Uterine Rupture Risk In A Trial of Labor After Cesarean Section With & Without Previous Vaginal Births

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Abstract

Purpose: Previous cesarean delivery (CD) is the main risk factor for uterine rupture when attempting a trial of labor. Previous vaginal delivery (PVD) is a predictor for trial of labor after cesarean (TOLAC) success and a protective factor against uterine rupture. We aimed to assess the magnitude of PVD as a protective factor from uterine rupture.

Methods : A retrospective cohort study was conducted, including women who underwent TOLACs from 2003-2015. Women with and without PVD were compared. Inclusion criteria were one previous CD, trial of labor at ≥24 weeks' gestation, and cephalic presentation. We excluded pre-labor intrauterine fetal death and fetal anomalies. The primary outcome was uterine rupture. Secondary outcomes were maternal and fetal complications. Logistic regression modeling was applied to analyze the association between PVD and uterine rupture while controlling for confounders.

Results: A total of 11,235 women undergoing TOLAC were included, 6,795 of whom had a PVD. Women with PVD had significantly lower rates of uterine rupture (0.18% vs. 1.1%; OR 0.19, p<0.001), were less likely to be delivered by an emergency CD (13.2% vs. 39.4%, OR 0.17, p<0.0001), were more likely to undergo labor induction (OR 1.56, p<0.0001), and were less likely to undergo an instrumental delivery (OR 0.14, p<0.001). Logistic regression modeling revealed that PVD was the only independent protective factor, with an aOR of 0.22.

Conclusion: PVD is the most important protective factor from uterine rupture in patients undergoing TOLAC. A trial of labor following one CD should therefore be encouraged in these patients.

Introduction:

Cesarean delivery (CD) rates have increased significantly worldwide over the past decades. Latest available data show that 21% of women worldwide gave birth by CD (in 2018) ranging from 5% in sub-Saharan Africa to 43% in Latin America and the Caribbean. It is estimated that at this growth rate, by 2030, 28.5% of women worldwide will give birth by CD. Beyond medical indications, many of the CDs are performed as a result of women's and families' preferences as well as due to health professionals' views and beliefs [1].

Rates of trial of labor after cesarean (TOLAC) have fluctuated over time. The main reason for the observed reduction in attempted TOLACs is the concern from uterine rupture, occurring in 0.5% of cases [2–5]. Nevertheless, the potential short- and long-term benefits of a successful vaginal birth after cesarean (VBAC) and the relatively low incidence of uterine rupture, warrant identification of subgroups of women with low risk for such an event, who may substantially benefit from TOLAC.

Previous studies concluded that TOLAC is a reasonable option for women with a single past CD [6–9]. It was also demonstrated that vaginal birth history, either before or after the CD, was associated with both higher rates of TOLAC success and lower rates of uterine rupture [10–14]. However, most of these studies

were based on relatively small cohorts, using various methodologies, showing mixed results, and with different primary outcomes (not necessarily uterine rupture).

In order to provide optimal and precise counseling for patients considering TOLAC vs. repeat cesarean, it is of paramount importance to be able to isolate candidates who are at a low risk for uterine rupture and a high chance of success (VBAC). The aim of this study was to assess the magnitude of protection (from uterine rupture) that a history of previous VD provides, in a large cohort of patients undergoing TOLAC.

Methods:

This retrospective cohort study was based on electronic medical records (EMR) of patients who delivered in the two Obstetrics Departments of the two campuses of Hadassah University Medical Centers, Jerusalem, between the years 2003 and 2015. Together, these medical centers serve 50% of Jerusalem (and its surrounding) population of over 1,000,000 inhabitants [15]. The two medical centers are characterized by high delivery volume (more than 10,000 deliveries annually) as well as a large proportion of parturients desiring and attempting TOLACs. The cohort included singleton deliveries at ≥24 0/7 weeks of gestation with cephalic presentation who attempted TOLAC with a history of a single cesarean delivery. Parturients with no previous cesarean delivery or with more than one previous cesarean deliveries, multifetal gestation, planned CD, pre-labor intrauterine fetal death, and major anomalies of the neonates, were excluded from the analysis.

