Blood Pressure and Prediction of Preeclampsia

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Abstract

Among the several risk factors of preeclampsia (PE), blood pressure (BP) elevation could be one of the earliest and most reliable signs of the disease. Various BP parameters, such as mean arterial pressure, ambulatory BP, and home BP, could be useful for the prediction of PE in pregnant women. When a pregnant woman before 20th gestational week has high BP, three possibilities can be considered: white-coat hypertension, sustained hypertension, and hypertension with chronic kidney disease. White-coat hypertension can be diagnosed by home BP monitoring or ambulatory BP monitoring (ABPM), and not at high risk for PE. So antihypertensive drugs are usually not necessary. In the case of sustained hypertension, early treatment is usually needed, but in some patients with sustained hypertension, BP can be normalized early in the course of pregnancy because of the physiological fall of BP. On the other hand, caution is needed for mild hypertension with CKD. Although most of the components of maternal outcomes depend on baseline levels of renal function, high BP can exacerbate renal functions of these patients, even during pregnancy. In this situation, the BP target is set as <140/90mmHg. In case of essential hypertension during pregnancy, the risk of ‘pre-existing hypertension plus superimposed gestational hypertension with proteinuria’ would be a previous history of preeclampsia and mild BP elevation such as SBP 130-139 mm Hg, and DBP 80-89 mm Hg. Appropriate BP control using antihypertensive medication other than renin angiotensin aldosterone system blockers is needed.

INTRODUCTION

In recent years, women have tended to marry in their 30s and 40s. Thanks to the development of infertility treatment, women can become pregnant at an older age, so the prevalence of pregnancy complicated with essential hypertension or pregnancy-induced hypertension is increasing. Early treatment of the signs of preeclampsia (PE) is important, but early prediction of preeclampsia in clinical practice is not very easy. Among the several risk factors of PE, blood pressure (BP) elevation could be one of the earliest and most reliable signs of the disease. In this chapter, we review papers on the prediction of PE using various methods of BP monitoring in pregnant women.

WHICH PATIENTS DEVELOP PREECLAMPSIA?

In epidemiological studies, the risk factors of PE were multigravida, obesity, history of preeclampsia, and borderline hypertension before pregnancy. In a recent study, a combination of factors in the maternal history, mean arterial pressure (MAP), uterine artery pulsatile index, serum pregnancy-associated plasma protein-A (PAPP-A), and placental growth factor (PIGF) at 11 to 13 weeks of gestation were effective for first-trimester prediction of early preeclampsia [1]. The study is interesting, but the applicability of the results is limited because it included expensive tests; therefore, not all pregnant women can be examined using these tests. According to a recent report from the American College of Obstetricians and Gynecologists, no screening tests are recommended to predict preeclampsia beyond obtaining an appropriate medical history to evaluate risk factors [2]. However, the assessment of BP in these subjects may be important because the BP level is usually included in prediction models of PE [1]. A large study combing first trimester testing detected more than 60% of those who will develop PE several months later using log multiple of the median MAP, ethnic origin, BMI, and personal history of preeclampsia. The areas under the receiver operating characteristic curves (AROCs) for the detection of PE were significantly higher with the combined model (AROC: 0.852) than with either history alone (AROC: 0.801; P = 0.017) or MAP alone (AROC: 0.734; P < 0.001) [1]. In a meta-analysis of BP parameters for predicting PE, Cnossen et al. showed that MAP was a better predictor of PE than systolic BP and diastolic BP or an increase of BP in the first or second trimester of pregnancy [3]. In receiver operating characteristic curve analyses of systolic BP, diastolic BP, and MAP in a low-risk populations in the second trimester, the area under the curve was 0.68 (95% confidence interval: 0.64 to 0.72) for systolic BP, 0.66 (0.59 to 0.72) for diastolic BP, and 0.76 (0.70 to 0.82) for MAP. For a specificity of 90%, the sensitivities of diastolic BP and
MAP were both 35%, whereas for systolic BP the sensitivity was only 24%. Second trimester MAP of 90 mm Hg or more showed a positive likelihood ratio of 3.5 (95% confidence interval: 2.0 to 5.0) and a negative likelihood ratio of 0.46 (0.16 to 0.75). Furthermore, in women at high risk, diastolic BP of 75 mm Hg or more at 13 to 20 weeks’ gestation best predicted PE [3]. Therefore, BP and its combination with the clinial background can help predict the development of PE.

When a pregnant woman before 20th gestational week has high BP, three possibilities can be considered: white-coat hypertension (WCH) (transient hypertension), sustained hypertension (true hypertension), and hypertension with chronic kidney disease (CKD). WCH can be diagnosed by home BP monitoring or ambulatory BP monitoring (ABPM). In the ESC Guidelines during pregnancy [4], the usefulness of ABPM in predicting pregnancy-associated outcomes is described based on two references [5,6]. WCH is frequently seen in pregnant women, but patients with WCH are not at high risk for PE. Brown et al. showed that WCH was a common phenomenon in pregnant women who have high BP in routine clinic BP measurements in early pregnancy [6]. In women with WCH, antihypertensive drugs are usually not necessary initially, but they should be carefully followed up at short intervals if they become true hypertensives. In general, they will have better pregnancy outcomes than women with true essential hypertension (Figure 1). However, continued monitoring throughout pregnancy remains important to detect the small group of white coat hypertensives who develop PE.

