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Hypertension and patterns of induced labor at term

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Abstract

OBJECTIVE—To study patterns of induced labor at term in hypertensive women.

STUDY DESIGN—We performed a retrospective cohort study using the Consortium on Safe Labor database; a multicenter study of labor and delivery practices from electronic medical records in 19 hospitals. 55,572 women were studied: 28,254 nulliparas and 27,318 multiparas, undergoing induction of labor at term without a prior cesarean with a singleton vertex live born fetus. Four hypertensive groups were defined: chronic hypertension (n=1,164), gestational hypertension (n=1,861), preeclampsia (n=1,513) and superimposed preeclampsia (n=655), compared to controls (no hypertension, n=50,379). Labor characteristics and patterns were compared among the groups, stratified by parity.

MAIN OUTCOME MEASURES—Interval-censored regression analysis estimated median and 95th% duration of labor, stratified by centimeter-by-centimeter dilation. Repeated-measures analysis established mean labor curves.

RESULTS—Time to progress from 4 to 10 centimeters was 7.5, 6.4, 4.9 and 4.6 hours in nulliparous women with superimposed preeclampsia, chronic hypertension, preeclampsia and gestational hypertension respectively, which differed from controls (4.9 hours; p<0.05 for chronic hypertension and superimposed preeclampsia). Multiparous women required 3.8, 3.9, 3.2 and 3.3 hours, respectively, compared to controls (3.2 hours, p<0.05 except preeclampsia p=0.1) to progress from 4–10cm. Second stage of labor without epidural was longer for all nulliparous groups compared to controls except for women with chronic hypertension, but second stage did not differ in multiparas.

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CONCLUSION—Regardless of parity, women with chronic disease, chronic hypertension and superimposed preeclampsia, labor longer whereas those with relatively acute disease, gestational hypertension and preeclampsia, progress more rapidly.

Keywords

hypertension; labor; induction; preeclampsia

INTRODUCTION

Both acute and chronic forms of hypertensive disease can impact pregnancy outcomes and place women at higher risk of perinatal morbidity and mortality [1]. A common phenomenon within the spectrum of hypertensive disease lies in vascular endothelial dysfunction [1,2]. Dysregulation of endothelial-dependent mechanisms is thought to be involved in the pathophysiology of essential hypertension [3]. Prostacyclin (PGI₂) is a known vasodilator which is reduced in essential hypertension and preeclampsia [4]. This same prostaglandin is important in oxytocin receptor responsiveness and its inhibition and has been shown to prolong gestation in animal models [5]. What is not known is whether the clinical impact of these changes on labor differs based on the severity or chronicity of the hypertensive disease.

The scientific study of labor patterns began with labor curves, which Friedman first introduced in the 1950s [6]. These curves have been updated to account for the characteristics of a more contemporary population [7,8]. In regard to hypertensive disease and its impact on labor, the data is primarily limited to women with preeclampsia. Edwards and Witter [9] did not show clinically significant differences in the labor of nulliparas with preeclampsia compared to controls. However, they did demonstrate that labor induction in women with preeclampsia increased the risk of cesarean delivery and additional studies have confirmed this finding [9,10]. Investigations that evaluate labor patterns in women with gestational or chronic hypertension are lacking.

Since many women with hypertension require induction of labor, it is critical to study this population with respect to labor progress. Since preeclampsia is more common in nulliparas, we believed that research in these women had the greatest potential to impact clinical practice [1,9]. Multiparas progress more quickly through each stage of labor and have more successful inductions compared to nulliparas [11]. Therefore, hypertensive disease would be expected to have the least effect on labor in multiparas. The objective of this study was to determine whether hypertensive disease affects labor patterns in women undergoing induction of labor at term. We hypothesized that women with chronic disease progress more slowly than those with new onset disease, either gestational hypertension or preeclampsia, the latter of whom we expected to progress more quickly compared to controls.

MATERIALS AND METHODS

Data from the Consortium on Safe Labor (CSL) were used to conduct a retrospective cohort study. The CSL database includes electronic medical records from 12 clinical sites (19 hospitals) across the US collected between 2002 and 2008. The database contains detailed

information on maternal demographics, medical history, reproductive and prenatal history, labor, delivery and postpartum events as well as newborn information. Each site obtained institutional review board (IRB) approval when they joined the CSL.