General and obstetrical medical history was available via national records shared among different medical centers and ambulatory clinics. In addition, data regarding labors and deliveries were extracted from the electronic medical records of the two centers. Diagnoses and outcomes are routinely uploaded to the electronic database by attending healthcare professionals. The coding method is in accordance with the ICD-9. Data collected included demographic and clinical details as well as maternal and neonatal outcomes.

In accordance with Hadassah medical center protocols, TOLAC is offered to women with a single prior low transverse CD. Following a conversation with the attending physician regarding the risks of TOLAC and the chances of a successful vaginal delivery, the patient is required to sign an informed consent form. Deliveries are managed at our labor and delivery units by certified nurse midwives under the supervision of a senior resident and a board-certified senior obstetrician. Women undergoing TOLAC are considered as high risk parturients and fetal heart rate is continuously monitored throughout all labor process. Cervical ripening and labor induction for women undergoing TOLAC, when indicated, is performed with either a uterine catheter (single or double balloon catheter), and/or amniotomy. Prostaglandins of any kind are not used. Low dose oxytocin (starting with a dose of 0.5 mU/min, increased by 0.5 mU/min every 20 minutes) is used as needed for labor induction or augmentation in these cases.

The primary outcome of this study was intra-labor uterine rupture (ICD-9-CM diagnosis code 665.1). Uterine rupture diagnosis was determined during the emergency CD by the surgeon, who is a senior

obstetrician.

Data collection:

Multiple obstetrical history data were collected, including maternal demographic and fetal characteristics, as well as maternal and neonatal outcomes and complications. The cohort was divided into two groups that were compared: parturients undergoing TOLAC with, and those without one or more previous vaginal deliveries (PVDs), either before or after the previous CD.

Staff members extracting and analyzing the data (M.L., J.G) were not involved in patient care; the delivery unit obstetricians and midwives were not aware of the study. Institutional ethical review board approval was obtained for the study (0081-19-HMO, August 29th 2019).

Statistical analysis:

Statistical analysis was performed with IBM SPSS 27 for Windows (IBM corp. Armonk, NY). Dichotomous features were compared with the $\chi 2$ test or Fisher exact test in cases of small numbers, as appropriate; the Mann-Whitney U test was applied to analyze differences in non-parametric continuous features. Logistic regression modeling was applied to analyze the association between previous vaginal delivery and uterine rupture while controlling for possible confounders including: maternal and gestational age, gestational diabetes, birthweight, epidural analgesia, and induction of labor. A p value of ≤ 0.05 was considered statistically significant.

Results:

During the years 2003-2015, 115,528 deliveries took place in both Hadassah campuses. Of these, 70,883 were the second delivery or more. A total of 11,235 women had a history of one previous cesarean delivery. We identified 6,795 (60.4%) post CD parturients who had a history of prior vaginal delivery (PVD) and 4,440 (39.5%) who had no prior vaginal delivery (no-PVD). Elective CD was chosen (for various reasons) by 732 women from the PVD group and by 1,082 women from the no-PVD group. In total, 9,421 eligible women underwent TOLAC and were included in this study - 6,063 with PVD and 3,358 with no-PVD (Figure 1).

Table 1 presents the demographic and obstetrical characteristics of both groups. Women in the PVD group were older (33.2 vs. 30.4, p<0.001), more likely to be diagnosed with gestational diabetes (4.2% vs. 3.4%, p=0.051), and to deliver heavier babies (birthweight 3304 gr vs. 3223 gr, p<0.001).

Uterine rupture was significantly more common in parturients in the no-PVD group; 37 (1.1%) women in the no-PVD group compared to 11 (0.18%) in the PVD group (p<0.001, OR 0.19 [0.09- 0.37], Table 1). Induction of labor was more common in the PVD group (12.7% vs. 9.8% in the no-PVD group, p<0.001), as was epidural analgesia (53.4% vs. 37.2% in the no-PVD group, p<0.001, OR 1.93 [1.77-2.11]. Women in the PVD group were less likely to deliver by an emergency CD or by vacuum extraction than

their counterparts (13.2% vs 39.4%, p<0.001, OR 0.17 [0.16-0.19], Table 1). Parity was not of noticeable significance, given the low occurrence of uterine rupture in total.

No significant differences between the groups were found in the rates of maternal blood transfusion, hysterectomy, neonatal intensive care unit (NICU) admission or intrapartum fetal death (Table 1).

