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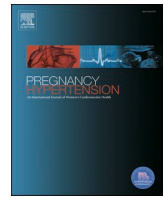
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Factors associated with attendance at the postpartum blood pressure visit in pregnancies complicated by hypertension

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ABSTRACT

Objectives: Women with hypertensive disorders of pregnancy should have a blood pressure evaluation no later than 7–10 days after delivery. The objective of this study was to identify the factors associated with patient attendance at the postpartum blood pressure follow-up visit.

Study design: This was a retrospective cohort study of postpartum women who had a hypertensive disorder of pregnancy. Postpartum follow-up rates were recorded, and characteristics of women who attended a postpartum visit for blood pressure evaluation were compared to women who did not return for the visit. Multiple logistic regression was performed.

Main outcome measures: Characteristics of women who returned for a blood pressure visit.

Results: There were 378 women who met inclusion criteria; 193(51.1%) attended the blood pressure visit. Women who returned were older and more likely to have preeclampsia, severe features, magnesium sulfate use, or severe hypertension during hospitalization. They were less likely to have gestational hypertension. Adjusted analysis demonstrated that black/non-Hispanic women (OR 0.53, 95% CI 0.34–0.83), the presence of any preeclampsia diagnosis (OR 2.19, 95% CI 1.03–4.81), and whether the woman underwent a cesarean delivery (OR 3.06, 95% CI 1.85–5.14) remained significant factors in predicting adherence.

Conclusions: Women who returned for a blood pressure visit were more likely to have had significant hypertensive disease or a cesarean delivery. Non-Hispanic black women had the lowest rate of follow-up. Given black women have the highest rates of maternal morbidity and mortality nationwide, effective interventions to increase follow-up for them are needed.

1. Introduction

Hypertensive disorders of pregnancy (HDP) are among the leading causes of maternal and perinatal morbidity and mortality worldwide [1]. In addition, women who suffer from HDP are at an increased risk for chronic hypertension and cardiovascular disease later in life [2,3]. The American College of Obstetricians and Gynecologists (ACOG) has previously recommended that women with HDP have a blood pressure evaluation no later than seven to ten days after delivery, and that women with severe hypertension should be seen within 72 h [4]. Early

postpartum blood pressure evaluation is important because the majority of readmissions for postpartum stroke occur within ten days of discharge postpartum [5], and readmissions for heart failure in women with HDP occur, on average, 11 days after discharge [6]. For these reasons, it is imperative that these high-risk women be monitored closely after discharge from the hospital, so that medical providers may have a better opportunity to identify disease early and intervene before serious consequences occur. Unfortunately, adherence to the traditional postpartum visit is notoriously low in the United States, especially in minority populations [7,8], but less is known about adherence to the

Abbreviations: HDP, hypertensive disorders of pregnancy; BP, blood pressure.

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blood pressure visit. Therefore, it is prudent to identify which patients will be less likely to attend a blood pressure evaluation, so that interventions to increase adherence may be attempted. The objective of this study was to identify the factors that are associated with patient attendance at the postpartum blood pressure follow-up visit at an urban, academic center.

2. Methods

This was a retrospective cohort study of postpartum women with a HDP. This cohort was derived from a separate study that began as a quality improvement project assessing the effect of implementing a post-birth warning signs education protocol to women after delivery. In February 2018, the study center, University Hospital, Newark, New Jersey, developed a protocol that required all postpartum patients to receive post-birth warning sign discharge instructions, as originally developed and promoted by the Association of Women's Health, Obstetric and Neonatal Nurses (AWHONN) [9]. Nursing staff was required to provide both verbal and written post-birth warning sign instructions to all women prior to discharge from the hospital after giving birth. English language refrigerator magnets containing these instructions were also distributed to patients. The study period was March to August 2017 and March to August 2018. This time period was chosen so that 6 months would be assessed prior to and after the protocol was implemented in February 2018. The same months of the year were chosen to avoid any seasonal differences in delivery rates. This quality improvement project did not demonstrate any difference in postpartum follow-up after protocol implementation [10]. Given that there was no difference in follow-up rates between these two cohorts, the groups were analyzed as a single group for the current study. This study was approved by the Rutgers New Jersey Medical School Institutional Review Board. Informed consent was waived.

