

Previous Preterm Cesarean Delivery and Risk of Subsequent Uterine Rupture

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OBJECTIVE: To determine if women with a history of a previous preterm cesarean delivery experienced an increased risk of subsequent uterine rupture compared

with women who had a previous nonclassic term cesarean delivery.

METHODS: A prospective observational study was performed in singleton gestations that had a previous nonclassic cesarean delivery from 1999 to 2002. Women with a history of a previous preterm cesarean delivery were compared with women who had a previous term cesarean delivery. Women who had both a preterm and term cesarean delivery were included in the preterm group.

RESULTS: A prior preterm cesarean delivery was significantly associated with an increased risk of subsequent uterine rupture (0.58% compared with 0.28%, $P < .001$). When women who had a subsequent elective cesarean delivery were removed (remaining $n = 26,454$) women with a previous preterm cesarean delivery were still significantly more likely to sustain a uterine rupture (0.79% compared with 0.46%, $P = .001$). However, when only women who had a subsequent trial of labor were included, there was still an absolute increased risk of uterine rupture, but it was not statistically significant (1.00% compared with 0.68%, $P = .081$). In a multivariable analysis controlling for confounding variables (oxytocin use, two or more previous cesarean deliveries, a cesarean delivery within the past 2 years, and preterm delivery in the current pregnancy), patients with a previous preterm cesarean delivery remained at an increased risk of subsequent uterine rupture ($P = .043$, odds ratio 1.6, 95% confidence interval 1.01–2.50) compared with women with previous term cesarean delivery.

CONCLUSION: Women who have had a previous preterm cesarean delivery are at a minimally increased risk for uterine rupture in a subsequent pregnancy when compared with women who have had previous term

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cesarean deliveries.

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In the United States, 29% of all pregnant women have cesarean deliveries, a rate similar to that in other developed countries.¹ With subsequent pregnancies after a cesarean delivery, the patient is faced with choosing between an elective repeat cesarean delivery and a vaginal birth after cesarean delivery (VBAC). As a result of the support and encouragement of the American College of Obstetricians and Gynecologists and insurance carriers in the United States, the VBAC rate grew from 3.1% in 1981 to 31% in 1998.² However, after reports of worse outcomes in mothers and neonates who attempted VBAC compared with women who have elective repeat cesarean deliveries, the rate dropped in the United States to 9.2% in 2004.³

Uterine rupture can be a catastrophic complication during pregnancy, with the potential sequelae of neonatal death, neonatal long-term neurologic handicap, or maternal morbidity or death.⁴ This complication is almost exclusively associated with previous uterine surgery, with most cases following a previous cesarean delivery. The rate of uterine rupture is dependent on the type of incision in the uterus, with a classic uterine incision having a rate between 9% and 12% compared with a rate of approximately 1% in women with a previous low transverse cesarean delivery.^{4–6} The etiology for this increased rate of uterine rupture with a classic incision has been attributed to the presence of the incision in the contractile portion of the uterus.

Preterm cesarean delivery is most often accomplished through a low transverse uterine incision. However, unlike a term cesarean delivery, the uterus is smaller, with a poorly, if at all developed, lower uterine segment, so that an incision is more likely to extend into the contractile portion of the uterus. Furthermore, the association between preterm delivery and infection and/or inflammation is well described and may contribute to poor wound healing and an increased risk of a subsequent uterine rupture.

The purpose of this analysis was to determine if women who have had a previous nonclassic preterm cesarean delivery were more likely to have a uterine rupture in a subsequent pregnancy than women who had a previous nonclassic term cesarean delivery.

MATERIALS AND METHODS

The Cesarean Registry is a prospective cohort study that was performed from 1999 to 2002 at 19 centers in the Maternal–Fetal Medicine Units Network. From 1999 to 2001, data were collected on all cesarean deliveries, and from 2001 to 2002, data were limited to repeat cesarean deliveries and vaginal births after cesarean delivery. Each center and the data-coordinating center received institutional review board approval for the study.