Logistic regression analysis revealed that a prior vaginal delivery was the ***single*** independent protective factor from uterine rupture while controlling for maternal age, gestational age, gestational diabetes mellitus, labor induction, epidural analgesia and neonatal birthweight (aOR 0.22 [CI 0.1 – 0.46], p<0.001, Table 2).

Discussion:

The principal finding of this study is that women with a PVD were 5 times less likely to experience uterine rupture during TOLAC, as compared with women who had not experienced a PVD. Moreover, the presence of a vaginal delivery in the obstetrical history of a women attempting TOLAC was the single and most important independent protective factor from uterine rupture. These parturients were also significantly more likely to experience a successful VBAC as compared to their counterparts with no such history. Importantly, overall rates of uterine rupture during TOLAC are low (0.5%), and yet, safety issues which cause patients as well as medical professionals to refrain from considering TOLAC, arise every day in the clinical milieu and led to a decline in TOLAC rates in the U.S to a nadir of 16% in 2010 [1,16,17]. For the patients, this kind of “anti-TOLAC” policy exposes them to the risks associated with repeated CDs in the short and long term, and overlooks the benefits VBAC offers, for both mother and offspring [14,18].

A recent meta-ethnographic review of women’s birth choices after CD by Black and colleagues [17] categorized women to 3 decision groups; predetermined for elective re-cesarean section (ERCS), predetermined for VBAC, and those with an “open minded” approach. As factors influencing decision making are various and derive from cultural, social and environmental influences in all three groups, women in the open-minded approach group sought and relied on facts and professional advice communicated by their healthcare professionals. In these cases, the health care professionals personal view and ability to assess the individual risk, were crucial in the decision-making process.

Several previous studies addressed the issue of the magnitude of PVD as a protective factor from uterine rupture, revealing mixed results. In concurrence with our results, *Zelop* et al [12] reported a compelling risk reduction to one fifth the risk of uterine rupture in these women, as compared to women with no prior VD. However their cohort included a relatively small number of parturients (1000), considering the rarity of uterine rupture.

Similar findings were reported by *Shimonovitz et al* [13] who demonstrated a statistically significant risk reduction for uterine rupture during TOLAC after a previous VD based on approximately 5000 women attempting TOLAC, between the years 1980-1997. The authors reported an incidence of uterine rupture of 0.59% for all women attempting TOLAC. The vast majority (81%) of the 26 women who experienced

uterine rupture, were attempting their first TOLAC, and the risk decreased dramatically for women with a prior successful VBAC. Although these findings are derived from a larger cohort, the study was based on data from over 30 years ago.

A different conclusion was published by *Grobman et al*. [14] who evaluated the success rates of labor induction in women with and without PVD. The authors concluded that women without PVD were at a greater risk for uterine rupture only if their labor involved induction. Women in the comparison group (no PVD) delivering spontaneously, did not differ in the risk for uterine rupture.

Two prospective studies by *Landon et al* [19,20] showed association between TOLAC and increased risk for uterine rupture, although the absolute risk was low in total. It was noted that higher risk for uterine rupture was associated with labor augmentation (0.9%, OR 2.42) and the highest risk was associated with labor induction (1.0%, OR 2.86). No sub analysis was made in these studies to assess uterine rupture risk in the context of PVD history.

Hendler et al [21] showed that although PVD taking place before and after the previous CD was associated with higher rates of TOLAC success, it was also a significant risk factor for uterine scar dehiscence. The authors hypothesized that VD causes uterine scar stretching that inclines the scar to dehisce during TOLAC in a subsequent pregnancy. However, the authors claimed that the higher rate of dehiscence does not necessarily translate into a higher rate of uterine rupture.

There are scarce data regarding the role of previous vaginal delivery timing in relation to the prior CD. A recent study by Atiya et. al [22] addressed an important question regarding the risk of uterine rupture with regards to the timing of the previous vaginal delivery ; before the CD or after (i.e. a history of VBAC). They showed that prior VBAC was associated with higher rates of TOLAC success and a reduced risk of uterine rupture. Interestingly, they also showed that women with a history of a vaginal delivery prior to their CD (and no VBAC) had similar uterine rupture rates compared to women without any vaginal delivery (before or after the CD), and were 5 times more likely for uterine rupture as compared to the prior VBAC group. This surprising result supports the notion that a proven scar is a protecting factor from uterine rupture, but questions the protective effect of a history of a vaginal birth before the CD on uterine rupture. It is important to note that in their study, women with prior vaginal delivery were significantly more likely to be diabetic, deliver macrosomic babies, have low bishop scores upon admission and were more likely to be augmented by Oxytocin - all of which are possible confounders that were not controlled for. Also, their prior CD was significantly more likely to be due to arrest of descent.

