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Scheduled Cesarean Delivery: Maternal and Neonatal Risks in Primiparous Women in a Community Hospital Setting

Lieschen H. Quiroz, M.D.¹, Howard Chang, M.S.², Joan L. Blomquist, M.D.³, Yvonne K. Okoh, M.P.H.⁴, and Victoria L. Handa, M.D.¹

¹Department Gynecology and Obstetrics, Johns Hopkins University School of Medicine, Baltimore, MD

²Department of Biostatistics, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD

³Department Obstetrics and Gynecology, Greater Baltimore Medical Center, Baltimore, MD

⁴Howard University College of Medicine, Washington, DC

Abstract

We compared the short-term maternal and neonatal outcomes of women who deliver by cesarean without labor compared with women who deliver by cesarean after labor or by vaginal birth. This was a retrospective cohort study of women delivering a first baby from 1998 to 2002. Hospital discharge diagnostic coding identified unlabored cesarean deliveries (UCDs), labored cesarean deliveries (LCDs), and vaginal births (VBs). Medical records were abstracted and mode of delivery confirmed. The three outcomes of interest were maternal bleeding complications, maternal febrile morbidity, and neonatal respiratory complications. Using logistic regression for each outcome, we investigated whether mode of delivery was associated with the outcome, independent of other factors. The study groups included 513 UCDs, 261 LCDs, and 251 VBs. Compared with the UCD group, the adjusted odds of bleeding complications was higher in the LCD comparison group (odds ratio [OR] 2.3; 95% confidence interval [CI] 1.21, 4.53) and the VB comparison group (OR 1.96; 95% CI 0.95, 4.02). The incidence of febrile morbidity was similar for both cesarean groups but lower in the VB group. Both comparison groups had lower odds of neonatal complications than the UCD group (OR for LCD comparison group 0.52; 95% CI 0.27, 0.95 and OR for VB comparison group 0.26; 95% CI 0.098, 0.59). Scheduled cesarean is associated with increased odds of neonatal respiratory complications but decreased odds of maternal bleeding complications.

Keywords

Cesarean morbidity; elective cesarean; neonatal complications; maternal complications

The number of cesarean births continues to rise, with 31.1% of pregnancies delivered by cesarean in 2006.¹ This trend is evident at community hospitals, where the rate of cesarean section tends to be higher compared with academic centers.^{2–4} An unknown proportion of cesarean births are “elective,” defined as cesarean delivery in the absence of maternal or obstetrical indication.⁵

The benefits and hazards associated with elective cesarean have been a source of recent debate in the medical literature.^{6,7} Cohort studies suggest a greater risk of maternal morbidity after cesarean,^{8,9} but these risks may be related to the indications for cesarean delivery rather than to the mode of birth. In addition, labor prior to cesarean may increase the risks associated with cesarean birth. Indeed, in a large randomized trial of breech pregnancies, perinatal outcomes were better after planned cesarean than planned vaginal birth.¹⁰ However, it is not clear whether these findings can be extrapolated to nonbreech deliveries. In response to the apparent rapid rise in elective cesareans, the National Institute of Child Health and Human Development (NICHD) sponsored a State-of-the-Science Conference in 2006 to address “Cesarean Delivery on Maternal Request (CDMR).”⁵ The panel concluded that there is not sufficient evidence at this time to recommend for or against elective cesarean.

The purpose of this study was to compare the short-term outcomes of women who deliver by cesarean without labor with those who deliver by cesarean after labor or vaginal birth. We considered both maternal and neonatal complications. Our hypothesis was that planned cesarean birth is associated with a lower risk of maternal and neonatal complications than either vaginal birth or cesarean after the onset of active labor.

MATERIALS AND METHODS

This was a retrospective cohort study. The study population included women delivering a first baby between July 1, 1998 and June 30, 2002 at the Greater Baltimore Medical Center (GBMC), a large community hospital in suburban Maryland. GBMC is a regional hospital that draws from a broad metropolitan area, reflecting the demographics of suburban metropolitan Baltimore.

