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Term induction of labor and subsequent preterm birth

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Abstract

Objective—Although the rate of inductions continues to rise, there is a paucity of data investigating subsequent pregnancy outcomes after induction. Our objective was to compare term inductions to term spontaneous labor and evaluate the rate of subsequent spontaneous preterm birth (sPTB).

Study Design—A retrospective cohort study of women with 2 consecutive deliveries from 2005–2010 was performed. Term inductions or term spontaneous labor in the index pregnancy were included, and those with a prior sPTB were excluded. Data were obtained through chart abstraction. The primary outcome was sPTB (<37wks) in a subsequent pregnancy. Categorical variables were compared with χ^2 analyses and logistic regression was used to calculate odds.

Results—887 women were included (622 inductions, 265 spontaneous labor). The overall subsequent sPTB rate was 7.2%. Term inductions were less likely to have a subsequent sPTB compared to term spontaneous labor (6 vs. 11%; OR 0.49, 95% CI 0.29–0.81, $p=0.005$). This remained after adjusting for confounders (aOR 0.55, $p=0.04$). The sPTB risk depended on gestational age of index delivery. At 37–38.9wks, the sPTB rate after spontaneous labor was 24% vs. 9% after induction (OR 3.0, 95% CI 1.44–6.16, $p=0.003$). This was not significant for 39–39.9wks ($p=0.2$) or 40wks ($p=0.8$).

Conclusions—Induction is not a risk factor for subsequent sPTB. Spontaneous labor; however, in the early term period is associated with subsequent sPTB. Further investigation among early term deliveries is warranted to evaluate the risk of sPTB and target interventions in this cohort.

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Keywords

Induction of labor; spontaneous early term labor; subsequent preterm birth

Introduction

The percentage of women undergoing an induction of labor is estimated to be greater than 20% and continues to rise¹. Cervical ripening agents such as vaginal prostaglandin and mechanical dilators have been used to help increase the rate of successful induction and decrease the rate of cesarean deliveries. Previous investigations have examined the efficacy of cervical ripening agents for success of vaginal delivery^{2,3}; however, there is a paucity of data looking at the potential effects these agents may have on a subsequent pregnancy, specifically on the risk of subsequent preterm birth (PTB).

Although the rate of PTB has decreased since 2006^{4,5}, the decline has been marginal and it still remains a large public health concern and a large contributor to the burden of neonatal morbidity. The overall PTB rate in the United States is currently 11.7%⁴⁻⁶ with spontaneous PTB (sPTB) accounting for 60% of the total preterm births⁷⁻⁸. There are many known risk factors for PTB including prior history of PTB⁹, shortened cervix¹⁰⁻¹², African American race^{4,5,8,9}, low pre-pregnancy body mass index (BMI)¹³, and smoking¹⁴. The majority of women, however, present in spontaneous preterm labor without an identified risk factor.

As we have observed that the induction rate has been increasing and the PTB rate only marginally decreasing, it is plausible that an induction of labor may affect cervical integrity, altering it for future pregnancies. Cervical ripening and induction agents are used to prime and dilate the cervix with the intent of achieving labor prior to the spontaneous labor process. An iatrogenic initiation of labor may disrupt the cervical stroma and affect its normal integrity and strength. If such a change in the cervix did occur, this process might alter a woman's risk for preterm birth in a future pregnancy. Therefore, it is possible that induction may be a predisposing risk factor for spontaneous PTB (sPTB). Given the number of women affected by an induction of labor, this is an important public health question to evaluate.

There are numerous studies looking at second trimester induced abortions and the risk of early loss or PTB in a subsequent pregnancy. The studies have looked at both the use of misoprostol as well as dilation and evacuation¹⁵⁻¹⁷, and have found varying and inconsistent results when looking at the risk of PTB in a subsequent pregnancy, with many of them suggesting an increased risk^{16,17}. These results are limited to the effects of second trimester induction. The impact of induction agents on subsequent pregnancy outcome has never been studied among women undergoing third trimester induction.