Our findings strongly support PVDs' role as a predominant protective factor from uterine rupture during TOLAC. We show that although women in the no-PVD group were younger, less likely to have gestational diabetes and to undergo labor induction, and with smaller newborns, all of which are considered favorable and protective factors, [20,21,23,24], they were still prone to fail TOLAC and had 5 times higher chances for uterine rupture.

A possible explanation for our findings may be that women with no PVD, much like nulliparous women, experience longer labors and use epidural analgesia more often. The prolonged duration of contractions and the relatively slow progress in these women, puts them in greater risk for uterine rupture. This concept was described by Omole-Ohonsi and colleagues [25] in the context of a successful VBAC. The authors showed that the cervical dilatation rate was in accordance with successful VBAC – as progress rate was higher, so were the chances for a successful VBAC. Others have also concluded that labor dystocia during TOLAC, and specifically during the later stages of labor, may be a sign of impending uterine rupture, and warrant intensive monitoring and frequent examinations [26].

The strengths of this study includes its large cohort, being one of the largest to date addressing this issue, and the high-quality data, collected from two tertiary centers with uniformity of labor and TOLAC management protocols and documentation.

Our study has a few limitations. First, the retrospective nature of the data with its inherent faults. Another limitation is that the data was collected from two medical centers characterized by a population motivated toward having large families and avoiding CD, and so, our findings may not be generalizable. Lastly, we had no access to data regarding the timing of the PVD and its relation to the previous CD (i.e. before or after the previous CD). These data could have enhanced the precision of the counseling provided. Certainly, future studies should address these issues.

To summarize, our findings highlight the overwhelming importance of PVD in predicting the course of an attempted TOLAC, in a combined effort to responsibly and safely raise TOLAC rates and reduce re-CD rates. Our data contributes to both patients and healthcare providers in the challenging decision-making process and strongly supports the feasibility and safety of TOLAC in general, and in women with a history of prior vaginal delivery in particular.

Declarations:

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The authors report no conflict of interest.

Authors contribution:

1. A. Nahum-Yerushalmy – Project development, Data management and analysis, Manuscript writing
2. A Walfisch – Protocol development, Manuscript editing
3. M Lipschuetz – Project development, Data analysis, Manuscript editing
4. JI Rosenbloom – Data analysis, Manuscript editing
5. D kabiri – Manuscript editing
6. H Hochler - Project development, Data collection and analysis, Manuscript editing

References:

