OBSTETRICS

Morbidity and mortality associated with mode of delivery for breech periviable deliveries

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OBJECTIVE: The purpose of this study was to estimate the odds of morbidity and death that are associated with cesarean delivery, compared with vaginal delivery, for breech fetuses who are delivered from 23-24 6/7 weeks' gestational age.

STUDY DESIGN: We conducted a retrospective cohort study of state-level maternal and infant hospital discharge data that were linked to vital statistics for breech deliveries that occurred from 23-24 6/7 weeks' gestation in California, Missouri, and Pennsylvania from 2000-2009 (N = 1854). Analyses were stratified by gestational age (23-23 6/7 vs 24-24 6/7 weeks' gestation).

RESULTS: Cesarean delivery was performed for 46% (335 fetuses) and 77% (856 fetuses) of 23- and 24-week breech fetuses. In multivariable analyses, overall survival was greater for cesarean-born neonates (adjusted odds ratio [AOR], 3.98; 95% confidence interval [CI], 2.24—7.06; AOR, 2.91; 95% CI, 1.76—4.81, respectively). When delivered for nonemergent indications, cesarean-born survivors were more than twice as likely to experience major morbidity (intraventricular hemorrhage, bronchopulmonary dysplasia, necrotizing enterocolitis, asphyxia composite; AOR, 2.83; 95% CI, 1.37—5.84; AOR, 2.07; 95% CI, 1.11—3.86 at 23 and 24 weeks' gestation, respectively). Among intubated neonates, despite a short-term survival advantage, there was no difference in survival to >6-month corrected age (AOR, 1.77; 95% CI, 0.83—3.74; AOR, 1.50; 95% CI, 0.81—2.76, respectively). There was no difference in survival for intubated 23-week neonates who were delivered by cesarean for nonemergent indications or cesarean-born neonates who weighed <500 g.

CONCLUSION: Cesarean delivery increased overall survival and major morbidity for breech periviable neonates. However, among intubated neonates, despite a short-term survival advantage, there was no difference in 6-month survival. Also, cesarean delivery did not increase survival for neonates who weighed <500 g. Patients and providers should discuss explicitly the trade-offs related to neonatal death and morbidity, maternal morbidity, and implications for future pregnancies.

Key words: breech, mode of delivery, outcome, periviable birth

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With technologic gains in neonatal intensive care capabilities, the threshold to provide antenatal interventions to improve survival has decreased to earlier gestational ages. Even in the face of rising periviable cesarean rates,[1,2] the optimal mode of delivery for breech periviable neonates remains controversial, and it remains unclear whether cesarean delivery in the periviable period actually improves neonatal outcomes.[2] In light of the known increase in maternal morbidity and implications for future pregnancies that are associated with classic cesarean delivery,[3] it is critically important that we have ample evidence to guide mode of delivery decisions at periviable gestational ages (GA). If cesarean delivery does not confer substantial benefits to neonates, it is difficult to justify the added morbidity to mothers.

Many studies consider neonatal death and morbidity but often do not report outcomes by mode of delivery,[4,5] and those studies that do examine mode of delivery often describe only death without morbidity-related outcomes.[2,6-15] Furthermore, no randomized controlled trials of adequate size have compared planned vaginal delivery with planned cesarean delivery for periviable neonates. Therefore, the literature leaves obstetricians ill-equipped to provide evidence-based recommendations and counseling to patients for periviable mode of delivery decisions.

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The purpose of this study was to fill this gap in current knowledge by describing neonatal morbidity and death by mode of delivery for breech periviable fetuses. To do so, we aimed to estimate the odds of neonatal morbidity and death that are associated with cesarean delivery compared with vaginal delivery of breech fetuses who are delivered between 23 and 24 6/7 weeks' GA.

