesarean

Failure of VBAC and conversion rate to CS was 19.3% (49 out of 254). Among the patients who failed VBAC and converted to cesarean section, the most common reason was dysfunctional labor (79.6%), followed by fetal distress (14.3%). Other reasons included two induction failures and one abruptio placentae. Our subgroup of dysfunctional labor involved the use of oxytocin, either for induction of labor or labor augmentation, but did not include induction failure (prolonged latent phase). However, the dosage of oxytocin and the time involved were not analyzed in this study.

#### Uterine rupture

Uterine rupture has been always a concern for TOLAC, as it is an emergent complication that may cause mortality of both the infant and the mother. Although the prevalence is low (approx. 0.02–0.06%), of all the reasons that might cause uterine rupture, previous CS has been shown to be the most important risk factor. In our study, there were two suspicious cases receiving emergent laparotomy immediately, both of which turned out to have no uterine rupture.

#### Blood loss

CS was shown to have significantly higher blood loss than any other delivery method. The average blood loss of CS was 726.93 ± 313.97 mL. In contrast, the average blood loss for NVD, vacuum-assisted delivery, and forceps-assisted delivery was 249.25 ± 131.55 mL, 352.44 ± 363.80 mL, and 233.57 ± 37.12 mL, respectively. The data are shown in Table 5.

### Discussion

Recent publications have shown various trends in obstetric practice, including a significant increase in the incidence rates of CS. In Taiwan, however, medical practice is influenced strongly by the public health insurance policy. The Taiwan National Health Insurance would cover repetitive CS. The patients could choose repetitive CS or TOLAC after a discussion with their own obstetrician. Most obstetricians might encourage repetitive CS to avoid any risks from TOLAC. However, the cesarean rate was considered a negative indicator of national health; therefore, our medical center has tried to follow a relatively strict indication for CSs since 2004. We also give the option of TOLAC, with a thorough explanation of the risks and benefits, to mothers. With these efforts, our center has managed to attain a lower total CS rate compared with the national data (Figure 3). The national data from 2003 to 2009 has been published online at <http://www.bhp.doh.gov.tw>. As the national cesarean rate has grown each year, we have lowered our cesarean rate each year (Table 6).

When we compare our TOLAC rate with the national data, we see a significantly higher TOLAC rate than the national average (Figure 4; Table 7).

**Table 5**  
Blood loss for each delivery method.

Delivery method	Blood loss (mL)	<i>p</i> <sup>a</sup>
Cesarean section	726.93 ± 313.97	NA
Normal vaginal delivery	249.25 ± 131.55	<0.01
Vacuum-assisted delivery	352.44 ± 363.80	<0.01
Forceps-assisted delivery	233.57 ± 37.12	<0.01

NA = not available.

<sup>a</sup> Compared with cesarean delivery.

From our study, our VBAC rate is 80.97%. The success rate for each year is shown in Table 8.

Although TOLAC is considered safe, induction of labor is thought to increase the risk of uterine rupture [16–18]. The risk of uterine rupture undergoing induction is estimated at about 1%, which is about 3 times higher than spontaneous labor (0.3%) [17].

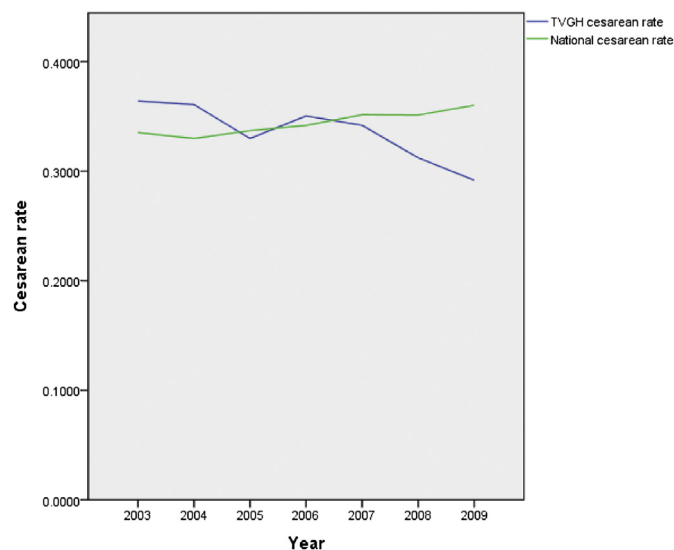
The risk of uterine rupture has been considered to differ with the various methods of induction of labor. The risk of uterine rupture with Prostaglandin E2 (PGE2) use for cervical ripening has been estimated to be 2.0% [19–23]. In contrast, the risk of uterine rupture following induction or augmentation of labor with oxytocin has been reported at 1.1% [19,24–27]. Therefore, we have chosen only oxytocin as a single agent for induction or augmentation of labor.

In our study, we applied oxytocin either for induction of labor or augmentation of labor, and there were no cases of uterine rupture. This shows the safety and feasibility of oxytocin augmentation/induction use for TOLAC.

In our study group, there were no actual occurrences of uterine rupture. In only two suspected cases, both patients were noted to have lower blood pressure while receiving TOLAC; an emergency cesarean section was arranged immediately, but they were proven to have no rupture.

