



ORIGINAL ARTICLE

## Assessment of central hemodynamic properties of the arterial wall in women with previous preeclampsia<sup>☆</sup>



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### KEYWORDS

Hypertension;  
Preeclampsia;  
Aortic distensibility;  
Reflected waves;  
Circadian blood  
pressure profile

### Abstract

**Background:** We investigated viscoelastic properties of the arterial wall in women with previous preeclampsia (PE) compared to those with normal pregnancy (NP).

**Methods:** In a cross-sectional study 45 women with previous PE and 55 with NP were included, matched for age (PE: 38±6 vs. NP: 38±5 years, NS) and body mass index: PE: 25±4 vs. NP: 26±4 g/m<sup>2</sup>, NS) studied respectively, 76±34 and 86±48 months after delivery. We assessed arterial distensibility – pulse wave velocity (PWV, Complior) and reflected waves (augmentation pressure [AP], mmHg) and augmentation index (AIx) – in the central pressure wave and blood pressure (BP) on 24-h ambulatory BP monitoring (ABPM).

**Results:** PE showed higher ( $p<0.01$ ) peripheral systolic blood pressure (SBP): PE 131±18 vs. NP 121±19, and central SBP: PE 122±18 vs. NP 110±19 mmHg, with less amplification of central-peripheral pressure: PE 10±4 vs. NP 12±5,  $p=0.041$ , and higher ( $p<0.05$ ) AP: PE 10±3 vs. NP 8±2, and AIx: PE 26±5 vs. NP 20±5 mmHg, but PE and NP did not differ in pulse wave velocity. On ABPM, PE (n=39) vs. NP (n=33) had higher nighttime SBP: PE 121±10 vs. NP 108±10 mmHg and lower percentage nocturnal SBP fall: PE 11±6 vs. NP 18±11%, both  $p<0.02$ . During follow-up, the need for antihypertensive medication was seven times higher in PE than in NP.

**Conclusion:** Women with previous PE have a greater risk of hypertension, higher nighttime BP values, blunted nocturnal BP fall and changes in central pressure suggestive of increased reflected waves and peripheral vascular resistance. These factors may contribute to their higher cardiovascular risk after pregnancy.

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**PALAVRAS-CHAVE**

Hipertensão;  
Antecedentes de  
pré-eclâmpsia;  
Rigidez aórtica;  
Ondas refletidas;  
Perfil tensional  
circadiário

**Avaliação das propriedades dinâmicas da pressão arterial em mulheres com antecedentes de pré-eclâmpsia****Resumo**

**Objetivo:** Investigar alterações hemodinâmicas e das propriedades viscoelásticas da parede arterial em mulheres com prévia pré-eclâmpsia (PE) versus mulheres com antecedentes de gravidezes normais (NT).

**Métodos:** Estudo transversal em mulheres, 45 com prévia PE e 55 NT, emparelhadas para idade: PE:  $38 \pm 6$  versus NT:  $38 \pm 5$  anos, n.s., índice massa PE:  $25 \pm 4$  versus NT:  $26 \pm 4$  kg/m<sup>2</sup>, n.s., e  $76 \pm 34$  (NT) e  $86 \pm 48$  (PE) meses após o parto. Avaliamos rigidez arterial – velocidade onda pulso (PWV, Complior) e ondas refletidas (pressão de aumentoção AP) e índice de aumentoção (Alx,%) na onda de pressão central e a pressão arterial de 24 horas (MAPA).

