Thieme

Successful Trial of Labor After Two Caesarean Sections (TOLA2C): Analysis of a Delivery Protocol with Feto-Maternal Outcome

Erfolgreiche vaginale Entbindung nach 2 vorangegangenen Sectiones caesareae (TOLA2C): Analyse eines Entbindungsprotokolls mit fetomaternalem Outcome

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ABSTRACT

Introduction

The majority of obstetrical clinics do not offer a trial of labor after two Caesarean sections (TOLA2C) due to concerns about fetal and maternal complications such as uterine rupture or asphyxia. This study aimed to establish a delivery protocol for safely undergoing TOLA2C and analyzed predictors for a successful vaginal delivery.

Methods

Analysis of retrospectively collected data of all pregnant women after two consecutive Caesarean sections was performed at the Obstetrics Department of a tertiary community hospital from January 2013 until December 2022. Those who desired TOLA2C were screened by a senior obstetrician and had to consent to a delivery protocol consisting of five pre- and eight peripartum criteria. Maternal demographic data, indications for previous Caesarean sections and feto-maternal outcome parameters were compared between the successful TOLA2C group and the intrapartum Third-Caesarean section group.

Results

In the study period, 385 women planned a delivery after two consecutive CS. Following the protocol, 358 patients (93.0%) were scheduled as elective repeat CS, while 27 (7.0%) attempted vaginal delivery. In this TOLA2C group, 17 women (63.0%) successfully delivered vaginally. In contrast, ten failed vaginal attempts (37.0%) resulted in nine intrapartum repeat CS and one intrapartum emergency CS. Women with prior vaginal delivery had a higher chance of a successful TOLA2C ($p = 0.04$). In comparison, women with a previous CS due to the indication of arrested labor had a higher risk for intrapartum repeat CS ($p = 0.02$). No fetal or maternal death occurred, and no major complications were observed.

Conclusion
Under the specified conditions, TOLA2C is safe for mother and fetus, and successful vaginal delivery is feasible.

ZUSAMMENFASSUNG

Einleitung
Die Mehrheit der Entbindungskliniken bieten keinen Wehenversuch nach 2 vorangegangenen Sectiones caesareae (Trial of Labor after two Caesarean sections, TOLA2C) aufgrund der Bedenken hinsichtlich möglicher fetaler und mütterlicher Komplikationen wie Uterusruptur und Asphyxie. Ziel dieser Studie war es, ein Entbindungsprotokoll für eine sichere TOLA2C zu entwickeln sowie die Prädiktoren für eine erfolgreiche vaginale Entbindung zu analysieren.

Methoden
Es wurde eine Analyse der retrospektiv gesammelten Daten aller schwangeren Frauen durchgeführt, die bereits 2 Sectiones caesareae erlebt hatten und zwischen Januar 2013 und Dezember 2022 in der geburtshilflichen Abteilung eines kommunalen Krankenhauses der Tertiärversorgung entbanden. Die Frauen, die eine TOLA2C wünschten, wurden von einem erfahrenen Geburtshelfer überprüft und mussten einem Entbindungsprotokoll mit 5 prä- und 8 peripartalen Kriterien zustimmen. Die mütterlichen demografischen Daten, die Indikationen für die vorangegangenen Kaiserschnittentbindungen sowie die fetomaternalen Ergebnisparameter der erfolgreichen TOLA2C-Gruppe und der intrapartalen Dritte-Sectio-Gruppe wurden verglichen.

Ergebnisse
Im Studienzeitraum planten 385 Frauen eine Entbindung nach 2 aufeinanderfolgenden Kaiserschnittentbindungen. Laut Protokoll wurde bei 358 Patientinnen (93,0 %) eine elektive erneute CS geplant, während 27 (7,0 %) eine vaginale Entbindung versuchten. Aus dieser TOLA2C-Gruppe haben 17 Frauen (63,0 %) erfolgreich vaginal entbunden. Dagegen gab es 10 erfolglose Versuche einer vaginalen Entbindung (37,0 %), die intrapartal zu 9 erneuten Kaiserschnittentbindungen und einer Notsectio führten. Bei Frauen, die schon einmal vaginal entbunden hatten, war die Chance eines erfolgreichen TOLA2C höher (p = 0,04). Dafür war das Risiko für eine erneute intrapartale Kaiserschnittentbindung höher bei Frauen, die schon einmal eine Indikation für eine Sectio caesarea hatten wegen Geburtsstillstand (p = 0,02). Es gab keine fetale Mortalität oder Müttersterblichkeit, und es wurden keine schwerwiegenden Komplikationen beobachtet.