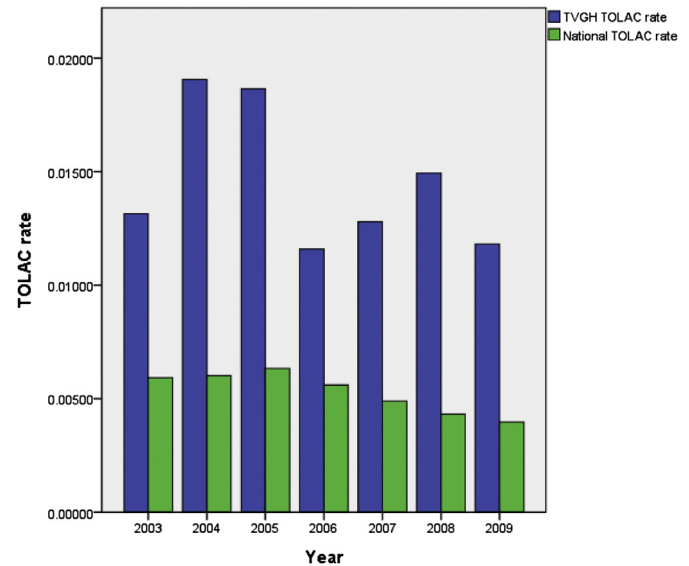
Our success rate for TOLAC is 80.97%, which is comparable with that in other studies, which ranged from 60% to 80% [9,18,24]. If patients have previous vaginal deliveries or repeated VBAC, the successful rate can be as high as 95.45–100% in our study group.

Next, we analyzed the reason(s) for failure of TOLAC and found that dysfunctional labor was the most common reason, accounting

**Figure 3.** Total cesarean rate: TVGH compared with national data. TVGH = Taipei Veterans General Hospital.**Table 6**  
Cesarean rates of TVGH and national registry data.

Year	TVGH cesarean rate	National cesarean rate
2003	0.3640	0.3352
2004	0.3609	0.3298
2005	0.3299	0.3370
2006	0.3505	0.3418
2007	0.3419	0.3515
2008	0.3122	0.3512
2009	0.2917	0.3601

TVGH = Taipei Veterans General Hospital.

**Figure 4.** Total TOLAC rate: TVGH compared with national data. TOLAC = trial of labor after cesarean; TVGH = Taipei Veterans General Hospital.**Table 7**  
TOLAC rate: TVGH versus national registry data.

Year	TVGH TOLAC rate	National TOLAC rate
2003	0.01315	0.00591
2004	0.01907	0.00601
2005	0.01866	0.00633
2006	0.01159	0.00560
2007	0.01279	0.00489
2008	0.01494	0.00432
2009	0.01182	0.00396

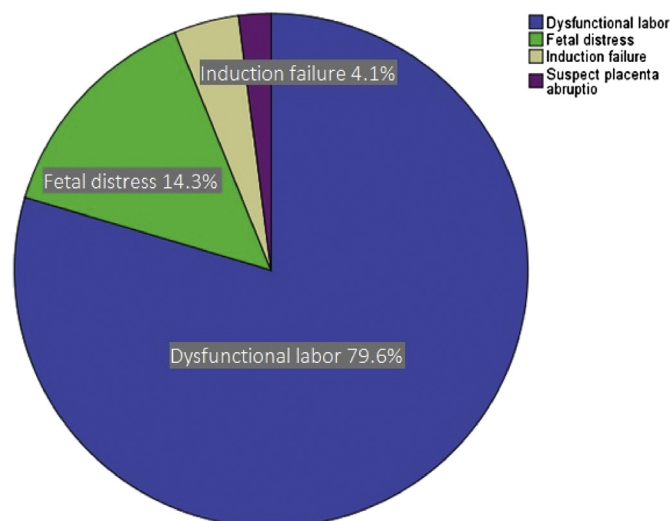
TOLAC = trial of labor after cesarean; TVGH = Taipei Veterans General Hospital.

**Table 8**  
Successful VBAC rate of TVGH for each year (2001–2010).

Year	Successful rate of TOLAC (VBAC)
2001	77%
2002	75%
2003	73%
2004	88%
2005	84%
2006	61%
2007	96%
2008	88%
2009	89%
2010	79%

TOLAC = trial of labor after cesarean; TVGH = Taipei Veterans General Hospital; VBAC = vaginal birth after cesarean section.





**Figure 5.** Reasons for failed TOLAC at TVGH (in proportion). TOLAC = trial of labor after cesarean; TVGH = Taipei Veterans General Hospital.

for 79.6% of all cases (Figure 5). The second most common reason was fetal distress (14.3%), followed by induction failure (4.1%).

In other studies, birth weight has shown no increase in risk of uterine rupture. Nevertheless, in our study, we have noticed that birth weight was higher in the failure group (3068 g vs. 3379 g,  $p < 0.01$ ). As a result, higher birth weight might influence the success of TOLAC. This is consistent with the report of the ACOG in 2010 and other studies that macrosomia (>4000 g) may have a lower likelihood of VBAC [16,28–30].

In our study, we have proven that the success rate and safety of TOLAC/VBAC is reasonable. Under intensive care and observation, trying vaginal delivery after previous CS is still a feasible choice. Nevertheless, the body weight of the baby has been shown to be a factor that can influence the success rate.

### Conflicts of interest

The authors have no conflicts of interest relevant to this article.

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