OBSTETRICS

Timing of delivery and pregnancy outcomes among laboring nulliparous women

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OBJECTIVE: The objective of the study was to compare pregnancy outcomes by completed week of gestation after 39 weeks with outcomes at 39 weeks.

STUDY DESIGN: Secondary analysis of a multicenter trial of fetal pulse oximetry in spontaneously laboring or induced nulliparous women at a gestation of 36 weeks or longer. Maternal outcomes included a composite (treated uterine atony, blood transfusion, and peripartum infections) and cesarean delivery. Neonatal outcomes included a composite of death, neonatal respiratory and other morbidities, and neonatal intensive care unit admission.

RESULTS: Among the 4086 women studied, the risks of the composite maternal outcome (*P* value for trend $< .001$), cesarean delivery ($P < .001$), and composite neonatal outcome ($P = .047$) increased with increasing gestational age from 39 to 41 or more completed weeks. Adjusted odds ratios (95% confidence interval) for 40 and 41 or more weeks, respectively, compared with 39 weeks were 1.29 (1.03-1.64) and 2.05 (1.60-2.64) for composite maternal outcome, 1.28 (1.05-1.57) and 1.75 (1.41-2.16) for cesarean delivery, and 1.25 (0.86-1.83) and 1.37 (0.90-2.09) for composite neonatal outcome.

CONCLUSION: Risks of maternal morbidity and cesarean delivery but not neonatal morbidity increased significantly beyond 39 weeks.

Key words: cesarean delivery, labor, nulliparous, optimal timing of delivery, pregnancy outcomes

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We reported increasing trends in neonatal morbidities associated with delivery beyond 39-40 weeks' gestation in a cohort of women undergoing prelabor elective repeat cesarean delivery.[1] The morbidities included respiratory complications, hypoglycemia, suspected or proven sepsis, and admission to the neonatal intensive care unit (NICU). Consistent with recommendations from the American College of Obstetricians and Gynecologists, few women desiring a cesarean are delivered beyond the window of 39-40 weeks' gestation.[1,2] However, the potential for increased neonatal risk

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with increasing gestational age is of public health importance for the majority of women who anticipate a vaginal delivery because a third of women remain pregnant beyond 39 completed weeks, and postdate induction typically is not recommended prior to the 41st week.[3-5] Furthermore, the cumulative risks and the gestational age–specific risks of stillbirth and other outcomes such as preeclampsia rise with each additional week of gestation,[6,7] and a Cochrane review of clinical trials does not support the commonly held view that cesarean rates are increased with labor induction compared with expectant management at a gestation of 37 or more weeks.[8]

Data from observational studies suggesting an increase in selected neonatal outcomes, cesarean delivery, or maternal morbidities with later delivery at term[9-12] raise questions concerning how long a pregnancy should be managed expectantly beyond 39-40 weeks' gestation and specifically concerning the current standards of management of postdate pregnancies.[3] The majority of relevant studies are retrospective and they often examine a limited number of outcomes. The objective of this study was to compare the frequency of maternal and neonatal outcomes by gestational age at delivery in a cohort of laboring nulliparous women enrolled in a clinical trial in which data on several maternal and neonatal outcomes were prospectively collected.

Materials and Methods

We conducted a secondary analysis of a multicenter randomized trial of fetal pulse oximetry as an adjunct to fetal heart monitoring conducted at 14 academic centers of the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development (NICHD) Maternal Fetal Medicine Units (MFMU) Network from 2002 to 2005.[13] Nulliparous women at 36 or more weeks of gestation, with viable singleton cephalic pregnancies and who were in spontaneous or induced labor were randomly assigned to open or masked fetal pulse oximetry groups at a cervical dilatation between 2 and 6 cm. In the open group, fetal oxygen saturation values were displayed to the clinician. In the masked group, the sensor was inserted and the values were recorded but not displayed.

Exclusion criteria for the primary study included planned cesarean, intrapartum fever prior to randomization, known human immunodeficiency virus or hepatitis infection, heart or renal disease, and diabetes mellitus. We also excluded pregnancies complicated by congenital malformations and those with medical or obstetric conditions that lead to immediate delivery or early delivery at term (hypertensive diseases, suspected growth restriction, reduced fetal movement, nonreassuring antepartum fetal testing, and oligohydramnios). Inductions performed for postdate pregnancies, spontaneous membrane rupture, or for elective reasons at any gestational age were not excluded. Our primary focus concerned women delivered at 39 completed weeks' gestation or later, but we also examined those delivered at 36-38 weeks as one way to assess the validity of our findings.

Gestational age was categorized into completed weeks: those delivered at 39 completed weeks (ie, $39^{0/7}$ to $39^{6/7}$ weeks), those delivered at 40 completed weeks, and those delivered at or beyond 41 completed weeks. Because of relatively small numbers, those delivered at 36-38 weeks were categorized into a single gestational age group. Gestational age determination was based on standardized criteria using last menstrual period (LMP) and/or first ultrasound. Dating was based on LMP if ultrasound agreed with LMP within 7 days up to $19^{6/7}$ weeks, within 14 days at $20\text{-}29^{6/7}$ weeks, or within 21 days at 30 weeks or beyond. If LMP data were not available, dating was based on the first ultrasound.

Maternal outcomes included a primary composite morbidity (of chorioamnionitis, endometritis, wound infection, uterine atony, and/or blood transfusion) and cesarean delivery (not included in the composite outcome). Chorioamnionitis was defined as a clinical diagnosis based on an elevated intrapartum body temperature, uterine tenderness, fetal or maternal tachycardia, and malodorous or purulent vaginal discharge and no other defined infection. Postpartum endometritis was also based on a clinical diagnosis of puerperal infection in the absence of clinical or laboratory findings, suggesting a nonuterine source of infection. Wound infection was based on a clinician diagnosis. Atony was defined as a clinical diagnosis based on failure of the uterus to contract after delivery or any treatment with uterotonics including 15-methyl prostaglandin F2á or methyl ergonovine.

Individual adverse neonatal outcomes included death, respiratory distress syndrome (RDS), transient tachypnea of newborn (TTN), seizure, sepsis, intraventricular hemorrhage (IVH), hypoglycemia, intubation and ventilator support, 5 minute Apgar score of 3 or less, hypoxic ischemic encephalopathy (HIE), and NICU admission. A neonate was considered to have the primary composite adverse neonatal outcome if it experienced any one of these individual outcomes. Because some neonates (eg, those born to women with gestational diabetes) may be admitted to the NICU for observation in the absence of complications, we examined an alternative composite neonatal outcome that excluded NICU admission less than 48 hours. Neonatal outcomes were based on diagnoses provided by the neonatology attending. RDS was based on the clinical diagnosis and need for oxygen therapy (fraction of inspired oxygen ≥ 0.4) for at least 24 hours or until death. TTN required a clinician diagnosis with need for oxygen therapy and/or mechanical ventilation/continuous positive airway pressure during the first 24 hours of life and no other demonstrable cause of respiratory distress such as RDS. Sepsis was defined as suspected systemic infection with positive cultures of blood, cerebrospinal fluid, or urine (catheterized or suprapubic) or (in the absence of positive cultures) clinical evidence of cardiovascular collapse or an unequivocal X-ray confirming infection in an infant believed to be clinically septic.

Data were analyzed using SAS (SAS Institute, Cary, NC). A χ^2 or Kruskal-Wallis test as appropriate was used to assess differences in maternal demographic and infant characteristics in