



ORIGINAL ARTICLE

## Early changes in atrial conduction times in hypertensive patients with elevated pulse pressure



Tolga Çimen\*, Hamza Sunman, Tolga Han Efe, Ahmet Akyel, Kadriye Yayla, Haluk Furkan Şahan, Murat Bilgin, Lale Dinç Asarcıklı, Ali Nallbani, Mehmet Doğan, Sadık Açikel, Ekrem Yeter

Department of Cardiology, Dışkapı Yıldırım Beyazıt Training and Research Hospital, Ankara, Turkey

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### KEYWORDS

Atrial conduction time;  
Electromechanical delay;  
Pulse pressure;  
Atrial fibrillation;  
Essential hypertension

### Abstract

**Objective:** Pulse pressure (PP) is the difference between systolic and diastolic blood pressure, and is an independent predictor of atrial fibrillation (AF). In this study we investigated the relationship between PP and atrial conduction times.

**Methods:** The study included 157 patients with essential hypertension. PP of 60 mmHg or more was regarded as elevated (n=56). Atrial electromechanical delay (EMD) was assessed with tissue Doppler echocardiography and P-wave dispersion (Pd) was calculated from the electrocardiogram.

**Results:** Left atrial volume index ( $23.6 \pm 4.9$  ml/m<sup>2</sup> vs.  $25.2 \pm 6.5$  ml/m<sup>2</sup>, p=0.141), left ventricular mass index ( $77.3 \pm 13.5$  g/m<sup>2</sup> vs.  $80.9 \pm 19.6$  g/m<sup>2</sup>, p=0.180) and grade I diastolic dysfunction (42% vs. 53%, p=0.242) were similar between groups. Inter-atrial ( $33.6 \pm 9.2$  ms vs.  $41.5 \pm 11.3$  ms, p<0.001), intra-left atrial ( $23.0 \pm 8.8$  ms vs.  $28.2 \pm 10.6$  ms, p=0.001) and intra-right atrial ( $10.5 \pm 5.8$  ms vs.  $13.2 \pm 4.9$  ms, p=0.004) EMD were found to be higher in patients with elevated PP. P-maximum ( $108 \pm 8$  ms vs.  $114 \pm 9$  ms, p<0.001) and Pd ( $30 \pm 13$  ms vs.  $38 \pm 13$  ms, p<0.001) were also prolonged in patients with elevated PP. Multivariate linear regression analysis revealed that PP was independently associated with inter-atrial EMD ( $\beta=0.379$ , t=4.088, p<0.001).

**Conclusion:** This study showed that elevated PP is associated with prolonged atrial EMD and Pd. Atrial conduction is disturbed in hypertensive patients with elevated PP before the development of significant structural remodeling.

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\* Corresponding author.

E-mail address: [drtolgacim@hotmail.com](mailto:drtolgacim@hotmail.com) (T. Çimen).

**PALAVRAS-CHAVE**

Tempo de condução auricular;  
Atraso eletromecânico;  
Pressão do pulso;  
Fibrilhação auricular;  
Hipertensão essencial

## Alterações precoces nos tempos de condução auricular nos doentes hipertensos com pressão de pulso elevada

**Resumo**

**Objetivos:** A pressão do pulso (PP) é a diferença entre as pressões sistólica e diastólica, e é um preditor independente da fibrilhação auricular. Neste estudo, investigamos a relação entre a PP e os tempos de condução auricular.

**Métodos:** O estudo incluiu 157 doentes com hipertensão essencial. Uma PP de 60 mmHg ou superior foi considerada elevada (n=56). O atraso eletromecânico auricular foi avaliado através de ecocardiografia Doppler tecidual e a dispersão da onda P foi calculada através de eletrocardiograma.