Existing hospital medical records were reviewed for this research. Case selection is diagramed in Fig. 1. From an administrative database, we identified 18,068 obstetrical deliveries at GBMC during the relevant 4-year time period. We then excluded women who would not be eligible for “cesarean delivery at maternal request,” as defined by the NICHD.⁵ Specifically, we excluded preterm births, multiple gestations, women diagnosed with placenta previa, and those with a prior myomectomy. Preterm births were defined as <37 completed weeks of gestation. Also, to eliminate cases in which the mode of delivery was influenced by antepartum complications, we excluded cases of abruption, antepartum bleeding, stillbirth, and uterine rupture. Exclusion criteria were identified using hospital discharge coding (e.g., 651.x, 656.4, 644.2, 665.1, 654.9, 641.0, 641.1, 641.2). Excluding deliveries with these diagnostic codes, we identified 15,430 potentially eligible births at GBMC during the 4-year period.

Of 15,430 births, 3776 were coded as cesarean births and 11,654 were coded as vaginal births (Fig. 1). Of the 3776 cesarean deliveries, we sought to classify these as either unlabored cesarean deliveries (UCDs) or labored cesarean deliveries (LCDs). There is no hospital discharge diagnostic code for labor. However, prior research^{11–13} has used discharge codes to identify women likely to have labored prior to cesarean (e.g., diagnostic codes for “obstructed labor” [660.x], abnormal forces of labor [661.x], long labor [662.x], failed induction of labor [659.0, 659.1], etc.). That algorithm is known to have a sensitivity of 98% and a specificity of 73%,¹⁴ indicating that deliveries with these discharge codes are very likely to have labored.

To most accurately classify UCD and LCD births, we reviewed each hospital record to confirm delivery type. Of the 3776 cesarean deliveries, there were 1314 cesarean deliveries without any discharge diagnostic codes related to labor (e.g., likely UCD births). We

reviewed all 1314 hospital records to exclude ineligible deliveries (based on the criteria described previously), to exclude multiparous women, and to identify women who had cesarean prior to active labor. We identified 508 eligible UCD births. These cases comprised the reference (unexposed) group for this study.

We then selected the two comparison groups: vaginal birth (VB) and cesarean birth after the onset of labor (LCD). For these two groups, deliveries were randomly selected (via random number generator) from the large pool of potentially eligible comparison births. Each randomly selected record was reviewed to confirm delivery mode, eligibility, and nulliparity. If our review indicated that a delivery was ineligible, we randomly selected another delivery. We continued randomly selecting and reviewing records until we had identified the desired number of deliveries for each of the comparison groups.

Abstraction of medical records also identified the relevant covariates and outcomes. Potentially relevant covariates included maternal age, gestational age at delivery, body mass index (BMI), race, marital status, medical conditions, obstetrical conditions, labor characteristics, neonatal birth weight, and the diagnosis of oligohydramnios.

There were three outcomes of interest. The first was neonatal morbidity. To capture this outcome, we considered a composite outcome that included resuscitation of the newborn (defined as any positive pressure ventilation), admission to the neonatal intensive care unit or transitional unit, and low 5-minute Apgar score (score <7). The second outcome was maternal hemorrhage. This was also a composite outcome that included any postpartum transfusion, any postpartum dilation and curettage or hysterectomy for bleeding, and any case of maternal postpartum hematocrit less than 25%. The final outcome of interest was febrile morbidity, defined as maternal postpartum fever (100.4°F or greater) on two occasions.

Unadjusted odds ratios were obtained by univariate logistic regression. Outcome-specific multivariate logistic regression models were obtained by stepwise (backward and forward) variable selection guided by Akaike's information criterion statistics. Confounders considered in the full models included maternal age, marriage status, maternal BMI, gestational age, indicator for black race, and birth weight. All analyses were performed using R version 2.5.1 (The R Project for Statistical Computing, 2007).

Our sample size was based on an assumption that the outcomes of interest would occur in 5% of deliveries among the unexposed women and in 10% of exposed women. Using a one-sided α of 0.05, with 508 women in the reference group, we calculated we would need 244 deliveries in each comparison group to achieve an 80% power for this study.