Trained and certified research nurses abstracted detailed information about the patient demographics, medical history, previous obstetric history, intrapartum course, postpartum course, and neonatal outcomes. These data were transmitted weekly via a telecommunication link to a central repository at The George Washington University Biostatistics Center. Data quality was verified by editing the transmitted center data for missing, out-of-range, and inconsistent values, and this was followed by transmittal of the edits to the referring center for correction or clarification. The primary outcome variable for this analysis was uterine rupture. This was defined as a disruption or tear of uterine muscle and visceral peritoneum or a separation of the uterine muscle with extension into bladder or broad ligament.

Women who had a previous cesarean delivery and a subsequent cesarean delivery after 20 weeks of gestation were included. Exclusion criteria included previous classic cesarean delivery, current multiple gestation, fetal anomalies or aneuploidy, and subsequent cesarean delivery at less than 20 weeks of gestation. Previous uterine incision type was defined by review of the medical record. The patients were divided into two groups: those who had a previous preterm cesarean delivery (preterm group) and women who had only previous term cesarean deliveries (term group). Women who had both a previous preterm and term cesarean delivery were included in the preterm group. A *preterm cesarean delivery* was defined as cesarean delivery that occurred before 37 weeks of gestation in a viable pregnancy. Stillbirths were excluded. *Term cesarean delivery* was defined as a cesarean delivery that occurred at or after 37 weeks gestation in a viable infant. Because assignment of incision type was based solely on the assignment by the dictating surgeon in previous operative reports and there is no standard for the definition of a low vertical, inverted “T” and “J” incisions, these were included in the analysis.⁷

Univariable analysis was performed by the Wilcoxon rank-sum test for continuous variables and the



Table 1. Demographic Data for the Entire Population

	Prior Preterm CD (n=5,839)	Prior Term CD (n=35,528)	P
Maternal age (y)	28.6±5.9	29.2±5.8	<.001
Parity	2.0±1.2	1.7±1.0	<.001
Body mass index	32.0±7.1	33.0±6.9	<.001
CD within 2 years	34.2	29.5	<.001
Two or more CD	24.2	21.9	<.001
Prior VBAC	16.7	13.6	<.001
Oxytocin	23.0	21.3	.003
Private insurance	41.0	43.4	<.001

CD, cesarean delivery; VBAC, vaginal birth after cesarean delivery.

Data are expressed as mean±standard deviation or %.

χ^2 test for categorical variables. Multivariable analysis controlling for potential confounding variables was performed by logistic regression. A two-sided $P<.05$ was considered significant. No adjustments were made for multiple comparisons. The Breslow-Day test was used for homogeneity.⁸ Data were analyzed with SAS 8.2 (SAS Institute Inc., Cary, NC).

RESULTS

There were a total of 378,063 deliveries during the study period. A total of 41,367 women with prior cesarean delivery were included in the study. An elective cesarean delivery was performed on 14,913 (36.1%), and 15,897 (38.4%) had a trial of labor.

There were 135 uterine ruptures in the cohort, for an overall rate of 0.33%. A total of 5,839 (14.1%) women had one or more previous preterm cesarean deliveries, and 35,528 (85.9%) had only previous term births. Among the 5,839 women with one or more previous preterm cesarean deliveries, 1,133 (19.4%) also had a previous term cesarean delivery.

The demographic and obstetric history information for women with previous preterm and term cesarean delivery is presented in Table 1. The preterm group were statistically younger, more parous, had a lower body mass index, and were more likely to have a cesarean delivery within 2 years, have two or more cesarean deliveries, have a prior VBAC, be exposed to oxytocin, and receive public assistance.

On univariable analysis, the preterm group had a significantly greater risk of subsequent uterine rupture compared with the term group (0.58% compared with 0.28%, $P\leq.001$) (odds ratio [OR] 2.05, 95% confidence interval [CI] 1.39–3.03). After excluding women who had an elective cesarean delivery, the preterm group was still significantly more likely to have a subsequent uterine rupture (0.79% compared with 0.46%, $P=.001$) (OR 1.73, 95% CI 1.17–2.55).