**Resultados:** PE apresentaram pressão sistólica (PAS) periférica PE:  $131 \pm 18$  versus NT:  $121 \pm 19$  e PAS central PE:  $122 \pm 18$  versus NT:  $110 \pm 19$  mais elevadas ( $p < 0,01$ ), menor amplificação central-periférica da pressão diferencial, PE:  $10 \pm 4$  versus NT:  $12 \pm 5$  mmHg,  $p = 0,041$ , e valores mais elevados ( $p < 0,05$ ) da AP: PE:  $10 \pm 3$  versus NT:  $8 \pm 2$  mmHg e do Alx%: PE:  $26 \pm 5$  versus NT:  $20 \pm 5$ %. A PWV foi semelhante nas PE e NT. Na MAPA PE versus NT a PAS noturna foi mais elevada PE:  $121 \pm 10$  versus NT:  $108 \pm 10$  mmHg com menor descida noturna da PAS: PE:  $11 \pm 6$  versus NT:  $18 \pm 11$ %, ambos  $p < 0,02$ . Durante o *follow-up* na PE a prescrição de anti-hipertensores foi 6-7 vezes mais frequente do que na NT.

**Conclusão:** Mulheres com PE prévia apresentam um risco maior de hipertensão, pressão noturna mais elevada, menor descida tensional noturna e alterações da pressão central sugestivas de aumento das ondas refletidas e das resistências vasculares periféricas. Estas alterações poderão contribuir para um risco cardiovascular aumentado em mulheres com antecedentes de PE.

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**Introduction**

Preeclampsia (PE) is defined as the development of hypertension and proteinuria from week 20 of gestation onwards and is characterized by generalized maternal endothelial dysfunction.<sup>1-3</sup> PE affects 3–5% of first pregnancies, and is the leading cause of maternal-fetal morbidity and responsible for 12% of maternal mortality during pregnancy and in the postpartum period.<sup>1-3</sup> In severe cases, PE may be associated with seizures (eclampsia), coagulation disorders (HELLP syndrome) and intrauterine growth restriction. The causes of PE are not fully understood. Recent theories focus on changes in placental development in early pregnancy that cause inflammation and oxidative stress in the placenta, leading to the release of placental hormonal factors into the maternal circulation.<sup>4</sup> These factors cause the generalized endothelial dysfunction that is characteristic of the pathophysiology of PE. It has also been suggested that PE is associated with the classic risk factors of cardiovascular disease (CVD), leading to the term ‘metabolic syndrome of pregnancy’.<sup>5</sup> Various changes that occur during a normal pregnancy, including insulin resistance,<sup>6</sup> dyslipidemia,<sup>7</sup> hypercoagulability<sup>8</sup> and hyperdynamic circulation,<sup>9</sup> are more marked in PE. Although most changes in PE regress following delivery, some functional and structural changes may persist in women who suffer PE; their risk of future cardiovascular (CV) complications may be greater,<sup>10</sup> due not only to the coexistence of CV risk factors but also to the subclinical vascular changes that occur in PE. However, according to recent reviews,<sup>11</sup> it is not certain whether women with previous PE have increased CV risk. The risk of these women developing hypertension also

remains to be clarified and if it occurs, whether it is accompanied by changes in circadian blood pressure rhythm and in aortic distensibility. The augmentation index (Alx) and aortic pulse wave velocity (PWV) are recognized markers of the hemodynamic properties of the arterial wall, aortic distensibility and peripheral resistance, and the changes assessed by these parameters are strong predictors of risk and of CV and renal events.<sup>12-16</sup> A few studies have shown increased Alx during PE<sup>17-19</sup> but there are no data on what happens to this marker years after childbirth.

Various studies have suggested that women with previous PE have a higher risk of developing CVD in later life,<sup>20-23</sup> and some authors have identified genetic factors that increase the risk of CVD and PE.<sup>21</sup> Of the studies investigating CV changes in women with previous PE, some assessed simple hemodynamic parameters such as blood pressure (BP), cardiac output and heart rate (HR), while others assessed biochemical parameters, including lipid profile, glucose metabolism and oxidative stress, and peripheral vascular resistance.<sup>24</sup> The aim of the present study was to assess the hemodynamic properties of the arterial wall (aortic stiffness), 24-h BP profile on ambulatory BP monitoring (ABPM) and prevalence of hypertension in women with a history of PE in the previous 2–10 years, compared to women with normal pregnancies and a similar time since childbirth, matched for age and body mass index (BMI).

**Methods**

This cross-sectional study was approved by the hospital’s ethics committee and participants gave their informed

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