Our objective was to first compare women that underwent an induction of labor and those that went into spontaneous labor and evaluate their rates of sPTB in a subsequent pregnancy. As part of this objective, we evaluated the various methods of induction to assess whether a specific method, such as mechanical dilation, may place a woman at increased risk of sPTB in a subsequent pregnancy. Our hypothesis was that induction, specifically mechanical dilation, disrupts the integrity of the cervical stroma, placing a woman at risk for cervical incompetence and PTB in a subsequent pregnancy.

Materials and Methods

This was a retrospective cohort study of all women with two consecutive deliveries at the Hospital of the University of Pennsylvania (HUP) during the years 2005 to 2010. The

starting year was chosen as 2005 since this was the start of the electronic medical record at our institution. Approval from the University of Pennsylvania Institutional Review Board was obtained prior to initiation of the study.

Our objective was to evaluate the risk of sPTB among women undergoing a term induction compared to those presenting in term spontaneous labor. Our exposed group was women who underwent a term induction in their index pregnancy. Our unexposed group was women who presented in spontaneous labor at term in their index pregnancy.

Methods of induction included mechanical induction and pharmacologic induction. Mechanical induction was via cervical foley and its use was defined by women that had a cervical foley placed at any time during their induction. Pharmacologic induction was defined by women that had (1) prostaglandin only (2) pitocin only or (3) prostaglandin and pitocin.

Outcome

The primary outcome for the study was spontaneous PTB in a subsequent pregnancy defined as spontaneous labor and delivery prior to 37 weeks gestation or preterm premature rupture of membranes prior to 37 weeks gestation. Secondary outcomes included mode of delivery in the subsequent pregnancy and PTB in the subsequent pregnancy <34 weeks, and <28 weeks gestational age.

Estimated gestational age at the time of delivery was based on standard obstetric dating¹⁸. For both the index pregnancy and subsequent pregnancy, if a patient presented with unknown dating (n=12, 1.4%), an ultrasound was obtained prior to delivery to confirm if preterm or term. In those patients where an ultrasound was unable to be performed prior to delivery (n=4), a birth weight >3000g confirmed a term gestation. Gestational age was then subsequently confirmed by a pediatric exam in all patients with unknown dating.

Sample size

For this study, we wanted to compare overall term induction to term spontaneous labor as well as compare mechanical induction to term spontaneous labor and pharmacologic induction to term spontaneous labor. We therefore calculated our sample size based on the least prevalent exposure, mechanical induction. Of women undergoing an induction, approximately 20% have a mechanical induction and 80% have a pharmacologic induction at our institution. We assumed a sPTB rate of 7%⁷⁻⁸ for women presenting in spontaneous labor. In order to have enough induction patients to enable subdivision into mechanical and pharmacologic inductions, we chose, a priori, to evaluate 2.5 times more induction patients than spontaneous labor patients. Using an alpha of 0.05 and a two sided test, we estimated that we would need a total of 887 patients (622 in the induction group and 265 in the spontaneous labor group) to give us 80% power to see a 2.5 fold increase risk in sPTB when comparing mechanical induction to spontaneous labor. With this sample size, we would have 85% power to see a 2 fold increase risk in sPTB when comparing overall induction (mechanical and pharmacologic combined) to spontaneous labor.

Patient selection

Using our electronic database, we were able to obtain a list of patients that had more than one delivery between 2005 and 2010. The first pregnancy during this time period was considered their "index" pregnancy. The index pregnancy may or may not equate to the patient's first pregnancy as multiparous women were included among index pregnancies. The second pregnancy during this time period was then considered a subsequent pregnancy. Patients were included in the study only once.

Only women whose index pregnancy was a singleton pregnancy at term (≥ 37 weeks gestation) and who had a consecutive subsequent delivery ≥ 16 weeks gestational age at our institution were included in the study. Women with a prior cesarean section were included. Women undergoing an induction prior to 37 weeks gestation, women presenting in spontaneous labor prior to 37 weeks, and women with a prior history of sPTB were excluded from the study given the high a priori risk of a preterm birth in a subsequent pregnancy.

