OBSTETRICS

Obstetric outcomes associated with induction of labor after 2 prior cesarean deliveries

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OBJECTIVE: We sought to determine whether, in the setting of induction, obstetric outcomes differ based on the number of prior cesarean deliveries (CD) and to determine whether women with 2 cesareans undergoing induction face increased risks of adverse outcomes compared to women undergoing a repeat CD.

STUDY DESIGN: This is a secondary analysis of a 4-year multicenter prospective cohort. Women with 1 or 2 CD were included. Frequencies of vaginal birth after cesarean as well as maternal and neonatal complications were compared among women with 1 CD undergoing induction, women with 2 CD undergoing induction, and women undergoing repeat CD with 2 cesareans.

RESULTS: Of the 10,262 women included in this study, 4100 (40.0%) underwent an induction after 1 CD, 152 (1.5%) underwent an induction after 2 CD, and 6010 (58.6%) had a repeat CD after 2 CD. In women undergoing induction, the chance of vaginal birth after cesarean was no different in women with 2 compared to 1 prior CD (65% vs 69%, $P = .28$). Similarly, composite maternal (adjusted odds ratio [aOR], 1.2; 95% confidence interval [CI], 0.6—2.3) and neonatal (aOR, 1.1; 95% CI, 0.7—1.7) outcomes were not different between the 2 groups. In women who had 2 prior CD, undergoing an induction carried similar composite adverse maternal and neonatal outcomes compared to having a repeat CD (aOR, 0.7; 95% CI, 0.3—2.0; aOR, 1.1; 95% CI, 0.6—2.2).

CONCLUSION: Labor induction outcomes are similar regardless of whether women have had 1 or 2 CD. After 2 CD, undergoing an induction carries similar maternal and neonatal risks as having a repeat CD.

Key words: induction of labor, multiple cesarean, repeat cesarean, trial of labor after cesarean, vaginal birth after cesarean

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There is significantly increased maternal morbidity associated with each additional cesarean delivery (CD). For example, the risks of blood transfusion, hysterectomy, operative injury, and intensive care admission all increase with each cesarean performed.[1] The alternative to having a repeat cesarean is a trial of labor after cesarean (TOLAC), which is associated with its own maternal and perinatal risks.[2] As such, American Congress of Obstetricians and Gynecologists (ACOG) recommends that women be counseled about the risks and benefits of each approach to delivery and decide with their care provider which approach is most preferred.[3]

Due to the overall rise in cesarean frequency in the United States, an increasing number of women have had 2 CD. When rates of maternal complications for women with 2 prior cesareans undergoing TOLAC are compared to those associated with having a repeat cesarean, transfusion, hysterectomy, and febrile morbidity rates have been reported to be similar.[4] Accordingly, ACOG considers women with 2 prior low transverse cesareans to be reasonable candidates for TOLAC.[3]

Nevertheless, in women motivated for TOLAC with 2 prior CD, spontaneous labor does not always occur. In this setting, if delivery is required, a physician is faced with the decision of whether to induce labor or perform a third CD. To our knowledge, there are no existing studies that examine obstetric outcomes specifically for women with 2 prior CD who undergo an induction of labor. Therefore, we sought to estimate the chance of achieving a vaginal birth after cesarean (VBAC) as well as the maternal and neonatal risks associated with induction of labor in women with 2 prior CD.

Materials and Methods

This is a secondary analysis of an observational study of women at 19 academic medical centers from 1999 through 2002. The methodology of the primary study has been described elsewhere.[2] Women were included in the present analysis if they had 1 or 2 prior CD, a singleton gestation, and no contraindication to a vaginal delivery (eg, placenta previa, breech presentation). Women with anomalous fetuses or antenatal stillbirths were excluded. Women with prior classic, T or J, or low vertical incisions also were excluded. Women with an unknown scar were included as it was assumed they were most likely to have had a low transverse

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TABLE 1
Patient characteristics stratified by number of prior cesareans and approach to delivery

