Validation of real-time 3D echocardiography study protocol in identification of anatomic mitral regurgitant defect in patients with prolapse or flail

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Background: In patients with mitral regurgitation (MR), valve repair is a major incentive to early surgery and is decided on the basis of the mechanisms and anatomic mitral lesions. These lesions can be easily studied with transesophageal echocardiography (TEE). A study protocol of real-time 3D echocardiography (RT3D) for the identifications of the valve defect is not well validated.

Objectives: This study was performed to validate a protocol of RT3D for assessment mitral valve for identification of anatomic valve defect due to prolapse or flail using TEE as gold standard.

Methods: One hundred and nineteen consecutive patients with moderate to severe MR (mean age 64±3.4) were studied with RT3D and TEE to identify the valve defects causing MR and the results were evaluated in blind manner. RT3D study protocol was performed as follows: data were acquired in a zoom mode and in a full-volume mode from apical window. Then, using 3D Qlab software (version 2.0, Philips), a volume rendered en-face view of the mitral valve from the left atrium was reconstructed and guided by this view, a series of longitudinal cutplanes were reconstructed to visualise A1-P1, A2-P2 and A3-P3. Segmental analysis of the valve was evaluated according to American Society of Echocardiography guidelines.

Results: Among 119 patients, 66 had prolapse or flail by TEE. The accuracy of RT3D for prolapse lesion was 97% (p=0.0001), with a sensitivity and specificity of 95% and 96%, whereas for flail lesion the accuracy was 95% (p=0.0001) with a sensitivity and specificity of 91% and 97%. The diagnostic accuracy for the individual scallops is reported in Table 1.

Conclusions: RT3D protocol using rendered en-face view and a series of longitudinal cutplanes is highly accurate in the identification of anatomic valve defect and its location, particularly showing high specificity values.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Defect location</th>
<th>Agreement</th>
<th>P value</th>
<th>Sensitivity</th>
<th>Specificity</th>
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<tbody>
<tr>
<td>A1 91% (109/119)</td>
<td>0.0001</td>
<td>90%</td>
<td>96%</td>
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<tr>
<td>A2 96% (115/119)</td>
<td>0.0001</td>
<td>97%</td>
<td>96%</td>
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<tr>
<td>A3 95% (113/119)</td>
<td>0.0001</td>
<td>94%</td>
<td>95%</td>
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<tr>
<td>P1 90% (108/119)</td>
<td>0.0001</td>
<td>89%</td>
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<tr>
<td>P2 97% (116/119)</td>
<td>0.0001</td>
<td>98%</td>
<td>93%</td>
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<td>P3 96% (114/119)</td>
<td>0.0001</td>
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Three-dimensional versus two-dimensional echocardiography in mitral valve repair

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Objectives: Our aim was to compare the diagnostic performance of three-dimensional echocardiogram versus two-dimensional in patients with regurgitant mitral valve.

Background: An accurate assessment of morphology and function of the mitral valve is essential for surgical repair. Two-dimensional (2D) transesophageal echocardiography has certain spatial limitations that could be overcome by three-dimensional (3D) imaging.

Methods: Patients undergoing surgical repair due to severe mitral regurgitation. Preoperative 2D and 3D transesophageal echocardiographic studies were compared to surgical findings (standard of reference). 3D images of the MV were obtained unaware of 2D or surgical findings.

Results: Eighty-one consecutive patients underwent surgical repair (2002-2004). Concordance regarding segments affected between the 2- and 3D studies and surgery was high, (2D: 88%-96%, 3D: 89%-100%). An increment of accuracy for 3D imaging was observed in A1 segment defects (p=0.05) and commissural dysfunction (p=0.02). 2D study incorrectly classified 22 segments mainly corresponding to complex disease. The three-dimensional study in correctly classified 14 segments, unrelated to complex disease. Five (6%) patients with complex disease, who suffered complex repair surgery, were incorrectly diagnosed with 2D but adequately with 3D echocardiography.

A non-expert observer analysis of the 3D images was in accordance (94%, x 0.845) with data of the experienced author.

Conclusions: Three-dimensional echocardiography offers high precision in the evaluation of the mitral valve, and it can complement two-dimensional study in patients with complex valve anatomy where surgical decisions are even more difficult. It provides easily interpretable images and thus a high degree of experience is not required.

Comparison of 2DTEE vs 3DTEE in identification of individual scallop prolapse of the mitral valve

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A pre-operative correct assessment of mitral valve (MV) anatomy is essential to surgical design in particular because advances in cardiac surgery extended MV repair also to complex MV prolapse (MVP). 2D transesophageal echocardiography (2DTEE) provides precise informations about leaflets anatomy, but 3D measurement (3D) echo could increase the understanding of mitral heart disease. In a previous study of our group 2DTEE and 3DTEE showed similar accuracy in the evaluation of MVP. Aim of this study was to compare the accuracy of the two methods (2DTEE and 3DTEE) in the evaluation of individual scallops involvement in MVP. Sixty patients referred to surgical repair of MVP and selected out of 102 consecutive cases on the basis of good or optimal quality of 3D MV reconstructions (3D/IVUS system), underwent 2DTEE intraoperatively. Individual MV scallops were examined and sensitivity (SENS), specificity (SPEC) and accuracy (ACC) were analysed in comparison with surgical inspection. Intra and interobserver variability was calculated.

Results: Global ACC of 3DTEE (91%) and 2DTEE (88%) were similar. SENS and SPEC of the 2 techniques were similar in the analysis of posterior leaflet (fig. 1), anterolateral commissural scallops and chordal rupture. SENS and ACC in evaluation of posterior commissural scallops (fig. 2) and anterior leaflet (fig. 3) involvement were significantly superior for 3DTEE vs 2DTEE.

Intraobserver variability was: 3DTEE 68%, 2DTEE 89% and interobserver variability was 3DTEE 68%, 2DTEE 77% respectively. In conclusion both 2DTEE and 3DTEE had similar good concordance with surgery in the evaluation of MV anatomy. 3DTEE was superior in the evaluation of more complex cases of MVP.

Assessment of mitral regurgitation mechanism. Three-dimensional transesophageal echocardiographic study

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Mitral regurgitation (MR) is a common surgical pathology and a correct judgment of its mechanism is important for optimal surgical intervention. A good understanding requires complete assessment of the mitral valvular apparatus. Two-dimensional transthoracic (TTE) and transesophageal echocardiography (TTE) requires mental integration of all data about morphology of mitral leaflets. Tidimensional echocardiography (3D) can be a better and a quicker alternative. We aim to evaluate the accuracy of 3D transesophageal echocardiographic reconstruction in assessing the mitral valve pathology in patients with significant MR.

Material and methods: A complete echocardiographic study (two-dimensional TTE, TEE and 3D TEE reconstruction) was performed in 50 patients (p) with severe MR caused by pathology of mitral valve, who underwent surgical intervention. The patients with ischemic MR, obstructive hypertrophic cardiomyopathy, MR due to mitral annulus dilation, and also congenital MR were excluded. Five patients had mitral mechanical prosthesis. The 3D study was performed using an ultrasound imaging system Sonos 5500, Agilent.