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Risk of Uterine Rupture Among Women Attempting Vaginal Birth After Cesarean with an Unknown Uterine Scar

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RISK OF UTERINE RUPTURE AMONG WOMEN ATTEMPTING VAGINAL BIRTH
AFTER CESAREAN WITH AN UNKNOWN UTERINE SCAR

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CONDENSATION

An unknown uterine scar does not appear to increase the risk for uterine rupture in women undergoing a trial of labor after one prior cesarean delivery.

SHORT VERSION OF ARTICLE TITLE

Risk of Uterine Rupture with Unknown Scar

ABSTRACT

Objective: To estimate the association of uterine rupture and prior incision type, either unknown or low transverse, among women attempting a trial of labor after one prior cesarean delivery.

Study Design: We conducted a secondary analysis of a prospective multicenter observational study of 15,519 women with term singletons who attempted a trial of labor after one prior cesarean delivery. Odds ratios for the association between uterine incision location, either unknown or low transverse, and uterine rupture were estimated using multivariable logistic regression.

Results: Between 1999 and 2002, 99 of the 15,519 women (0.64%) attempting a trial of labor after one prior cesarean delivery experienced a uterine rupture. Pregnant women with an unknown scar had lower odds of uterine rupture (adjusted odds ratio, OR, 0.71; 95% confidence interval, CI, 0.37-1.37) compared to women with a known low transverse scar. Other adverse maternal outcomes did not differ between the two groups of women.

Conclusion: Among this cohort, women with an unknown uterine incision attempting a trial of labor were not at increased risk of uterine rupture compared to women with a known low transverse incision.

Key Words (3 to 5 words): uterine rupture, unknown scar, trial of labor, vaginal birth after cesarean

INTRODUCTION

Cesarean section is the most common surgery performed among women in the United States and approximately one-third of cesarean deliveries are repeat operations.¹ The American Congress of Obstetricians and Gynecologists recommend that women with one previous low transverse cesarean delivery should be counseled and offered a trial of labor after cesarean (TOLAC) due to the increasing morbidity associated with multiple cesarean deliveries.^{2,3}

Uterine rupture is one of the most devastating complications of attempting a TOLAC and the risk varies based on the location of the uterine incision. The risk of rupture is lowest amongst women with a previous low transverse uterine incision, with estimates ranging from 0.7 to 0.9%, and increases with a prior fundal incision (1-2% with prior low vertical incision and up to 12% with prior classical incision).⁴⁻⁷ Given the potential for life-threatening complications, researchers have studied populations and conditions that make TOLAC a reasonable option. The risk of rupture among women with an unknown uterine scar is less understood. Previous studies have examined the association between rupture and incision type but have been limited by small sample size and retrospective study design.⁸⁻¹⁰

Our objective was to estimate the association between risk of uterine rupture and incision type, either unknown or low transverse incision, among a large cohort of women attempting a trial of labor after one prior cesarean.

MATERIALS AND METHODS

We performed a secondary analysis of the Cesarean Registry, a prospective, observational study of pregnant women with prior cesareans delivering at 19 academic medical

centers belonging to the National Institute of Child Health and Human Development Maternal Fetal Medicine Units Network between 1999 and 2002.⁴ The goal of the primary study was to assess maternal and neonatal morbidity associated with trial of labor compared to repeat cesarean section. This secondary analysis was reviewed and determined exempt by the University of North Carolina institutional review board.

Of the 73,257 women enrolled in the Cesarean Registry, we identified 15,519 women with one prior cesarean delivery who had either a prior low transverse or unknown uterine scar, delivered at >20 weeks gestation, and attempted a TOLAC (Figure 1). Patients were enrolled in the study through identification using the labor and delivery logbook or database at each center.⁴ The decision to attempt a TOLAC or schedule a repeat cesarean was determined by the provider and patient. Regardless of the intended mode of delivery, any woman presenting in labor with at least 4 cm cervical dilation and/or receiving oxytocin at any time was categorized as attempting a TOLAC. Exclusion criteria included prior classical, low vertical, or T or J incision, multi-fetal gestation, prior myomectomy, any prostaglandin use, and birthweight <500 grams. Records were excluded from the analysis if missing information for either inclusion or exclusion criteria.

