

Volumetric and functional assessment of a left ventricular aneurysm from a single acquisition by three-dimensional speckle-tracking echocardiography (from the MAGYAR-Path Study)

Üç boyutlu speckle-tracking ekokardiyografiden elde edilen tek bir görüntüye göre sol ventrikül anevrizmasının volümetrik ve fonksiyonel değerlendirilmesi (MAGYAR-Path çalışmasından)

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Summary– Three-dimensional speckle-tracking echocardiography (3DSTE) is accepted as a reliable and feasible method in the quantification of left ventricular (LV) volumes, strains and rotational characteristics. This case aimed to demonstrate the diagnostic importance of 3DSTE in volumetric and functional assessment of an LV aneurysm.

Özet– Üç boyutlu speckle-tracking ekokardiyografinin (3BSTE) sol ventrikül (SV) volümlerinin, gerimlerinin ve rotasyonel özelliklerinin kantitatif değerlendirmesinde güvenilir ve uygulanabilir bir yöntem olduğu kabul edilmiştir. Bu yazıda SV anevrizmasının volümetrik ve fonksiyonel değerlendirmesinde 3BSTE'nin tanısıl önemi vurgulandı.

Three-dimensional speckle-tracking echocardiography (3DSTE) is considered to be a reliable and feasible method in the simultaneous quantification of left ventricular (LV) volumes, strains and rotational characteristics from the same acquired 3D dataset without geometrical assumptions.^[1–3]

The aim of this case is to highlight the diagnostic importance of 3DSTE in volumetric and functional assessment of an LV aneurysm (LVA).

CASE REPORT

A 56-year-old male patient with LVA was examined using 3DSTE. The patient was involved in the Motion Analysis of the heart and Great vessels by three-dimensional speckle-tracking echocardiography in Pathological cases (MAGYAR-Path) Study, which was organised to validate 3DSTE-derived parameters, to find new applications for 3DSTE and to examine the diagnostic and prognostic significance of the calculated variables. 3DSTE was performed following most recent guidelines and practices. The apical window

was used for data acquisition with a 1-4 MHz PST-25SX matrix phased-array transducer using a Toshiba Artida®

echocardiography system (Toshiba Medical Systems, Tokyo, Japan). Six R-wave-triggered subvolumes were acquired for six consecutive cardiac cycles during one breath-hold to form a 3D full volume, including the entire LV. Quantification of the LVA was performed using a 3D Wall Motion Tracking software version 2.7 (Toshiba Medical Systems, Tokyo, Japan) with electrocardiographic gating. Due to unavailability of special applications for analysis of LVA, some corrections were made during assessments. The longitudinal plane was optimized to the LVA in both apical 4-chamber and 2-chamber views. Cross-sectional views were chosen immediately above the ostium of the LVA, at the middle of the LVA where its diameter seemed largest, and just below its apex (Figure 1). En-

Abbreviations:

3DSTE	Three-dimensional speckle-tracking echocardiography
LV	Left ventricular
LVA	LV aneurysm
RT3DE	Real-time 3D echocardiographic