Postpartum women with a HDP were provided with scheduled appointments for a blood pressure evaluation (3–10 days after birth) and a traditional postpartum visit (3–4 weeks preferred, but up to 6 weeks after birth is acceptable). Those with preeclampsia or chronic hypertension were also provided with a prescription for an automated blood pressure monitor and were instructed to measure their blood pressure two times daily and record the results. Women assigned to home blood pressure assessment were advised to bring these logs to their blood pressure and postpartum visits. Patients were counseled to report to the clinic or hospital if experiencing any signs or symptoms suggestive of severe features of preeclampsia. Assessment at the blood pressure evaluation visits included taking vital signs, a history and a focused physical examination by a physician or advanced practice nurse who also reviewed postpartum home blood pressure logs. For data collection, blood pressures at these visits were recorded as normal (less than 140/90 mmHg), elevated (140–159/90–109 mmHg), or severe (greater than 160/110 mmHg). If women had elevated blood pressures at these visits, antihypertensive medications would be adjusted if patients were already taking them, or they would be started on medication if indicated. These women would also be referred to a primary care physician for long-term blood pressure management. Women with an HDP who also underwent a cesarean delivery were scheduled for a single provider visit 7 to 10 days after delivery for blood pressure and wound evaluation.

Women were identified by departmental delivery records. Women were included if they carried a diagnosis of a hypertensive disorder of pregnancy, which included (1) chronic hypertension, (2) gestational hypertension, (3) preeclampsia without severe features, (4) preeclampsia with severe features, (5) chronic hypertension with superimposed preeclampsia without severe features, (6) chronic hypertension with superimposed preeclampsia with severe features, (7) eclampsia, or (8) hemolysis elevated liver enzymes and low platelets (HELLP) syndrome. Women who met the above criteria also had to have been delivered and discharged from University Hospital in the puerperium during the study period to be included. Women were excluded if they

had delivered elsewhere and were not discharged from our institution. For the current study, all women meeting inclusion criteria were included regardless of if they delivered in the pre- or post-protocol implementation time period.

Electronic medical records of included women were reviewed and data were collected. Data collected included maternal demographic information and medical history, delivery method and medical interventions received during hospitalization, hypertensive diagnosis, and laboratory information relevant to a HDP, including highest protein-to-creatinine ratio, serum creatinine, aspartate aminotransferase, alanine aminotransferase (ALT), lactate dehydrogenase, uric acid, and lowest platelet count. Postpartum follow-up information including if they attended a blood pressure evaluation within 10 days postpartum, a postpartum visit (separate from the blood pressure evaluation visit), or if they were re-hospitalized or had an emergency department visit within six months after delivery was also collected.

Two comparison groups were created for this study; (1) women who attended a postpartum blood pressure evaluation (BP visit) and (2) women who did not attend a postpartum blood pressure evaluation (no BP visit). A Shapiro-Wilk test was used to determine normality of the data. Mean with standard deviation was reported for normally distributed data and median with interquartile range was reported for non-normally distributed data. Characteristics between the groups were compared using a Fisher's Exact test for categorical variables and a Student T-test or Mann-Whitney U for continuous variables. A *P* value less than 0.05 was considered statistically significant. After univariate comparison and calculation of odds ratios with 95% confidence intervals, multivariate logistic regression analysis was conducted. A logistic regression model was developed with attendance at the BP visit as the dependent variable and the following independent variables: age, gestational age at delivery, black/non-Hispanic race and ethnicity, preeclampsia, severe features, and cesarean delivery. These variables were chosen due to their significant difference in the univariate analysis. Adjusted odds ratios and 95% confidence intervals were reported. Data were analyzed using Prism 8 (version 8.3.1).

3. Results

There were 378 women who met inclusion criteria during the study period; 193 (51.1%) attended the BP visit and 185 did not. The basic demographics of the two cohorts are shown in Table 1. Women who returned for the BP visit were significantly older, delivered at an earlier median gestational age, and were less likely to be black/non-Hispanic (OR 0.54, 95% CI 0.36–0.82).

Women in the BP visit group were more likely to have the diagnosis of preeclampsia (OR 2.05, 95% CI 1.33–3.13) or severe features (OR 1.78, 95% CI 1.15–2.82). They were also more likely to have taken an antihypertensive agent during pregnancy, received magnesium sulfate,

Table 1
Basic demographics of hypertensive cohort.

Characteristic	BP visit attended (n = 193)	BP visit not attended (n = 185)	<i>P</i> - value
Age (years)	29.8 ± 6.7	27.7 ± 6.6	0.002
Gravidity	3 (2)	3 (4)	0.791
Parity	2 (2)	2 (2)	0.381
Gestational age at delivery (days)	270 (18)	274 (17)	0.003
BMI (kg/m ²)	33.8 (9.3)	34 (9.8)	0.889
Birthweight (g)	3123 (750)	3155 (673)	0.420
Apgar 1 min	9 (1)	9 (1)	0.024
Apgar 5 min	9 (0)	9 (0)	0.142
Black/non-Hispanic, n (%)	101 (52.3)	124 (67)	0.005
Hispanic, n(%)	76 (39.4)	55 (29.7)	0.052

Data presented as mean ± standard deviation or median (IQR) unless otherwise specified, BP = blood pressure, BMI = body mass index.

had a blood pressure in the severe range (greater than or equal to 160 mmHg systolic or 110 mmHg diastolic) during hospitalization, or have received furosemide postpartum. They more often delivered via cesarean (OR 3.67, 95% CI 2.26–5.94). The BP visit group was over three times more likely to have an Emergency Department visit due to hypertension (OR 3.07, 95% CI 1.25–7.57) or return for a postpartum visit (OR 3.47, 95% CI 2.23–5.43). They were less likely to have the diagnosis of gestational hypertension (Table 2).

