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Home blood pressure measurement in women with pregnancy-related hypertensive disorders

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ABSTRACT

Objectives: To determine if home blood pressure measurement (HBPM) provides comparable results to clinic blood pressure (BP) measurement.
Study design: A prospective, single-centre study of 37 pregnant and early post-partum women with a hypertensive pregnancy or at high-risk of developing a hypertensive pregnancy were asked to perform HBPM for a minimum period of one week. This was subsequently compared to clinic BP measurement both before and after the period of home measurement.
Main outcome measures: The accuracy of HBPM compared to clinic measurement, and the acceptability by patients for HBPM.
Results: The HBPM was comparable to clinic measurements [for the systolic blood pressure (SBP), the mean home reading was 123.4 mmHg (122.0–124.9 mmHg) versus 123.9 mmHg (121.3–126.5 mmHg) for the clinic reading ($p = 0.69$); for the diastolic blood pressure (DBP) the mean home reading was 81.6 mmHg (80.4–82.8 mmHg) versus 84.4 mmHg (82.6–86.2 mmHg) for the clinic ($p < 0.01$)]. There were no reported issues associated with the use of HBPM, but it did lead to 5 women contacting health care professionals for management of their BP between clinic visits.
Conclusions: HBPM provides comparable results to the clinic BP measurement. It is also an acceptable technique for pregnant and early post-partum women. However, it should be used as an adjunct to clinic measurement, and cannot at this present stage replace clinic visits or clinic BP measurement.

1. Introduction

Pregnancy-related hypertension affects up to 10% of all pregnancies worldwide [1–4]. They continue to be a leading cause of maternal and perinatal morbidity and mortality [5–7]. To date, the diagnosis and management of these disorders have depended upon accurate BP measurement [2,4].

For the general population, BP is now routinely measured outside of the clinic [8,9]. These "out-of-office" measurements include 24-h ambulatory blood pressure measurement (ABPM), and with the development of automated self-measuring blood pressure devices, HBPM [8,10]. A number of guidelines for undertaking HBPM are available for clinical use in the general population [11–13]. However the acceptance of HBPM in the pregnant population, particularly those with pregnancy-related hypertension, is limited. This is a result of concerns of both under- and over-estimation of BP in pregnancy by automated devices, and a lack of research in the area. In addition, there are only a limited number of automated devices that have been validated for use in pregnancy or pre-eclampsia [14–18].

There are a number of benefits for performing HBPM in the general population. Firstly, it can identify white-coat hypertension (WCH) and masked hypertension [13,19]. Secondly, it has a better predictive value for future cardiovascular events [20,21] and end-organ damage [22] compared to clinic BP. Finally, it has been associated with improved treatment adherence and assists in overcoming "therapeutic inertia" [13,23]. Within the pregnant and early-postpartum population, clinic and hospital BP measurement are currently the main means of monitoring BP. Studies have assessed the utility of 24-h ABPM, and normal blood pressure ranges using 24-h ABPM have been established during the different stages of pregnancy [24]. However, the main role for 24-h ABPM in pregnancy appears to be in ruling out WCH, particularly within the first twenty weeks of gestation [25–27].

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We have previously assessed the use of an inexpensive automated device (Omron HEM7211) in an outpatient clinic assessing women who may have a hypertensive pregnancy [28]. Rather than performing a protocol-driven validation of the device, we performed a clinical study on its use, and found that the device provided clinically acceptable BP readings when compared to the mercury sphygmomanometer. As a natural extension of this study, we decided to assess whether HBPM would provide similar results clinic BP readings. Also, we frequently found that women attending our clinic, were already checking BP at home without having had any instruction on how or when to check their BP.

2. Methods

2.1. Participant recruitment

Study participants were recruited from the Hypertensive Disorders of Pregnancy outpatient clinic at Royal Prince Alfred Hospital. Patients seen in this clinic include: women with a hypertensive pregnancy; post-partum women up to 3 months after a hypertensive pregnancy; and women who were considered at high risk of developing a hypertensive pregnancy. Patients were only asked to participate in the study if they were scheduled to return to the clinic within 2 weeks of their initial visit. Patients were excluded if they did not have access to an automated device, were not able to perform regular BP readings at home, or had a mid-arm circumference < 24 cm or > 42 cm. Study subjects were recruited between February 2014 to October 2015. Ethics approval was granted by the Institutional Ethics Committee (HREC/13/RPAH/180), and written consent was obtained prior to study enrolment.