RESULTS

Indications for cesarean sections were documented for most cases. In the UCD group, the most common indications were malpresentation or breech presentation (244, 48%), "fetal well-being" (defined as nonreassuring fetal heart rate, fetal distress, fetal bradycardia, or "late decelerations") (102, 20%), macrosomia (79, 15%), and herpes simplex virus infection (41, 8%). In the LCD comparison group, the most common indications were failure to progress (191, 73%) and "fetal well-being" (40, 15%).

The obstetric and maternal characteristics of all three groups are listed in Table 1. Compared with the UCD group, the VB group was younger, less likely to be married, and had lower mean BMI. The LCD group had a higher mean birth weight compared with the UCD group. Comparing the UCD group with both comparison groups, the UCD group was more likely to deliver before 40 weeks.

There were no maternal deaths, no maternal admissions to the intensive care unit, and no cases of venous thromboembolism. There was one cesarean hysterectomy. Bleeding complications were significantly higher in the LCD and VB comparison groups than the UCD group (Table 2). Neonatal complications were significantly more common in the UCD group than in either of the two comparison groups. There were no cases of febrile morbidity in the VB group, a finding of statistical difference when compared with the incidence of febrile morbidity in the UCD group. There were no significant differences in febrile morbidity between the UCD and LCD groups.

Table 3 contrasts the unadjusted and adjusted odds ratios (ORs) for the three complications of interest. First, in the unadjusted analysis, we observed increased odds of bleeding complications for the LCD and VB control groups compared with the UCD group. Adjusting for the confounding effects of maternal age and birth weight, the odds of bleeding complications was 2.3 times higher in the LCD control group in comparison to the UCD group (adjusted OR 2.3; 95% confidence interval [CI] 1.21, 4.53). In the multivariate analysis, the odds of bleeding complications was two times higher in the VB group but this difference was not significant (adjusted OR 1.96; 95% CI 0.95, 4.02).

For neonatal complications, both control groups had lower odds of neonatal complications than the UCD group. This difference was significant even after controlling for marital status, BMI, and race. Compared with the UCD group, the odds of neonatal morbidity was reduced by 48% for the LCD group (adjusted OR for LCD control group 0.52; 95% CI 0.27, 0.95) and by 74% for the VB group (adjusted OR for VB control group 0.26; 95% CI 0.098, 0.59).

The odds of febrile morbidity were similar for the UCD and LCD groups, both in the unadjusted analysis and also after adjusting for confounding of black race and marital status (Table 3). There were no cases of febrile morbidity in the VB comparison group; therefore, we could not calculate the relative odds of febrile morbidity in this group.

Because some of the more common indications for cesarean in the UCD group could be considered risk factors for neonatal complications, we also developed a second adjusted model that controlled for breech position and an antepartum diagnosis of oligohydramnios. In a model that controlled for these two diagnoses, as well as marital status, BMI, and race, we were not able to detect a significant difference in the odds of neonatal complications between the UCD and LCD groups. The odds of a neonatal complication were 37% lower for women delivered vaginally than for women delivered by unlabored cesarean (OR 0.32, 95% CI 0.12, 0.78).

DISCUSSION

The results of this study contribute to the ongoing debate on the risks, benefits, and safety of cesarean delivery. Our data suggest that cesarean section performed in primarous women before the onset of active labor is associated with a significant decrease in the risk of maternal bleeding complications but an increase in the risk of neonatal complications. Both these conclusions are consistent with recent literature^{5,15–17} However, most prior research on this topic has been set in tertiary academic centers, and this study examines outcomes in a large community hospital. We specifically chose this setting because it is most relevant to the question of “elective” cesarean section.