Demographic information, obstetric and medical history, and intrapartum events were obtained from the medical records by trained study nurses.⁴ We evaluated each variable for missing data and excluded any variable with >10% missing information. Neonatal data was abstracted up to 120 days after delivery or at the time of discharge.⁴ Uterine rupture was defined as a disruption or tear of the uterine muscle and visceral peritoneum or a separation of the uterine muscle with extension to the bladder or broad ligament.⁴ The orientation of the uterine rupture was not documented. Uterine dehiscence was defined as a disruption of the uterine muscle with intact serosa.⁴

Statistical Analysis

Participant characteristics were compared by incision type with χ^2 test or Fisher exact tests to evaluate differences for categorical variables and t-tests to evaluate differences for continuous variables. Multivariable logistic regression was used to estimate odds ratios for the association between incision type and uterine rupture. Estimates were adjusted for potential confounders and covariates identified a priori from the literature as being associated with incision type and uterine rupture, including prior vaginal delivery or VBAC, inter-delivery interval, cervical dilation upon admission, induced or spontaneous labor, intrauterine pressure catheter placement, epidural use, gestational age, and birthweight. Covariates were removed from the model using backward stepwise elimination and remained if the OR varied by less than 10 percent. Maternal and neonatal outcomes were compared between women with a prior low transverse incision and women with an unknown uterine incision. Data were analyzed using SAS software, version 12.0 (SAS Institute, Inc, Cary, NC).

RESULTS

A total of 15,519 women attempted a TOLAC of whom 2,460 women (15.9%) had a prior unknown uterine scar and 13,059 women (84.1%) had a prior low transverse scar (Figure 1). Compared to women with a prior low transverse scar, women with an unknown uterine scar were less likely to be married, to smoke, be obese, to be enrolled in prenatal care, or have insurance at delivery ($P \leq 0.01$ for all associations)(Table 1). A higher proportion of Hispanic women had a prior unknown scar. Women with an unknown uterine scar were also more likely to be enrolled in spontaneous labor and to have experienced a prior vaginal delivery or successful vaginal birth after cesarean (VBAC) compared to women with a prior low transverse

incision. Maternal age, gestational age at delivery, and birthweight were similar between the groups.

A successful VBAC was achieved in 75.1% (1,847 successful VBACs of the 2,460 attempted) of women with a prior unknown scar compared to 72.3% (9,441 successful VBACs of the 13,059 attempted) with a prior low transverse scar ($P < 0.01$). During the study period, 99 women (0.64%) experienced a uterine rupture. Women who attempted a TOLAC with an unknown uterine scar had lower odds of uterine rupture than women with a known low transverse scar, but this association was not statistically significant (adjusted odds ratio, OR 0.71, 95% CI 0.37-1.37; Table 2). Controlling for prior vaginal delivery within the final model did not change the risk estimate.

Other adverse maternal outcomes including hysterectomy, blood transfusion, maternal death, and intraoperative complications were similar among the groups, except less uterine dehiscence appeared to occur among the unknown scar group (Table 3). None of the maternal deaths occurred to women with a uterine rupture or dehiscence. A uterine dehiscence did not result in a hysterectomy for any patient with an unknown scar. No differences in adverse neonatal outcomes among term infants were apparent between the groups, except an increased number of NICU admissions in the unknown scar group (Table 3). None of the intrapartum stillbirths occurred among women with a uterine rupture or dehiscence. Three of the neonatal deaths occurred to women attempting a TOLAC with a low transverse incision. No neonatal deaths occurred among women with an unknown scar.

COMMENT

Our data indicate that the risk of uterine rupture among women with an unknown scar was not increased over the baseline risk for women with a known low transverse incision.

This study confirms the findings of other researchers examining this clinical question among smaller cohorts that were underpowered to detect clinically meaningful differences in uterine rupture.^{8,10} However, our results contrast those of Grubb et al⁹ in which an increased risk of uterine scar separation among women with an unknown scar. This increase was hypothesized to be a result of augmentation of latent phase labor and longer exposure to oxytocin.⁹ Within our cohort, patients with an unknown scar were more likely to present in spontaneous labor. Therefore, the population may have favored an increased likelihood of successful VBAC and subsequently decreased risk for uterine rupture.

Our study is strengthened by its large, multi-center, and prospective design. Data collection of both maternal and neonatal morbidity information was prospectively performed by trained study nurses using standardized definitions, thereby increasing the validity and generalizability of the results.

An important limitation to consider when analyzing our results is the potential for selection bias. Women delivering by scheduled repeat section are inherently different from those attempting a trial of labor. First, the provider must discuss the option to consider a TOLAC. This option may be withheld from women with history of a prior preterm cesarean section, history of difficult extraction, or other factor increasing suspicion for a non-transverse incision. A previous analysis revealed an unknown uterine incision as the most frequent indication for performing a repeat cesarean irrespective of the onset of labor.¹¹ Second, after appropriate counseling regarding the risks and benefits, characteristics of patients choosing a trial of labor

may be inherently different from those deciding upon a repeat cesarean section. Finally, intrapartum management between the two groups may differ regarding cervical dilation upon admission, amount of oxytocin administered, and tolerance of abnormalities in the fetal heart rate tracing. Although we attempted to control for these differences in our analysis, we cannot exclude the possibility that our results may underestimate the risk of uterine rupture in the general population.