Inclusion criteria for our study were women undergoing an induction of labor at term (37 weeks) who delivered a live born, non-anomalous, singleton in cephalic presentation. Women with eclampsia or a prior cesarean delivery were excluded. Only the first pregnancy in the database of each multipara was analyzed. Maternal characteristics included maternal age, race, body mass index (BMI), parity, comorbidities, and substance use. Labor and delivery characteristics included initial cervical exam, epidural use, method of induction, magnesium sulfate exposure, chorioamnionitis, operative vaginal or cesarean delivery, number of cervical exams, gestational age, and birthweight. Four groups of women with hypertensive diseases were identified including chronic hypertension, gestational hypertension, preeclampsia, or superimposed preeclampsia defined by the National High Blood Pressure Education Program Working Group on High Blood Pressure in Pregnancy and documented in the electronic medical record [12].

Maternal characteristics were analyzed using chi-squared and ANOVA tests as appropriate and both individual and group analyses were performed using women without hypertension as controls. In order to assess labor duration, at least two cervical exams were required, regardless of delivery mode. We performed an interval-censored regression analysis to estimate the time to progress from one integer of dilation to the next in centimeters assuming a log normal distribution reported as median and 95th percentiles. For this analysis, the parturient did not need to reach full dilation and therefore we included data from women who had cesarean deliveries prior to reaching full dilation. This analysis controlled for age, race, BMI, gestational age, substance use, maternal comorbidities, chorioamnionitis, and exposure to magnesium sulfate. Comparisons were performed between individual hypertensive study groups and controls as well as a group analysis, stratified by parity.

For women who achieved full dilation, a labor curve was constructed for each hypertensive group and controls, also stratified by parity. A full description of the methodology has been previously published [7]. A repeated-measures analysis with an eighth-degree polynomial mix model using SAS v9.2 was used to develop mean labor curves as described by Zhang et al [7,8].

RESULTS

We identified 213,514 pregnancies to be the first pregnancy of a woman recorded within the database. Of these, 55,572 women were undergoing induction of labor at term without a prior cesarean delivery; 28,254 were nulliparas and 27,318 were multiparas (Figure 1). Overall, among both nulliparous and multiparous women, we identified 1,164 women with chronic hypertension, 1,861 with gestational hypertension, 1,513 with preeclampsia, 655 with superimposed preeclampsia, and 50,379 controls. Regardless of parity, women with chronic hypertension and superimposed preeclampsia were more likely to be black or Hispanic and had more comorbidities when compared to controls. Women with hypertensive disease regardless of type had greater BMI's compared to controls ($p<0.05$; Table 1).

The labor and delivery characteristics are depicted in table 2. The mean gestational age at time of delivery was less for all hypertensive groups and greater than 80% of all nulliparas and more than two thirds of all multiparas had at least 5 cervical exams. For many women more than one induction agent was used. Pitocin was the most common agent used in all study groups ranging from 29.4% of preeclamptic women to 51.8% of women with gestational hypertension. AROM was the second most common induction method in the controls (12.9%) and gestational hypertensive group (35.7%), while in women with chronic hypertension it was administration of misoprostol (27.0%). Cesarean delivery occurred more often in women with chronic hypertension, preeclampsia and superimposed preeclampsia than controls or women with gestational hypertension. The indication for cesarean section was most commonly reported as failure to progress ranging from 55.73% in the preeclamptic women to 71.75% in the superimposed preeclamptic women. Cesarean section for non-reassuring fetal heart tones was the next most common indication in all groups ranging from 18.64% in the superimposed preeclamptic group to 28.87% in the controls.

The times to traverse through each centimeter of dilation, a composite of 4–10 cm as well as 2nd stage of labor are represented in Tables 3 and 4 for nulliparas and multiparas, respectively. Regardless of parity, women with chronic hypertension or superimposed preeclampsia required more time to progress from 4–10 cm. After 4–5 cm, women with gestational hypertension required less or equal time per centimeter interval of progress in the first stage of labor when compared to controls. Nulliparous women with gestational hypertension, preeclampsia or superimposed preeclampsia without an epidural required more time for second stage of labor compared to controls. No differences were found among the groups in the second stage of labor for multiparous women.

The mean labor curves are depicted in Figures 2 (nulliparas) and 3 (multiparas). Women with gestational hypertension or preeclampsia reached full dilation faster than controls, whereas those with chronic hypertension or superimposed preeclampsia required more time, irrespective of parity.