The most important finding from this research is that neonatal complications were more common after unlabored cesarean, even after controlling for measured confounders. This is consistent with previous findings of neonates born by cesarean section being at greater risk of experiencing respiratory problems at birth, warranting admission to the neonatal intensive care unit.^{16–19} The biological rationale for this difference may be related to the lack of labor

and the respiratory transition of the neonate.^{20,21} In this study, when we controlled for breech presentation and oligohydramnios (two characteristics that might confound the association between delivery mode and neonatal morbidity), we did not see a statistically significant difference in newborn outcomes between the LCD and UCD groups. In this expanded model, VB had the lowest risk of neonatal respiratory complications.

Women who delivered by cesarean after labor were at least two times more likely to have a bleeding complication than women who underwent cesarean before labor. In this population, women who delivered by UCD were at the lowest risk of bleeding complications. These results are consistent with other published literature suggesting decreased bleeding complications in cesarean without labor when compared with either vaginal delivery or cesarean section after labor.^{9,22} We considered a composite outcome for bleeding complications, and the majority of bleeding complications were limited to a postpartum hematocrit <25%. Transfusion was rare in this population. We cannot exclude the possibility that preexisting anemia contributed to the apparent association between mode of delivery and postpartum anemia.

We were surprised at the very low incidence of febrile morbidity in all three groups. As a result, we had limited power to detect differences between groups. This finding is in contrast to the previously reported rate of postpartum infections after cesarean delivery of up to 10%.²³ However, our results suggest that there is no clinically significant difference in febrile morbidity between women who undergo cesarean before labor and those who undergo cesarean during labor. Women who delivered vaginally were at lowest risk of postpartum fever. A recent study from Germany reached similar conclusions. In that study, the incidence of postpartum fever was 2.37% in 1998. They observed an increased risk of infectious morbidity in patients who had a cesarean section (with and without labor) compared with vaginal delivery.²⁴ We did not investigate antibiotic use in this population, and it is possible that the use of intrapartum or postpartum antibiotics influenced our results.

The main strength of our study is the setting in which our study was conducted. Our population is a large obstetrical population at a community hospital. We believe that addressing the possible risk and complications of cesarean section without labor in this population and comparing it with other modes of delivery is crucial in light of the rising trend of elective cesarean sections in United States. Another strength of our study is the abstraction of individual medical records by experienced research personnel. We did not rely on diagnosis codes to identify unlabored cesarean deliveries or to obtain information about maternal or neonatal complications during the delivery admission.

We acknowledge the limitations of our study. First, we did not investigate long-term complications. Readmissions and outpatient treatments for complications, such as wound infections and postoperative thromboembolic disease, were not studied. These morbidities may be more common after cesarean section than vaginal delivery.⁸ Due to this limitation, we only reported short-term outcomes and could not report on long-term complications, including those manifested during the next pregnancy.

In this study, we used “unlabored cesarean” as a surrogate for elective cesarean. However, the majority of women in our unlabored cesarean group had an indication for cesarean delivery. Specifically, 48% had breech presentation and 20% underwent cesarean birth due to a concern pertaining to “fetal well-being.” The nature of the indications for the unlabored cesarean group may have had a direct impact on the higher rates of neonatal morbidity seen in this group. Specifically, because delivery type was not randomly assigned in this population, we cannot be certain that the differences in outcomes were not confounded by unmeasured characteristics. We recognize the magnitude of difficulty encountered by

researchers addressing this question, as a random assignment of mode of delivery carries moral and ethical implications.

In conclusion, our results have implications for women considering elective cesarean. Primary cesarean sections are on the rise, and a growing proportion of primary cesareans is elective.^{1,5} This is especially relevant in community hospitals, where the rate of cesarean section tends to be higher than in large academic centers.^{2,3} Therefore, it is important to address the risk and benefits of elective cesarean. Our results suggest that scheduled cesarean birth is associated with a greater risk of neonatal respiratory morbidity. Due to the retrospective nature of our study, we cannot conclude with certainty that the association is causal. Further research is needed to explore this question and to investigate the long-term impacts of this practice, including the impact on future deliveries and the lifetime incidence of pelvic floor symptoms.

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Figure 1.
Diagrammed case selection.