2.2. Materials and methods

Demographic data was collected from each study participant during their initial clinic visit. This data included age, previous history of preeclampsia, the presence of diabetes, mid-upper arm circumference, and the current use of antihypertensive medications.

BP was measured during each visit to the clinic. This was measured on the right arm, after the individual had been seated for a minimum of five minutes. The appropriate-sized cuff was used, as determined by the mid-upper arm circumference. Three sequential BP readings were performed using the automated blood pressure measuring device, in this case the Omron HEM-7200 (Kyoto, Japan), with each reading being 30–60 s apart.

For the home BP readings, each participant was provided with both verbal and written instructions on how to perform measurements. They were instructed to undertake their readings both in the morning and in the evening. For the morning readings, they were advised to take their BP within one hour of waking, but after voiding. For the evening readings, they were asked to measure their BP after having at least fifteen minutes of rest prior. For both sets of readings, the participants were instructed to be seated with both their feet flat to ground, and the BP cuff placed two to three finger widths above their elbow. They were also asked to take three sequential measurements 30–60 s apart both in the morning and in the evening, over a period of at least one week, and to record each individual reading on to a BP diary provided at their clinic visit. If the participant was on any anti-hypertensive medications, they were asked to take their BP measurements prior to their medications. All patients were advised to contact the hospital or doctor if their blood pressure readings were consistently elevated (> 140/90 mmHg) or too low (< 100/60 mmHg).

2.3. Statistical analysis

Each clinic visit was taken as an individual event, and the mean of the three BP readings performed during each visit was determined. The mean of the recorded HBPM was calculated after excluding the first day of readings and the first reading at each sitting. This method is advocated by a number of hypertension societies [11–13]. The means were then compared using paired t-tests, with a statistically significant p-value being < 0.05. Comparisons were performed for the overall group, and within the sub-groups of ante-partum and post-partum women. In addition, comparisons were also made when the study participants were on the same level of anti-hypertensive therapy both during the clinic visit and the time they were measuring their home blood pressure. The difference between the mean of the readings obtained by the two techniques were also assessed by Bland-Altman plots. Statistical analyses were performed by using Stata/IC version 12.0 (StataCorp, College Station, TX).

Table 1
General characteristics of patients.

Characteristics	Patients (n = 37)
Age	
Median (yrs)	33.4
Range (yrs)	25.2–46.6
Ante-partum (%)	21 (57%)
Median (weeks)	27.4
Range (weeks)	6.6–38.9
Post-partum (%)	16 (43%)
Median (weeks)	1.9
Range (weeks)	1–3.9
Nulliparous/first pregnancy (%)	27 (73%)
Singleton pregnancy (%)	34 (92%)
Gestational diabetes mellitus (%)	13 (35%)
Chronic hypertension (%)	8 (22%)
Previous pre-eclampsia (%)	5 (14%)
Arm circumference	
Median (cm)	28.25
Range (cm)	24–42
Receiving antihypertensive medication at time of first clinic visit (%)	26 (70%)
Diagnosis after pregnancy (%)	
Pre-eclampsia	20 (54%)
Chronic hypertension with super-imposed pre-eclampsia	1 (3%)
Gestational hypertension	6 (16%)
Chronic hypertension	7 (19%)
Normotension	3 (8%)

3. Results

3.1. Study participants

46 patients consented to participate in the study. Of these 46 patients, 37 participants completed the study for a total of 51 clinic visits. The characteristics of these 37 patients are provided in Table 1. Just over half of the participants were ante-partum at the time of their first clinic visit (57%). The majority of participants attended the clinic as part of the study only on two occasions (73%), and the majority were on oral antihypertensive medication at the time of their first clinic visit (70%). The diagnosis for the patients was determined after the pregnancy was completed. The majority of HBPM (82%) were performed using a device manufactured by Omron Electronics.

3.2. Comparison of clinic readings to home readings

In total, there were 102 sets of readings, with the mean of the HBPM being compared to both the mean BP of the initial and the follow-up clinic visit. This was assessed for the overall group, as well as within the sub-groups of those who were antepartum and those who were post-partum. At the same time, comparisons were made between the mean HBPM to the mean clinic BP readings if the patient was on the same level of anti-hypertensive for both readings. The results are shown in Table 2. Overall, there were small, not clinically significant differences between the two means.