DISCUSSION

Hypertension in pregnancy requires careful clinical surveillance especially at term when induction of labor is often indicated. We found that regardless of whether they reach full dilation, women with chronic hypertension and superimposed preeclampsia require longer time to progress through labor overall compared to controls. For women who reach full dilation, as displayed in the labor curves, those with gestational hypertension and preeclampsia follow a more rapid pattern than controls. These findings suggest that women with chronic disease may benefit from allowing more time to labor, regardless of parity. Despite the more rapid labor patterns of multiparas, we demonstrated significant differences in the first stage but not the second stage of induced labor among the hypertension and control groups. These findings suggest that hypertensive diseases do play a role in labor progress in both nulliparas and multiparas.

The study of labor in women with hypertensive disease has previously been limited to women with preeclampsia [9,10,14,15]. The Hypertension and Pre-eclampsia Intervention

Trial at Term (HYPITAT) study demonstrated that induction of labor reduces morbidity and mortality associated with preeclampsia and gestational hypertension [15]. However, they did not focus on labor patterns. Edwards and Witter [9] were not able to demonstrate a difference in the labor of nulliparas with preeclampsia undergoing induction compared to controls. Their increased cesarean rate was confirmed in one investigation [10], but not in the HYPITAT trial [15].

We suspect that the acuity of the disease process involved in preeclampsia and gestational hypertension may account for the more rapid pattern noted in our labor curves. Given that Prostacyclin (PGI₂) is down regulated in chronic hypertension and has been demonstrated in animals to play an important role in uterine responsiveness to oxytocin with inhibition prolonging gestation, it is possible that this mechanism could explain the differences in labor patterns we have demonstrated [4,5]. Whereas women with chronic hypertension have accommodated to higher intravascular pressure and have long-standing endothelial dysregulation, those with gestational hypertension or preeclampsia have a shorter disease process with less time for such accommodation. As such, it is possible that the adaptation of the uteroplacental unit in the more acute disease processes to inflammatory mediators and their byproducts such as prostacyclin are less marked. We speculate that these mechanisms may lead to a uterus more ready to respond to labor signals, whereas the adaptations in women with chronic disease states may lead to a slower, less effective response. This theory will require much further investigation. Although as many as 46% of women with gestational hypertension will develop preeclampsia, the disease itself is thought to be distinct and the pattern of labor in women with gestational hypertension that we noted was significantly more rapid than those with preeclampsia [16,17].

Previous studies have examined whether magnesium sulfate, a known tocolytic, influences labor progress and delivery route outcomes [13,14]. Randomized double blinded placebo controlled trials have concluded that the only effect that magnesium has on labor is that higher doses of oxytocin were required to achieve a vaginal delivery [13,14]. In our study, magnesium sulfate use varied among the groups and did not appear to prolong labor. In fact, the two groups with the highest magnesium sulfate administration, women with preeclampsia and superimposed preeclampsia, had very different labor patterns. According to the labor curves, women with preeclampsia progressed rapidly through the 1st stage of labor. For nulliparous women, the median traverse times and 95th percentiles were 4.9 (17.2) hours and 7.5 (26.4) hours to progress from 4–10 cm in women with preeclampsia and superimposed preeclampsia, respectively. Of note, approximately 1–2% of controls and 14–20% of women without the diagnosis of preeclampsia received magnesium during their labor. Misclassification of the hypertensive groups or magnesium use for seizure prophylaxis in women at increased risk for developing preeclampsia may account for the differences. For example, women with severe chronic hypertension or gestational hypertension may have received magnesium in the absence of proteinuria at the discretion of the clinician. We controlled for magnesium use in the median traverse time analysis and it had no effect on the labor progress we reported. Furthermore, after repeating the analysis removing all women from the control, chronic hypertension, and gestational hypertension groups who were labeled as being treated with intrapartum magnesium sulfate, we found no differences in the median traverse times in both nulliparas and multiparas (data not shown). We conclude that

even if there was misclassification of groups, the effect of magnesium sulfate on median traverse times was negligible.

Edwards and Witter [9] have shown that women with preeclampsia have a higher risk of cesarean delivery than their case matched controls. They suggested that the difference was related to the responsiveness to oxytocin and arrest disorders rather than the disease urgency. If we consider that women with chronic hypertension or superimposed preeclampsia require more time to reach full dilation, it is possible that allowing more time to progress through labor may minimize the risk of cesarean delivery for arrest disorders. This idea, however, will require further investigation.