By using the *International Classification of Disease, 9th edition* (ICD-9) and undergoing a detailed chart review, we were able to identify which patients underwent an induction, which ones presented in spontaneous labor, and which ones had their subsequent pregnancy at our institution. The ICD-9 codes for induction (73.01, 73.1, 73.4) helped to identify patients that underwent an induction; however, detailed chart review was required to confirm induction and assure that it met our strict definition. We defined induction as (1) use of any cervical ripening agent (prostaglandin or cervical foley) (2) artificial rupture of membranes or pitocin use in the setting of contractions with cervical dilation <4 cm (3) cervical dilation ≥ 4 cm in the absence of contractions. Spontaneous labor was defined by (1) cervical dilation ≥ 5 cm or (2) cervical dilation ≥ 4 cm in the presence of documented cervical change. All data abstraction was performed by two of the investigators (LDL, AH).

After the term induction cohort was formed, the term spontaneous labor group was identified. When identifying the term spontaneous labor group, we frequency matched for year and for day of admission to labor and delivery. First, we identified the total number of induction patients per year (2005–2010) that met inclusion criteria and calculated the respective percentage this was of the total induction patients included. Then, to reduce potential variation over time and by providers, spontaneous labor patients were sampled in proportion to the induction patients by year and day of admission.

Data collection

Data collection was through chart abstraction from the maternal and neonatal electronic medical records. Variables collected included maternal demographics, as well as a full obstetrical, gynecological, medical, and social history. All induction parameters were collected including the starting exam, induction agents used, the sequence of use, timing of use, and number used. The lengths of the latent and active phases of labor and the second stage of labor were obtained. Delivery information was abstracted including mode of delivery and neonatal information for both the index and subsequent pregnancies.

Data analysis

Our analysis occurred in three stages. The first part of the analysis compared demographic data between the two groups. Mann-Whitney U tests were used to compare non-parametric data and chi-square tests were used to compare categorical variables.

The second part used bivariate comparisons to assess for potential confounders or risk factors for the outcome. Based on analysis with our dependent variable, sPTB, we included risk factors in our multivariable model that had an association at a significance level of $p < 0.2$. We then created our multivariable model and used a backwards stepwise elimination strategy to obtain a parsimonious model. The confounders included in the final model were chronic hypertension, any history of cocaine use, and no prenatal care in the subsequent pregnancy. Maternal age and race were maintained in the final model given the biological plausibility of an association with both the exposure and the outcome. The Hosmer-Lemeshow test was used to evaluate the goodness of fit of the model. Bootstrapping was performed to assure stability of our models and tests of statistical significance¹⁹.

Third, based on the findings from the initial analysis, we did subsequent exploratory analyses by looking at different gestational age categories to help explain our findings and to see if gestational age of delivery of index pregnancy modified the outcome. We used both the distribution of the gestational age (weeks) data as well as clinically applicable groupings to obtain the 3 categories of gestational age: 37–38.9, 39–39.9, and 40 weeks.

Data analysis was performed using STATA 12.0 for Windows (STATA Corporation, College Station, TX). Statistical significance was set at $p < 0.05$.

Results

Overall, there were 3263 women with two deliveries at our institution from 2005–2010. Once the targeted sample size of 622 inductions was obtained, 265 spontaneous labor patients were randomly selected as noted in the methods section (Figure 1).

The demographic characteristics for the induction and spontaneous labor groups are shown in Table 1. The induction group had a significantly higher BMI and a higher percentage of patients with chronic hypertension (CHTN) and pregnancy related hypertension, defined as gestational hypertension or preeclampsia. There were a significantly greater percentage of nulliparous women in the induction group compared to the spontaneous labor group and a significantly greater percentage of women with no prenatal care in the spontaneous labor group. There was no difference in the percentage of women with a cesarean delivery prior to the index pregnancy; however, there was a significantly increased rate of cesarean delivery in the index pregnancy among the induction group as compared to the spontaneous labor. There were also a higher percentage of neonatal intensive care unit admissions in the induction group. The gestational age of the index delivery was similar in both groups; however a smaller percentage of women went into spontaneous labor after 41 weeks gestation. There was no difference in the inter-pregnancy interval between the two groups.

The baseline characteristics for the induction group are detailed in Table 2. Of the women that underwent an induction, 57% were for maternal or fetal indications, 32% were for premature rupture of membranes or post-term pregnancies (>41 weeks gestational age), and 11% were elective. The majority of women (78%) undergoing an induction had an unfavorable cervix, defined as ≤ 2 cm dilation. More than half (52%) received a vaginal prostaglandin as the initial agent. Only 7% of women had a cervical Foley used as the first agent; however, 23% had it used at some point during the induction.

