



ORIGINAL ARTICLE

## Left ventricular longitudinal systolic dysfunction is associated with right atrial dyssynchrony in heart failure with preserved ejection fraction



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### KEYWORDS

Heart failure;  
Right atrial  
dyssynchrony;  
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function

### Abstract

**Objective:** We aimed in this study to assess the role of longitudinal left ventricular (LV) systolic function in heart failure with preserved ejection fraction (HFpEF) in delayed intra- and interatrial conduction time.

**Methods:** In 85 consecutive patients with HFpEF (age  $60 \pm 11$  years, ejection fraction [EF]  $\geq 45\%$ ), a complete M-mode echocardiographic and tissue Doppler imaging (TDI) study was performed. The times from the onset of the P wave on the ECG to the beginning of the A' wave (PA) from the lateral and septal mitral and tricuspid annuli on TDI were recorded. The difference between these intervals gave the intra- and interatrial dyssynchrony. Based on mitral annular plane systolic excursion (MAPSE), patients were classified as having HFpEF with impaired (MAPSE  $\leq 1.2$  cm) or normal (MAPSE  $> 1.2$  cm) longitudinal systolic function.

**Results:** Patients with impaired MAPSE were older ( $p < 0.001$ ), had higher LV mass index ( $p < 0.001$ ), greater left atrial (LA) minimum volume ( $p = 0.007$ ), reduced left atrial EF ( $p < 0.001$ ), higher E/e' ratio ( $p = 0.002$ ), reduced lateral and septal e' wave ( $p = 0.005$  and  $p = 0.006$ , respectively), prolonged tricuspid PA' ( $p = 0.03$ ) and significantly increased right atrial (RA) dyssynchrony ( $p = 0.001$ ) compared with normal MAPSE. MAPSE correlated with RA dyssynchrony ( $r = -0.40$ ,  $p < 0.001$ ) but not with interatrial and LA dyssynchrony.

**Conclusion:** In patients with HFpEF and impaired MAPSE, RA dyssynchrony is increased, compared to those with normal MAPSE. As patients with RA dyssynchrony are at higher risk for arrhythmia, assessment of this dyssynchrony may help to improve treatment, as well as to predict outcome in these patients.

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**PALAVRAS-CHAVE**

Insuficiência cardíaca;  
Dessincronia auricular direita;  
Função sistólica longitudinal

## Disfunção sistólica longitudinal ventricular esquerda encontra-se associada a dessincronia auricular direita em doentes com insuficiência cardíaca e fração de ejeção preservada

**Resumo**

**Objetivos:** Com este estudo pretendemos avaliar o papel da função sistólica longitudinal ventricular esquerda (VE) na insuficiência cardíaca com fração de ejeção preservada (ICFEp) no atraso da condução intra e interauricular.

**Métodos:** Em 85 doentes consecutivos com ICFEp ( $60 \pm 11$  anos,  $FE \geq 45\%$ ) foi realizado estudo ecocardiográfico completo modo-M e Doppler tecidual. O intervalo desde o início da onda P no ECG, até ao início da onda A no anel mitral lateral e septal e no anel tricúspide direito (em Doppler tissular) foi registado. A diferença entre estes intervalos forneceu a dessincronia intra e interauricular. Baseado na excursão sistólica de pico do anel mitral (ESPAM), os doentes foram divididos em ICFEp com disfunção ( $ESPAM \leq 1,2$  cm) e função sistólica normal longitudinal ( $ESPAM > 1,2$  cm).

**Resultados:** Os doentes com ESPAM baixa eram mais velhos ( $p < 0,001$ ), tinham índice de massa VE mais elevado ( $p < 0,001$ ), volume auricular esquerdo (VAE) superior ( $p = 0,007$ ), FE auricular esquerda (AE) mais baixa ( $p < 0,001$ ), rácio  $E/e'$  mais elevado ( $p = 0,002$ ), onda  $e'$  lateral e septal reduzidas ( $p = 0,005$  e  $p = 0,006$ ), onda tricúspide PA prolongada ( $p = 0,03$ ) e aumento significativo da dessincronia da aurícula direita (AD) ( $p = 0,001$ ), quando comparados com doentes com ESPAM normal. A ESPAM estava correlacionada com a dessincronia AD ( $r = -0,40$ ,  $p < 0,001$ ), mas não com a dessincronia interauricular e da AE.

**Conclusão:** Nos doentes com ICFEp e ESPAM baixa, existe dessincronia AD, quando comparada com os doentes com ESPAM normal. Como os doentes com dessincronia AD têm risco mais elevado de arritmia, a avaliação desta dessincronia pode ajudar a melhorar o tratamento, bem como a auxiliar na previsão prognóstica destes doentes.

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**Introduction**

Heart failure (HF) with preserved ejection fraction (HFpEF) is a major public health problem worldwide, with increasing prevalence and morbidity.<sup>1</sup> Although current therapeutic approaches have improved quality of life, mortality remains high.<sup>2,3</sup> Many studies have reported comorbidity of atrial fibrillation (AF) in HFpEF as a result of electrical and structural remodeling of the atria.<sup>4,5</sup> Atrial remodeling in these patients may cause delayed intra- and interatrial conduction time, as well as atrial dyssynchrony,<sup>6,7</sup> which is among the factors responsible for the initiation of reentry and the development of AF.<sup>8,9</sup>

The time from the onset of the P wave on the ECG to the beginning of the A' wave on tissue Doppler imaging (TDI) (PA'-TDI interval) is a simple and noninvasive method for assessing atrial conduction time<sup>10,11</sup> which correlates strongly with total atrial conduction time in invasive procedures.<sup>12</sup>

The presence of atrial dyssynchrony and prolonged total intra- and interatrial activation time in HF patients has been previously reported.<sup>13,14</sup> Several biochemical and echocardiographic parameters have been shown to correlate with atrial dyssynchrony,<sup>15,16</sup> such as left ventricular ejection fraction (LVEF) and diastolic dysfunction.<sup>17,18</sup> However, the relationship of longitudinal left ventricular (LV) systolic function, assessed by mitral annular plane systolic excursion (MAPSE), with delayed atrial conduction time has not

been tested. We aimed in this study to investigate the relationship between LV longitudinal systolic function and atrial dyssynchrony in HFpEF patients.

**Methods****Study population**

We studied 85 patients (mean age  $60 \pm 11$  years, 75% female) with HFpEF (LVEF  $\geq 45\%$ ) and New York Heart Association (NYHA) functional class I–III. Based on the mean normal value of MAPSE derived from previous studies, patients were classified as having HFpEF with impaired MAPSE ( $\leq 1.2$  cm,  $n=42$ ), or with normal MAPSE ( $>1.2$  cm,  $n=43$ ).<sup>19,20</sup>

Patients were referred to the Service of Cardiology, Internal Medicine Clinic, University Clinical Centre of Kosovo, between February 2013 and November 2013. At the time of the study all patients were on conventional medical treatment, optimized at least two weeks prior to enrollment, based on symptoms and renal function: 76% were receiving angiotensin-converting enzyme inhibitors or angiotensin receptor blockers, 58% beta-blockers, 34% diuretics, 66% aspirin and 20% calcium channel blockers. Patients with clinical evidence of cardiac decompensation, limited physical activity due to factors other than cardiac symptoms (e.g. arthritis), stage  $>2$  chronic renal failure (glomerular filtration rate  $\leq 89$  ml/min), chronic obstructive pulmonary

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