In the case of sustained hypertension, early treatment is usually needed, but in some patients with sustained hypertension, BP can be normalized early in the course of pregnancy because of the physiological fall of BP [4]. On the other hand, caution is needed for mild hypertension with CKD. Although most of the components of maternal outcomes depend on baseline levels of renal function, high BP can exacerbate renal functions of these patients, even during pregnancy. In this situation, the BP target is set as <140/90 mmHg [7]. Needless to say, appropriate BP control using antihypertensive medication other than renin angiotensin aldosterone system (RAS) blockers is needed.

**WHICH METHOD OF MEASUREMENT IS BETTER FOR THE PREDICTION OF PREECLAMPSIA?**

There are two possibilities that hypertensive women continue to have gestational hypertension (GH), and that some women advance to PE. Preeclampsia is generally considered as placental disorder, but some markers of placental dysfunction are associated with progress to PE. Efforts have been made to predict PE by using ambulatory BP monitoring. Bellomo et al. showed that in women with elevated BP during their third trimester of pregnancy, 24-hour BP was superior to office BP (distinguishing true hypertension from WCH) to predict the outcome. The sensitivity and specificity of 24-hour blood pressure (BP) monitoring are 87.5% and 77.7%; for office BP measurement, 91.6% and 55.4%; for 24-hour proteinuria, 47.2% and 100%, respectively, for the prediction of PE [8]. Therefore, the usefulness of ABPM during pregnancy was confirmed.

Brown et al. have shown in 122 pregnant women that awake and sleeping BP was higher in mid-pregnancy in women who later developed PE or GH [9]. In particular, hypertension during sleep was a common finding in women with hypertensive disorders of pregnancy, particularly PE. These women also had higher awake BP and a greater frequency of adverse maternal and fetal outcomes [10]. On the other hand, Hermida et al. have shown that, in pregnancy, the hyperbaric index (area of BP excess above the upper limit of a time-specified tolerance interval) derived from ambulatory monitoring was superior to office measurements for predicting the outcome of pregnancy [11]. However, this hypothesis was not reproduced and supported by another group [12]. Davis et al. have shown that those who developed PE after presenting with GH had higher awake and 24-hour SBP than those who continued to have GH [13]; however, it is possible that the higher ambulatory BP was the result, not the cause of PE. The sensitivity of ABPM was not better than that of other predictive tests, even in women at high risk for PE [9]. Therefore, although ABPM during pregnancy is a promising tool, its usefulness in predicting clinical outcomes is still not established.

What about home BP monitoring for the prediction of PE? Metoki et al. showed the normal pattern of the change in home BP during the course of a normal pregnancy, and concluded that home BP is influenced by gestational weeks and seasons [14]. The significance of home BP monitoring in patients with PE has not been shown. Brown et al. examined the effect of home BP monitoring (HEM 705CP, Omron Health Care, Kyoto, Japan), and showed that home BP was a useful device for measuring group average BPs in pregnant women suspected of having WCH. However, home BP was not as good as ABPM [15]. Further study of home BP is needed for the prediction of PE.

**RISK OF SUPERIMPOSED PREECLAMPSIA**

What about essential hypertension during pregnancy? Pre-existing hypertension complicates 1–5% of pregnancies and is defined as BP ≥140/90 mmHg that either precedes pregnancy or develops before 20 weeks of gestation [4]. When pre-existing hypertension is associated with further worsening of BP and protein excretion ≥3 g/day in 24 h urine collection after 20 weeks of gestation, it is classified as ‘pre-existing hypertension
plus superimposed gestational hypertension with proteinuria [4]. In patients with chronic hypertension plus superimposed preeclampsia, home BP and ambulatory BP monitoring were recommended by the Task Force Report of the American College of Obstetricians and Gynecologists [2], because BP is sometimes elevated by the white-coat effect.

Chappell et al. investigated the factors associated with superimposed PE in 822 women with chronic hypertension [16]. They concluded that black ethnic origin, high BMI, present smoking, SBP 130–139 mm Hg, and DBP 80–89 mm Hg, a previous history of PE or eclampsia and chronic renal disease were risk factors for superimposed PE. In this study, adverse maternal and perinatal outcomes, such as the prevalence of infants born small for gestational age and preterm, were considerably higher than background rates and increased further in women with superimposed PE. A recent study by Lecarpentier et al. partly followed this study. In essential chronic hypertensive women treated before pregnancy, previous PE and MAP >95 mmHg were associated with an increased risk of superimposed PE [17]. Together, these two variables may identify women at extremely high risk of superimposed PE.

In conclusion, various BP parameters, such as MAP, ambulatory BP, and home BP, could be useful for the prediction of PE in pregnant women. Although serum markers or uterine ultrasound Doppler may be superior to the conventional risk measurements in predicting gestational hypertension and preeclampsia. J Hypertens. 2010; 28: 127-134.