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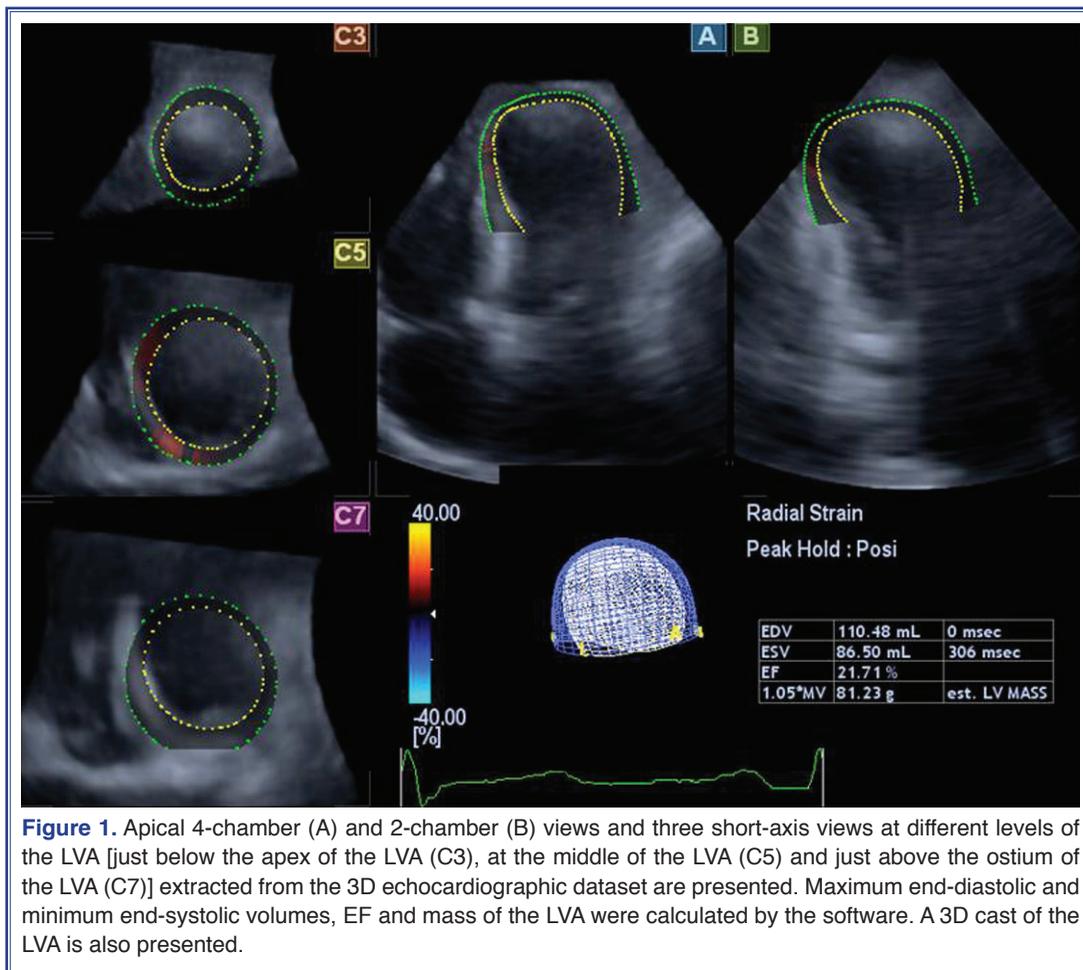


Figure 1. Apical 4-chamber (A) and 2-chamber (B) views and three short-axis views at different levels of the LVA [just below the apex of the LVA (C3), at the middle of the LVA (C5) and just above the ostium of the LVA (C7)] extracted from the 3D echocardiographic dataset are presented. Maximum end-diastolic and minimum end-systolic volumes, EF and mass of the LVA were calculated by the software. A 3D cast of the LVA is also presented.

docardial and epicardial borders were manually identified by reference points, and 3D tracking performed by the software to generate a 3D model of the LVA. Maximum end-diastolic, minimum end-systolic LVA volumes, and LVA ejection fraction (EF) and mass were calculated by the software (Figure 1).

From the 3D echocardiographic dataset, time-segmental radial (Figure 2a), longitudinal (Figure 2b), circumferential (Figure 2c), area (Figure 2d) and 3D (Figure 2e) strain curves were also generated at the same time. Segmental radial strains showed negative values, meaning thinning of the myocardium (mean value: $-27.6 \pm 16.2\%$). Segmental 3D strains were also negative. Mean 3D strain proved to be significantly decreased ($-19.8 \pm 8.6\%$) together with reduced mean longitudinal ($-6.4 \pm 6.7\%$), circumferential ($-11.0 \pm 4.6\%$) and area strains ($-17.3 \pm 10.6\%$), confirming severely impaired segmental LVA function. Moreover, apical (white arrow) and basal-ostial

(dashed arrow) LVA rotations were in the same counterclockwise direction, confirming near absence of LVA twist (Figure 2f).

DISCUSSION

In a recent volumetric real-time 3D echocardiographic (RT3DE) study, ratio of LVA volume and LV end-diastolic volume was found to be a sensitive and reliable marker of cardiac function after LVA formation in an animal model.^[4] Moreover, strain rate imaging-derived indices were found to be significantly reduced in aneurysmal segments in comparison with either the same segment in normal subjects or normal functioning segments in the same patients.^[5] As demonstrated in the present case, one of the most important advantages of 3DSTE over RT3DE is the ability to obtain from a single 3D data acquisition not only the volumetric, but also the functional properties of the LVA, and to calculate unidirectional (radial, longitudinal