Labor induction has more than doubled over the past 3 decades with as many as 23.8% of all gravid women undergoing induction of labor in the United States in 2010 [18]. There is no method of labor induction that has been shown to be superior to another and practices vary widely across the country. In our retrospective study across multiple centers we were unable to dictate the method of induction, and there was a fair amount of data that was missing regarding the specific modes of induction which limited our ability to incorporate it into our analysis. However, the information collected reflects actual practice. The majority of women received oxytocin for induction, one of the most commonly used drugs for this purpose in the United States. While women with pregnancies complicated by hypertension are known to have a higher incidence of intrauterine growth restricted (IUGR) fetuses who may be unable to tolerate labor or titration of induction agents, the indications for cesarean section actually reflect similar rates of fetal intolerance to labor and failure to progress among all study groups suggesting that the groups were similarly affected.

We conducted a retrospective cohort analysis of a large multicenter database. The size and diversity of the women included in the database increases the application of our findings to most populations and minimizes the subjective nature inherent to the study of labor. However, its retrospective approach limited our ability to determine whether the findings were cause or effect. In addition, the diagnoses of the four groups of hypertensive diseases could not be verified in the database, so we relied on the clinical decisions of the individual clinicians as well as their documentation and coding practices. High concordance was reported when the database was reviewed for four common outcomes, as reported in the primary study [19].

The labor duration analysis was performed via two methods. We compared centimeter by centimeter progress by interval-censored regression analysis and also constructed labor curves through repeated-measures analysis. Characteristics of the data such as variance and skew contribute to the statistical comparison in the linear regression employed in the centimeter by centimeter progress analysis. As such, the data may differ statistically despite similar medians and 95th percentiles. In addition, the interval censored regression analysis included women who did not necessarily reach full dilation and may have required cesarean delivery prior to reaching full dilation. As such, the data could be confounded by dysfunctional labor patterns in the first stage of labor. In contrast, in order to construct a labor curve a woman must reach full dilation and therefore the labor curves are more representative of normal labor patterns in the first stage.

CONCLUSIONS

Women with hypertensive disease often require induction of labor to minimize the risk to both maternal and fetal well-being. Understanding the pattern of labor in these women is instrumental to their care. We sought to determine whether labor in women induced at term with pregnancies complicated by hypertensive disease differed from normotensive controls. We report that women with a more chronic disease process such as chronic hypertension or superimposed preeclampsia required more time to progress through the first stage of labor. Alternatively, women with gestational hypertension or preeclampsia progressed more rapidly through their induction to reach full dilation as demonstrated in the labor curves. This pattern was not borne out in the median traverse times which included labor data from women who did not reach full dilation and therefore may be confounded by dysfunctional patterns in their first stage of labor. These findings suggest that women with chronic hypertension or superimposed preeclampsia may benefit from allowing more time in the first stage of labor and that such practice may decrease the risk of cesarean delivery; however this concept requires further investigation. Whether the chronicity of the disease impacts the ability of the uteroplacental unit to respond to the signals of labor also warrants further exploration.

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ABBREVIATIONS

CSL	Consortium on Safe Labor
IRB	Institutional Review Board
BMI	Body Mass Index
HYPITAT	Hypertension and Pre-eclampsia Intervention Trial at Term

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HIGHLIGHTS

- A comparison of labor patterns in hypertensive women undergoing labor induction at term was performed
- Labor requires more time in women with superimposed preeclampsia or chronic hypertension compared to controls
- Labor requires less time in women with gestational hypertension compared to controls
- It is possible that women with more chronic disease such as chronic hypertension and superimposed preeclampsia may exhibit adaptations leading to a slower less effective uterine response to labor signals

Figure 1. Flow Diagram for Participant Selection

Women delivering a liveborn non-anomalous singleton at term (≥ 37 weeks) in vertex presentation undergoing labor induction. Data were collected from the first pregnancy only for each woman in the database. Only women with a trial of labor, defined as at least two vaginal exams, were included.

CHTN-chronic hypertension, GHTN-gestational hypertension, PreE-preeclampsia

Figure 2. Labor Curves for Nulliparous Women

Labor curves for each hypertensive group and controls.

Control black, chronic hypertension blue, gestational hypertension red, preeclampsia green, superimposed preeclampsia purple.

HTN-hypertension, PreE-Preeclampsia, cm-centimeter, h-hours

Figure 3. Labor Curves for Multiparous Women

Labor curves for each hypertensive group and controls.

Control black, chronic hypertension blue, gestational hypertension red, preeclampsia green, superimposed preeclampsia purple.