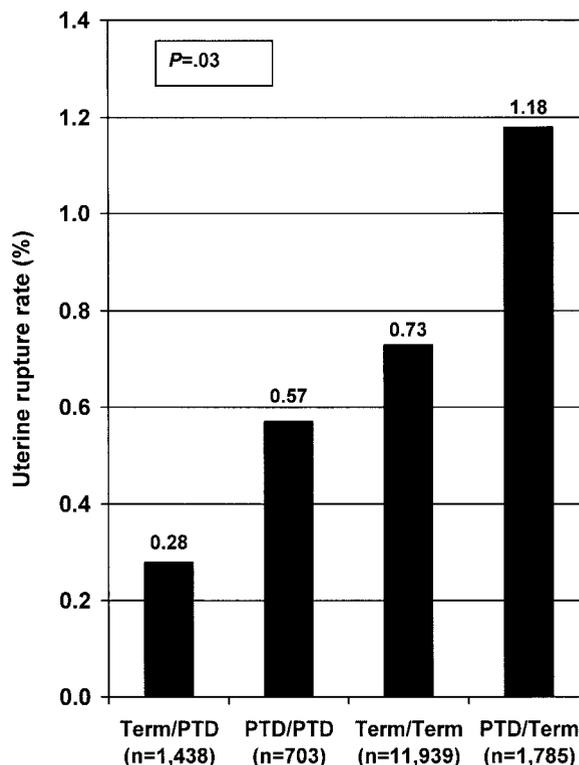


Fig. 1. Uterine rupture rate by timing of previous cesarean delivery and timing of subsequent delivery in women with a trial of labor. PTD, preterm delivery.

Sciscione. Preterm Cesarean Delivery and Uterine Rupture. *Obstet Gynecol* 2008.

When women who had a trial of labor were analyzed, the risk of uterine rupture was greater, although not statistically significant, in the preterm group (1.00% compared with 0.68%, $P=.081$) (OR 1.48%, 95% CI 0.95–2.31). However, on multivariable analysis in this group, controlling for oxytocin use, two or more cesarean deliveries, cesarean delivery within 2 years, and subsequent preterm delivery, the preterm group was statistically more likely to have a subsequent uterine rupture ($P=.043$; OR 1.6, 95% CI 1.01–2.50).

The rate of uterine rupture also differed significantly, related to the timing of the previous and subsequent delivery (Fig. 1). The rate of uterine rupture was lowest in women who had previous term cesarean deliveries and a subsequent preterm birth and highest in women who had a previous preterm cesarean delivery and a subsequent term birth.

To examine the possible affect of birth weight in the previous delivery, we compared the rate of uterine rupture among four weight categories. There was no correlation between weight of the infant in a previous preterm cesarean delivery and subsequent uterine rupture (Fig. 2).



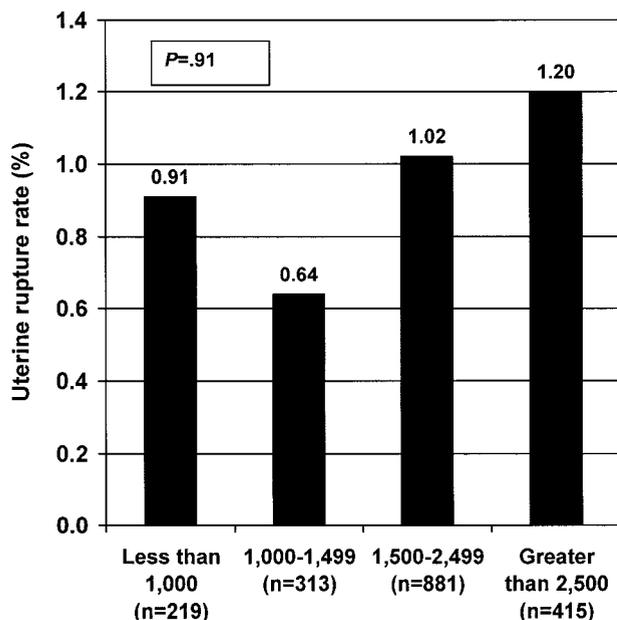


Fig. 2. Uterine rupture rate by birth weight (in grams) in previous cesarean delivery in women with a trial of labor. Sciscione. *Preterm Cesarean Delivery and Uterine Rupture*. *Obstet Gynecol* 2008.

