

Intrapartum Uterine Rupture and Dehiscence in Patients With Prior Lower Uterine Segment Vertical and Transverse Incisions

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Objective: To determine whether gravidas with prior low vertical uterine incision(s) are at a higher risk for uterine rupture during a trial of labor after cesarean delivery than women with prior low transverse uterine incision(s).

Methods: The medical records of women undergoing a trial of labor after prior cesarean delivery over a 12-year period (July 1984–June 1996) at a tertiary-care hospital were reviewed. Maternal and perinatal outcomes for women with prior low transverse and low vertical incision were compared. Women whose low vertical incision was noted to extend into the corpus of the uterus were excluded. All uterine scar disruptions, which included both symptomatic ruptures and detected asymptomatic dehiscences, were analyzed together, and ruptures were examined separately.

Results: The outcomes of 2912 patients undergoing trial of labor for the low transverse group and 377 patients undergoing trial of labor for the low vertical group were compared. Overall, there were 38 (1.3%) scar disruptions in the low transverse group and six (1.6%) in the low vertical group, $P = .6$. There were 28 (1.0%) symptomatic ruptures in the low transverse group and 3 (0.8%) in the low vertical group, $P > .999$. The study had a power of 80% to detect an increase in the low vertical rupture rate from 1% (as noted for low transverse incisions) to 3%.

Conclusion: Gravidas with a prior low vertical uterine incision are not at increased risk for uterine rupture during a trial of labor compared with women with a prior low transverse uterine incision. (Obstet Gynecol 1999;94:735–40. © 1999 by The American College of Obstetricians and Gynecologists.)

Over the past few decades, a trial of labor in women who have had a previous cesarean delivery has been used, at least in part, to limit the number of repeat cesareans performed. Numerous studies have shown the relative safety of a trial of labor in this patient population.^{1–3} Most studies have included women who have had a prior low transverse cesarean delivery, or those with no documentation of the prior uterine incision. Few studies address the safety of a trial of labor among those women who have had a prior low vertical cesarean delivery.

A few retrospective reports have evaluated the safety of a trial of labor in women who have had a prior low vertical uterine incision.^{4–6} These studies have been relatively small, with the largest single study including fewer than 180 trials of labor after cesarean delivery. As these small studies have been unable to evaluate adequately the rate of rare adverse outcomes such as uterine rupture, a thorough evaluation of the safety of a trial of labor in women who have had a prior low vertical uterine incision has not been available. We conducted the current study to determine whether gravidas undergoing a trial of labor after cesarean delivery who have had at least one prior low vertical uterine incision are at a higher risk of uterine rupture than women who have had at least one prior low transverse uterine incision.

Materials and Methods

The medical records of all gravidas admitted to the labor floor at or after 24 weeks' gestation with the intent of undergoing a trial of labor after cesarean delivery at Brigham and Women's Hospital over the 12-year period from July 1984 through June 1996 were reviewed. To ensure inclusion of all eligible subjects, we identified all women with a prior cesarean delivery who delivered

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during this period. Specifically, we reviewed the medical records for all women whose discharge diagnoses included delivery with a history of prior cesarean delivery, trial of labor, repeat cesarean delivery, vaginal birth after cesarean (VBAC), or uterine rupture.

Data were abstracted from the medical records of all women admitted to undergo a trial of labor who had either a previous low transverse or previous low vertical uterine incision. The specific data abstracted have been described previously.⁷

A low transverse uterine was defined as a transverse incision in the lower uterine segment. A low vertical incision was defined as a vertical incision confined to the lower uterine segment. Any uterine incision with documentation on a previous operative report of extension into the upper contractile portion, or corpus, of the uterus, or any low vertical uterine incision with classical extension, was excluded from the study. Classical uterine incisions and those that were documented as inverted "T"s also were excluded.

From the records, we identified 4393 trials of labor after at least one prior cesarean delivery during the study period. The medical records for 18 trials of labor were unavailable; therefore, data on a total of 4375 trials of labor were abstracted. We evaluated women undergoing a trial of labor who had one or more prior low transverse incision or one or more prior low vertical uterine incisions. The current analysis was limited to the first trial of labor for each woman during the study period. Those women undergoing a subsequent trial of labor at Brigham and Women's Hospital during the study period were not analyzed; therefore, 487 trials of labor were excluded from the analysis. We also excluded those trials of labor with at least one prior undocumented uterine incision ($n = 590$), and those with both prior low transverse and low vertical uterine incisions ($n = 9$). Of note, one of the nine women with both scar types, after undergoing a trial of labor, experienced a symptomatic uterine rupture.