HTN-hypertension, PreE-Preeclampsia, cm-centimeter, h-hours

Table 1

Characteristics of Parturients

Nulliparous					Multiparous					
	Control	CHTN	GHTN	PreE	SIPE	Control	CHTN	GHTN	PreE	SIPE
N	25000	578	1197	1093	386	25379	586	664	420	269
Age (y)	25.9(6)	26.7(6)	24.7(5)	25.4(6)	24.8(6)	29(5)	31(6)	29(5)	31(6)	31(6)
Race										
White	12151(51)	172(30)	782(67)	626(61)	114(30)	14714(60)	143(25)	420(66)	212(54)	63(24)
Black	5243(22)	223(39)	209(18)	203(20)	149(39)	4503(18)	276(48)	122(19)	1071(26)	118(45)
Hispanic	4516(19)	141(25)	138(12)	125(12)	90(24)	3947(16)	118(21)	85(13)	52(13)	63(24)
Asian/pacific islander	1342(6)	3(<1)	21(2)	52(5)	5(1)	756(3)	11(2)	8(1)	21(5)	6(2)
Other	692(3)	31(5)	15(1)	20(2)	20(5)	541(2)	27(5)	7(1)	9(2)	13(5)
BMI (kg/m ²)	30.6(6)	36.3(8)	33.3(6)	33.8(6)	34.9(7)	31(6)	37(8)	35(7)	35(7)	36(8)
Tobacco Use										
	1155(5)	26(5)	43(4)	29(3)	19(5)	1489(6)	41(7)	26(4)	21(5)	21(8)
Comorbidities ^B										
	2137(9)	121(21)	101(8)	96(9)	55(14)	2310(9)	144(25)	69(10)	59(14)	51(19)

^AData expressed as mean ($\pm$ SD) or N (%)^BComorbidities include a composite of gestational and pregestational diabetes, renal disease, heart disease or thromboembolic history.

All p values were 0.02 for both group and individual comparisons using Chi squared for categorical and ANOVA tests for continuous variables.

CHTN=chronic hypertension, GHTN=gestational hypertension, PreE=preeclampsia, SIPE=superimposed preeclampsia

Table 2

Labor and Delivery Characteristics

	Nulliparous						Multiparous					
	Control	CHTN	GHTN	PreE	SIPE	Control	CHTN	GHTN	PreE	SIPE	Control	CHTN
N	25000	578	1197	1093	386	25379	586	664	420	269		
Cervical Exam on Admission												
Dilation (cm)	1.9 (1.5)	1.6 (1.6)	1.7 (1.3)	1.6 (1.4)	1.7 (1.5)	2.6 (1.4)	2.3 (1.4)	2.3 (1.2)	2.2 (1.4)	2.3 (1.5)		
Effacement (%)	65.0 (25)	53.5(33)	62 (23)	58.0 (25)	54.6 (32)	64 (21)	53 (27)	63 (21) ^D	55 (22)	55 (27)		
Station	-2.0 (1.2)	-2.5(1.5)	-2 (1.4) ^C	-2.1 (1.1)	-2.2 (1.5)	-1.9 (1.3)	-2.5 (1.3)	-1.9 (1.4) ^C	-2.2(1.2)	-2.3 (1.4)		
Labor Characteristics												
Epidural	14329(68)	295 (60)	633 (62)	379 (51)	200 (55)	14603 (67)	237 (49)	410 (70)	127 (50)	108 (46)		
Magnesium sulfate	498 (2)	45 (13)	219 (20)	364 (33)	87 (42)	174 (<1)	29 (7)	87 (15)	113 (27)	54 (29)		
Chorioamni onitis^C	1710 (7)	27 (5)	42 (4)	35 (3)	10 (3)	233 (0.9)	3 (0.5)	3 (0.5)	5 (1.2)	1 (0.4)		
> 5 vaginal exams	20491 (82)	469 (81)	1076 (90)	969 (89)	338 (88)	18846 (74)	404 (69)	532 (80)	338 (80)	225 (84)		
Delivery Characteristics												
Operative delivery^{B,C}	2429 (8)	23 (4)	179 (15)	106 (10)	23 (6)	1075 (4)	19 (3)	31 (5)	21 (5)	8 (3)		
Cesarean delivery	7433 (30)	274 (48)	311 (26)	436 (40)	177 (46)	1495 (6)	81 (14)	43 (6)	62 (15)	42 (16)		
Gestational age (wks)	39.7 (1.2)	38.9(1.2)	38.9 (1)	38.9 (1.2)	38.6 (1.2)	39.3 (1)	38.7 (1)	38.6 (1)	38.7 (1)	38.5 (1)		
Birth weight (g)	3363 (455)	3256(448)	3276(460)	3277(494)	3160(472)	3428(446)	3302(506)	3347(474)	3289(488)	3252(497)		

^AData expressed as mean ($\pm$ SD) or N (%)

^BVacuum or forceps assisted vaginal delivery

^CP-value >0.05 for both group and individual comparisons of the hypertensive groups to the controls using Chi-square for categorical and ANOVA tests for continuous variables; otherwise all other comparisons have a p-value <0.05.