Schlussfolgerung
Unter den vorgegebenen Bedingungen ist TOLA2C ein sicherer Entbindungsmodus für Mutter und Kind, und eine erfolgreiche vaginale Entbindung ist möglich.

List of Abbreviations

CS	Caesarean section
ECV	External Cephalic Version
ERCS	Elective Repeat Caesarean Section
PDA	Peridural Anaesthesia
TOLAC	Trial of Labor after Caesarean section
TOLA2C	Trial of Labor after Two Caesarean sections

Introduction

In 2015, a large cross-sectional study among all 194 WHO member states showed that a Caesarean section (CS) rate of up to 19 % was associated with lower feto-maternal mortality, while higher rates would increase morbidity [1, 2]. However, the rates of CS increased worldwide within the last 20 years and peaked at around 30 % [3]. Even in Austria, there was a 2.5-fold increase in rate over the previous 25 years [4]. To better monitor and compare the drivers and consequences of the increasing numbers, the Robson classification, based on simple obstetrics parameters, has been established in many countries since 2001 [5].

The most common reasons for increased CS rates are elective repeat Caesarean sections (ERCS) and breech presentation, followed by intrapartum repeat CS due to fetal distress and dystocia [5]. Worldwide, the CS rates in women even with one previous CS are 67 % compared to 24 % in primigravid, and in the US, more than 90 % of women with one previous CS deliver with a repeat CS [6]. According to international guidelines [7, 8, 9], the success rate of trial of labor after Caesarean (TOLAC) is between 60–85 % and is associated with fewer complications than an ERCS [10]. However, failed TOLAC is associated with higher maternal morbidity and mortality rates, which shows the importance of the selection process for the ideal candidates undergoing TOLAC [10].

As there is sufficient evidence for offering TOLAC to women, international guidelines state it is reasonable for patients to consider a trial of labor after two previous low transverse CS and to counsel them based on factors that affect their probability of achieving a successful TOLA2C [11]. However, the literature is limited, and TOLA2C is mostly not considered among obstetricians [12]. As the experiences of obstetricians are a determinant factor for CS indication, most women with two CS are scheduled for an elective repeat CS [3].

This study aimed to establish a standardized protocol for making TOLA2C more accessible in the clinical routine of a single obstetrical institution in Austria and identify criteria to predict a successful TOLA2C.

Methods

Study population and data sources

From January 2013 till December 2022, one senior obstetrician screened all patients with two consecutive CS and desired TOLA2C in the second trimester at the Obstetric Department in Sankt Josef Hospital in Vienna, Austria. Within the screening, an obstetric and medical history, maternal demographic factors and indications of previous CS were collected, and fetal biometry was performed. All patients were informed about pre- and peripartal criteria and signed a shared decision form for undergoing TOLA2C. Sankt Josef Hospital is an ISO-certified tertiary community hospital, including a perinatal center with approximately 4000 annual deliveries and has a scientific collaboration with the University Hospital Salzburg. A retrospective analysis of the delivery protocol and feto-maternal outcome was performed for quality testing.

Delivery protocol

Five prepartal criteria for continuation of attempt for vaginal delivery were defined:

- desire for spontaneous delivery after two consecutive CS
- spontaneous onset of contraction
- no indication for induction of labor
- no indication for an elective repeat CS
- individual one-to-one care (one woman– one midwife setting)

An induction was recommended if the biometry at term was above the 95th percentile. An estimated fetal birth weight of more than 4500 g was planned as ERCS. A minimum interval after the last previous CS was not defined. If women did not meet all criteria, an ERCS was scheduled for 39 + 0 weeks of gestation.

The following eight criteria were determined during labor:

- minimal progress of one-centimeter cervix dilatation in less than two hours in the first stage of labor
- delivery within two hours after a fully dilated cervix was aimed
- deep amniotomy was possible
- Kiwi vacuum extraction was allowed if the fetal head was at the pelvic floor
- Peridural anesthesia (PDA) was not recommended but possible upon patient request with continuous unsuspicious cardiotocograph (CTG) surveillance
- Kristeller maneuver was strictly prohibited
- use of oxytocin was not allowed
- CTG with insuspicious pattern according to FIGO guidlines

A senior obstetrician was consulted if one of these criteria was not fulfilled, and intrapartum repeat CS was performed.