When assessing differences in laboratory results between the women in both groups, the BP visit group had a lower mean platelet count (182 ± 52 vs 194 ± 57 cells $\times 10^3/\mu\text{L}$, $P = 0.032$). This group also had higher median ALT and uric acid values (Table 3).

The multivariate logistic regression model demonstrated that black/non-Hispanic race and ethnicity, the presence of any preeclampsia diagnosis, and whether the woman underwent a cesarean delivery remained significant factors in predicting adherence or non-adherence to the blood pressure visit (Table 4).

4. Discussion

In this historical cohort, we identified factors associated with patient attendance at the postpartum blood pressure visit in pregnancies complicated by hypertension. In the univariate analysis, women who were most likely to return had evidence of preeclampsia and severe disease during delivery. They were also more likely to have delivered by cesarean, and were less likely to have a diagnosis of gestational hypertension or be black/non-Hispanic. The adjusted analysis demonstrated that the presence of preeclampsia and cesarean delivery were significantly more frequent in those who attended the BP visit, and women of black/non-Hispanic race were less likely to attend. Women who presented for their BP visit were over three times more likely to attend their

Table 2

Characteristics of women with hypertensive disorders of pregnancy who attend a postpartum blood pressure visit.

Characteristic	BP visit attended (n = 193)	BP visit not attended (n = 185)	Odds Ratio	95% Confidence Interval
History of hypertensive disorder of pregnancy	66 (34.2)	50 (27)	1.40	0.90–2.17
Gestational HTN	78 (40.4)	102 (55.1)	0.55	0.36–0.83
Chronic HTN	23 (11.9)	26 (14.1)	0.83	0.46–1.53
Preeclampsia (any)	92 (47.7)	57 (30.8)	2.05	1.33–3.13
Severe features	69 (35.8)	44 (23.8)	1.78	1.15–2.82
Pregestational diabetes	11 (5.7)	8 (4.3)	1.34	0.54–3.30
Gestational diabetes	17 (8.8)	15 (8.1)	1.10	0.55–2.26
Antihypertensive agent taken during pregnancy	18 (9.3)	6 (3.2)	3.07	1.25–7.57
Cesarean delivery	82 (42.5)	31 (16.8)	3.67	2.26–5.94
Magnesium sulfate use	68 (35.2)	43 (23.2)	1.80	1.16–2.78
Severe range BP during hospitalization	68 (35.2)	44 (23.8)	1.74	1.13–2.76
IV antihypertensive	49 (25.4)	33 (17.8)	1.57	0.95–2.59
Aspirin use during pregnancy	16 (8.3)	8 (4.3)	2.00	0.87–4.55
Readmission for HTN postpartum	10 (5.2)	3 (1.6)	3.32	0.96–11.36
Emergency room visit for HTN postpartum	18 (9.3)	6 (3.2)	3.07	1.25–7.57
Furosemide taken postpartum	57 (29.5)	31 (16.8)	2.08	1.27–3.45
Postpartum visit attended	148 (76.7)	90 (48.7)	3.47	2.23–5.43

Data presented as n (%), BP = blood pressure, HTN = hypertension, IV = intravenous.

Table 3

Laboratory characteristics of women who attend a postpartum blood pressure visit.

Laboratory test	BP visit attended	BP visit not attended	P-value
Urine protein-to-creatinine ratio	0.25 (0.39)	0.21 (0.26)	0.098
Lowest platelet count (cells $\times 10^3/\mu\text{L}$) (mean \pm SD)	182 ± 52	194 ± 57	0.032
Creatinine (mg/dL)	0.6 (0.2)	0.6 (0.2)	0.201
AST (U/L)	21 (9)	19 (10)	0.255
ALT (U/L)	13 (8)	11 (8)	0.045
Uric acid (mg/dL)	5.1 (2)	4.8 (1.5)	0.009
Lactate dehydrogenase (U/L)	211 (87)	206 (79.5)	0.689

Data presented as median (IQR) unless otherwise specified.

BP = blood pressure, AST = aspartate aminotransferase, ALT = alanine aminotransferase.

Table 4

Adjusted odds ratios for characteristics of women who attend a postpartum blood pressure visit.