We examined the mean gestational age at subsequent uterine rupture between the groups. Uterine rupture occurred earlier in the preterm group than in women who had a previous cesarean delivery at term (37.2 ± 3.0 compared with 39.0 ± 2.6 , $P \leq .001$). However, there were no differences in the rate of neonatal intensive care unit admission, need for ventilation, or mortality between those infants delivered from the preterm group or the term group.

Limiting the analysis to women with only one previous cesarean delivery ($n=32,167$), uterine rupture was still more common in the previous preterm group (0.59% compared with 0.32%, $P=.005$) (OR 1.86, 95% CI 1.20–2.88) and remained statistically significant when women who had a subsequent elective cesarean delivery were removed (0.73% compared with 0.46%, $P=.036$) (OR 1.59, 95% CI 1.03–2.47). There was a trend to a higher uterine rupture rate in women who had a subsequent trial of labor (0.99% compared with 0.66%, $P=.077$) (OR 1.51, 95% CI 0.95–2.41). However, on multivariable analysis in this group, controlling for oxytocin use, cesarean delivery within 2 years, and subsequent preterm delivery, the preterm group was more likely to have a subsequent uterine rupture (OR 1.62, 95% CI 1.01–2.60, $P=.045$).

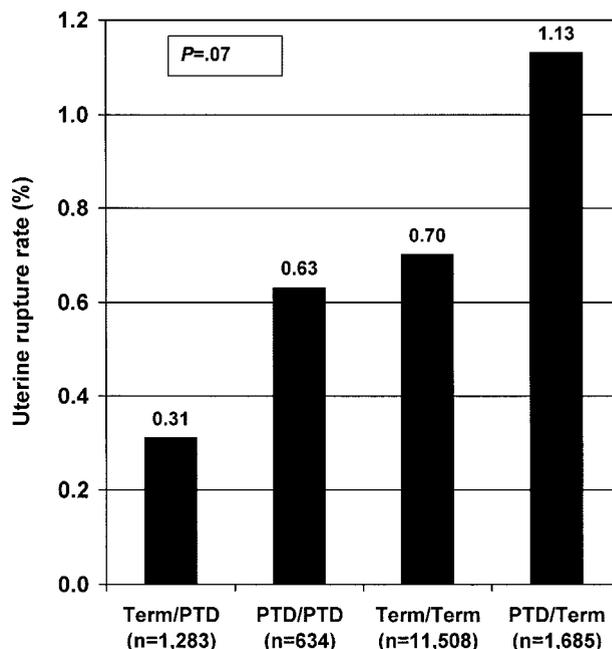


Fig. 3. Uterine rupture rate by timing of previous cesarean delivery and timing of subsequent delivery in women with a trial of labor and one previous cesarean delivery. PTD, preterm delivery.

Sciscione. *Preterm Cesarean Delivery and Uterine Rupture*. *Obstet Gynecol* 2008.

The timing of the previous cesarean delivery and rate of uterine rupture in women with one previous cesarean and a trial of labor is displayed in Figure 3. The uterine rupture rate was higher (but not significantly so) in women who had a previous preterm cesarean delivery and a subsequent term birth compared with women who had a previous term cesarean delivery and a subsequent preterm birth (1.13 compared with 0.31%, $P=.07$ across all groups).

In an effort to examine if there was an effect of “T,” “J,” and low vertical incisions ($n=511$) on uterine rupture rates, we performed a Breslow-Day test for homogeneity of the odds ratios and found no difference across the groups ($P=.12$). Furthermore, among patients with a trial of labor, controlling for “T,” “J,” and low vertical incisions, along with the other confounders, resulted in an OR of 1.6 (95% CI 1.01–2.49, $P=.047$) for uterine rupture in women who had a previous preterm cesarean. Hence, it is unlikely these types of incisions affected uterine rupture rates.