The racial disparity of the cohort was an interesting finding, with an increased number of Hispanic women with a prior unknown scar. This may reflect difficulty with obtaining prior obstetric records in immigrant populations.

In a similar cohort, we recommend that women with a singleton gestation and one prior cesarean with unknown uterine scar who desire a trial of labor should not be discouraged from attempting a VBAC.

REFERENCES

1. Martin JA, Hamilton BE, Ventura SJ, et al. Births: Final Data for 2009. National Vital Statistics Reports, Volume 60, Number 1, November 3, 2011
2. Landon MB, Spong CY, Thom E, et al. Risk of uterine rupture with a trial of labor in women with multiple and single prior cesarean delivery. *Obstet Gynecol* 2006;108(1):12-20.
3. Silver RM, Landon MB, Rouse DJ, et al. Maternal morbidity associated with multiple repeat cesarean deliveries. *Obstet Gynecol* 2006;107(6):1226-32.
4. Landon MB, Hauth JC, Leveno KJ, et al. Maternal and perinatal outcomes associated with trial of labor after prior cesarean delivery. *NEJM* 2004;351(25):2581-2589
5. Macones GA, Peipert J, Nelson DA, et al. Maternal complications with vaginal birth after cesarean delivery: A multicenter study. *Am J Obstet Gynecol* 2005;193:1656-1662
6. Practice Bulletin No 115. Vaginal birth after previous cesarean delivery. 2010;116(2,Pt 1):450-463
7. Landon MB and Lynch CD. Optimal timing and mode of delivery after cesarean with previous classical incision or myomectomy: a review of the data. *Semin Perinatol* 2011;35:257-61.
8. Beall M, Eglinton GS, Clark SL, et al. Vaginal delivery after cesarean section in women with unknown types of uterine scar. *J Reprod Med* 1984;29:31-5.
9. Grubb DK, Kjos SL, Paul RH. Latent labor with an unknown uterine scar. *Obstet Gynecol* 1996;88(3)351-355.
10. Pruett KM, Kirshon B, Cotton DB. Unknown uterine scar and trial of labor. *Am J Obstet Gynecol* 1988;159:807-10.
11. Spong, CY, Landon MB, Gilbert S, et al. Risk of uterine rupture and adverse perinatal outcome at term after cesarean delivery. *Obstet Gynecol* 2007;110(4)801-807.
12. Landon MB, Leindecker S, Spongy CY, et al. The MFMU Cesarean Registry: factors affecting the success of trial of labor after previous cesarean delivery. *Am J Obstet Gynecol* 2005;193:1016-23.
13. Leung AS, Farmer RM, Leung EK, et al. Risk factors associated with uterine rupture during trial of labor after cesarean delivery: a case control study. *Am J Obstet Gynecol* 1993;168:1358-63.
14. Caughey AB, Shipp TD, Repke JT, et al. Rate of uterine rupture during a trial of labor in women with one or two prior cesarean deliveries. *Am J Obstet Gynecol* 1999;181:872-6.
15. Halperin ME, Moore DC, Hannah WJ. Classical versus low-segment transverse incision for preterm cesarean section: maternal complications and outcome of subsequent pregnancies. *Br J Obstet Gynaecol* 1988;95:990-6.

Figure 1: Patient Selection Flowchart

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Table 1. Demographic and pregnancy characteristics of women attempting a TOLAC, stratified by previous incision type