1. Betran AP, Ye J, Moller AB, Souza JP, Zhang J (2021) Trends and projections of caesarean section rates: global and regional estimates. BMJ global health 6(6):e005671. https://doi.org/10.1136/bmjgh-2021-005671
2. O'brien-Abel N (2003) Uterine rupture during VBAC trial of labor: risk factors and fetal response. *Journal of midwifery women's health* 48(4):249–257. https://doi.org/10.1016/s1526-9523(03)00088-6
3. Guise JM, Eden K, Emeis C, Denman MA, Marshall N, Fu RR, Janik R, Nygren P, Walker M, McDonagh M (2010) Vaginal birth after cesarean: new insights. Evidence report/technology assessment 191:1–397
4. Uddin SF, Simon AE (2013) Rates and success rates of trial of labor after cesarean delivery in the United States, 1990–2009. Matern Child Health J 17(7):1309–1314. https://doi.org/10.1007/s10995-012-1132-6
5. Lydon-Rochelle M, Holt VL, Easterling TR, Martin DP (2001) Risk of uterine rupture during labor among women with a prior cesarean delivery. N Engl J Med 345(1):3–8. https://doi.org/10.1056/NEJM200107053450101
6. ACOG Practice Bulletin No. 205: Vaginal Birth After Cesarean Delivery, Obstetrics & Gynecology: February 2019 - Volume 133 - Issue 2 - p e110-e127 doi: 10.1097/AOG.0000000000003078
7. Vaginal delivery after previous cesarean birth (1996) Number 1–August 1995. Committee on Practice Patterns. American College of Obstetricians and Gynecologists. Int J Gynaecol Obstet 52(1):90–98
8. Young CB, Liu S, Muraca GM, Sabr Y, Pressey T, Liston RM, Joseph KS, Canadian Perinatal Surveillance System (2018) Mode of delivery after a previous cesarean birth, and associated maternal and neonatal morbidity. CMAJ: Canadian Medical Association journal = journal de l'Association medicale canadienne 190(18):E556–E564. https://doi.org/10.1503/cmaj.170371
9. Guise JM, Denman MA, Emeis C, Marshall N, Walker M, Fu R, Janik R, Nygren P, Eden KB, McDonagh M (2010) Vaginal birth after cesarean: new insights on maternal and neonatal outcomes. Obstetrics gynecology 115(6):1267–1278. https://doi.org/10.1097/AOG.0b013e3181df925f
10. Curtin SC, Gregory KD, Korst LM, Uddin SF (2015) Maternal Morbidity for Vaginal and Cesarean Deliveries, According to Previous Cesarean History: New Data From the Birth Certificate, 2013. *National vital statistics reports: from the Centers for Disease Control and Prevention, National Center for Health Statistics, National Vital Statistics System*, *64*(4)
11. Cunningham FG, Bangdiwala SI, Brown SS, Dean TM, Frederiksen M, Rowland Hogue CJ, King T, Spencer Lukacz E, McCullough LB, Nicholson W, Petit NF, Probstfield JL, Viguera AC, Wong CA, Zimmet SC (2010) NIH consensus development conference draft statement on vaginal birth after cesarean: new insights. *NIH consensus and state-of-the-science statements*, *27*(3), 1–42
12. Zelop CM, Shipp TD, Repke JT, Cohen A, Lieberman E (2000) Effect of previous vaginal delivery on the risk of uterine rupture during a subsequent trial of labor. American journal of obstetrics

gynecology 183(5):1184–1186. https://doi.org/10.1067/mob.2000.109048

13. Shimonovitz S, Botosneano A, Hochner-Celnikier D (2000) Successful first vaginal birth after cesarean section: a predictor of reduced risk for uterine rupture in subsequent deliveries. The Israel Medical Association journal: IMAJ 2(7):526–528
14. Grobman WA, Gilbert S, Landon et al (2007) Outcomes of induction of labor after one prior cesarean. Obstetrics gynecology 109(2 Pt 1):262–269. https://doi.org/10.1097/01.AOG.0000254169.49346.e9
15. Israeli central bureau of statistics (CBS) https://www.cbs.gov.il/en/settlements/Pages/default.aspx, Sep. 10th 2021
16. O'Donovan C, O'Donovan J (2018) Why do women request an elective cesarean delivery for non-medical reasons? A systematic review of the qualitative literature. Birth (Berkeley Calif) 45(2):109–119. https://doi.org/10.1111/birt.12319
17. Black M, Entwistle VA, Bhattacharya S, Gillies K (2016) Vaginal birth after caesarean section: why is uptake so low? Insights from a meta-ethnographic synthesis of women's accounts of their birth choices. BMJ open 6(1):e008881. https://doi.org/10.1136/bmjopen-2015-008881
18. Dodd JM, Crowther CA, Huertas E, Guise JM, Horey D (2004) Planned elective repeat caesarean section versus planned vaginal birth for women with a previous caesarean birth. Cochrane Database Syst Rev, (4), CD004224. https://doi.org/10.1002/14651858.CD004224.pub2
19. Landon MB, Hauth JC, Leveno et al National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network (2004) Maternal and perinatal outcomes associated with a trial of labor after prior cesarean delivery. N Engl J Med 351(25):2581–2589. https://doi.org/10.1056/NEJMoa040405
20. Landon MB, Leindecker S, Sponget al, National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network (2005) The MFMU Cesarean Registry: factors affecting the success of trial of labor after previous cesarean delivery. American journal of obstetrics gynecology 193(3 Pt 2):1016–1023. https://doi.org/10.1016/j.ajog.2005.05.066
21. Hendler I, Bujold E (2004) Effect of prior vaginal delivery or prior vaginal birth after cesarean delivery on obstetric outcomes in women undergoing trial of labor. Obstetrics gynecology 104(2):273–277. https://doi.org/10.1097/01.AOG.0000134784.09455.21
22. Atia O, Rotem R, Reichman O, Jaffe A, Grisaru-Granovsky S, Sela HY, Rottenstreich M (2021) Number of prior vaginal deliveries and trial of labor after cesarean success. Eur J Obstet Gynecol Reprod Biol 256:189–193. https://doi.org/10.1016/j.ejogrb.2020.11.009
23. Wu Y, Kataria Y, Wang Z, Ming WK, Ellervik C (2019) Factors associated with successful vaginal birth after a cesarean section: a systematic review and meta-analysis. BMC Pregnancy Childbirth 19(1):360. https://doi.org/10.1186/s12884-019-2517-y
24. Hammoud A, Hendler I, Gauthier RJ, Berman S, Sansregret A, Bujold E (2004) The effect of gestational age on trial of labor after Cesarean section. *The journal of maternal-fetal neonatal medicine: the official journal of the European Association of Perinatal Medicine the Federation of*