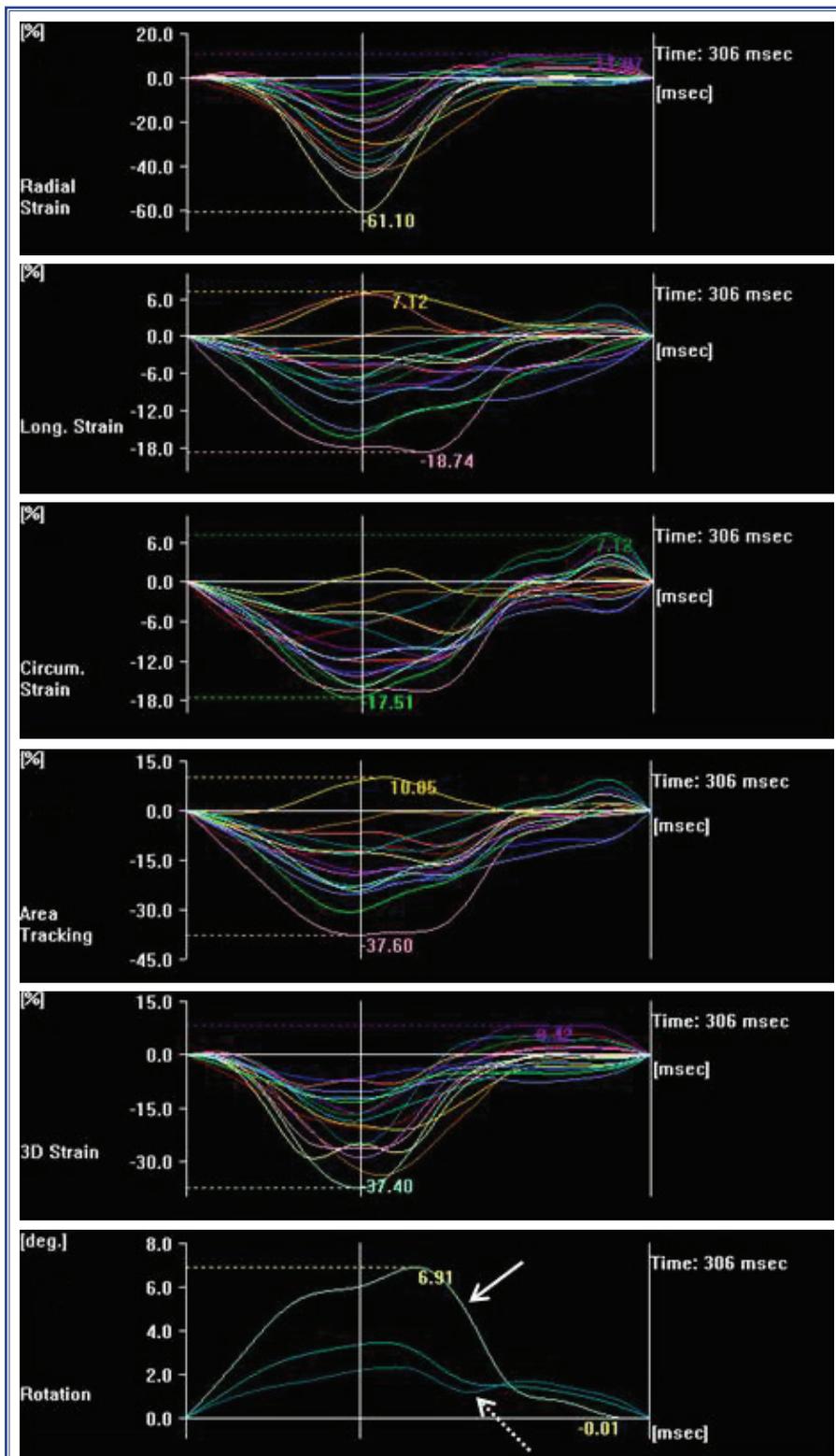


Figure 2. Different time-segmental strain curves including radial (A), longitudinal (B), circumferential (C), area (D) and 3D (E) strains were generated for functional characterization of the LVA from the same 3D echocardiographic dataset. Near absence of LVA twist (F) was confirmed by apical (white arrow) and basal-ostial (dashed arrow) LVA rotations in the same counterclockwise direction.

and circumferential) and complex (area and 3D) strain parameters together with rotational characteristics.^[4,5] To the best of the authors' knowledge this is the first time volumetric and functional assessment of LVA is demonstrated by 3DSTE. It has been shown that detailed 3D segmental assessment of the LVA function shows different pattern of thinning-thickening with quantitative data as compared to the normal functioning myocardium.^[6] Further studies with large patient numbers are warranted to confirm the diagnostic and prognostic impact of 3DSTE-derived LVA volumetric and strain/rotational parameters alone or in combination with LV data. Apart from the known limitations of 3DSTE,^[7] a comparative evaluation with magnetic resonance imaging (MRI) was not possible in this case to confirm accuracy of 3DSTE-derived volumetric evaluation. However, 3DSTE-derived volumetric quantification has already been validated with MRI.^[2]

Conflict-of-interest issues regarding the authorship or article: None declared.

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Anahtar sözcükler: Anevrizma; ekokardiyografi, speckle-tracking; ekokardiyografi; üç boyutlu; sol ventrikül.