Materials and Methods

Study design and population

We conducted a retrospective cohort study, analyzing state-level maternal and infant hospital discharge data, linked to birth and death certificate data, for California, Missouri, and Pennsylvania from 2000-2009. The Institutional Review Board of the Departments of Health in California, Missouri, and Pennsylvania; the Children's Hospital of Philadelphia approved this study. The data were input by the Department of Health for each respective state; then the data were cleaned and validated with the use of sources that included birth certificates and maternal and infant hospital data with strong concordance (eg, mode of delivery is >99.5% concordant). The records were created by linking birth certificate data with maternal hospital discharge records and newborn infant hospital discharge data records or death certificate data in the event of a fetal death. Records were linked with the use of previously described methods.[16] With these techniques, >98% of birth and death certificates are matched to maternal and newborn infant hospital records.[17] These data have been used extensively in our and others' publications.[18-21]

Live singleton births and in-hospital fetal deaths that occurred between 23 and 24 6/7 weeks of reported GA were included in the analysis. Because periviable births that are not resuscitated at the time of the delivery potentially may be classified as fetal deaths,[22] it was important that fetal deaths not be excluded entirely from the analysis. We sought to distinguish these types of fetal deaths from fetal deaths that occurred out of the hospital or as intrauterine deaths. Such deaths were designated as "outpatient" or "intrauterine" fetal deaths with criteria described by Phibbs et al[22] in previous work and excluded from the analysis (Appendix; Supplementary Material A). Fetal anomalies were also excluded.

Variable selection and data analysis

The primary predictor of interest was cesarean delivery (*International Classification of Diseases*, ninth revision, Clinical Modification [ICD-9-CM] code 669.7x and 74.x), which had to be documented in the maternal or the infant record. Ultimately, documentation from the maternal record is reflected in all but 28 of the 8157 cases (99.0%). Breech neonates were identified by the following ICD-9-CM codes: 652.2, 652.20, 652.21, 652.23, and 763.0. Death-related outcomes of interest included overall survival (defined as 6-month corrected age among intubated and nonintubated neonates) and survival to >24-hours, >1-week, and >6-month corrected age among neonates for whom intubation was performed or attempted (ICD-9-CM codes 96.01, 96.02, 96.03, 96.04, 96.05 and current procedural terminology code 31500). Morbidity outcomes included respiratory distress syndrome (RDS), bronchopulmonary dysplasia (BPD), grade III/IV intraventricular hemorrhage (IVH), necrotizing enterocolitis (NEC), retinopathy of prematurity, and asphyxia. Also included were composite outcome measures of "major morbidity" designated as BPD, grade III/IV IVH, NEC, or asphyxia and a "composite" for death or asphyxia. ICD-9-CM codes used for specific diagnoses are listed in Appendix (Supplementary Material B). Maternal sociodemographic characteristics were also considered: age in 3 categories (<18, 18-35, >35 years); race or ethnicity designated in 4 categories (white, black, Hispanic, and other); parity in 4 categories (0, 1, 2, ≥3); education in 2 categories (<high school education or ≥high school education); median income by ZIP code (<\$20,000, \$20,000-40,000, \$40,000-60,000, >\$60,000) to approximate household income; and insurance payer (fee for service, Health Maintenance Organization, federally insured, uninsured, and other). In an effort to control for potential confounding factors, sociodemographic characteristics (insurance, race, and age) that were associated with mode of delivery were included as covariates in the final models. Likewise, maternal comorbidities, pregnancy complications, and delivery indications were also included in the full model, specifically: preexisting diabetes mellitus, gestational diabetes mellitus, chronic hypertension, pregnancy-induced hypertension (PIH), preterm labor, preterm premature rupture of membranes, placental abruption, repeat cesarean delivery, placenta previa, and chorioamnionitis. ICD-9-CM codes that were used for specific diagnoses are listed in Appendix (Supplementary Material B). Finally, year of delivery was included because the incidence of cesarean delivery increased over time in our cohort.

We conducted all analyses using SAS statistical software (version 9.2; SAS Institute Inc, Cary, NC). Descriptive statistics were calculated with χ^2 tests and Fisher exact test, as appropriate. Logistic regression was performed for multivariable analyses, which included potential modifying factors such as sociodemographic factors, maternal comorbidities, pregnancy complications, and delivery indications in the model. Delivery hospital was also included as a fixed effect to account for potential clustering of outcomes at the level of the delivery hospital. We initially examined the relationship between mode of delivery and death and morbidity in the overall cohort. Separate analyses were conducted that excluded "emergent indications," which were designated as fetal distress, PIH, previa, and abruption. We reasoned that these indications typically require immediate delivery and may also be associated with poorer outcomes, regardless of mode of delivery. We also examined survival over 3 time periods among the subset of neonates who were intubated. Finally, we constructed separate models to evaluate the potential interaction between cesarean delivery and birthweight in relationship to morbidity and death. Statistical tests were considered significant at $\alpha = .05$, adjusted for