For our primary outcome, we first evaluated the risk of sPTB in a subsequent pregnancy (Table 3). The overall PTB rate in this cohort (both spontaneous and medically indicated PTB) was 11.4% and the sPTB rate was 7.2%. In bivariate analysis, significant independent risk factors for sPTB were race, no prenatal care in the subsequent pregnancy, CHTN, and any cocaine use. When compared to women that presented in spontaneous labor in their index pregnancy, those that had a term induction in the index pregnancy were less likely to have a sPTB in a subsequent pregnancy (11% vs 6%, OR 0.49). This reduced risk remained after adjusting for confounders (aOR=0.55 [0.31–0.97]).

When restricting analysis to only those women that had a vaginal delivery in their index pregnancy, this reduced risk of sPTB in a subsequent pregnancy after an induction as compared to spontaneous labor was still noted (OR 0.52 [0.30–0.90], $p=0.019$). Among those with a subsequent sPTB, there was no difference in the median gestational age of sPTB between the two labor groups (induction group: 35.6 weeks [31.9–36.6 weeks], the spontaneous labor group: 35.3 [32.1–36.6 weeks], $p=0.52$).

We then evaluated the sPTB risk among various subgroups of induction compared to spontaneous labor patients (Table 4). These subgroups included method of induction, starting cervical exam at the time of induction, and indication for induction. This was done in order to evaluate subgroups among those induced that may have influenced our outcome. First, we evaluated the use of mechanical dilation for induction as a risk factor for PTB. We found that both mechanical and pharmacologic induction were associated with a reduced risk of sPTB when compared to spontaneous labor, although this did not remain significant after adjusting for confounders. We found that the risk of subsequent sPTB was modified by the starting cervical exam at time of induction ($p=0.003$). Women with an unfavorable cervix (≤ 2 cm) had a 61% reduced risk of sPTB compared to those who presented in spontaneous labor. Women with a favorable cervix (>2 cm) did not have a statistically significant reduced risk. These findings remained after adjusting for confounders. The reduced sPTB risk was not explained by the indication for induction. As seen in Table 4, the significantly reduced sPTB risk seen among premature rupture of membranes and post-term inductions did not remain significant after adjusting for confounders.

Next, we stratified by gestational age of the index delivery to evaluate if there was a specific gestational age driving the unexpected finding of a reduced risk of sPTB after induction (Table 5). Among both the induction and spontaneous labor groups, we found that as the gestational age of delivery in the index pregnancy increased, the risk of sPTB among both groups decreased. Previously, we evaluated induction as the exposure; however, when we now evaluate spontaneous labor as an exposure and compare those that presented in spontaneous labor to those that underwent an induction, the odds of a sPTB decreased with increasing gestational age of index delivery. Specifically, there was a 3 fold higher odds for sPTB in a subsequent pregnancy if presenting in spontaneous labor between 37–38.9 weeks as compared to undergoing an induction at the same gestational age (Table 5). When excluding the 12 women (1.4%) with unknown dating from the analysis of sPTB for women presenting in spontaneous labor between 37–38.9 weeks compared to those that had an induction at the same gestational age, the increased risk of sPTB was still present (OR 2.5 [1.16–5.29]). The three gestational age categories in Table 5 were chosen based on clinically applicable groupings and the distribution of the data. However, if the 37–38.9 week category was separated for each week of gestation, the OR when comparing spontaneous labor to induction from 37–37.9 weeks is 2.59 [0.82–8.16], $p=0.11$ and from 38–38.9 weeks is 3.84 [1.41–10.44], $p=0.008$.

Outcomes of the index pregnancy were also compared. While the cesarean delivery rate was higher for the induction group (23%) compared to the spontaneous labor group (8%) as seen in Table 1, there was no difference in rate of subsequent sPTB between the two modes of delivery ($p=0.3$). An increased risk of neonatal intensive care unit admission (9% vs. 4%, $p=0.003$) and postpartum hemorrhage (10% vs. 3%, $p=0.001$) with the induction group was also noted.

