OBSTETRICS

Defining an abnormal first stage of labor based on maternal and neonatal outcomes

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OBJECTIVE: The objective of the study was to determine the threshold for defining abnormal labor that is associated with adverse maternal and neonatal outcomes.

STUDY DESIGN: This study consisted of a retrospective cohort of all consecutive women admitted at a gestation of 37.0 weeks or longer from 2004 to 2008 who reached the second stage of labor. The 90th, 95th, and 97th percentiles for progress in the first stage of labor were determined specific for parity and labor onset. Women with a first stage above and below each centile were compared. Maternal outcomes were cesarean delivery in the second stage, operative delivery, prolonged second stage, postpartum hemorrhage, and maternal fever. Neonatal outcomes were a composite of the following: admission to level 2 or 3 nursery, 5 minute Apgar less than 3, shoulder dystocia, arterial cord pH of less than 7.0, and a cord base excess of −12 or less.

RESULTS: Of the 5030 women, 4534 experienced first stage of less than the 90th percentile, 251 between the 90th and 94th percentiles, 102 between the 95th and 96th percentiles, and 143 at the 97th percentile or greater. Longer labors were associated with an increased risk of a prolonged second stage, maternal fever, the composite neonatal outcome, shoulder dystocia, and admission to a level 2 or 3 nursery ($P < .01$). Depending on the cutoff used, 29-30 cesarean deliveries would need to be performed to prevent 1 shoulder dystocia.

CONCLUSION: Although women who experience labor dystocia may ultimately deliver vaginally, a longer first stage of labor is associated with adverse maternal and neonatal outcomes, in particular shoulder dystocia. This risk must be balanced against the risks of cesarean delivery for labor arrest.

Key words: first stage of labor, labor dystocia

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Emanuel Friedman[1-3] revolutionized the management of labor with a series of publications describing the patterns of normal labor of nulliparous and multiparous women in the 1950s. These analyses led to the development of labor partograms and definitions of abnormal labor, with specific actions recommended when the labor times exceeded predefined action lines.[4,5]

Changes in the population combined with rising induction and cesarean rates have led to renewed interest in defining normal labor. Several contemporary labor curves utilizing populations of women who reach 10 cm of dilation have been published using interval censoring and polynomial modeling, techniques that account for repeated cervical measurements and the impact of examination times on individual labor curves.[6-13] In these analyses, it has become customary to report the time to achieve 1 cm dilation in terms of the median and 95th percentiles; however, these labor curves have been created in populations in which all women achieved 10 cm of dilation. Thus, even though women exceed the 95th percentile, they may still achieve full dilation and deliver vaginally.

The presentation of the 95th percentile in these publications appears to have been chosen based on statistical customs rather than physiological significance or an association with adverse outcomes. Unfortunately, this custom of reporting the 95th percentile inherently suggests the 95th percentile as a threshold for abnormal labor, despite any documented association of adverse outcomes with exceeding this threshold. Interventions for labors that exceed the 95th percentile may lead to unnecessary cesarean deliveries without improving the maternal and neonatal outcomes.

Therefore, we sought to evaluate the impact of exceeding several percentile

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FIGURE 1
Time in hours from 4 cm to 10 cm dilation

