

**LENGTH OF THE SECOND STAGE OF LABOR AND
RISK OF PRETERM DELIVERY IN A SUBSEQUENT PREGNANCY**

Tara LOCKSTEIN,¹ Daniel GOMEZ MD,² Joanne N. QUIÑONES MD MSCE,³ William E.
SCORZA MD³

¹Research Scholar, Division of Maternal Fetal Medicine, Department of Obstetrics and
Gynecology, Lehigh Valley Health Network, Allentown, Pennsylvania, United States 18034

²Department of Obstetrics and Gynecology, Lehigh Valley Health Network, Allentown,
Pennsylvania, United States 18034

³Division of Maternal Fetal Medicine, Department of Obstetrics and Gynecology, Lehigh Valley
Health Network, Allentown, Pennsylvania, United States 18034

Abstract

OBJECTIVE: To evaluate whether an increased duration of the second stage of labor in a primiparous singleton term delivery increases the risk of preterm birth in the subsequent singleton pregnancy.

METHODS: Cohort study of retrospectively collected obstetric data at Lehigh Valley Health Network between April 2007 and November 2013. The characteristics of a woman's first pregnancy delivered ≥ 37 weeks gestation were obtained and the length of the second stage of labor was used as the exposure of interest. Characteristics of the woman's subsequent delivered pregnancy were analyzed and the gestational age at delivery was the primary outcome of interest. Other outcomes of interest included the diagnosis of spontaneous preterm labor and/ or the diagnosis of cervical shortening in the second pregnancy.

RESULTS: Twenty-six out of thirty-three patients were identified as eligible for inclusion in the study, for a total of 52 pregnancies included in analysis. Out of the pregnancies analyzed, 3 patients delivered preterm in their second pregnancy. Our primary outcome of interest, gestational age in a subsequent pregnancy, was similar between the groups (38.8 weeks \pm 1.5 weeks in those with a normal second stage of labor (n=17, 73.9%) vs. 39.6 \pm 1.0 weeks in those with a prolonged second stage of labor (n=6, 26.1%), p=0.26).

CONCLUSION: Our data thus far does not demonstrate a difference in gestational age among women by the length of the second stage of labor, although results are limited by the small sample size. Through this study possible risk factors for cervical shortening and spontaneous preterm birth in women who have previously delivered at term will be evaluated. The observations made from this study may influence health care providers to make recommendations for preterm delivery screening and labor management in women who do not have obvious risk factors for preterm birth.

Introduction

Preterm birth (PTB) is defined as a delivery that occurs prior to 37 weeks of gestation. Within the United States, twelve percent of births occur before 37 weeks (Norwitz, 2014). Around 70 to 80 percent of preterm births occur spontaneously, which is often due to preterm labor or preterm premature rupture of membranes (PPROM). Preterm labor comprises 40 to 50 percent of preterm births and preterm premature rupture of membranes (PPROM) is responsible for 20 to 30 percent of preterm births. The other 20 to 30 percent of preterm births are medically indicated due to maternal or fetal complications such as preeclampsia, placenta previa, abruptio placenta, fetal growth restriction and multiple gestations (Lockwood, 2014).

Preterm birth is the main cause of neonatal death, defined as death in the first 28 days of life. Twenty seven percent of neonatal deaths worldwide are due to preterm birth, making up over one million deaths annually. Preterm birth is associated with neonatal morbidity and long-term after effects such as neurodevelopmental deficits, which include cerebral palsy, impaired learning or visual disorders. Preterm birth is also correlated with having an increased risk of an array of diseases in adulthood (Lockwood, 14). The increasing rate of preterm birth in some countries may be due to an increase in multiple gestations that occurred through assisted reproductive technology. Ultrasound identification of a short cervix (<30 mm) in symptomatic and asymptomatic preterm patients, often relates to an increased risk of preterm labor and birth (Lockwood, 14).

The greatest risk factor for preterm birth is a prior preterm birth (PTB) with recurrence risks in the range of 25-55%. A prior term birth seems to reduce the PTB risk to 5-8%. This observation suggests that women with PTB after a prior term birth may have a different etiologic distribution than other women with PTB.