There were no significant differences in our secondary outcomes of sPTB <34 weeks or sPTB <28 weeks. There was an increased risk of cesarean delivery in a subsequent pregnancy for those that were exposed to an induction in their index pregnancy. This risk, however, was not significant when controlling for whether they had a cesarean in the first pregnancy or induction in the subsequent pregnancy (aOR 1.38 [0.78–2.49], $p=0.3$).

Comments

This is the first large study to evaluate the effect of an induction of labor in one pregnancy and the risk of spontaneous preterm birth in a subsequent pregnancy. Contrary to our

hypothesis, we found that women who undergo an induction are at a 45% reduced risk for sPTB in a subsequent pregnancy.

When evaluating subgroups within the induction cohort, there was no specific characteristic among this group that could fully explain the decreased risk of sPTB. Sciscione et al²⁰ found no increased risk of preterm delivery in a subsequent pregnancy after induction with cervical foley although they were underpowered for this outcome. Our evidence; however, supports the finding that the use of a cervical foley does not increase the risk of PTB in a subsequent pregnancy as compared to those that present in spontaneous labor. When evaluating the subgroups of starting cervical exam and indication for induction, we found that there was a greater reduction in the sPTB rate among those starting with a cervical exam ≤ 2 cm compared to those starting with a cervical exam >2 cm and that the indication for induction did not impact the results.

While it is important and encouraging that an induction of labor is not a risk factor for a subsequent preterm birth, we sought to explore possible explanations as to why an induction appears to be “protective” against a subsequent sPTB. The most plausible explanation for why our observed results are different from our hypothesis is that induction may not be protective, but that spontaneous labor, even in the early term period, may be a risk factor for sPTB. Although our cohort was comprised of all full term deliveries, we evaluated the gestational age at delivery of the index pregnancy to see if gestational age influenced our findings. For both the induction and spontaneous labor group, we noted a decreased risk of sPTB with increasing gestational age at delivery of index pregnancy. When the risk of sPTB was compared between the two labor groups, we found that the odds of having a sPTB after spontaneous labor at 37–38.9 weeks was 3 times higher than the odds of having a sPTB after an induction at the same gestational age. These findings suggest that women who go into spontaneous labor in the early term period, not just those who are preterm, appear to be at risk for sPTB in a subsequent pregnancy. These observations are exploratory and require further study in other patient samples; however, they support the emerging evidence that there are distinct differences among “full term” deliveries that occur at earlier gestational ages²¹.

This study has several strengths. It is the first large study to evaluate an association between induction and sPTB in a subsequent pregnancy and the first to demonstrate that spontaneous labor and delivery, even between 37–39 weeks gestation, may be a risk factor for sPTB. Additionally, this study is a large cohort study using data from multiple pregnancies at one large urban hospital. Performing a study using data from one site minimizes practice variation during labor and delivery. Given the concern for inaccuracies with ICD-9 coding, detailed chart abstraction and data collection were performed solely by two investigators (LDL, AH) with the use of strict definitions for induction and spontaneous labor to limit misclassification bias.

Our study was not without limitations. Our study population represents an urban population with a large percentage of African American patients that have delivered more than one child at the same hospital which may not be comparable to other communities. However, this study required two deliveries for each patient and a multi-institutional study would be less feasible. While 75% of our cohort was African American which may limit generalizability, these women are at an increased risk of PTB and therefore this is an important population within which to evaluate PTB. A limitation to many cohort studies is confounding by indication. Specifically, in this study, we worry about systematic differences inherent in women that undergo an induction compared to those that present in spontaneous labor as well as the choice of induction agent used. We addressed this by looking at other factors that may be associated with the exposure as seen in our demographics table and controlling for

these confounders. Furthermore, while we used strict criteria to define induction and spontaneous labor, inherent in the way we defined induction, there is potential for patients in early spontaneous labor to be classified as induction. While this would lead to misclassification, it would likely bias our results towards the null. Additionally, while the subgroup analysis among different gestational age categories yielded interesting results, this would need to be validated in other studies. Lastly, we intentionally chose a larger induction group in order to allow enough power to evaluate the method of induction on sPTB risk. While the smaller spontaneous labor group still allowed us to be powered for both of our objectives, future studies could match 1:1 (induction to spontaneous labor) given that method of induction was not an independent risk factor for sPTB.

