Published in final edited form as:

Obstet Gynecol. 2008 July ; 112(1): 116–120. doi:10.1097/AOG.0b013e31817946f4.

Risk Factors for Bladder Injury in Patients With a Prior Hysterotomy

Alison G. Cahill, M.D.¹, Molly J. Stout, M.D.¹, David M. Stamilio, M.D., M.S.C.E.¹, Anthony O. Odibo, M.D., M.S.C.E.¹, Jeffrey F. Peipert, M.D., Ph.D.¹, and George A. Macones, M.D., M.S.C.E.¹

¹Department of Obstetrics and Gynecology, Washington University in St. Louis

Abstract

Objective—To estimate the rate of and risk factors for bladder injury in vaginal birth after cesarean (VBAC) candidates.

Methods—Between 1995 and 2000, a 17-center, retrospective cohort study was performed, evaluating women with prior cesarean delivery for delivery mode-specific morbidity during subsequent pregnancy. Trained nurses extracted information from medical records on demographics, medical and obstetric history, pregnancy and delivery. This secondary analysis examines the rate and risk factors for bladder injury, defined as having occurred if identified and recorded by the physician at delivery. Univariable and multivariable analyses were performed.

Results—Of 25,005 patients with at least one prior cesarean, 107 (0.43%) sustained a bladder injury, and 91.6% (n=98) of these occurred without concurrent uterine rupture. Bladder injury risk was not affected by delivery mode: VBAC trial vs. elective cesarean (0.44% vs 0.42%, adjusted OR 1.36, 95% CI 0.85–2.19). For the women who undertook a VBAC trial and did not experience a uterine rupture, failure to deliver vaginally was the only predictor of bladder injury (0.86% vs 0.22%, adjusted OR 4.61, 95% CI 2.70–8.11). In women that elect repeat cesarean, greater than one prior cesarean was significantly associated with bladder injury (0.68% vs 0.29%, adjusted OR 2.40, 95% CI 1.30–4.43).

Conclusion—Risk of bladder injury in women with a prior cesarean is not affected by planned mode of delivery. Though rare, bladder injury in women undergoing VBAC is strongly associated with a failed VBAC trial. A heightened awareness for bladder injury is warranted when performing repeat cesareans in the setting of failed VBAC attempts.

Introduction

For women with a history of a prior cesarean, planning mode of delivery for subsequent pregnancies involves careful consideration of several factors, including potential complications associated with repeat cesarean versus vaginal birth after cesarean. While uterine rupture is arguably the most morbid of VBAC-associated morbidities, it occurs rarely^(1,2). The precise incidence and risk for other morbidities associated with vaginal birth after cesarean (VBAC),

Corresponding Author: Alison G. Cahill, M.D. Division of Maternal-Fetal Medicine Washington University School of Medicine Phone: 314 362 7139; Fax: 314 747 1256 Email: cahilla@wustl.edu.

Financial Disclosure: The authors have no potential conflicts of interest to disclose.

Presentation: Presented as a poster at the annual meeting of the American College of Obstetricians and Gynecologists, May 5–9, 2007, San Diego, CA.

Precis: In women with a prior hysterotomy, bladder injury occurs most commonly in the setting of a failed attempt at vaginal birth after cesarean.

such as bladder injuries, surgical complications, febrile morbidities, and need for blood transfusions, are less well characterized. Specifically, the factors associated with bladder injury in this patient population are not well established.

The published literature contains several case-reports of uterine rupture with concomitant bladder injury or rupture(3-5). However, given that uterine rupture is not common, it is important for the obstetrical surgeon to be aware of what other factors, if any, increase a patient's risk for injury to the bladder. We undertook this study to estimate the incidence of, and risk factors associated with bladder injury in patients with a history of a prior cesarean.

Materials and Methods

A multicenter retrospective cohort study of women with at least one prior cesarean delivery was conducted at 17 centers, both tertiary and community, in the northeastern United States between 1995 and 2000. Institutional review board approval was obtained for all 17 centers. The study was designed to estimate the incidence of maternal morbidities associated with vaginal birth after cesarean (VBAC), and which factors were associated with these morbidities. The primary outcome for the initial cohort was symptomatic uterine rupture. In this secondary analysis, those patients who sustained a bladder injury were compared to those patients who did not sustain a bladder injury, to estimate both the incidence of and the risk factors associated with bladder injuries of women with a history of at least one prior cesarean delivery. A detailed description of the large, retrospective cohort study has been published previously,(2) but a brief description follows.