Data analysis

The study's primary outcome was the success rate of women undergoing TOLA2C who fulfilled the predefined protocol. Additionally, feto-maternal outcome parameters (APGAR, fetal pH, estimated maternal blood loss, anaesthesia mode, hospital admission duration, tears grade, and indication for repeat CS) were documented. Maternal demographic data, indications for previous CS and feto-maternal outcome parameters were compared between the successful TOLA2C group and the abandoned TOLA2C group. Due to the study's retrospective design and since TOLA2C was considered birth management within the standard of care at St. Josef Hospital Vienna, no ethical approval was necessary. The data were anonymously analyzed for quality testing at the University Hospital Salzburg.

Statistical analysis

A descriptive analysis of maternal demographics and feto-maternal outcome was performed with means and standard deviation for normally distributed data, medians and maximum/ minimum range for non-normally distributed data. Categorical variables were reported numerically and in percentages. Respecting the small sample size as not normally distributed, we calculated differences between the TOLA2C and abandoned TOLA2C group with the Mann-Whitney U test for metric values and compared nominal data with Fisher Exact Test.

The statistical analysis was performed with IBM SPSS software package (version 27.0, IBM Corp., Armonk, NY). The level of significance was set at p value < 0.05.

Results

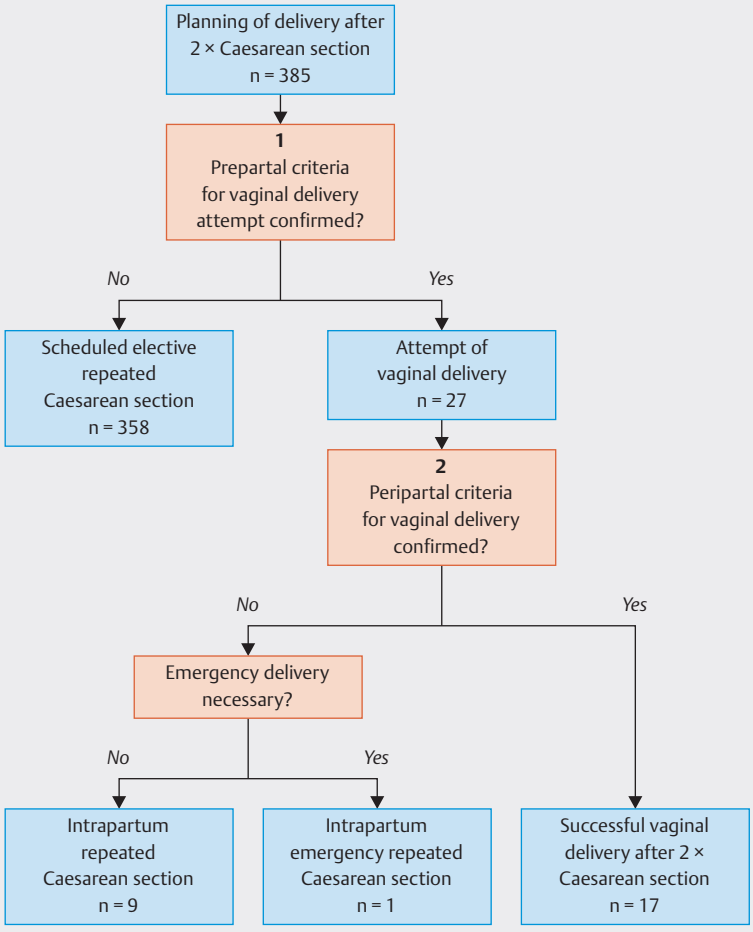
Clinical characteristics (▶ Fig. 1)

Between 2013 and 2022, 385 women planned a delivery after two consecutive CS. According to defined prepartum criteria, 358 patients (93.0 %) were scheduled as ERCS, while 27 (7.0 %) for attempting vaginal delivery. In the TOLA2C group, 17 women (63.0 %) delivered vaginally, while in ten women (37.0 %) a vaginal delivery attempt was not successful. Of these ten failed cases, nine resulted in an intrapartum repeat CS and one in an intrapartum emergency CS. In 70.0 %, the indication was a pathological CTG; in 30.0 %, labor was arrested. In all patients included, no maternal or fetal death occurred, and no maternal or fetal stay at the intensive care unit was necessary.