Asia Oceania Perinatal Societies the International Society of Perinatal Obstetricians 15(3):202–206. https://doi.org/10.1080/14767050410001668329

25. Omole-Ohonsi A, Muhammad Z, Iliyasu Z (2007) Value of partogram in vaginal birth after caesarean section. Journal of obstetrics gynaecology: the journal of the Institute of Obstetrics Gynaecology 27(3):264–266. https://doi.org/10.1080/01443610701195041
26. Harper LM, Cahill AG, Roehl KA, Odibo AO, Stamilio DM, Macones GA (2012) The pattern of labor preceding uterine rupture. American journal of obstetrics gynecology 207(3):210.e1–210.e2106. https://doi.org/10.1016/j.ajog.2012.06.028

Tables

Table 1: Demographic and obstetrical characteristics of the study population stratified by history of prior vaginal delivery

	No prior vaginal delivery N = 3358	Vaginal delivery prior to CD N = 6063	p value*	Odds Ratio (95% Confidence Interval)
Current pregnancy and delivery parameters				
Maternal Age (years)	30.4 (±5.4)	33.2 (±4.9)	<0.001	
Gestational Diabetes n(%)	128 (3.4%)	243 (4.2%)	0.051	
Male fetus n(%)	2,291 (51.6%)	3,488 (51.3%)	0.787	
Gestational age (weeks)	38.9 (±1.9)	39.1 (±1.8)	<0.001	
Neonatal birth weight (grams)	3,223 (±505)	3,304 (±519)	<0.001	
Induction of labor	329 (9.8%)	768 (12.7%)	<0.001	1.33 (1.16-1.53)
Epidural use	1249 (37.2%)	3235 (53.4%)	<0.001	1.93 (1.77-2.11)
Mode of delivery:				
NVD	1459 (43.4%)	4971 (82%)		Reference group
Instrumental delivery	577 (17.2%)	289 (4.8%)	<0.001	0.14 (0.12-0.17)
Unplanned Cesarean Delivery	1322 (39.4%)	803 (13.2%)	<0.001	0.17 (0.16-0.19)
Maternal outcomes:				
Uterine rupture	**37 (1.1%)**	**11 (0.18%)**	**<0.001**	**0.19 (0.09-0.37)**
Blood transfusion	4 (0.1%)	5 (0.1%)	0.730	0.68 (0.18-2.56)
Hysterectomy	0 (0.0%)	4 (0.1%)	0.304	-
Neonatal outcomes:				
NICU	82 (2.4%)	124 (2.0%)	0.212	0.83 (0.62-1.11)
Intrapartum fetal death	4 (0.1%)	8 (0.1%)	1.000	1.1 (0.33-3.7)

***** Comparing history of vaginal delivery using Chi square or Fisher's exact test as appropriate

CD- cesarean delivery, NVD- natural vaginal delivery, NICU- neonatal intensive care unit

Table 2: Logistic regression analysis for the association between previous vaginal delivery and uterine rupture.

