OBSTETRICS

Evaluation of delivery options for second-stage events

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BACKGROUND: Cesarean delivery in the second stage of labor is common, whereas the frequency of operative vaginal delivery has been declining. However, data comparing outcomes for attempted operative vaginal delivery vs cesarean in the second stage are scant. Previous studies that examine operative vaginal delivery have compared it to a baseline risk of complications from a spontaneous vaginal delivery and cesarean delivery. However, when a woman has a need for intervention in the second stage, spontaneous vaginal delivery is not an option she or the provider can choose. Thus, the appropriate clinical comparison is cesarean vs operative vaginal delivery.

OBJECTIVE: Our objective was to compare outcomes by the first attempted operative delivery (vacuum, forceps vs cesarean delivery) in patients needing second-stage assistance at a fetal station of +2 or below.

STUDY DESIGN: We conducted secondary analysis of an observational obstetric cohort in 25 academically affiliated US hospitals over a 3-year period. A subset of ≥37 weeks, nonanomalous, vertex, singletons, with no prior vaginal delivery who reached a station of +2 or below and underwent an attempt at an operative delivery were included. Indications included for operative delivery were: failure to descend, nonreassuring fetal status, labor dystocia, or maternal exhaustion. The primary outcomes included a composite neonatal outcome (death, fracture, length of stay ≥3 days beyond mother's, low Apgar, subgaleal hemorrhage, ventilator support, hypoxic encephalopathy, brachial plexus injury, facial nerve palsy) and individual maternal outcomes (postpartum hemorrhage, third- and fourth-degree tears [severe lacerations], and postpartum infection). Outcomes were examined by the 3 attempted modes of delivery. Odds ratios (OR) were calculated for primary outcomes adjusting for confounders. Final mode of delivery was quantified.

RESULTS: In all, 2531 women met inclusion criteria. No difference in the neonatal composite outcome was observed between groups. Vacuum attempt was associated with the lowest frequency of maternal complications (postpartum infection 0.2% vs 0.9% forceps vs 5.3% cesarean, postpartum hemorrhage 1.4% vs 2.8% forceps vs 3.8% cesarean), except for severe lacerations (19.1% vs 33.8% forceps vs 0% cesarean). When confounders were taken into account, both forceps (OR, 0.16; 95% confidence interval, 0.05—0.49) and vacuum (OR, 0.04; 95% confidence interval, 0.01—0.17) were associated with a significantly lower odds of postpartum infection. The neonatal composite and postpartum hemorrhage were not significantly different between modes of attempted delivery. Cesarean occurred in 6.4% and 4.4% of attempted vacuum and forceps groups ($P = .04$).

CONCLUSION: In patients needing second-stage delivery assistance with a station of +2 or below, attempted operative vaginal delivery was associated with a lower frequency of postpartum infection, but higher frequency of severe lacerations.

Key words: forceps, operative vaginal delivery, second stage of labor, vacuum

Introduction

Cesarean delivery in the second stage of labor is common in the United States and represents 23% of primary cesarean deliveries.[1] The high frequency of cesarean deliveries could potentially be offset by first attempting an operative vaginal delivery. However, in recent years, the frequency of operative vaginal delivery has been declining. Operative vaginal deliveries dropped from 9.01% in 1990 to 3.30% in 2013.[2] While opinions have been published on the pros and cons of second-stage modes of delivery, there is no consensus on which mode is better.[3,4]

Previous studies that examine operative vaginal delivery have compared it to a baseline risk of complications from a spontaneous vaginal delivery and cesarean delivery.[5-7] However, when a woman has a need for intervention in the second stage, spontaneous vaginal delivery is not an option she or the provider can choose. The appropriate clinical comparison is cesarean vs operative vaginal delivery. Furthermore, previous large studies have relied on administrative data and thus were limited to evaluating final mode of delivery rather than attempted mode of delivery.[5] Because successful operative delivery may have different outcomes than nonsuccessful vaginal operative attempts, it is important to assess attempted delivery and not assign outcomes of failed operative attempts to the cesarean group.

There have been several small trials of operative vaginal delivery, but these compared forceps to vacuum or to spontaneous vaginal delivery.[8-11] In an arrest of labor or need for urgent delivery due to fetal tracing issues, spontaneous delivery is not a choice. In the studies that compared vacuum with forceps, there were a wide variety of stations as entry criteria, and because complications can vary with higher stations, these trials may not be directly applicable.

In the present day, a clinically relevant question is what to do when a patient has arrest of decent or has nonreassuring fetal status at fetal station of +2 or below. At these stations, with rare exception, most women are candidates for any of the 3 modes of delivery although the

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data are limited for clinicians to make informed decisions.

Our study sought to compare the maternal and neonatal complications with cesarean, vaginal vacuum, or vaginal forceps for women with a need for intervention in the second stage of labor and at a fetal station of +2 or below.

