



ORIGINAL ARTICLE

Left atrial ejection force correlates with left atrial strain and volume-based functional properties as assessed by three-dimensional speckle tracking echocardiography (from the MAGYAR-Healthy Study)



Györgyike Ágnes Piros^a, Péter Domsik^a, Anita Kalapos^a, Csaba Lengyel^b,
Andrea Orosz^c, Tamás Forster^a, Attila Nemes^{a,*}

^a 2nd Department of Medicine and Cardiology Centre, Medical Faculty, Albert Szent-Györgyi Clinical Centre, University of Szeged, Szeged, Hungary

^b 1st Department of Medicine, Medical Faculty, Albert Szent-Györgyi Clinical Centre, University of Szeged, Szeged, Hungary

^c Department of Pharmacology and Pharmacotherapy, Medical Faculty, University of Szeged, Szeged, Hungary

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KEYWORDS

Correlation;
Ejection force;
Left atrium;
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Three-dimensional;
Speckle tracking
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Abstract

Introduction and Objective: Three-dimensional (3D) speckle tracking echocardiography (3DSTE) is a novel method for assessment of left atrial (LA) volumes and function without geometrical assumptions. 3DSTE allows detailed assessment of LA features including volume measurements, strain assessments and calculation of LA ejection force (LAEF). LA strain and volume-based functional parameters originate from the same 3D dataset, but assessment of LAEF requires more data including measurement of mitral annular dimensions and Doppler-derived inflow velocities. The present study was designed to find correlations between LAEF and 3DSTE-derived LA volume-based functional properties and strain parameters in healthy subjects.

Methods: The study population comprised 34 randomly selected healthy subjects (age 36.1 ± 11.2 years, 15 men) in sinus rhythm, all of whom had undergone standard two-dimensional transthoracic Doppler echocardiographic study extended with 3DSTE.

Results: Mitral annulus diameter-based LAEF correlated with global LA peak circumferential ($r=0.39$, $p=0.02$), longitudinal ($r=0.32$, $p=0.05$) and area ($r=0.43$, $p=0.01$) strain, total atrial stroke volume ($r=0.30$, $p=0.05$) and total atrial emptying fraction ($r=0.31$, $p=0.05$) characterizing (systolic) LA reservoir function and global LA 3D strain at atrial contraction ($r=-0.44$, $p=0.01$) and active atrial emptying fraction ($r=0.36$, $p=0.04$) characterizing (diastolic) LA contraction function (booster pump phase).

* Corresponding author.

E-mail address: nemes.attila@med.u-szeged.hu (A. Nemes).

PALAVRAS-CHAVE

Correlação;
Força de ejeção;
Aurícula esquerda;
Função;
Tridimensional;
Ecocardiografia de
speckle tracking

Conclusions: Complex LA functional assessment can be provided by 3DSTE, including calculation of LAEF and volume-based and strain functional properties, with significant correlations between these parameters.

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Força de ejeção correlacionada com pressão auricular esquerda e propriedades funcionais de volume conforme avaliado na ecocardiografia tridimensional de *speckle tracking* (Estudo MAGYAR)

Resumo

Introdução e objetivos: A ecocardiografia tridimensional (3D) com *speckle tracking* (E3DST) é um novo método para avaliação do volume e da função da aurícula esquerda (AE) sem pressupostos geométricos. A E3DST permite a avaliação detalhada das características da AE, incluindo as medições volumétricas, as avaliações da pressão e o cálculo da força de ejeção da AE (FEAE). A força da AE e os parâmetros funcionais baseados no volume são provenientes dos mesmos dados 3D, mas a avaliação da FEAE requer mais dados incluindo a medição das dimensões do anel mitral e das velocidades do fluxo derivado do Doppler. Este estudo foi concebido para encontrar correlações entre a FEAE e a E3DST derivadas das propriedades funcionais baseadas no volume da AE e nos parâmetros de pressão em indivíduos saudáveis.

Métodos: Este estudo incluiu 34 indivíduos saudáveis selecionados aleatoriamente ($36,1 \pm 11$ anos, 15 homens) em ritmo sinusal, submetidos a estudo ecocardiográfico Doppler bidimensional transtorácico padrão associado a E3DST.

Resultados: A FEAE no anel mitral baseada no diâmetro correlacionada com o pico global da AE circunferencial ($r = 0,39$, $p = 0,02$), longitudinal ($r = 0,32$, $p = 0,05$) e área ($r = 0,43$, $p = 0,01$) força, volume arterial total de acidente vascular cerebral ($r = 0,30$, $p = 0,05$) e fração auricular total de esvaziamento ($r = 0,31$, $p = 0,05$) caracterizando a função de reservatório da AE (sistólica) e a força 3D da AE na contração auricular ($r = 0,44$, $p = 0,01$) e fração auricular de esvaziamento ativa ($r = 0,36$, $p = 0,04$) caracterizando a função da contração da AE (diastólica) (fase da bomba de reforço).

Conclusões: A E3DST podia providenciar a avaliação funcional complexa da AE incluindo o cálculo da FEAE e das propriedades funcionais baseadas no volume e na força com correlações significativas entre estes parâmetros.

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Introduction

Three-dimensional (3D) echocardiography coupled with speckle tracking capability is a novel approach that may become a powerful methodology for the assessment of left atrial (LA) volumes and function without geometrical assumptions.^{1,2} Despite basic differences, volumetric real-time 3D echocardiography (RT3DE) and strain-based 3D speckle tracking echocardiography (3DSTE) were found to be comparable, reproducible and interchangeable for quantification of LA dimensions and functional properties.³ It is well known that LA function in the cardiac cycle is a complex process that includes storing of pulmonary venous return during left ventricular (LV) contraction and isovolumetric relaxation in systole (reservoir function), transfer of blood passively into the LV in early diastole (conduit function), and active contraction at late diastole (booster pump function).⁴ In earlier studies 3DSTE was used for detailed assessment of all LA features including volume measurements,⁵⁻⁹ strain assessment⁷⁻¹¹ and calculation of LA ejection force (LAEF).¹²

LA strain and volume-based functional parameters originate from the same 3D dataset, but assessment of LAEF requires more data including measurement of mitral annular dimensions and Doppler-derived inflow velocities. However, the relationship between these functional properties has never been assessed. Therefore, the present study was designed to find correlations between LAEF and LA volume-based functional properties and strain parameters in healthy subjects.

Patients and methods**Patient population**

The study group consisted of 34 healthy subjects (mean age: 36.1 ± 11.2 years, 15 men) in sinus rhythm. None had known disease or any factor which could theoretically affect the results. Data on these subjects were taken from the MAGYAR-Healthy study (Motion Analysis of the heart and Great vessels by three-dimensional speckle tracking

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