Cervical insufficiency is the inability of the uterine cervix to retain a pregnancy in the absence of contractions or labor, most often due to a structural weakness of the cervix. Cervical insufficiency may stem from diethylstilbestrol exposure, over-dilation of the cervix during pregnancy termination, cervical trauma from conization, loop electrosurgical excision procedure, congenital Müllerian anomalies, and deficiencies in cervical collagen and elastin. A precipitous delivery and a prolonged second stage of labor have shown to have a correlation with cervical insufficiency. Women who have had a first trimester curettage procedure have shown to be five times more susceptible to cervical insufficiency than other multiparous women who have never had the procedure done (Vyas, 2006). There is a chance that cervical insufficiency increases the likelihood of having a second trimester abortion or premature labor (Johnstone, 1976). The etiology for cervical shortening/insufficiency and preterm delivery in women without otherwise obvious risk factors may be structural damage to the cervix during a previous term birth, due to a precipitous or prolonged second stage, cervical laceration, or an operative vaginal delivery.

The objective of our study is to determine if an increased duration of the second stage of labor or prolonged labor dystocia in a primiparous term delivery increases the likelihood in the subsequent pregnancy of delivery before 37 weeks gestation, second trimester loss and/or cervical shortening. We propose that the length of the second stage of labor may cause cervical trauma that will possibly increase the chance of preterm labor, cervical malfunction and thus preterm delivery in a subsequent pregnancy.

Material and Methods

To determine whether the duration of the second stage of labor in a first term pregnancy impacts the risk of early delivery (<37 weeks) gestation in a subsequent pregnancy, a cohort study of retrospectively collected obstetric data from April 2007 to November 2013 at Lehigh Valley Health Network was performed. Characteristics of the first pregnancy delivered at a gestational age of ≥ 37 weeks, including the exposure of interest: the length of the second stage of

labor (normal vs. prolonged; >3 hours), were obtained. Information regarding the women's second pregnancy was collected and the gestational age at delivery was the primary outcome of interest. Other outcomes evaluated included the diagnosis of spontaneous preterm labor and/or the diagnosis of cervical shortening in the subsequent pregnancy.

Data analyzed was obtained from the Lehigh Valley Health Network (LVHN) Department of Obstetrics and Gynecology Division of Quality Assurance. A total of 1000 patients were identified in the database to have had both a first term delivery at LVHN and a subsequent birth also at LVHN. Medical records were reviewed for 33 patients. Data gathered from both the first and subsequent pregnancies included maternal demographic information such as age, race and pre-pregnancy body mass index. Data regarding medical co-morbidities, gestational age at delivery, duration of the first stage of labor, duration of the second stage of labor regardless of mode of delivery, mode of delivery (spontaneous vaginal, operative vaginal or cesarean), indication for cesarean delivery, intrapartum complications (chorioamnionitis, abruption placentae, preeclampsia), postpartum complications (postpartum hemorrhage) and neonatal birthweight were also obtained from the database.

Data abstracted from the first and subsequent pregnancy included antepartum course, cervical dilation on admission, oxytocin use in spontaneous labor, whether labor was spontaneous or induced, presence of cervical lacerations and use of regional analgesia. Data abstracted from the subsequent pregnancy included antenatal complications including the diagnosis of cervical shortening, advanced cervical dilation or preterm labor, use of cerclage or progesterone, as well as fetal and/or neonatal outcome including birth weight and other complications such as fetal demise. Pregnancies excluded from the study include women that had a previous cervical conization or excision procedure, pregnancies in which there were fetal anomalies, the presence of aneuploidy or a subsequent pregnancy with a delivery at less than 16 weeks gestation. The network's Institutional Review Board approved the study.

The primary outcome of this study was the rate of early delivery (<37 weeks gestation) in subsequent pregnancies as related to a normal vs. prolonged second stage of labor in the first delivery. Statistical analyses included descriptive statistics such as chi-square or Fisher's exact test for categorical variables and the Student's *t* or Mann Whitney U tests for continuous variables. Statistical significance was defined by a p value < 0.05.

Once the entire patient database is reviewed, risk ratios will be calculated in order to determine the risk of preterm birth/ and or cervical shortening in a subsequent pregnancy by the length of the second stage of labor of the first pregnancy. Multivariate regression models will be created in order to assess adjusted risk ratios for cervical shortening and/or preterm delivery in a subsequent pregnancy determined by the length of the second stage of labor in a first pregnancy, adjusted for potential confounders.