Characteristic	IOL after 1 prior cesarean, n = 4100	*P* value	IOL after 2 prior cesareans, n = 152	*P* value	Repeat cesarean after 2 prior cesareans, n = 6010
Age at delivery, y	29.6 ± 5.7	.008	30.8 ± 5.4	.046	29.9 ± 5.5
Race		.039		< .001	
White	2009 (49.0)		60 (39.5)		2147 (35.7)
Black	1365 (33.3)		65 (42.8)		1398 (23.3)
Hispanic	537 (13.1)		23 (15.1)		2184 (36.3)
Other/unknown	189 (4.6)		4 (2.6)		281 (4.7)
Married	2563 (62.5)	.021	81 (53.3)	.033	3715 (61.8)
Public insurance	1537 (37.5)	< .001	79 (52.0)	.036	2174 (37.9)
BMI at delivery, kg/m^2	33.1 ± 7.3	.044	34.4 ± 6.5	< .001	33.7 ± 7.1
Tobacco use	621 (15.2)	.015	34 (22.4)	.001	803 (13.4)
Prior vaginal delivery	2036 (49.9)	.329	82 (54.0)	< .001	809 (13.6)
Prior VBAC	1373 (34.8)	.003	67 (46.9)	< .001	346 (5.9)
Interval since last cesarean, y	5.6 ± 3.8	.175	6.1 ± 4.0	< .001	4.3 ± 3.1
Gestational age at delivery, wk	39.1 ± 2.6	.056	38.7 ± 4.3	.33	38.5 ± 2.3
Epidural anesthesia	3395 (86.6)	.177	119 (82.6)	—	—
Cervical dilation on admission, cm	1.7 ± 1.2	.188	1.6 ± 1.3	—	—
Birthweight, g	3306 ± 645	.081	3211 ± 754	.008	3344 ± 598

Data presented as mean ± SD or n (%).

BMI, body mass index; *IOL*, induction of labor; *VBAC*, vaginal birth after cesarean.

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cesarean. Women were divided into 3 groups: those with 1 prior CD undergoing induction of labor, those with 2 prior CD undergoing induction of labor, and those with 2 prior CD undergoing a repeat cesarean without a TOLAC.

Demographic and clinical characteristics of the population were examined. Student *t* or χ^2 tests were performed for these bivariable comparisons, as appropriate. Maternal and perinatal outcomes, including the frequency of VBAC and maternal complications were compared among the 3 study groups as well. A post-hoc power calculation demonstrated that this study had 80% power to detect a 10% difference in the chance of VBAC.

Maternal complications included endometritis, any blood product transfusion, thromboembolic disease (deep venous thrombosis or pulmonary embolus), operative injury (broad ligament hematoma, cystotomy, bowel injury, or ureteral injury), uterine rupture, uterine dehiscence, hysterectomy, intensive care unit admission, or postpartum readmission. Uterine rupture was defined as either a disruption of both the myometrium and serosa or a disruption of only the myometrium but with extension into the bladder or broad ligament. Uterine dehiscence was defined as disruption of the myometrium alone without any extension. A composite adverse maternal outcome was created and documented to be present if any 1 of the aforementioned complications were present.

Neonatal complications also were analyzed and similar bivariable comparisons made. Specific neonatal complications examined included a 5-minute Apgar of <7, neonatal intensive care unit admission, hypoxic ischemic encephalopathy, intrapartum stillbirth, and neonatal death. A composite adverse neonatal outcome was created and documented to be present if any 1 of the aforementioned complications were present.

Three multivariable logistic regressions were then performed to compare outcomes of induction of labor in women with 1 vs 2 prior cesareans: 1 for the dependent variable of VBAC, 1 for the dependent variable of the composite maternal outcome, and 1 for the dependent variable of the composite neonatal outcome. Independent variables were added to the equation if they were found to be significant in the bivariable analysis with a $P < .05$. The presence of 2 prior CD was forced into the equation and an adjusted odds ratio calculated to estimate whether the