Comparison of successful versus failed TOLA2C group

Demographics (▶ Table 1)

The mean maternal age and BMI between the successful and failed TOLA2C group did not differ significantly. Regarding ethnicity, all women in the successful group were Caucasians, while 20.0 % of the failed group were African Americans, which was statistically insignificant (p = 0.13). Both groups underwent, on average, their fourth gravidity (successful: 3.9 ± 0.5 versus failed: 3.8 ± 0.9, p = 0.82) and had two children (2.4 ± 0.5 versus 2.0 ± 0.0, p = 0.14). Six women had a previous vaginal delivery in the successful group, while none in the failed TOLA2C group, which was statistically significant (p = 0.04). The gestational age on the delivery date did not differ significantly among both groups. This study could not show a statistical difference between the two groups birthweight (successful: 3750 g [IQR: 930] versus failed: 3495 g [IQR: 680], p = 0.31).



Comments

1 **Prepartal criteria for continuation of attempt for vaginal delivery:**
   1. Maternal desire for spontaneous delivery
   2. Spontaneous start of contractions
   3. No indication for induction of labor
   4. No indication for elective repeated Caesarean section
   5. 1 : 1-care by midwife available

2 **Peripartal criteria for continuation of attempt for vaginal delivery:**
   1. No use of oxytocin
   2. First stage of labor with min. progress of + 1 cm dilation of cervix ≤ 2 hours
   3. Delivery within ≤ 2 hours after fully dilated
   4. Deep amniotomy possible
   5. CTG stats FIGO (n)
   6. PDA possible with continuous CTG
   7. No Kristeller maneuver
   8. Kiwi vacuum extraction delivery if fetal head at bottom of pelvic floor

▶ **Fig. 1** Flowchart of study enrollment. The figure shows the election process of the study and displays the safety protocol for undergoing TOLA2C.

▶**Table 1** Maternal demographics. The table displays mean values, standard deviation and comparison of maternal demographics among successful and failed TOLA2C groups.

	Total cohort (n = 27)	**Successful TOLA2C** (n = 17)	**Failed TOLA2C** (n = 10)	**P value**
Age (years)	34.4 (4.4)	34.5 (4,0)	34.3 (5.2)	0.94
BMI	26.4 (2.5)	26.4 (2.8)	26.4 (1.8)	0.80
Ethnicity	European: 92.6 % African: 7.4 %	European: 17 (100 %) African: 0 (0 %)	European: 8 (80 %) African: 2 (20 %)	0.13
Gravidity	3.9 (0.9)	3.9 (0.9)	3.8 (0.9)	0.82
Parity	2.2 (0.4)	2.4 (0.5)	2.0 (0.0)	0.14
Prior vaginal delivery (n)	6 (22.2 %)	6 (35.3 %)	0 (0 %)	0.04
Gestational week	39.5(1.3) + 1.3 (2.2)	39.5 (1.3) + 4.6 (1.6)	39.4 (1.4) + 2.3 (2.3)	0.82
Birth weight (g) (median and IQR)	3600 (IQR: 930)	3750 (IQR: 930)	3495 (IQR: 680)	0.31
Fetal percentile (%)	55.5 (32.1)	59.8 (31.9)	48.3 (32.8)	0.41

▶**Table 2** Feto-maternal outcomes. The table displays mean values, standard deviation and comparison of feto-maternal outcomes among successful and failed TOLA2C groups.