DISCUSSION

In this study, women who have had a previous preterm cesarean delivery were at a significantly increased risk (twice as high) for uterine rupture in a subsequent pregnancy compared with women with



previous term cesarean deliveries. Furthermore, this significant difference was still present, even when women who had only one previous cesarean delivery were studied. The highest rate of subsequent uterine rupture was in women who had a previous preterm cesarean delivery followed by a term birth, and the lowest rate was in women who had a previous term cesarean delivery followed by a subsequent preterm delivery. These findings are consistent with the findings of Quinones et al⁹ and Durnwald (Durnwald C. The MFMU cesarean registry: safety and efficacy of VBAC in preterm trial of labor [abstract]. *Am J Obstet Gynecol* 2005;193:S20), who both found a lower uterine rupture rate in a subsequent preterm trial of labor in women who had a VBAC.

The possible explanation for an increased risk of uterine rupture in women who had a prior preterm cesarean delivery is speculative, but inadvertent extension into the contractile portion of the uterus is a potential explanation. Unfortunately, our data collection process did not ascertain the presence or absence of labor preceding a previous preterm cesarean delivery. It could be hypothesized that women who labored might have a better developed lower uterine segment and should be less susceptible to an inadvertent extension of the uterine incision and, thus, at a lower risk for uterine rupture. Additionally, a larger fetus would create a more favorable lower uterine segment and decrease the risk of uterine rupture. However, among women with a trial of labor, we did not find a difference in the uterine rupture rate across varying neonatal weight categories from the previous pregnancy. Furthermore, the incision in the smaller preterm uterus may be made relatively higher compared with that in a term uterus.

Although the reason for preterm birth in previous cesarean deliveries was not recorded in the registry, it is very likely that most of the women in the preterm cesarean group delivered as a result of preterm labor and/or preterm premature rupture of membranes. Subclinical intrauterine infection, specifically the production of inflammatory cytokines, appears to play an important role in the pathophysiology of preterm labor and preterm premature rupture of membranes.¹⁰⁻¹⁴ Wound healing in the presence of infection and inflammatory cytokines appears defective, leading to compromised scar integrity.^{15,16} In the preterm delivery group, wound healing likely took place in the presence of infection and inflammatory cytokines, which may have contributed to not only the earlier timing of uterine rupture in the preterm group but also the increased risk of uterine rupture before the onset of labor in the preterm group.

There is little information on the uterine rupture rates associated with other uterine incisions besides low transverse and classic cesarean deliveries. The largest studies compared uterine rupture rates in 2,912 women who had low transverse cesarean deliveries compared with 377 women who had a low vertical cesarean. The rate of uterine rupture was 1.0% in the low transverse group and 0.8% with the lower vertical group ($P=1$).¹⁷ Naef et al¹⁸ reported on 262 women who had a low vertical cesarean delivery with a subsequent uterine rupture of 1.1% ($n=2$) in women who had a trial of labor. A similar rate of uterine rupture rate of 1.3% (1 in 77) was found by Adar et al.¹⁹ Reports of uterine rupture rate with women who have had a "J" or "T" incision are even more limited, with one study reporting no uterine rupture in women with inverted "T" uterine incisions.²⁰

The strengths of this study are that it is a large, prospective, multi-center trial with a validated database. All cases of uterine rupture were documented. The findings of this trial corroborate the findings of Rochelson et al,²¹ who in a much smaller analysis found significantly higher risk of subsequent uterine rupture in women who had preterm low transverse cesarean deliveries. The weaknesses are the lack of information on the indication for delivery for the index delivery and the specifics of the operative procedure. Future studies should examine the potential contribution of these factors.

In conclusion, women who have had a previous preterm cesarean delivery appear to have an increased risk for uterine rupture when compared with women who had only previous term cesarean deliveries. Furthermore, subsequent uterine rupture appears to occur at an earlier gestational age in women who have a preterm cesarean delivery. Because of the uncommon occurrence of uterine rupture, these risks may be acceptable to women with a previous preterm cesarean delivery. In women who have had a previous preterm cesarean delivery who elect a repeat cesarean, an earlier gestational age for this procedure should be considered.

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