Characteristic	Odds Ratio	95% CI
Age	1.02	0.99–1.06
Gestational age at delivery	0.99	0.98–1.00
Black/non-Hispanic	0.53	0.34–0.83
Preeclampsia (any)	2.19	1.03–4.81
Severe features	0.70	0.30–1.59
Cesarean delivery	3.06	1.85–5.14

traditional postpartum visit or have an Emergency Department visit for hypertension.

Postpartum blood pressure monitoring and follow-up in women with hypertension is essential. A short-interval visit to review blood pressure logs and assess for signs or symptoms of severe disease is practical because providers may identify and address disease before decompensation occurs. The majority of postpartum strokes and cases of heart failure, which are often complications of hypertensive disease, occur within 10–11 days after discharge postpartum. Eclamptic seizures postpartum can also occur, and are often preceded by symptoms [11]. Failure to be assessed in this timeframe may result in a worse initial presentation of disease. Although ACOG previously recommended a BP visit within 10 days postpartum, in their latest guidance on gestational hypertension and preeclampsia, this particular follow-up was no longer discussed [12]. However, ACOG does recommend in their most recent Committee Opinion on optimizing postpartum care that hypertensive women should have a blood pressure evaluation no later than 7–10 days after delivery. Based on existing literature, it would appear that this recommendation is justified.

Women with chronic diseases like hypertension and diabetes mellitus benefit from postpartum follow-up so navigation to primary care providers and specialists for continued medical care can occur. Several of the elements of the standard postpartum visit, such as discussing adverse pregnancy outcomes, cardiovascular disease risk assessment, and addressing chronic health conditions may also be discussed at the BP visit. Descriptions of interdisciplinary postpartum clinics that meet with women diagnosed with preeclampsia to discuss cardiovascular risk reduction have been published [13]. This visit provides women with an additional opportunity for assessment by a provider, which is important in light of the poor rate of postpartum follow-up.

It is widely recognized that there is a low rate of postpartum follow-up in the United States. Investigations into why women fail to attend postpartum visits have revealed that socioeconomic factors play a large role. Women who are younger, of ethnic-minority groups, and have Medicaid or no insurance are less likely to attend a postpartum visit [7,14]. Low-income, single-status, and fewer than five prenatal visits during the pregnancy are also predictors of non-attendance. Women who undergo cesarean delivery are more likely to attend a postpartum

visit [15,16]. Our study discovered similar factors affecting attendance at the blood pressure visit.

Strengths of this study include the large number of hypertensive women evaluated over a 12-month timeframe and the significant data obtained via regression analysis. These results are likely to be applicable to similar urban, minority patient populations. A limitation of the study is the narrow demographic diversity of our cohort, which included primarily black non-Hispanic and Hispanic women. Another potential limitation is the possibility that patients returned to outside providers for postpartum evaluation, although this number was likely small given our protocol to schedule women for postpartum visits in our network prior to discharge. We also would not expect this small number to affect the results.

It is important to address barriers with women that may limit their ability to return for the BP visit postpartum. This can be assessed prior to hospital discharge, in the form of a questionnaire or other query investigating factors that may hinder their ability to follow-up. If any of these postpartum hypertensive women verbalize barriers, then a social worker/case manager may be consulted to assist with any and all barriers encountered. The healthcare team can then provide patients with the necessary resources to facilitate a return for the BP visit, which may require an outreach program.

Some investigators have developed specific protocols to increase compliance and monitor hypertensive women in the postpartum period, such as via call-center driven blood pressure management [17] or text-based remote monitoring [18]. Others have provided tablets to postpartum women so they can participate in telehealth visits [19]. These studies are limited but results appear promising in obtaining postpartum blood pressure measurements of hypertensive women, though in-person assessment is lost using these protocols.

Our results provide important information for obstetric providers. The study identifies characteristics of women who attend and fail to attend the BP visit, and underscores the need for interventions to increase follow-up. This study also provides another example of health disparities present for African-American women, who returned for a BP visit half as often as other patients in this cohort. African-American women have the highest rate of maternal morbidity and mortality in the United States [20–22], and therefore it is essential to improve follow-up rates for these women.

5. Conclusions

There are several factors that are associated with adherence to the postpartum blood pressure visit for women with HDP. Hypertensive non-Hispanic black women were unlikely to attend a blood pressure evaluation visit following delivery in this cohort. Those who did return more often had preeclampsia and were more likely to have undergone a cesarean delivery. Counseling women prior to discharge on the importance of follow-up is imperative. Given the long-term cardiovascular risks and increased mortality in women with HDP, effective interventions to increase adherence to postpartum visits are essential.

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Declaration of Competing Interest

The authors declare that they have no known competing financial

interests or personal relationships that could have appeared to influence the work reported in this paper.

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