	Total cohort (n = 27)	**Successful TOLA2C** (n = 17)	**Failed TOLA2C** (n = 10)	**P value**
pH	7.3 (0.08)	7.26 (0.1)	7.27 (0.09)	0.54
BE	− 4.5 (2.7)	− 5.3 (2.1)	− 3.2 (3.2)	0.03
APGAR (1/5/10 min)	9/10/10	9/10/10	8/10/10	0.51
Blood loss (ml)	335.2 (79.4)	335.3 (94.8)	335.0 (47.4)	0.57
Anesthesia	PDA: 2 (7.4 %) SPA: 7 (26.0 %) General: 2 (7.4 %) No: 16 (59.3 %)	No: 16 (94.0 %) PDA: 1 (6.0 %)	PDA: 1 (10.0 %) SPA: 7 (70.0 %) General: 2 (20.0 %)	< 0.01
Childbed	Spontaneous: 17 (63.0 %) Cesarean: 10 (37.0 %)	Outpatient delivery: 7 (41.1 %)	Iron supplement: 3 (30.0 %)	< 0.01
Perineal tears	Total tears: 11 (40.7 %)	Without tear: 6 (35.3 %) Tear: 11 (64.7 %) ▪ Low-grade perineal: 4 (36.4 %) ▪ Vaginal tear: 1 (9.1 %) ▪ Labial tear: 2 (18.2 %) ▪ Clitoral tear: 1 (9.1 %) ▪ Combined tears: 3 (27.3 %)	0	n.a.
Fetal position	Anterior occipital position: 26 (96.3 %) Posterior occipital position: 1 (3.7 %)	Anterior occipital position: 17 (100 %) Posterior occipital position: 0 (0.0 %)	Anterior occipital position: 9 (90.0 %) Posterior occipital position: 1 (10.0 %)	0.37
Complications (n)	n = 2 (7.4 %) ▪ Uterine rupture: 1 (3.7 %) ▪ Dystocia: 1 (3.7 %)	Dystocia: 1 (6.0 %)	Uterine rupture: 1 (10.0 %)	n.a.
Indication for Caesarean			Pathologic CTG: 7 (70.0 %) Arrest of labor: 3 (30.0 %)	n.a.

Fetal outcome (▶ **Table 2**)

The fetal outcome parameters of the umbilical artery pH and APGAR showed no difference between the successful TOLA2C and the intrapartum repeat CS group. In all cases, the fetal position was an anterior occipital head position besides one posterior occipital head position in the intrapartum repeat CS group. Two offspring needed short oxygen support, but both were allowed to stay with the mother immediately after the neonatological examination.

Maternal outcome (▶ **Table 2**)

Senior obstetricians estimated the blood loss during labor, which did not differ among both groups (335.3 ± 94.8 versus 335.0 ± 47.4, p = 0.57). In the TOLA2C group, only one patient needed a PDA. In the intrapartum repeat CS group, seven women had spinal anesthesia, one an epidural and two general anesthesia. In the spontaneous group, six patients (35.3.%) delivered without a tear. A labial tear occurred in two cases (18.2 %), a low-grade perineal tear in four (36.4 %), an isolated vaginal tear in one (9.1 %), a periclitoral tear in one (9.1 %) and combined tears in three (27.3 %).

Outpatient delivery was possible in seven cases in the TOLA2C group (41.1 %). In the intrapartum repeat CS group, an iron substitution was given to three patients due to a hemoglobin decline under 10 mg/dl (30.0 %). The only emergency CS was performed due to a pathological CTG because of a covered uterine rupture without further complications. No postpartum hysterectomy was needed, and all women had an uncomplicated postpartum period.

Indications for first Caesarean sections (▶ **Table 3**)

The most common indication for a prior Caesarean section in the TOLA2C group was a fetal breech position (23.5 %), followed by a prior CS (20.6 %). In the intrapartum repeat CS group, birth arrest was the most common reason (45.0 %), followed by pathological CTG (15.0 %). Further, not repetitive indications were weakness of contractions, twin pregnancy, preterm delivery, fetal gastroschisis, maternal myopia, uterine rupture, HELLP syndrome, and ovarian torsion during labor. The indication of obstructed labor was significantly higher in the intrapartum repeat CS group, 14.8 % versus 45.0 % in the successful TOLA2C group (p = 0.022).

▶**Table 3** Indications for previous Caesarean sections. The table displays frequencies and comparisons of indications for previous Caesarean sections among successful and failed TOLA2C groups.

Factor (n)	Successful TOLA2C (n = 34)	Failed TOLA2C (n = 20)	P value
Birth arrest	5 (14.7%)	9 (45.0%)	0.02
Breech position	8 (23.5%)	3 (15.0%)	0.35
Pathological CTG	5 (14.7%)	3 (15.0%)	0.63
Primary re-sectio	7 (20.6%)	2 (10.0%)	0.27
Weakness of contractions	4 (11.8%)	0 (0.0%)	0.15
Gemini gravidity	2 (5.9%)	0 (0.0%)	0.39
Preterm	1 (2.9%)	0 (0.0%)	0.63
Gastroschisis	0 (0.0%)	1 (5.0%)	0.37
HELLP	1 (2.9%)	0 (0.0%)	0.63
Myopia	1 (2.9%)	0 (0.0%)	0.63
Rupture	0 (0.0%)	1 (5.0%)	0.37
Ovarian torsion	0 (0.0%)	1 (5.0%)	0.37