Characteristic	Total (%) (N=15,519)	LTCS (%) (N=13,059)	Unknown Scar (%) (N=2,460)	P value
Maternal age at delivery (y)				0.46
≤17	12,725 (82.0)	10,726 (82.1)	1,999 (81.3)	
18-34	2,655 (17.1)	2,214 (17.0)	441 (17.9)	
≥35	139 (0.9)	119 (0.9)	20 (0.8)	
Race				<0.01
Black	5,259 (33.9)	4,717 (36.1)	542 (22.0)	
White	5,706 (36.8)	5,093 (39.0)	613 (24.9)	
Hispanic	3,747 (24.1)	2,593 (19.9)	1,154 (46.9)	
Other or unknown	807 (5.2)	656 (5.0)	151 (6.1)	
Married	8,713 (56.1)	7,357 (56.3)	1,356 (55.1)	<0.01
Smoking during pregnancy (any)	2,342 (15.1)	2,031 (15.6)	311 (12.7)	<0.01
BMI at delivery (kg/m²)				<0.01
<25	1,638 (11.5)	1,382 (11.4)	256 (11.9)	
≥25-29.9	4,889 (34.2)	4,101 (33.8)	788 (36.5)	
≥30	7,771 (54.4)	6,658 (54.8)	1,113 (51.6)	
Insurance at delivery				<0.01
Medicaid/Medicare	6,894 (44.4)	5,798 (44.4)	1,096 (44.6)	
Private	6,392 (41.2)	5,714 (43.8)	678 (27.6)	
No coverage	2,231 (14.4)	1,545 (11.8)	686 (27.9)	
Prenatal Care	15,054 (97.0)	12,731 (97.5)	2,323 (94.5)	<0.01
Maternal disease (%)	2,577 (16.6)	2,213 (17.0)	364 (14.8)	0.01
Prior vaginal delivery	7,686 (49.5)	6,341 (48.7)	1,345 (55.4)	<0.01
Prior VBAC	4,992 (32.2)	4,085 (31.3)	907 (36.9)	<0.01
Type of Labor				<0.01
None, failed induction	35 (0.2)	32 (0.3)	3 (0.1)	
Induction	3,225 (21.3)	2,831 (22.1)	394 (16.6)	
Spontaneous	6,371 (42.0)	5,184 (40.5)	1,187 (50.0)	
Spontaneous, augmented	5,533 (36.6)	4,743 (37.1)	790 (33.3)	
Interval <2yrs since CD	3,844 (25.9)	3,419 (27.3)	425 (18.3)	<0.01
Cervical Dilation <4cm on Admit	8,036 (54.3)	6,954 (55.8)	1,082 (45.9)	<0.01
Epidural anesthesia	10,915 (81.4)	9,352 (82.0)	1,563 (78.2)	<0.01
IUPC Use	6,211 (41.0)	5,386 (42.1)	825 (34.8)	<0.01
Chorioamnionitis	863 (5.6)	702 (5.4)	161 (6.5)	0.02
Gestational age at delivery (wk)				0.28
<37	1,903 (12.3)	1,582 (12.1)	321 (13.1)	
37 0/7 - 40-6/7	11,817 (76.2)	9,974 (76.4)	1,843 (74.9)	
≥41	1,799 (11.6)	1,503 (11.5)	296 (12.0)	
Birthweight (g)				0.74
≥500 - 2499	1,369 (8.8)	1,147 (8.8)	222 (9.0)	
≥2500 - 3999	12,722 (82.0)	10,701 (81.9)	2,021 (82.2)	
≥4000	1,428 (9.2)	1,211 (9.3)	217 (8.8)	

Table 2. Unadjusted and Adjusted ORs of uterine rupture by incision type

	Unadjusted OR	Adjusted OR
Uterine rupture		
Unknown uterine scar	0.59 (0.31-1.15)	0.71 (0.37-1.37)*
Low transverse uterine incision	ref	ref

* Adjusted for cervical dilation upon admission and intrauterine pressure catheter use

Table 3. Maternal and neonatal morbidity of women attempting a TOLAC, stratified by incision type

	Known LTCS N=13,059 (%)	Unknown Scar N=2,460 (%)	P value
Maternal			
Uterine rupture	89 (0.68)	10 (0.41)	0.13
Uterine dehiscence	91 (0.70)	5 (0.20)	<0.01
Hysterectomy	24 (0.18)	5 (0.20)	0.80
Transfusion	194 (1.49)	41 (1.67)	0.50
Maternal death	2 (0.02)	1 (0.04)	0.41
Other maternal adverse events*	50 (0.38)	9 (0.37)	0.90
Neonatal			
Term intrapartum stillbirth [§]	2 (0.02)	0	0.54
Term HIE [§]	10 (0.09)	2 (0.09)	0.93
Term neonatal death [§]	8 (0.07)	2 (0.09)	0.71
Term NICU admission [§]	991 (8.63)	230 (10.75)	<0.01
Term 5-minute Apgar ≤ 5 [§]	95 (0.83)	16 (0.75)	0.70

* Defined as broad-ligament hematoma, cystotomy, bowel injury, ureteral injury

§ There were 11,477 term deliveries of TOL patients with prior LTCS and 2,139 term deliveries of TOL patients with prior unknown uterine scar.