Table 1

Characteristics of Women Who Underwent Cesarean before Labor, Cesarean during Labor, and Vaginal Birth

Characteristic	Cesarean before Labor (<i>n</i> = 513)	Cesarean during Labor (<i>n</i> = 261)	Vaginal Birth (<i>n</i> = 251)
Age, mean (SD)	30.0 (5.4)	29.9 (5.5)	27.6 (5.5)*
Race			
White	397 (77.4%)	204 (78.2%)	202 (80.5%)
Black	87 (17%)	41 (15.7%)	39 (15.5%)
Other	29 (5.6%)	16 (6.1%)	10 (4%)
Married	401 (78.2%)	209 (80.1%)	172 (68.5%)
Maternal BMI at admission (kg/m ²)	31.4 (6.5)	32.2 (6.1)	29.3 (5.5)*
Gestational age >40 wk	152 (30%)	130 (50%)	110 (44.2%)*
Birth weight (g)	3422 (554)	3516 (463)*	3406 (438)

* *p* value for comparison with cesarean before labor group ≤ 0.01 .

SD, standard deviation; BMI, body mass index.

Table 2**Maternal and Neonatal Outcomes**

Outcomes	Cesarean before Labor (n = 513)	Cesarean during Labor (n = 261)	Vaginal Birth (n = 251)
Deliveries with a bleeding complication *			
Hematocrit <25% on first postpartum day	18 (3.5%)	22 (8.4%) [†]	18 (7.2%) [‡]
Hysterectomy	0	1 (0.4%)	0
Dilation and curettage	0	0	0
Transfusion	1 (0.2%)	1 (0.4%)	0
Total	19 (3.7%)	24 (9.2%) [†]	18 (7.2%) [‡]
Deliveries with neonatal complication *			
Neonatal intubation	2 (0.4%)	1 (0.4%)	0
Neonate ventilated in delivery room	26 (5.1%)	6 (2.3%)	6 (2.4%)
5-minute Apgar <7	4 (0.8%)	0	2 (0.8%)
NICU admission	27 (5.3%)	8 (3.1%)	0 [†]
Total	59 (11%)	15 (5.7%) [†]	8 (3.2%) [†]
Febrile morbidity *	18 (3.5%)	12 (4.6%)	0 [†]

* Bleeding complications defined as either hematocrit <25% on first postpartum day or transfusion or hysterectomy. Neonatal complications defined as either neonatal intubation, ventilation, 5-minute Apgar <7, or admission to the neonatal intensive care unit (NICU). Febrile morbidity defined as (postpartum fever >100.4°F, twice).

[†] p value for comparison with cesarean before labor group ≤ 0.01.

[‡] p value for comparison with cesarean before labor group <0.05.

Table 3**Odds Ratio for Maternal and Neonatal Complications**

Outcomes	Cesarean before Labor	Cesarean during Labor	Vaginal Birth
Maternal bleeding complications			
OR (CI)			
Unadjusted	Reference	2.5 (1.3, 4.86)	2.12 (1.08, 4.18)
Adjusted		2.3 (1.21, 4.53)*	1.96 (0.95, 4.02)*
Neonatal complications			
OR (CI)			
Unadjusted	Reference	0.5 (0.26, 0.9)	0.22 (0.9, 0.48)
Adjusted		0.52 (0.27, 0.95) [†]	0.26 (0.10, 0.6) [†]
		0.63 (0.31, 1.24) [‡]	0.32 (0.12, 0.78) [‡]
Febrile morbidity			
OR (CI)			
Unadjusted	Reference	1.33 (0.61, 2.77)	—
Adjusted		1.23 (0.52, 2.8) [§]	—

* Adjusted for birth weight and maternal age.

[†] Adjusted for black race, marital status, and body mass index.

[‡] Adjusted for marital status, body mass index, breech presentation, black race, and oligohydramnios.

[§] Adjusted for black race, birth weight, and marital status.

There were no cases of febrile morbidity in the vaginal birth group; thus, relative odds cannot be calculated. OR, odds ratio; CI, 95% confidence interval.