Complications

In one successful vaginal delivery, shoulder dystocia occurred, which was resolved with the Woods maneuver. After the exclusion of neonatal injury by the neonatologist, the bonding process was started in the labor ward. Only one intrapartum emergency CS was necessary due to a pathological CTG and intense, persistent abdominal pain with abnormal vaginal bleeding in the first stage of labor. During the CS, a covered uterine rupture could be identified. The offspring adapted quickly, and no transport to the NICU was necessary.

Discussion

This study established a protocol for safely attempting vaginal birth after two consecutive Caesarean sections. Additionally, vaginal delivery and obstructed labor in obstetric history were confirmed as predictive markers for vaginal delivery outcome. To date, we have analyzed the largest cohort of women attempting TOLA2C in German-speaking countries.

Women were recruited at a level two perinatal center with approximately 4000 deliveries annually and a CS rate of 29.1%, below the Austrian-wide rate of 32.4% [4]. The success rate for TOLA2C was 63.0%, comparable to the literature [13]. A large multicenter study by Macones et al. [14] analyzed 1082 patients with a history of two CS, aiming for a spontaneous delivery with a success rate of 74.5% [14]. Tahseen et al. [12] described a success rate for TOLA2C ranging from 45 to 89% [12]. The success rate for TOLA2C is significantly lower than in TOLAC, with a postulated success rate of 76.5% [15]. Respecting the wide range of success rates, the selection process of women undergoing TOLA2C is crucial to predict a spontaneous delivery.

Various prediction models for success rates of TOLAC have been established and validated [16, 17, 18]. Previous vaginal delivery and favorable cervix at the delivery room increase the success rate, while a prior arrest of labor or indication for induction results more likely in an intrapartum repeat CS [16]. Further negative predictive factors are maternal age over 30 years, a BMI over 40, early and late-term delivery, hypertensive disorders, augmentation during labor and non-Hispanic Black women [13]. This study confirmed previous vaginal delivery to increase the success rate also in TOLA2C, while prior indication of birth arrest is a significant risk factor for failing TOLA2C. This data is supported by Rotem et al. [19], who analyzed only patients who had a spontaneous delivery before two CS and described a success rate of 86.2% [12].

Facing maternal risks of undergoing TOLA2C, uterine rupture is one of the most relevant complications. In this study, a covered uterine rupture occurred in one case (3.7%). Tahseen et al. [12] stated a uterine rupture rate ranging from 0.5 to 4% [12]. A large prospective multicenter study performed by Landon et al. [20] with 975 TOLA2C cases showed no increased risk for a uterine rupture among women with more CS in their history compared to women with only one (0.7% versus 0.9%), while Macones et al. [14] with 1082 TOLA2C cases stated an increased risk for a uterine rupture comparing women with two versus one previous CS [21]. Risk factors for uterine ruptures after CS are oxytocin augmentation, induction of labor, previous corporal incisions, epidural anaesthesia, fetal macrosomia and less than two years interval from previous CS [20].

Another crucial risk factor is placenta accreta spectrum, which correlates with the number of previous CS and is a leading cause of postpartum hysterectomy [22]. In the literature, the hysterectomy rate in patients undergoing TOLA2C ranges between 0.5–3.6% compared to 0.63% in the repeat CS group [20]. The transfusion rate of 1.99% is higher in the TOLA2C group compared to 1.21% in the TOLAC and comparable with 1.7% in the repeat CS group [12].

There is no difference comparing the neonatal outcome between TOLAC and TOLA2C regarding fetal asphyxia, perinatal death or NICU admission [22]. A successful TOLA2C is associated with a decreased risk for maternal morbidity in the index and subsequent delivery. In contrast, a failed TOLA2C is associated with increased maternal and neonatal morbidity compared to an elective repeat CS [11]. These deliveries must be in a clinical setting, which allows a prompt reaction in any obstetric emergency [15].

