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Automated Function Imaging (AFI): A new onboard and clinically applicable method of LV global function assessment by speckle tracking

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Background: Echocardiographic quantification of left ventricular (LV) function is still limited by a significant lack of accuracy and reproducibility. Speckle tracking technique is based on a pure 2D grayscale ultrasound acquisition allowing calculation of segmental strains. In order to become clinically relevant, the speckle tracking technique has been implemented onboard for a quick and automated evaluation of LV function called AFI.

Objective: To evaluate feasibility, calculation time, accuracy and reproducibility of AFI in determining LV function in comparison to reference echo and angiographic methods.

Methods: 40 patients scheduled for an X-ray angiography were previously scanned the same day using a Vivid 7 system. Image quality, global parameters of LV function (ejection fraction, aortic flow, +dP/dt) and segmental contraction were conventionally measured. Global longitudinal strain parameter (GS) was obtained by 2 observers from the apical 2, 3 and 4 chamber views after placing 3 landmarks in each view. GS was then compared to EF from both echo and angiography, but also to other hemodynamic echo parameters.

Results: GS was obtained successfully in 90% of patients. Mean calculation time included counting landmarks was less than 60 seconds. GS was significantly lower in patients with EF below 50% (18±3% vs -9±5%, p<0.01). A strong correlation was observed between EF and GS (Table 1) with good reproducibility.

Conclusion: Global Strain onboard obtained by AFI is clinically applicable and of high relevance in echocardiography as demonstrated by its short acquisition time, its feasibility and its high level of accuracy.

Table 1

<table>
<thead>
<tr>
<th>Regression</th>
<th>Correlation</th>
<th>P</th>
<th>Feasibility</th>
<th>Variability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global Strain vs :</td>
<td>88%</td>
<td>6-8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Angio EF</td>
<td>y = -0.26x + 0.83</td>
<td>0.88</td>
<td>&lt;0.01</td>
<td>100%</td>
</tr>
<tr>
<td>Aortic flow</td>
<td>y = 0.27x - 1.22</td>
<td>0.74</td>
<td>&lt;0.05</td>
<td>100%</td>
</tr>
<tr>
<td>+dP/dt</td>
<td>y = 0.001x - 6.7</td>
<td>0.63</td>
<td>&lt;0.05</td>
<td>50%</td>
</tr>
</tbody>
</table>

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Assessment of left ventricular torsion by Speckle Tracking Echocardiography

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Purpose: Left ventricular torsion has an important role in both left ventricular systole and diastole. During systole the left ventricle presents an opposite rotation between apex and base: as viewed from the apex it is counterclockwise at the apex and clockwise at the base level. This opposite rotation causes the torsion of the left ventricle that has been evaluated in previous studies by cinefluoroscopy or tagged magnetic resonance. Aim of our study was to assess left ventricular torsion in a group of normal patients using the speckle tracking echocardiography. The speckle formations in a gray scale echocardiographic image can be used as myocardial tissue markers that can be tracked during the cardiac cycle. The markers allow to assess myocardial strain or rotation.

Method: We studied 17 patients (9 men; age mean 36±18 years) with normal ejection fraction (60±5%) and without significant valvular disease. We acquired 2D standard short axis images of the left ventricle at the base (just distal the mitral annulus) and at the apex (as distal as possible). The acquisition was performed from 40 to 90 fsec. All images were elaborated by a dedicated software that calculated in a semiautomatic manner basal and apical rotation (expressed in degrees, negative if clockwise and positive if counterclockwise), and the time to peak from electrocardiographic R wave (expressed in ms). We estimated this parameter as the difference between basal and apical rotation. All the values are mean plus standard deviation.

Results: At the basal level we obtained a small early systolic counterclockwise rotation (2.8±2.4°; time to peak 80±36 ms) followed by a wider late systolic clockwise rotation (9.2±5°; 338±58 ms). At the apical level we obtained a small early systolic clockwise rotation (1.1±0.9°; 32±21 ms) followed by a late systolic counterclockwise rotation (10.9±4.4°; 301±73 ms). We calculated a small early systolic clockwise torsion (-2.3±1.8°; time to peak 50±27 ms) and a bigger late systolic counterclockwise torsion (18±5°; 316±53 ms). Our data are comparable with those calculated by tagged magnetic resonance in previous studies. Moreover, the speckle tracking echocardiography allows to assess the minimal clockwise apical early systolic rotation that cannot be revealed by tagged magnetic resonance, given its lower frame rate.

Conclusion: Echocardiography with speckle tracking imaging allows to evaluate opposite rotation of basal and apical levels and the consequent torsion of the left ventricle.

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Speckle tracking is a reliable new method for quantitative evaluation of left ventricular function

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Background: The recommended method for evaluation of left ventricular ejection fraction (LVEF) using modified Simpson’s rule is user-dependent and time consuming. Speckle tracking echocardiography (STE) is a method based on an algorithm for the detection of myocardial motion allowing quantitative analysis of global longitudinal strain (GLS) and determination of end-systolic (ESV) as well as of end-diastolic volume (EDV) and LVEF. In this study, we compared the reproducibility of STE based LVEF, EDV, ESV and GLS measurements performed by an inexperienced interpreter with the results obtained by an experienced echocardiographer using measurements with modified Simpson’s rule as a reference.

Material and methods: In 28 patients (17 men and 11 women), digital loops from apical 4-, 2-, and 3-chamber views were recorded for subsequent offline analysis on GE EchoPac workstation. Both the experienced and the inexperienced echocardiography interpreter were blinded to all clinically relevant information and performed their readings independently of each other two times at 2 different occasions.

Results: There was a numerically small (by 8.2%) but statistically significant (p<0.001) underestimation of LVEF by the inexperienced interpreter. On the other hand, there was a good linear correlation between the Simpson’s rule-based ESV, EDV and LVEF determinations of the experienced echocardiographer and STE based results of the inexperienced interpreter (r=0.759 and 0.566, respectively) without any significant differences between the obtained results. Similarly, there was a good correlation between the first and second LVEF, EDV and ESV determination of the experienced echocardiographer with the results obtained by an inexperienced interpreter with the results obtained by the experienced echocardiographer with the results obtained by the experienced echocardiographer with the results obtained by the experienced echocardiographer with the results obtained by the inexperienced interpreter.

Conclusion: Speckle tracking appears to be a reliable, user-friendly and powerful tool for the quantitative analysis of left ventricular function. Furthermore, it can be used as a valuable tool for the training of the novice echocardiographers in the daily clinical practice.