**Resultados:** O índice do volume auricular esquerdo ( $23,6 \pm 4,9$  mL/m<sup>2</sup> versus  $25,2 \pm 6,5$  mL/m<sup>2</sup>, p=0,141), o índice da massa ventricular esquerda ( $77,3 \pm 13,5$  g/m<sup>2</sup> versus  $80,9 \pm 19,6$  g/m<sup>2</sup>, p=0,180) e a relação da disfunção diastólica grau I ( $42$  versus  $53\%$ , p=0,242) foram semelhantes entre os grupos. Um atraso eletromecânico auricular inter ( $33,6 \pm 9,2$  ms versus  $41,5 \pm 11,3$  ms, p<0,001), intraesquerdo ( $23,0 \pm 8,8$  ms versus  $28,2 \pm 10,6$  ms, p=0,001) e intradireito ( $10,5 \pm 5,8$  ms versus  $13,2 \pm 4,9$  ms, p=0,004) foram considerados superiores nos doentes com PP elevada. Uma pressão máxima ( $108 \pm 8$  ms versus  $114 \pm 9$  ms, p<0,001) e uma dispersão da onda P ( $30 \pm 13$  ms versus  $38 \pm 13$  ms, p<0,001) foram também prolongados nos doentes com PP elevada. Uma análise multivariada de regressão linear revelou que a PP estava independentemente associada ao atraso eletromecânico auricular ( $\beta=0,379$ , t=4,088, p<0,001).

**Conclusão:** Este estudo mostrou que a PP elevada está associada ao prolongamento do atraso eletromecânico auricular e da dispersão da onda P. A condução auricular revela mais alterações nos doentes hipertensos com PP elevada antes do desenvolvimento de remodelagem estrutural significativa.

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**Introduction**

Hypertension plays a significant role in the etiology of various cardiovascular diseases. Pulse pressure (PP), defined as the difference between systolic blood pressure (SBP) and diastolic blood pressure (DBP), has a strong and independent association with cardiovascular morbidity and mortality.<sup>1</sup>

Atrial fibrillation (AF) is the most common sustained arrhythmia, for which the classical risk factors are age, diabetes, obesity, hypertension, left ventricular hypertrophy, coronary artery disease, heart failure and valvular disease.<sup>2</sup> Previous studies have indicated that both high blood pressure (BP)<sup>3</sup> and elevated PP independently predict development of AF.<sup>4</sup> Additionally, increased PP is associated with left atrial (LA) enlargement, which is another known risk factor for AF.<sup>5</sup> Although pathophysiologically it has been proposed that increased arterial stiffness can lead to increased left ventricular load by elevating PP, it has been determined that PP elevation is a more important risk factor for AF than increased arterial stiffness.<sup>6</sup>

Delayed atrial conduction is important in the development in AF via initiation of reentry.<sup>7</sup> Atrial electromechanical delay (EMD), defined as the time from the onset of the P wave on the electrocardiogram (ECG) to the onset of the late diastolic wave (A) from the ventricular annulus and atrial walls on tissue Doppler imaging (the PA interval), is one of the indicators of an arrhythmogenic substrate in patients with AF.<sup>8,9</sup>

There are few data on the role of delayed atrial conduction in the development of AF in hypertensive patients with increased PP. In this study, we investigated the relationship between PP and atrial EMD, which are both important precursors of AF, in hypertensive patients with no structural cardiac abnormalities.

**Methods****Study population**

The study included 284 consecutive patients previously diagnosed with essential hypertension, aged 18-75 years. Detailed physical examinations were performed and medical histories were obtained from all patients. Complete blood count and biochemical analysis together with anthropometric measurements were performed on the same day as the echocardiographic examination. Antihypertensive treatments were recorded.

The following patients were not included in the study: those taking antihypertensive drugs causing PR interval prolongation (such as beta-blocking agents, verapamil, and diltiazem) and those with diabetes, structural heart disease (more than mild valvular disease, left ventricular mass index [LVMI] greater than 95 g/m<sup>2</sup> in women and 115 g/m<sup>2</sup> in men, grade >1 diastolic dysfunction, or LA enlargement [LA volume index (LAVI) >34 mL/m<sup>2</sup>]), sustained atrial or ventricular arrhythmia, systemic inflammatory disease, hepatic, renal

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