CHTN-chronic hypertension, GHTN-gestational hypertension, PreE-preeclampsia, SIPE-superimposed preeclampsia

Table 3

Duration of Labor for Nulliparous Parturients

Cervical Dilation (cm)	Control	CHTN	GHTN	PreE	Superimposed PreE
Parturients (N)	25000	578	1197	1093	386
First Stage	Hours-Median (95th %)				
3-4	2.1 (11.7)	1.5 (8.5)	1.9 (11.1)	2.1 (12.2)	3.5 (20.2)
4-5	1.2 (6.0)	1.7 (8.3)	1.2 (5.8)	1.3 (6.5) ^A	2.7 (13.4)
5-6	0.8 (3.4)	1.4 (5.8)	0.7 (3.1)	0.8 (3.3)	1.3 (5.5)
6-7	0.6 (2.1)	0.7 (2.5)	0.5 (1.7)	0.6 (2.3)	0.6 (2.2) ^A
7-8	0.5 (1.7)	0.6 (1.8)	0.4 (1.4)	0.5 (1.6) ^A	0.4 (1.4)
8-9	0.5 (1.6)	0.4 (1.3)	0.4 (1.2)	0.5 (1.5) ^A	0.4 (1.4) ^A
9-10	0.6 (2.0)	0.5 (1.8) ^A	0.6 (1.9)	0.5 (1.8) ^A	0.5 (1.6)
4-10	4.9 (17.1)	6.4 (22.7)	4.6 (16.0) ^A	4.9 (17.2)	7.5 (26.4)
Second Stage	Minutes-Median (95th %)				
No epidural	62 (93)	49 (83) ^A	66 (96)	83 (105)	72 (110)
Epidural	93 (133)	86 (109) ^A	93 (116)	87 (119) ^A	67 (115) ^A

^A p>0.05, otherwise all p values are <0.05 in both group and individual comparisons using interval censored regression analysis

CHTN=chronic hypertension, GHTN=gestational hypertension, PreE=preeclampsia. Analysis was controlled for age, race, BMI, gestational age, substance use, maternal comorbidities, chorioamnionitis, and exposure to magnesium sulfate.

Table 4

Duration of Labor for Multiparous Parturients

Cervical Dilation (cm)	Control	CHTN	GHTN	PreE	Superimposed PreE
Parturients (N)	25379	586	664	420	269
First Stage	Hours-Median (95 th %)				
3-4	2.3 (13.9)	2.4 (14.2) ^A	2.6 (15.9)	2.0 (11.7)	2.8 (17.0)
4-5	1.0 (5.3)	1.4 (6.8)	1.4 (7.1)	1.0 (4.9)	1.5 (7.4)
5-6	0.6 (2.4)	0.8 (3.1)	0.6 (2.2)	0.7 (2.9)	0.8 (3.0) ^A
6-7	0.4 (1.4)	0.4 (1.3)	0.4 (1.3)	0.4 (1.3)	0.4 (1.4)
7-8	0.3 (0.8)	0.3 (0.8)	0.3 (0.8)	0.3 (0.9) ^A	0.4 (0.9)
8-9	0.3 (0.7)	0.3 (0.7) ^A	0.3 (0.7)	0.3 (0.7) ^A	0.3 (0.7) ^A
9-10	0.3 (0.8)	0.3 (0.7)	0.3 (0.7)	0.3 (0.7)	0.3 (0.9)
4-10	3.2 (13.5)	3.9 (16.1)	3.5 (14.8)	3.3 (13.9) ^A	3.8 (15.7)
Second Stage	Minutes-Median (95 th %)				
No epidural ^A	22 (26)	17 (25)	18 (23)	23 (29)	13 (17)
Epidural ^A	28 (41)	21 (37)	27 (35)	34 (50)	40 (57)

^A p>0.05, otherwise all p values are <0.001 in both group and individual comparisons using interval censored regression analysis

CHTN-chronic hypertension, GHTN-gestational hypertension. PreE-preclampsia Analysis was controlled for age, race, BMI, gestational age, substance use, maternal comorbidities, chorioamnionitis, and exposure to magnesium sulfate.