Uterine disruptions were classified as either symptomatic ruptures or asymptomatic dehiscences. Symptomatic uterine rupture was diagnosed when there was a complete disruption of the prior uterine scar in association with at least one of the following associated symptoms or signs: laparotomy for hemorrhage or hemoperitoneum, excessive injury to the uterus necessitating hysterectomy, injury to the bladder, extrusion into the peritoneal cavity of any portion of the fetal-placental unit, or cesarean delivery for nonreassuring fetal testing or suspected rupture. Other disruptions of the prior uterine scar were considered asymptomatic dehiscences. These asymptomatic dehiscences would be identified in all women delivering by cesarean; for women delivering vaginally, however, asymptomatic

dehiscences would only be identified in women whose uterine scar was evaluated vaginally after delivery.

The previous delivery history, including specific mention of the type of prior uterine incision(s), was obtained from the medical record and used to form the two comparison groups, the low transverse and low vertical groups. The incidence of uterine rupture and the frequency of detected asymptomatic dehiscence were ascertained and compared between the two groups. Demographic characteristics, obstetric history, and characteristics of the index pregnancy and labor were compared for the two groups. Outcomes compared for the index pregnancy included the mode of delivery; Apgar scores at 1 and 5 minutes; change in maternal hematocrit from admission to postpartum day 1; and whether the patient received transfusion, had an intrapartum fever of greater than 38C, or had postpartum endomyometritis. In addition, the maternal and neonatal outcomes were compared between the low transverse and low vertical groups for the women who had a symptomatic rupture of the prior uterine incision.

Because the extent of a low vertical uterine incision is a subjective assessment made at the time of cesarean delivery, we further characterized the low vertical incisions from the available data in the medical records. For the low vertical group, we also examined the gestational age at the prior cesarean delivery, the number of layers of closure of the uterine incision, and whether one or more sutures were required at the upper pole of the incision.

Statistical significance for crude comparisons of categorical variables was determined using the χ^2 test or Fisher exact test as appropriate, and continuous variables were compared using the Student t test. Statistical significance was defined as $P < .05$. Multiple logistic regression was used to evaluate the associations while controlling for potential confounding factors. From the current literature, assuming a 1% rate of rupture with a low transverse incision during a trial of labor, this study had a power of 80% to exclude an increase in the low vertical uterine rupture rate to 3%.

Results

There were 3280 trials of labor in 2912 women who had had at least one prior low transverse uterine incision and 425 trials of labor in 377 women who had had at least one prior low vertical incision. In the low transverse group, 2591 (88.9%) women had one trial of labor, 280 women had two trials of labor, 35 had three trials of labor, and six had four trials of labor. For the low vertical group, 336 (89.1%) had one trial of labor, 34 had two trials of labor, and seven had three trials of labor. Altogether, 3289 women were analyzed. If a woman

Table 1. Demographic Data According to Type of Previous Uterine Scar

	Low transverse (n = 2912)	Low vertical (n = 377)	P
Maternal age (y)	31.2 ± 5.2	29.7 ± 5.9	<.001
Insurance carrier			.001
Commercial	43.4	51.1	
Health maintenance organization	38.2	13.6	
Public aid	15.2	31.3	
Unknown	3.3	4.0	
Gravidity >2	48.6	61.0	.001
Parity >1	17.8	29.4	.001
Indication for prior cesarean			.001
Failure to progress	48.5	24.4	
Breech presentation	20.8	44.3	
Nonreassuring fetal testing	19.2	15.1	
Other	11.5	16.2	

Data are presented as mean ± standard deviation or %.

had more than one trial of labor in our data, only the first trial of labor during the study period was included in the analysis. Our analysis included 2912 women with prior low transverse incisions and 377 women with prior low vertical uterine incisions.