In the 1990 s and 2000 s, the TOLAC prevalence rate was over 50.0%, dropping to under 10.0%, and consequently, even lower TOLA2C rates [23]. According to a prospective questionnaire study by Cobec et al. [24], most women decide on delivery mode after CS independently of the medical consultation. Therefore, the responsible obstetrician should objectively inform the women about the risks and benefits of both delivery modes and respect their final decision [24]. In our study, 7.0% of all women who gave birth after two consecutive CS aimed for TOLA2C, comparable to the rate of Wagner et al. [11]. Offering a trial of labor after two CS would be one possibility to reduce the CS rates. Still, the low incidence rates would only affect a low percentage range. However, due to cultural influences, the desire for a trial of labor after CS is still high in developing countries [25].

Dombrowski et al. [22] analyzed that previous vaginal delivery, greater utilization of prenatal care, hospital type (teaching hospital, NICU and a higher proportion of births), unmarried women, African Americans, tobacco use, multigravida, receiving public assistance, and lower birth weights were correlated with a higher likeability of attempting a vaginal birth after CS [22]. Patients who wanted elective CS had higher rates of assisted reproductive technology, older age, early term, maternal obesity, anemia and pregnancy diseases [22]. Yee et al. [26] stated that the odds for delivery by CS were higher in all minority groups than in non-Hispanic white women [26].

Besides previous CS and fetal distress, breech presentation is the most common indication for a CS in German-speaking countries [27]. The external cephalic version (ECV) has become an alternative to elective CS or spontaneous breech delivery [28]. There is sufficient data that ECV can also be safely performed in women with previous CS [29]. In a few published cases where ECV was conducted in women with previous repetitive CS, the complication and success rates were comparable to women with only one CS [30].

Furthermore, there has been a steady decline in offering TOLA2C due to limited practice and increasing legal safety concerns [20]. Guidelines, on the one hand, endorse this practice, but on the other hand, limit this option to subgroups [20]. It is crucial to make an evidence-based approach to patient selection, counselling and intrapartum management of women undergoing TOLA2C [21].

Therefore, a protocol with predefined criteria can help identify women for vaginal delivery even after two previous CS. Rotem et al. [19] defined the willingness of the parturient, prior vaginal delivery, both previous CS with low-segment transverse uterotomy, and the onset of labor must be spontaneous as criteria for undergoing TOLA2C. Maroyi et al. [25] included an inter-delivery interval of 18 months, clinically normal pelvis, single fetus above 36th week of gestation, fetal weight less than 3500 g on the last biometry, spontaneous onset of labor, cephalic fetal presentation, uterine scar thickness over 35 mm and previous spontaneous delivery [25]. Our selection protocol also allowed women who had no spontaneous delivery in history to undergo TOLA2C and had a focus on one woman–one midwife setting. In addition to the already established protocols, we also defined intrapartum criteria for guiding obstetricians during the selection process and delivery.

Strengths and limitations

The main strength of this study was the long-term ten-year period and single center design with consecutive patients undergoing standardized criteria for TOLA2C counselled by trained and engaged staff. Furthermore, the collective was homogenous regarding the demographic aspects and obstetric anamnesis. However, the homogenicity limits the generalization of the results. The limited sample size and the retrospective character of this study are limitations. Therefore, prospective studies with large sample sizes must perform multivariable regression analysis. However, a randomized, double-blinded study will not be possible due to ethical aspects.

Conclusion

This study defined a protocol for safely undergoing a trial of labor after two Caesarean sections and identified vaginal delivery and birth arrest in obstetric history as predictive markers. These results can help obstetricians in their counselling for an individually adjusted delivery mode and identify ideal candidates for vaginal delivery even after two previous Caesarean sections.

Availability of Data

The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.

Funding Information

None.

Ethics Statement

No ethical approval was necessary due to the study's retrospective design and since TOLA2C was considered birth management within the standard of care at St. Josef Hospital Vienna. The data were analyzed anonymously for quality testing at the University Hospital Salzburg.

Contributors' Statement

The study was designed and planned by Maximilian Brandstetter, Andreas Brandstetter and Gerhard Bogner, who analyzed and interpreted the data and wrote and revised the manuscript. Sabine Kainz-Schultes was the responsible midwife for all women undergoing TOLA2C deliveries. Volker R. Jacobs, Claudius Fazelnia and Thorsten Fischer revised the manuscript. All the authors read and approved the final manuscript.

Conflict of Interest

The authors declare that they have no conflict of interest.

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