Materials and Methods

From 2008 through 2011, we assembled a cohort of women and their neonates born at 25 academically affiliated hospitals in the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network. This study, the Assessment of Perinatal Excellence (APEX), designed to develop quality measures for intrapartum obstetrical care, was approved by the institutional review board at each participating institution under a waiver of informed consent. Details regarding the APEX study have been previously described.[12] Briefly, patients eligible for data collection were those who delivered within the institution, were at least 23 weeks of gestation, and had a live fetus on admission. The medical records of all eligible women and their newborns were abstracted by trained and certified research personnel at the hospital and entered into a World Wide Web–based data entry system. Data recorded included demographic characteristics, details of the medical and obstetrical history, information about intrapartum and postpartum events, and patients' race and ethnicity as reported in the chart. Maternal data were collected until discharge and neonatal data were collected up until discharge or until 120 days of age, whichever came first. This was a planned secondary analysis of the APEX data set.

We created a subset of term (≥37 weeks) women with nonanomalous, vertex, singleton gestations, with no previa and no prior vaginal delivery, who had reached complete cervical dilation with a fetal station of +2 or below and were operatively delivered. The pelvic examination documenting station had to be within 1 hour of the decision to proceed with delivery. To be included women had to have 1 of the following indications for labor intervention: failure to descend, labor dystocia, maternal exhaustion, or nonreassuring fetal status. Because failure of operative vaginal delivery and need to proceed to cesarean is a known possibility, women were classified by whether they had an attempted vaginal vacuum or forceps delivery, not by whether that attempt was successful, ie, not by final delivery mode. Women undergoing attempts at both vacuum and forceps vaginally were excluded from the main analysis, as that strategy need not be chosen by an operator, and its inclusion could unfairly bias the results against an initial attempt at operative vaginal delivery. Because the American Congress of Obstetricians and Gynecologists (ACOG) generally advises against 2 modes of operative attempt, these patients may be different in some unmeasurable way.[13] Conversely, if an attempt at operative vaginal delivery was unsuccessful and proceeded to a cesarean delivery, it was included.

A subsequent supplemental analysis was performed to assess outcomes of women who failed the first attempt at operative vaginal delivery and went on to have a second attempt at a vaginal operative delivery with a different instrument.

Maternal and neonatal outcomes were set a priori. A composite neonatal outcome was created that included the occurrence of any of the following: death, fracture other than clavicular, length of stay ≥3 days beyond mother's hospital stay, Apgar score <4 at 5 minutes, subgaleal hemorrhage, ventilator support within 24 hours of birth on at least 2 days, hypoxic encephalopathy, brachial plexus injury, and facial nerve palsy. Secondary neonatal outcomes included skin laceration and brain bleed (intracranial or intraventricular hemorrhage [all grades]). Maternal outcomes included postpartum hemorrhage (defined as occurrence of any of the following: an estimated blood loss ≥1500 mL at delivery or the immediate postpartum period, a blood transfusion, or a hysterectomy for hemorrhage, placenta accreta, or atony), postpartum infection (defined as occurrence of any of the following: endometritis, wound cellulitis requiring antibiotics, wound reopened for fluid collection or infection, or wound dehiscence during the delivery hospitalization), and severe perineal laceration (defined as the occurrence of a third- or fourth-degree perineal laceration). Outcomes were examined by the 3 attempted modes of delivery. The final mode of delivery was also quantified.

Univariate comparisons of the patient population and outcomes were performed using χ^2, Fisher exact, and Kruskal-Wallis tests. Odds ratios (OR) were calculated adjusting for appropriate confounders using multivariable logistic regression. The c statistic was computed for each of the multivariable adjusted models. Model fit was assessed using the Hosmer-Lemeshow test. To determine whether associations varied by station or by birthweight, models with interaction terms (attempted mode of delivery × station and attempted mode of delivery × birthweight) were assessed. Because these tests for interaction were planned a priori, tests of interaction are generally underpowered, and our sample size was relatively small, $P < .15$ was used to define statistical significance for the interaction terms. $P < .05$ was used to define statistical significance for all other analyses. All tests were 2-tailed and no imputation for missing data was performed. All analyses were performed using SAS software (SAS Institute, Cary, NC).

Results

Of the 115,502 women in the APEX data set, 2531 met criteria for the main analysis of this secondary analysis (Supplemental Figure). Demographic characteristics are shown in Table 1. Of the women included in this analysis, 16% were of Hispanic ethnicity and 11% were non-Hispanic black. The largest percent had an attempted vaginal vacuum delivery (54.6%) followed by attempted vaginal forceps (40.2%) and cesarean (5.2%). There were significant differences between women in age, race/ethnicity, smoking, body mass index, intrapartum chorioamnionitis, and birthweight, with larger babies more