Results

Record reviews were performed for 33 patients in the database, 26 of which met criteria for study analysis for a total of 52 births analyzed. Seven women were excluded from analysis since their deliveries were either scheduled as cesareans due to macrosomia or were not eligible for vaginal birth due to malpresentation. A multiparous woman was misclassified as primiparous in the database and was thus excluded from the study analysis.

Patient demographics and labor characteristics were similar between patients in their first and subsequent deliveries (Table 1), except for maternal age as expected.

Six patients had a prolonged second stage (≥ 3 hours) in their first delivery whereas 17 patients had a normal second stage of labor in their first delivery. Our primary outcome of interest, gestational age in a subsequent pregnancy, was similar between the groups (Figure, $p=0.26$). The lengths of the first and second stages of labor in the first delivery were similar between women who delivered either at term or preterm in the subsequent pregnancy (Table 2).

Although gestational ages in the subsequent pregnancy were similar regardless of the second stage of labor length in the first delivery, we reviewed the etiology of PTB in the 3 women who delivered preterm in the subsequent pregnancy. One of the women who delivered preterm was admitted for preterm contractions/labor. Upon record review, it was determined that she had complete placenta previa and this was the indication for preterm delivery via cesarean at 36+1 weeks gestation. One of the other women was also admitted for preterm contractions/labor. This woman was admitted three times before she delivered. On her first admission she was 28 weeks pregnant and two centimeters dilated. She received tocolysis to prevent a preterm birth and also received corticosteroids for fetal benefit. She was eventually discharged home in stable condition. On her second admission she was at 33 weeks gestation and six centimeters dilated. She eventually delivered preterm, at a gestational age of 36+4 weeks gestation. A woman with suspected chorioamnionitis in her second pregnancy delivered preterm at a gestational age of 36+6 weeks gestation.

Discussion

Our data thus far does not demonstrate a difference in gestational age in a subsequent pregnancy exposed to a normal vs. prolonged second stage of labor in a first delivery. Limitations of our study include the small sample of patients analyzed when compared to the total number of patients whose pregnancies are to be included in the study. While at the Division of Maternal Fetal Medicine there was time to only review 52 pregnancies. Our sample size calculation estimates that we need to evaluate at least 1000 patients to find an increased risk of preterm birth from 8% in those with a normal second stage of labor to 24% in those with a prolonged second stage of labor. Once the entire database is analyzed we hope to identify whether the length of the second stage of labor in a first pregnancy impacts the gestational age at delivery of a subsequent pregnancy. Results at this time are thus limited to reach definitive conclusions.

Loss of confidentiality of the patients being reviewed is a factor that is to be taken into consideration in this study. To decrease such risk, the data was only monitored by the primary investigators and the data was de-identified and maintained safely using password protection.

Once completed, the information gathered from this study could give support to the literature in terms of risk factors for cervical shortening and spontaneous preterm birth in women who have previously delivered at term, women who otherwise are not identified to be at risk of preterm birth after experiencing a term birth. Labor may be handled in a different manner if certain clinical outcomes such as the length of labor, length of pushing, cervical lacerations and neonatal birthweight are found to potentially impact future pregnancies. There may be an emphasis on preterm delivery screening and different labor management in women who otherwise do not have traditional risk factors for preterm birth. Understanding the cause of a potential risk for preterm birth in a subsequent pregnancy would allow physicians to focus their attention on preventing these specific events from occurring. The significant impact of preterm birth on neonatal morbidity, neonatal mortality, and resource utilization makes our research question an important topic to further investigate.

Table 1. Patient demographics and labor characteristics by first and subsequent delivery

Demographics and labor characteristics	First delivery n = 26	Subsequent delivery n = 26
Maternal age (years) ^a	27.4 ± 5.0	29.6 ± 5.0
Resident service (vs. private), n (%)	4 (15.4)	5 (19.2)
Cesarean delivery, n (%)	3 (11.5)	4 (15.4)
First stage labor length (hours) ^a	9.9 ± 4.6	8.0 ± 4.5
Second stage labor length (hours) ^a	2.0 ± 1.6	0.5 ± 0.7
Gestational age at delivery (weeks) ^a	39.2 ± 1.2	39.0 ± 1.4
Neonatal birthweight (grams)	3249.2 ± 507.8	3447.8 ± 595.7

Data analyzed with Student *t* and chi square tests, as indicated.