Patients were identified by International Classification of Disease, 9th Revision (ICD-9) codes for "previous cesarean delivery, delivered". Data were extracted from medical records by trained research nurses using standardized, closed-end data collection forms. Re-extraction of 3% of the medical records was used for quality assurance monitoring. Extensive information on maternal history and demographics, pregnancy, labor and delivery, and complications was obtained. Additionally, detailed information was collected on specific maternal morbidities, including bladder injury. Bladder injury was defined as any full-thickness injury to the bladder identified by the patient's physician during their course of care, requiring repair. Charts were reviewed to distinguish full-thickness bladder injuries, which were the subject of this analysis, from incidental and less clinically relevant bladder injuries such as denuding of the bladder serosa. For this secondary analysis, the two study groups were defined by presence or absence of a bladder injury. The assessment of bladder injury risk factors was further stratified by planned delivery mode.

Descriptive statistics were used to estimate the incidence of bladder injury in patients with at least one prior cesarean overall and by planned mode of delivery. The characteristics and birth outcomes of patients who sustained a bladder injury were compared to those who did not sustain one, using Student's t-test, chi-square, or Fisher exact analysis as appropriate. Stratified analysis was conducted to identify potential confounding variables. Finally, the results of the univariable and stratified analyses were used to select factors for our final multivariable models for bladder injury, stratified by planned mode of delivery. Backward selection was used to reduce the number of variables in the model by assessing the magnitude of change in the effect size of other risk covariates. Differences in the hierarchical explanatory models were tested using the likelihood ratio test or Wald test. All variables that were statistically significant, as well as those with known biologic importance or that were historically associated with VBAC morbidity and bladder injury, were included in the final models. Since hospital site was a potential confounder beyond the level of individual patient data, and could have resulted in non-independence within hospital groups, it was evaluated by cluster analysis in the final

models. All statistical analyses were completed using STATA software package, version 8, Special Edition (College Station, TX).

Results

Of 25,005 patients with at least one prior cesarean section, 107 (0.43%) sustained a bladder injury. Bladder injury risk was not affected by planned mode of delivery, with VBAC trial and elective cesarean conferring similar risk (0.44% vs. 0.42%, adjusted OR 1.36, 95% CI 0.85–2.19). Of the 107 bladder injuries, 91.6% (n=98) occurred without concurrent uterine rupture.

The two study groups, those who experienced a bladder injury and those who did not, were compared on baseline characteristics (Table 1). The two groups were similar in many respects. There was no difference in gravidity, maternal race, gestational age at delivery, birth weight, or rate of comorbidities such as diabetes. There was also no difference in rates of acceptance to VBAC. The two groups differed slightly with regard to two parameters. Women who experienced a bladder injury were one year older, on average and were more likely to have had more than one prior cesarean than the women who did not experience a bladder injury. In addition, patients with bladder injury appeared to have a higher rate of gestational hypertension compared to patients without bladder injury, but the difference did not reach statistical significance ($p=0.07$).

When multivariable logistic regression was used to determine which factors were most strongly associated with bladder injury among patients that attempted VBAC ($n=13,706$), while adjusting for relevant confounding effects, a failed VBAC trial was significantly associated with over a 4-fold increased risk for bladder injury (0.86% vs 0.22%, adjusted OR 4.61, 95% CI 2.70–8.11) (Table 2). Other established risk factors for VBAC failure and VBAC-associated morbidities were not significantly associated with bladder injury in the multivariable model, including number of prior hysterotomies, history of a prior vaginal delivery, delivery prior to 34 weeks gestation, induced (vs spontaneous) labor, and black race (vs. Caucasian, Asian, or “other race”).

For patients who elected repeat cesarean delivery ($n=11,299$; Table 3), having more than one prior hysterotomy was the only significant factor independently associated with an increased risk of bladder injury (0.68% vs 0.29%, adjusted OR 2.40, 95% CI 1.30–4.43). As in the model constructed for patients that attempted VBAC, other factors that have historically been associated with delivery-associated morbidities in VBAC candidates were not significantly associated with bladder injury in patients electing repeat cesarean. The absolute risk of bladder injury in patients with a prior hysterotomy increased in the following ascending order: successful VBAC (0.2%), elective repeat cesarean after one prior cesarean (0.3%), elective repeat cesarean after more than one prior cesarean (0.7%), failed VBAC attempt (1.1%).

Discussion

We found that the risk for bladder injuries in patients who have undergone a prior cesarean is not related to planned mode of delivery. Interestingly, for patients undergoing a VBAC trial, over 90% of bladder injuries occur without a concomitant uterine rupture. In fact, the most bladder injuries occur in the setting of a failed trial of labor. A heightened awareness by obstetricians of the increased risk of bladder injury during cesarean delivery for failed VBAC attempt could potentially reduce the rate of bladder injuries or reduce the risk of undiagnosed bladder injury in this patient population.