Women with prior low vertical incisions were on average younger and were more likely to receive public aid compared with women with prior low transverse incisions (Table 1). There was no difference in the mean gestational age at delivery or proportion with preterm delivery between the two groups (Table 2). Birth weight, epidural use, and oxytocin use also were similar between the low transverse and low vertical groups. Although the length of the first stage of labor was similar in the two groups, the second stage of labor was on average 0.3 hours shorter in the low vertical group. Women in the low vertical group also were of higher gravidity and parity and were more likely to have had breech presentation as the indication for their prior

Table 2. Labor Data for the Index Pregnancy According to Type of Previous Uterine Scar

	Low transverse (n = 2912)	Low vertical (n = 377)	P
Gestational age (wk)	39.0 ± 2.3	39.0 ± 2.2	.9
Delivery before 37 wk	8.2	9.9	.2
Birth weight (g)	3414 ± 599	3376 ± 560	.3
Epidural use	71.0	69.0	.4
Oxytocin use	57.1	55.4	.5
Prostaglandin E ₂ gel use	3.4	1.9	.1
Length of labor (h)			
First stage	8.1 ± 5.8	8.0 ± 6.2	.8
Second stage	1.5 ± 1.4	1.2 ± 1.3	<.001

Data are presented as mean ± standard deviation or %.

Table 3. All Scar Disruptions and Symptomatic Uterine Ruptures According to Previous Scar Type

	Low transverse (n = 2912)	Low vertical (n = 377)	P
All scar disruptions	38 (1.3)	6 (1.6)	.6
Symptomatic uterine ruptures	28 (1.0)	3 (0.8)	>.999

Data are presented as n (%).

cesarean delivery compared with women in the low transverse group.

There were 38 (1.3%) women undergoing a trial of labor in the low transverse group who had a scar disruption detected during the trial of labor, and six (1.6%) women in the low vertical group who had a scar disruption detected ($P = .6$) (Table 3). Of greater clinical importance, the symptomatic rupture rate also was similar between the two groups, with a rupture rate of 1.0% for those in the low transverse group and 0.8% for those in the low vertical group, ($P > .999$).

As shown in Table 4, women undergoing a trial of labor with a prior low vertical incision were more likely to have a spontaneous vaginal delivery during the index trial of labor. The percentage of those with Apgar scores less than 7, intrapartum fever, endomyometritis, and transfusion was similar between the groups. The mean change in hematocrit between admission and postpartum day 1 also was similar between the two groups. Overall, there were nine hysterectomies in the low transverse group (0.31%), and one in the low vertical group (0.27%). Three of the hysterectomies in the low transverse group were not associated with uterine rupture.

There were 12 perinatal deaths among those in the low transverse group (0.4%) and four among those in the low vertical group (1.1%). There were 11 antenatal deaths before admission in the low transverse group and one neonatal death of an infant who was born weighing 740 g. Within the low vertical group, there

Table 4. Maternal and Perinatal Outcome for the Index Pregnancy

	Low transverse (n = 2912)	Low vertical (n = 377)	P
Spontaneous vaginal delivery	1643 (56.4)	254 (67.4)	.001
Apgar < 7 at 1 min	321 (11.0)	33 (8.8)	.2
Apgar < 7 at 5 min	62 (2.1)	8 (2.1)	>.999
Intrapartum temperature >38C	212 (7.3)	19 (5.0)	.11
Endomyometritis	34 (1.2)	8 (2.1)	.14
Transfusion	21 (0.7)	3 (0.8)	.75
Hematocrit change (admission minus postpartum d 1 hematocrit) (%)	5.2 ± 3.7	4.9 ± 3.7	.2

Data are presented as mean ± standard deviation or n (%).

Table 5. Maternal and Perinatal Complications for All Uterine Ruptures

	Low transverse (n = 28)	Low vertical (n = 3)	P
Maternal deaths	0	0	
Perinatal deaths	1 (3.6)	0	>.999
Apgar < 7 at 5 min	4 (14.3)	1 (33.3)	.4
Extrusion of fetal-placental unit	8 (28.6)	0	.5
Hysterectomy	6 (21.4)	1 (33.3)	.6
Oophorectomy	2 (7.1)	0	>.999
Damage to bladder	5 (17.9)	1 (33.3)	.5
Transfusion	7 (25.0)	1 (33.3)	>.999

Data are presented as n (%) of all uterine ruptures.

were three antenatal deaths before admission and one neonatal death due to anomalies.