^aData expressed in mean \pm SD

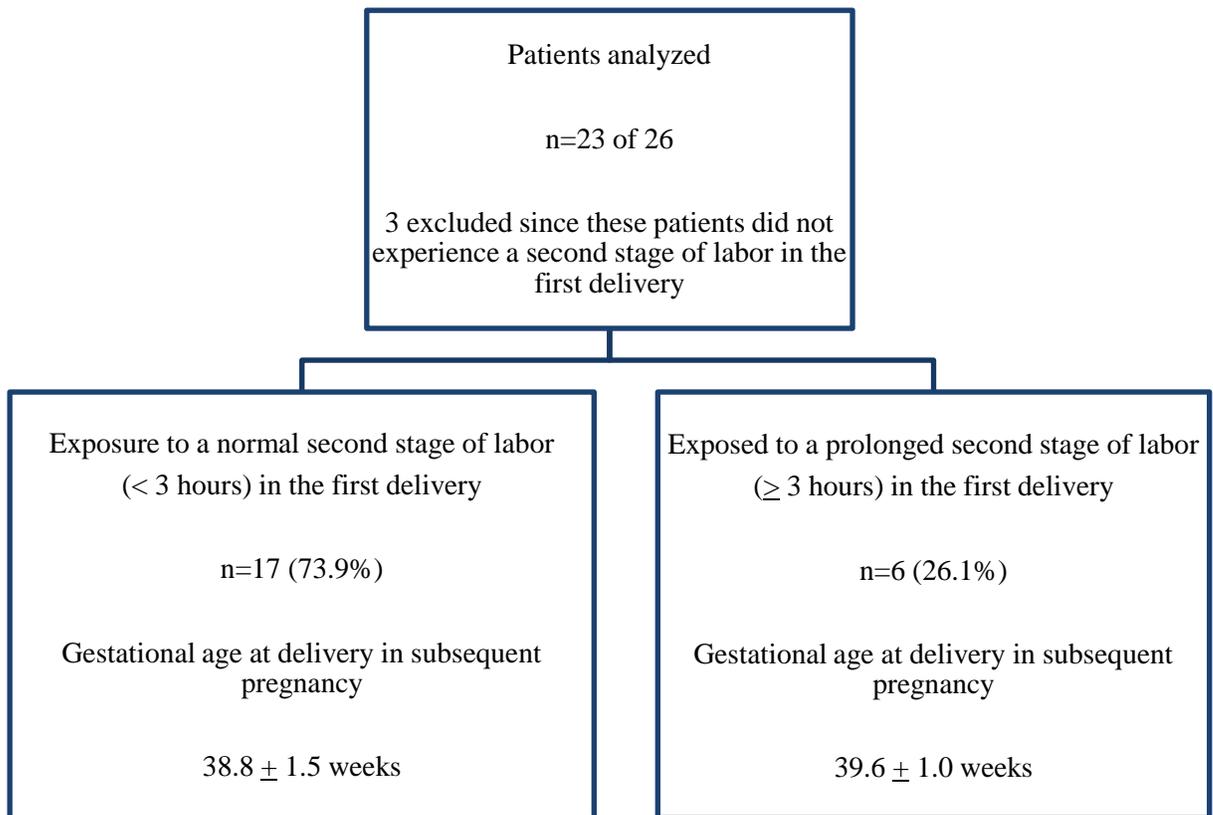
Table 2. Labor characteristics by gestational age in subsequent pregnancy

Labor characteristics	Term delivery in subsequent pregnancy n = 23	PTB in subsequent pregnancy n = 3	p value
Gestational age in subsequent pregnancy (weeks) ^a	39.4 \pm 1.1	36.4 \pm 0.3	0.0001
First stage labor length in the first term delivery (hours) ^a	n = 18 9.9 \pm 4.7	n = 3 9.8 \pm 4.7	0.98
Second stage labor length in the first term delivery (hours) ^a	n = 20 2.0 \pm 1.7	n = 3 1.0 \pm 0.7	0.27

Data analyzed with Student *t* tests, as indicated.

^aData expressed in mean \pm SD

Figure. Study flow diagram with primary outcome of interest



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