	Adjusted Odds Ratio	p-value
previous vaginal delivery	0.22 (0.1 - 0.46)	<0.001
Maternal Age	1.04 (0.98 - 1.09)	0.25
Gestational age	1.16 (0.98 - 1.36)	0.08
Epidural	0.64 (0.34 -1.2)	0.16
Induction of labor	2.04 (0.61 - 7.14)	0.24
Gestational diabetes	1.11 (0.14 - 8.33)	0.92
Birth weight	1.00 (0.99 - 1.01)	0.76

Figures

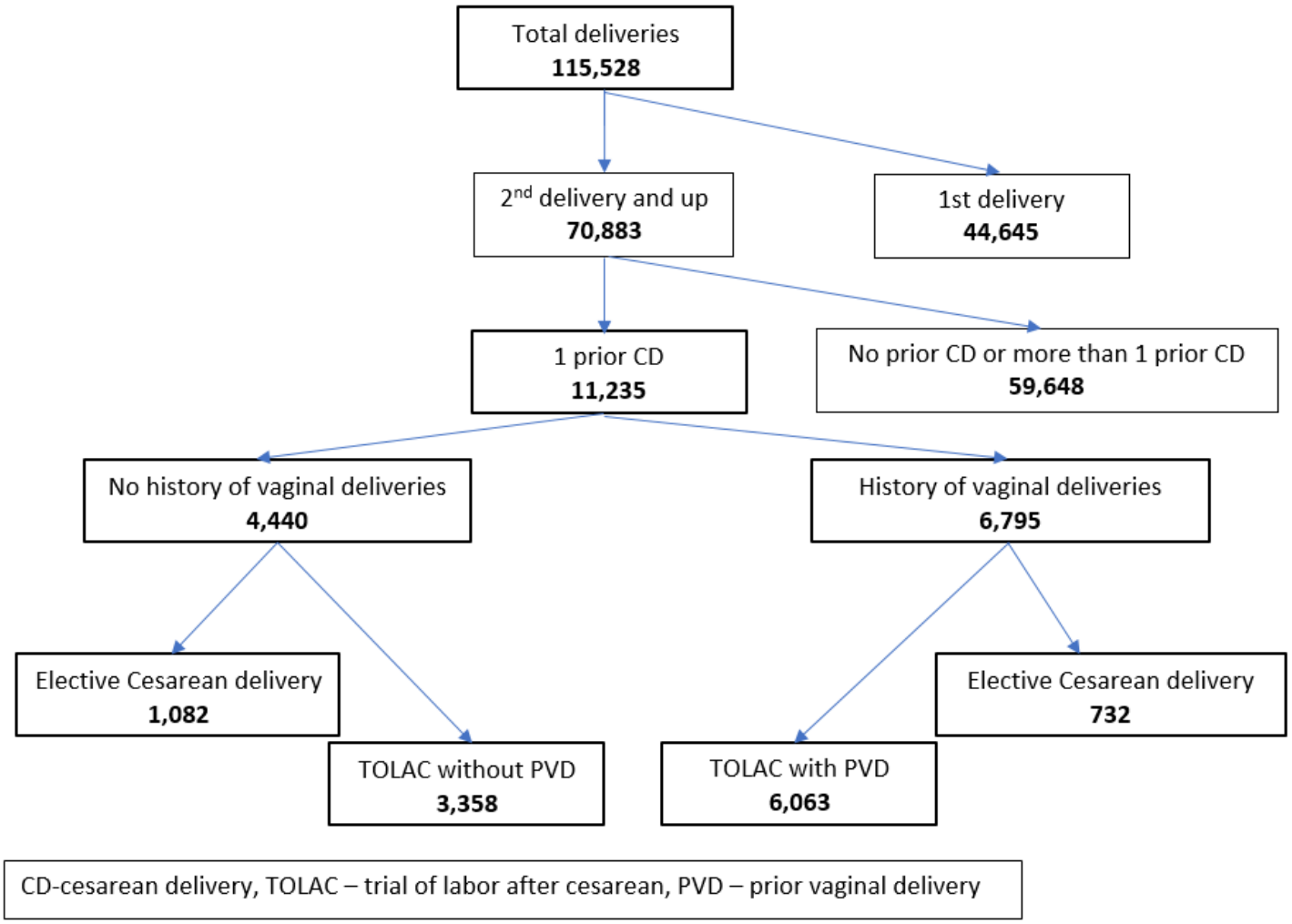

Figure 1

Study population flow chart