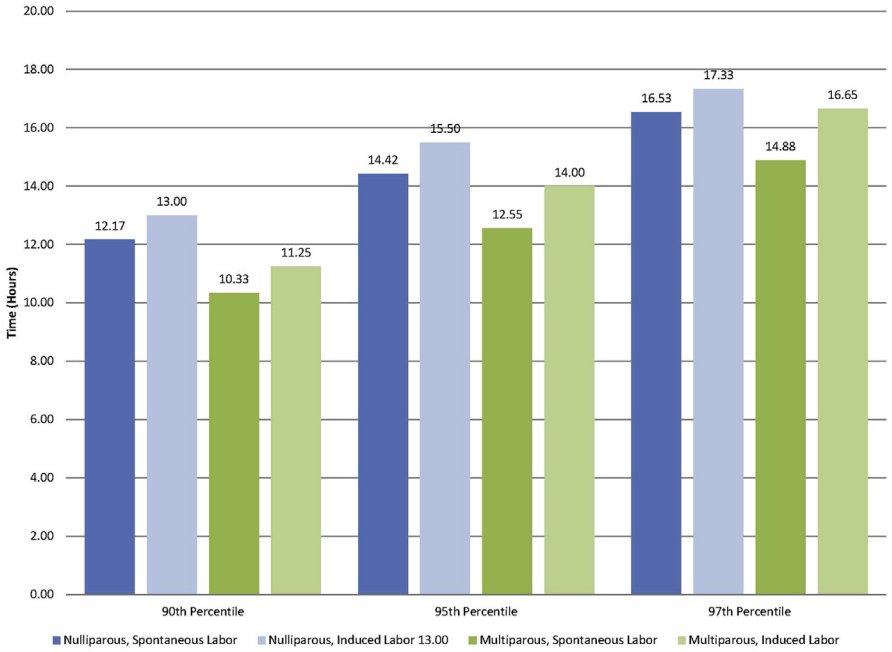

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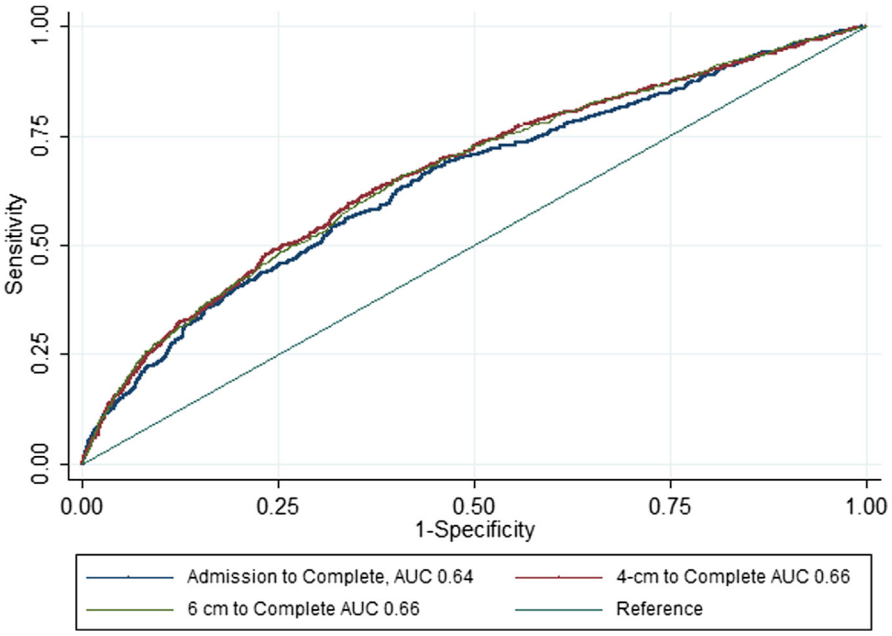
FIGURE 2
Receiver operator characteristic curve for varying definitions of active labor



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thresholds of the first stage of labor on maternal and neonatal outcomes in a contemporary population of women who reached 10 cm of dilation.

Materials and Methods

We conducted a 4 year retrospective cohort study of all consecutive term (gestation of ≥37 weeks) deliveries at Washington University School of Medicine (St. Louis, MO) from July 2004 to June 2008 who reached 10 cm dilation. Institutional board review approval was obtained from Washington University School of Medicine.

Women were included if their gestational age was at least 37 0/7 weeks' gestation at admission to labor and delivery, carried a singleton pregnancy in vertex presentation, and had an arterial umbilical cord gas obtained at delivery. Women were excluded if they had a prior cesarean, delivered preterm, had fetuses with congenital anomalies, or delivered by cesarean before complete dilation.

Detailed information on maternal sociodemographic, obstetric and gynecological history, medical and surgical history, prenatal history, antepartum history, and labor and delivery course was extracted from the medical charts. The labor and delivery records included medications, labor type, cervical examinations, cervical examination times, length of labor stages, mode of delivery, and postpartum record. All data were extracted using close-ended forms by trained research assistants who underwent regularly scheduled training.

Because the first stage of labor can be defined in many ways, receiver-operator characteristic (ROC) curves were generated to determine the definition of the first stage of labor most closely associated with maternal and neonatal outcomes. The first stage of labor was defined as the time from admission to complete dilation, time from 4 cm of dilation to complete, dilation and time from 6 cm of dilation to complete dilation.

Women presenting with cervical examinations greater than 4 cm or greater than 6 cm were assigned times based on the time of the first cervical examination to complete. The areas under the ROC