The potential for bladder injury is not foreign to obstetricians. Injury to the bladder has been reported at rates of approximately 0.1 per 1000 births(6), and 3.1 per 1000 cesarean deliveries (7). Recently, Phipps and colleagues(8) performed a nested case-control study within a

retrospective cohort of women undergoing cesarean delivery in order to identify factors associated with the risk of bladder injury. They found bladder injury occurred in 0.28% of over 14,000 deliveries, and identified a few factors associated with bladder injuries at the time of cesarean, including prior cesarean (adjusted OR 3.82, 95% CI 1.62–8.97). However, clinical details needed to fully characterize the association were not available for the subgroup of patients with a prior hysterotomy.

Our study allowed a more precise estimate of the risk of bladder injury in patients who had undergone a prior cesarean. Additionally, our study design enabled us to assess different risk factors associated with bladder injury in patients who underwent a trial of labor or elected a repeat cesarean. Recently published data by Alexander et al(9) helps put this risk in context. They compared maternal and fetal outcomes of women who underwent a primary cesarean during the first stage of labor and compared those of women who underwent cesarean in the second stage of labor. Of the several intraoperative complications studied, bladder injury was one of them. The investigators found that 0.4% of the 2,716 women who had a cesarean during the second stage of labor sustained a bladder injury as compared to 0.1% of women who had a cesarean during the first stage of labor. The elevated risk of cystotomy in patients undergoing cesarean after complete cervical dilation found by Alexander and colleagues is similar to the risk of cystotomy in our VBAC study. These investigators were not able to comment on specific factors associated with risk of bladder injury and their results are not necessarily generalizable to VBAC candidates since the study population included only patients undergoing primary cesarean. Thus our study compliments theirs, and we were able to determine that the dominant risk factors for cystotomy in patients with a prior cesarean were having a failed VBAC attempt and the number of prior hysterotomies.

Our study offers several strengths. The large sample size allowed us to study a relatively rare outcome, which has limited other authors in their ability to comment on risk associated with bladder injury in this patient population. The robust information on patients in the cohort, including history, demographics, and pregnancy course, allowed us to test the association of several factors with the risk of bladder injury, while adjusting for known potentially confounding effects. Conversely, there were some study weaknesses that should be considered. We were not able to adjust for individual operator factors, such as the surgeon's level of experience. However, we did account for surrogate markers, such as delivery site, and whether or not a particular institution had an obstetric residency training program. Additionally, it is possible that the bladder injury risk may be associated with the indication or urgency of the cesarean, but we were not able to evaluate cesarean indication because the information was not available. Two additional potential weaknesses are worth noting. First, there is potential for ascertainment bias. That is, for women who did not deliver by cesarean, it is possible that they experienced a bladder injury that went undetected because they did not undergo a laparotomy. However, we would offer that these injuries may not have clinical significance since, by definition, they go undetected because patients are asymptomatic. Finally, the retrospective nature of the study design introduces the potential for selection bias since patients were not randomized to mode of delivery. However, given good clinical practice, the existence of this would most likely bias the results toward the null. Despite these limitations, we feel our findings are valid and clinically important.

For patients who have had at least one prior cesarean delivery, the risk of bladder injury at subsequent delivery is relatively infrequent, and not related to mode of delivery. Contrary to case reports of uterine rupture with concomitant bladder injury, which suggests that most bladder injuries in patients attempting VBAC happen in the setting of uterine rupture, the overwhelming majority of bladder injuries in VBAC candidates occur in the absence of uterine rupture. For patients attempting VBAC, the majority of bladder injuries occur in the setting of a failed VBAC. Similar to the findings by Silver and colleagues, an increasing number of prior

cesareans appears to increase the risk for bladder injury in patients electing repeat cesarean (10). We believe these data will help heighten physician awareness of the increased risk for bladder injury when performing a cesarean in the setting of a failed VBAC attempt or elective repeat cesarean.

Funding

Supported by a grant from NICHD (RO1 HD 35631; to GAM). Dr. Macones is a recipient of a K24 grant from NICHD (K24 HD01289), and Dr. Peipert is a recipient of a K24 grant from NICHD (K24 HD01298). Both grants partially supported this work.