The overall sPTB rate in our study (7.2%) is similar to the national sPTB rate of 7–8%^{7,8,22} and similar to the overall sPTB at our institution²³. However, the women in our cohort all had at least one term delivery prior to the sPTB. Literature supports an even lower sPTB rate among women with a prior term delivery (5%)^{24–26}. Therefore, our finding of a sPTB rate of 24% among women who had spontaneous labor and delivery between 37–38.9 weeks in their prior pregnancy is almost five times higher than the quoted sPTB rate after a term delivery. This is of great public health concern and warrants further investigation. It is important to note that there was no difference in the median gestational age of delivery (in the 35th week for both groups) for the sPTB in the subsequent pregnancy when comparing those that had an induction and those that went into spontaneous labor.

In summary, given the rising induction rate, it is reassuring to find that an induction of labor is not a risk factor for sPTB in a subsequent pregnancy. Novel to this study, however, is the idea that early term spontaneous labor may be a risk factor for a subsequent sPTB. Although it is reasonable to believe that women with early term spontaneous labor are at risk for preterm delivery given the continuum of the late preterm/early term period, it has yet to be demonstrated in the literature. In keeping with the emerging evidence that deliveries in the early term period have outcomes different than deliveries after 39 weeks²⁷, our manuscript supports the idea of redefining what is considered “full term,” as suggested by others²¹. The importance of evaluating the definition of a “term” pregnancy has become the focus of attention of many important organizations which culminated in a consensus meeting in conjunction with the National Institute of Child Health and Human Development¹⁶. Their goals were to address the need for redefining “term” given the known difference in maternal and neonatal outcomes that can occur across the entire “term” period. The findings from our study give credence to the concept that not all “term” deliveries have the same outcomes, nor do they have the same implications for future pregnancy. Further investigations among the early term patients are warranted to evaluate their risk of subsequent PTB. This could have large public health implications for targeted therapeutic strategies in these patients if they are found to be at high risk for preterm birth.

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Figure 1.
Flowchart of included patients
sPTB: Spontaneous preterm birth

Table 1

Demographic information

	Induction group (n=622)	Spontaneous labor group (n=265)	p-value
Maternal age (years) *	24 (19–30)	23 (19–28)	0.1
BMI (kg/m²) *	26.8 (22.8–31.6)	24.7 (21.6–29.8)	0.002
BMI categories **			
Underweight	20 (3)	8 (3)	0.01
Normal weight	218 (36)	119 (48)	
Overweight	188 (31)	63 (25)	
Obese	185 (30)	59 (24)	
Race **			
Black/AA	453 (76)	194 (77)	0.3
White	99 (17)	34 (14)	
Other	42 (7)	23 (9)	
Medical comorbidities **			
CHTN	27 (4)	2 (1)	0.006
GDM	12 (2)	3 (1)	0.8
PRH	142 (23)	13 (5)	<0.001
Parity **			
Nulliparas	416 (67)	141 (53)	<0.001
Multiparas	206 (33)	124 (47)	
No prenatal care in subsequent pregnancy **	40 (6)	38 (14)	<0.001
Cocaine use ever	9 (1)	9 (4)	0.051
Prior cesarean delivery	13 (2)	7 (3)	0.7
Mode of delivery in index pregnancy **			
Vaginal delivery	477 (77)	243 (92)	<0.001
Cesarean delivery	145 (23)	22(8)	
Birth weight (g) ***	3276 (±20)	3284 (±27)	0.8
NICU admission	57 (9)	9 (4)	0.003
Gestational age at index delivery (weeks) **			
37–38.9	180 (29)	76 (29)	<0.001
39–39.9	148 (24)	79 (30)	
40–40.0	138 (22)	83 (31)	
41	156 (25)	27 (10)	

	Induction group (n=622)	Spontaneous labor group (n=265)	p-value
Inter-pregnancy interval (years) *	1.9 (1.4–2.6)	2.1 (1.4–2.8)	0.1