A multiple logistic regression analysis was performed to examine the association of uterine rupture with scar type while controlling for the potential confounding effects of maternal age, parity, length of labor, public aid insurance, gestational age, use of epidural, use of oxytocin, centimeters of cervical dilatation at admission, birth weight, indication for prior cesarean delivery, and year of delivery. In this model, those women who had a prior low vertical uterine incision remained no more likely to have a uterine rupture compared with women who had a prior low transverse uterine incision (odds ratio [OR] = 1.0, 95% confidence interval [CI] 0.29, 3.45). The year of delivery was not a significant predictor of uterine rupture (OR = 1.0, 95% CI 0.9, 1.1).

We then compared the maternal and neonatal outcomes for the symptomatic ruptures in both study groups (Table 5). Outcome in the presence of rupture was similar in the low transverse and low vertical groups. There were no maternal deaths in either group, and the only perinatal death occurred in a patient with a prior low transverse hysterotomy. This particular patient was sent home after a failed induction, and several days later was found to have had a fetal demise. An induction was reinitiated, and during this second induction, she had a uterine rupture. We also calculated the need for blood replacement among the women with uterine ruptures. Within the low transverse group, seven women received packed red blood cells, with a range of between one and nine units of blood and a median value of two units of blood. For the low vertical ruptures, one woman received six units packed red blood cells.

As controversy remains regarding the definition of a low vertical incision, we further characterized the low vertical group. None of the three women having a uterine rupture and 24.7% (87 of 352) of the women without a uterine rupture had their prior low vertical

incision performed before 37 weeks' gestation. For low vertical scar disruptions, four of the six prior cesarean deliveries were performed at 38 weeks' gestation or later, and two were performed at 36 and 37 weeks' gestation. The low vertical uterine incision had been closed in two layers for the three women having a uterine rupture in a subsequent trial of labor and also for the three women with detected asymptomatic dehiscences. For the entire low vertical group, closure of the prior low vertical uterine incision was performed in two layers in 77%, in three layers in 3%, and with at least one required additional suture at the upper pole of the incision in 9.4%. The closure method could not be determined from the operative report in 10.5%.

Discussion

We found no difference in risk of uterine rupture following a trial of labor among women with prior low vertical incisions compared with prior low transverse uterine incisions, even when controlling for multiple confounding factors in a logistic regression analysis. This study has one of the largest number of trials of labor among women with prior low vertical uterine incisions that we were able to identify in the English literature. Our finding of a 0.8% risk of uterine rupture among women with a prior low vertical incision during a trial of labor is consistent with existing literature.^{4,6} In a recent compilation of case series of trials of labor with a prior low vertical uterine incision, the risk for uterine rupture during a trial of labor was reported to be 1%, based on fewer than 400 trials of labor.⁶ Of the four prior low vertical-related uterine ruptures in the literature, one was in a parturient with a prior low vertical and then a prior low transverse uterine incision, and one was in a gravida with two prior low vertical incisions.⁴ The third occurred in a woman with an undocumented uterine scar who was found to have a presumed prior low vertical uterine incision.⁸ The last was a posterior rupture that occurred in a woman with one prior low vertical incision undergoing a trial of labor.⁵ Our three ruptures, and all our scar disruptions in the low vertical group, occurred in women who had only one prior low vertical uterine incision, and our rate of uterine rupture was just under 1%. Whereas we also have included those detected asymptomatic dehiscences as a component of all disruptions of the prior uterine scar, this measure is quite unreliable as an indicator of the rate of complication, as it is identified incompletely after successful trials of labor. It is identified easily at cesarean delivery, but it is noted after a vaginal delivery only when a uterine examination is performed. Our definition of a rupture of the prior cesarean scar, a uterine scar disruption that we have

defined as symptomatic in some way to parturient or fetus, is the truer measure of morbidity from a trial of labor.