References

1. Landon MB, Hauth JC, Leveno KJ, Spong CY, Leindecker S, Varner MW, et al. Maternal and perinatal outcomes associated with a trial of labor after prior cesarean delivery. *N Engl J Med* Dec 16;2004 351 (25):2581–9. [PubMed: 15598960]
2. Macones GA, Peipert J, Nelson DB, Odibo A, Stevens EJ, Stamilio DM, et al. Maternal complications with vaginal birth after cesarean delivery: a multicenter study. *Am J Obstet Gynecol* Nov;2005 193 (5):1656–62. [PubMed: 16260206]
3. Forsnes EV, Browning JE, Gherman RB. Bladder rupture associated with uterine rupture. A report of two cases occurring during vaginal birth after cesarean. *J Reprod Med* Mar;2000 45(3):240–2. [PubMed: 10756505]
4. Oteng-Ntim E, Iskaros J, Dinneen M, Penn Z. Simultaneous intrapartum uterine and bladder rupture. *J Obstet Gynaecol* Nov;2002 22(6):685–6. [PubMed: 12554267]
5. Webb JC, Gilson G, Gordon L. Late second stage rupture of the uterus and bladder with vaginal birth after cesarean section: a case report and review of the literature. *J Matern Fetal Med* Nov-Dec;2000 9 (6):362–5. [PubMed: 11243296]
6. Rajasekar D, Hall M. Urinary tract injuries during obstetric intervention. *Br J Obstet Gynaecol* Jun; 1997 104(6):731–4. [PubMed: 9197879]
7. Eisenkop SM, Richman R, Platt LD, Paul RH. Urinary tract injury during cesarean section. *Obstet Gynecol* Nov;1982 60(5):591–6. [PubMed: 7145252]
8. Phipps MG, Watabe B, Clemons JL, Weitzen S, Myers DL. Risk factors for bladder injury during cesarean delivery. *Obstet Gynecol* Jan;2005 105(1):156–60. [PubMed: 15625157]
9. Alexander JM, Leveno KJ, Rouse DJ, Landon MB, Gilbert S, Spong CY, et al. Comparison of maternal and infant outcomes from primary cesarean delivery during the second compared with first stage of labor. *Obstet Gynecol* Apr;2007 109(4):917–21. [PubMed: 17400854]
10. Silver RM, Landon MB, Rouse DJ, Leveno KJ, Spong CY, Thom EA, et al. Maternal morbidity associated with multiple repeat cesarean deliveries. *Obstet Gynecol* Jun;2006 107(6):1226–32. [PubMed: 16738145]

Table 1

Characteristics of woman with a history of a cesarean delivery who had a bladder injury at delivery, as compared to those who did not

Variable	Bladder injury (n=107)	No bladder injury (n=24,898)	p
Maternal age (years)	32.2 ± 5.1	31.0 ± 5.4	0.01
> 1 Prior uterine scar (%)	29.0	19.2	0.01
VBAC attempt (%)	56.1	54.8	0.79
Gravidity (mean)	3.7	3.5	0.28
Prior vaginal delivery (%)	18.7	26.5	0.07
Spontaneous labor (%)	58.1	56.5	0.82
Gestational age at delivery (weeks)	38.0 ± 3.0	38.3 ± 2.6	0.33
Postdate delivery (>41 weeks) (%)	18.7	15.4	0.35
Pre-term delivery (<34 weeks) (%)	4.7	3.5	0.53
Birth weight (grams)	3264 ± 788	3346 ± 687	0.34
Non-Caucasian (%)	29.0	26.1	0.51
Twin gestation (%)	2.8	2.2	0.62
University hospital (%)	50.5	59.2	0.06
OB/GYN residency (%)	20.6	27.2	0.12
Chronic hypertension (%)	4.7	3.4	0.45
Gestational hypertension (%)	7.8	4.2	0.07
Pre-eclampsia (%)	4.0	3.0	0.54
Pre-gestational diabetes (%)	1.9	1.5	0.76
Gestational diabetes (%)	7.5	5.9	0.48
Asthma (%)	8.4	8.4	0.99
Tobacco use (%)	22.8	18.0	0.19

Table 2

Multivariable logistic regression: Factors associated with risk of bladder injury in women who attempt VBAC and did not experience a uterine rupture (n=13,578)^{*}

Factor	Unadjusted RR	Adjusted OR [†]	95% CI	p
Failed VBAC attempt	4.6	4.6	2.7–8.1	<0.01
Delivery prior to 34 weeks	1.6	2.0	0.6–6.7	0.24
>1 prior cesarean	1.2	1.2	0.5–2.7	0.74
Induced labor	1.4	1.1	0.6–1.9	0.70
Prior vaginal delivery	0.6	1.0	0.5–1.8	0.95
Black race	1.2	1.0	0.6–1.8	0.98

^{*} There were 51 bladder injuries for this subgroup analysis

[†] Multivariable model included hospital site as a cluster variable

Table 3

Multivariable logistic regression: Factors associated with risk of bladder injury in women who elected a repeat cesarean delivery (n=11,294)^{*}

Factor	Unadjusted RR	Adjusted OR [†]	95% CI	p
>1 prior cesarean	2.4	2.4	1.3-4.4	<0.01
Black race	1.2	1.2	0.5-2.9	0.68
Delivery prior to 34 weeks	1.1	1.2	0.2-8.3	0.83
Macrosomia	1.3	1.4	0.6-2.9	0.41

^{*} There were 47 bladder injuries for this subgroup analysis

[†] Multivariable model included hospital site as a cluster variable