* Medians and inter-quartile ranges reported

** n (%)

*** Means (SD)

BMI: body mass index, AA: African American, CHTN: chronic hypertension, GDM: gestational diabetes, PRH: pregnancy related hypertension, NICU: neonatal intensive care unit

Table 2

Induction of labor characteristics

Characteristics	n (%)
<i>Indication for induction</i>	
Maternal	158 (25)
Fetal	199 (32)
Premature rupture of membranes	84 (14)
Post-term	115 (18)
Elective	66 (11)
<i>Starting cervical dilation</i>	
2cm	487 (78)
>2cm	135 (22)
<i>First agent used for induction</i>	
Misoprostol	294 (47)
Dinoprostone	32 (5)
Cervical foley	41 (7)
Oxytocin	231 (37)
Rupture of membranes	24 (4)
<i>Agent used at anytime during induction</i>	
Misoprostol	304 (49)
Dinoprostone	33 (5)
Cervical foley	143 (23)
Oxytocin +/- rupture of membranes	563 (94)

Table 3

Preterm birth risk among the two groups

	Induction group * n=622	Spontaneous labor group * n=265	OR ***	CI	p-value	aOR ⁺	CI	p-value
sPTB	35 (6)	29 (11)	0.49	0.29–0.81	0.006	0.55	0.31–0.97	0.04
Overall preterm birth	63 (10)	38 (14)	0.67	0.44–1.04	0.07	0.64	0.40–1.03	0.07

sPTB: spontaneous preterm birth

* n (%)

** Comparing induction to spontaneous labor

+ Adjusted for maternal age, race, no prenatal care in subsequent pregnancy, cocaine use, and chronic hypertension

Table 4

Spontaneous preterm birth risk for various subgroups of induction patients compared to spontaneous labor

	sPTB n (%)	Unadjusted			Adjusted*		
		OR	CI	p-value	OR	CI	p-value
Agents used for induction							
Cervical Foley used ever (n=143)	5 (4)	0.29	0.11–0.78	0.01	0.41	0.15–1.12	0.08
Pharmacologic induction only (n=455)	29 (6)	0.56	0.32–0.95	0.03	0.59	0.32–1.1	0.09
Starting cervical exam for induction							
2cm (n=487)	22 (5)	0.39	0.22–0.68	0.001	0.49	0.26–0.91	0.02
>2cm (n=135)	13 (10)	0.87	0.44–1.73	0.7	0.77	0.34–1.72	0.5
Indication for induction							
PROM (n=84)	3 (4)	0.30	0.089–1.02	0.053	0.44	0.13–1.54	0.20
Postterm (n=115)	4 (3)	0.29	0.10–0.85	0.025	0.42	0.14–1.27	0.12
Maternal (n=158)	11 (7)	0.61	0.30–1.26	0.18	0.73	0.32–1.66	0.45
Fetal (n=199)	12 (6)	0.52	0.26–1.05	0.069	0.63	0.29–1.35	0.24
Elective (n=66)	5 (8)	0.67	0.25–1.80	0.42	0.87	0.31–2.44	0.78

PROM: premature rupture of membranes

* Adjusted for race, maternal age, no prenatal care in subsequent pregnancy, cocaine use, and chronic hypertension

Table 5

Spontaneous preterm birth risk among different gestational age categories

Gestational age of delivery of index pregnancy (weeks) (n ¹ , n ²)	n (%) [*] sPTB among the induction group	n (%) ^{**} sPTB among the spontaneous labor group	OR ⁺	CI	p-value
37–38.9 (180, 76)	17 (9)	18 (24)	3.0	1.44–6.16	0.003
39–39.9 (148, 79)	6 (4)	7 (9)	2.3	0.75–7.10	0.15
40 [^] (294, 110)	12 (4)	4 (4)	0.89	0.28–2.81	0.8

* The percentage of sPTB among the induction group for each gestational age category.

** The percentage of sPTB among the spontaneous labor group for each gestational age category.

⁺ sPTB risk comparing spontaneous labor to induction - In this analysis, spontaneous labor is the exposure.

n¹ = total n for induction group for this gestational age category

n² = total n for the spontaneous labor group for this gestational age category

[^] Reported as a single category due to the lack of sPTB in the spontaneous labor group after 41 weeks