We also compared maternal and neonatal outcome for women with uterine rupture because differences in serious sequelae for mother and infant could result. Among women with uterine ruptures, there was no difference between the two groups in the rate of maternal or perinatal death, and none of the deaths appeared to be related to the trial of labor. Interestingly enough, there were no cases of extrusion of any part of the fetal-placental unit in the low vertical group, although this complication occurred in one-fourth of the uterine ruptures in the low transverse group. Extrusion of the fetus or placenta into the peritoneal cavity is a well-described complication for uterine ruptures with prior vertical uterine incisions extending to the corpus or fundus.⁹ This complication did not occur in any of the three women with ruptures of a prior low vertical incision in our study. The rates of hysterectomy, oophorectomy, damage to bladder, and transfusion were not statistically different between the low transverse and low vertical groups. However, it is difficult to compare the rate of these rare events because the number of events was small.

The precise definition of a low vertical uterine incision is not clear.¹⁰⁻¹² Although any noted uterine incision with extension into the upper contractile portion of the uterus was excluded from this study, a sizable proportion of patients had required closure of the prior uterine incision with more than two layers, or with additional required sutures at the upper pole. We did not exclude these patients from our analysis because they were thought at the time of surgery to have no corpus extension of the uterine incision and therefore met our criteria for a low vertical incision. After the delivery, and with contraction of the uterus, the upper portion of some of these incisions required more than a standard two-layer closure. None of the scar disruptions had prior low vertical incisions that required anything more than the standard two-layer closure. In addition, all of the detected low vertical scar disruptions occurred in women who had their prior cesarean deliveries at gestational ages at which the lower uterine segment should have been well developed. No ruptures occurred in the 87 trials of labor in women whose prior cesarean delivery was performed earlier in gestation. For women with a prior low vertical incision undergoing a trial of labor after cesarean delivery, our data did not suggest an increased risk regardless of the gestational age at which the prior cesarean was performed or the manner in which the incision was closed.

The upper limit of risk considered acceptable for adverse outcome during a trial of labor is a subjective

measure unique to each practicing physician and to each gravida planning a delivery after prior cesarean. Although the overall risk of uterine rupture for women with a prior low transverse uterine incision is close to 1%, identified subgroups of these women with higher risks are offered trials of labor routinely. For women with multiple prior cesarean deliveries, or those undergoing oxytocin administration during a trial of labor, the risk for scar disruption during a trial of labor has been reported to range from 1-8%.¹³⁻¹⁶ In a large study of maternal and fetal outcomes after a prior cesarean delivery involving more than 100 uterine ruptures, the incidence of uterine rupture with two or three prior cesareans is between 2 and 3%.⁹ For women with prior classical hysterotomy, the risk is even higher, on the order of at least 12%.¹ It is generally considered that the risk for women with a prior classical uterine incision is too high to allow a trial of labor, whereas for women with multiple prior cesarean deliveries, the risk is frequently considered acceptable.¹⁷ Although we saw no increase in risk of uterine rupture when comparing women with prior low transverse incisions to women with prior low vertical incisions, the potential for a type II statistical error must be considered. We had sufficient power in this study to exclude an increase in uterine rupture rate from 1%, as noted among those with a prior low transverse uterine incision, to 3%, a rate similar to that for a trial of labor among women with multiple prior uterine incisions, or for women receiving oxytocin during a trial of labor.

A limitation of this study bears further discussion. There has been much concern in the literature about the precise definition of a low vertical cesarean incision, specifically in defining the exact boundary of the upper pole of this incision. The subjectivity of this assessment makes conclusions regarding risks related to use of this incision potentially difficult. We sought to exclude any patients with known extension of the uterine incision into the upper contractile portion of the uterus. Undoubtedly, as the data for the study were obtained from the medical record, some patients may have been included if the extension into the upper portion of the uterus was not well documented. Inclusion of these patients in our study could have increased the rupture rate associated with low vertical incisions. The rates, however, of the two groups were the same. In addition, although our numbers are small, we did not see any instances of uterine rupture among women with closure of the prior uterine incision in more than two layers or among women whose prior surgery was done before 37 weeks' gestation when the lower uterine segment may be less well-developed.

This study of labor after cesarean delivery with a low vertical incision suggests that the rate of uterine rupture

is comparable to that of women with a prior low transverse incision. The level of uterine rupture (1% and up to 3% given with power calculation) agrees with and is at the lower end of that reported by ACOG (1–7%).¹⁸ The clinical recommendation of whether vaginal birth after cesarean is indicated in certain patients is summarized elsewhere.¹⁸ Our finding of a similar rate of rupture among women with prior low vertical and low transverse incisions will be useful to women and clinicians making this complex decision.

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