Assessment of mitral annular motion during diastole in patients with left ventricular hypertrophy by real-time 3D echocardiography

S.M. Park1, J. Kwan2. 1Korea University Hospital, Division of cardiology, Ainan, Gyeonggi-do, Korea, Republic of; 2Inha University Hospital, Cardiovascular Center, Incheon, Korea, Republic of.

Background: The purpose of this study was to assess the mitral annular motion during left ventricular diastole in patients with left ventricular hypertrophy (LVH) in comparison with normal controls using a 3D computer program (TomTec).

Methods: Real-time 3D echocardiography (RT3DE) was performed in 10 LVH patients and 10 normal controls. All subjects had a normal left ventricular systolic function on echocardiography. Non-planarity of annulus was estimated by non-planar angle (NPA) between 2 vectors from two hinge-points of the annulus in the antero-posterior plane to the center of the axis connecting two commissures in the commissure-commissure plane. NPA was measured on early, mid and late diastole.

The mid diastole was defined as median frame number in diastole. The mid diastole was defined as median frame number in diastole.

Results: There was no difference of heart rate between two groups and all subjects had normal sinus rhythm on ECG. NPA was decreased from early to late diastole (12±3° vs 7±1°, p< 0.01). The pattern of changes of NPA were also different. NPA more decreased from early to mid diastole than from mid to late diastole in controls (8±1° vs 5±1°, p<0.01). Contrary to patients with LVH, NPA was more decreased from mid to late diastole (2±1° vs 5±2°, p<0.01).

Conclusion: RT3DE, with a 3D computer program, demonstrated that the longitudinal mitral annular motion of LVH was significantly decreased than that of controls. And the blurred change of NPA during early to mid diastole in LVH could be explained the impaired early active LV relaxation.

Semi-automatic tracking of the mitral annulus in real time 3D echocardiography: a tool for clinician

F. Veronesi1, C. Corsò1, E.G. Caiani2, C. Lambert2. 1Università di Bologna, DEBS, Bologna, Italy; 2Istituto di Biomeccanica, Milano, Italy.

The analysis of the mitral annulus (MA) shape deformation along the cardiac cycle is an important determinant for the evaluation of several cardiomyopathies. In particular, mitral regurgitation and dilated cardiomyopathy could be evaluated assessing quantitative parameters such as MA area, commissure-commissure length and antero-posterior annulus length. Using 2D echocardiography, these parameters are usually evaluated by manual tracing and geometric modeling by assuming an elliptic shape for the MA from different views (2- and 4-chambers). Recently, real-time 3D echocardiography (RT3DE) has been utilized to quantify the MA; however, measurements were manually obtained by multiple rotational 2D views. Our goal was to develop a semi-automated tool for MA reconstruction and tracking in the 3D space, thus exploiting the information contained in the dataset and allowing more accurate and less subjective 3D measurements. First, from a RT3DE dataset representing an apical view, the MA is manually identified on the end-diastolic frame by selecting the points corresponding to its contour in 8 rotational planes. Starting from this points an algorithm based on optical flow technique is applied. By using a differential technique and sequentially a matching technique, that consider the presence of Rayleigh noise in the echographic data, our algorithm allows automatic tracing of the MA throughout the cardiac cycle. By carrying out this analysis it is possible to reconstruct the 3D shape of the MA and to assess the parameters necessary for the diagnosis and moreover it is possible to analyze the parameters during cardiac cycle. In the figure an example of the detected MA (right) and the MA area throughout the cardiac cycle is presented (right, from the ED frame).

Accuracy of real-time 3D echocardiography for identification of mechanisms of mitral regurgitation: a comparative study with transesophageal echocardiography

E. Agnoliola, M. Pisani2, M. Oppizzi2, A. Menis1, A. Manganaro1. 1Milan, Italy; 2San Raffaele Hospital, Division of Noninvasive Cardiology, Milano, Italy.

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 mechanisms can be studied easily with transesophageal echocardiography (TEE), whereas the accuracy of real-time 3D echocardiography (RT3D) for the identifications of the mechanisms of regurgitation is not well known.

Objectives: This study was performed to determine the accuracy of 3RTD compared with TEE as gold standard, and evaluate the incremental accuracy over transesophageal echocardiography (TEE) for identification of mechanisms of MR.

Methods: Fifty-four consecutive patients with moderate to severe MR (mean age 64±13.4, 24 men and 30 women) were studied with RT3D, TTE and TEE for identification of mechanism of MR and the results were evaluated in blind manner. The mechanisms of MR were classified according to Carpentier classification: type I: normal leaflet motion; type II: excess of leaflet motion; type III: restricted leaflet motion. The incremental accuracy of RT3D over TEE was tested using McNemar’s test.

Results: We identified a total of 55 mechanisms. Compared with TEE, the overall accuracy of RT3D was 94%, and was 80% for type I, 96% for type II and 94% for type III. The incremental accuracy of RT3D over TEE was higher for type II and similar for type I and III (Table 1).

<table>
<thead>
<tr>
<th>Type</th>
<th>Accuracy</th>
<th>p value</th>
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dd
Clinical use of real time 3D-echocardiography after percutaneous mitral commissurotomy (commissural assessment and valve area measurements)

D. Mosaka-Zolotuk, E. Brochet, B. Jung, B. Cormier, A. Vahanian, Hospital Bichat, Cardiology Clinic, Paris, France

Background: Two-dimensional echocardiography (2DE) is the method of choice for the assessment of percutaneous mitral commissurotomy (PMC) results: mitral valve area (MVA-2D) and commissural splitting. However, assessment of commissural opening by 2DE is hindered by the complex 3D-shape of the mitral valve and it has been recently suggested that Real-Time-3D-Echocardiography (RT-3DE), allowing appropriate plane orientation, may provide more accurate MVA measurements (MVA-3D). Nevertheless, since only 3D-guided 2D MVA measurements are possible, the superiority of quantitative RT-3DE for experienced operators can be questioned. We sought to compare 2DE and RT-3DE assessment of MVA and commissural opening after PMC.

Methods: MVA and commissural opening were assessed 24 to 48 hours after PMC in 27 patients (mean age 68±14 years, 76% female, and 22% atrial fibrillation). 3D measurements were performed blind of 2D results. For both modalities, commissural opening was semi-quantitatively scored as none, mild, or severe, and mean transmural gradient as described elsewhere.

Results: After PMC, MVA-2D increased (1.06±0.21 to 1.84±0.29 cm², p<0.0001) and mean transmural gradient decreased (0.1±0.4 to 0.4±2.4 mm Hg, p<0.001). All except 5 patients had a good valve opening (final valve area ≥1.5 cm²). Mean MVA-3D was 1.87±0.35 cm². Compared to MVA-2D, correlation was excellent (r=0.77, p<0.001), mean difference small (0.16±0.15 mm) and no significant difference observed (p=0.34). Commissural opening assessment by 2DE and RT-3DE are presented in the Table. Agreement between the 2 methods was strong (kappa=0.92) and 2DE underestimated the degree of commissural opening (p<0.0001).

Conclusion: After PMC: 1) for MVA measurement quantitative RT-3DE is not superior to 2DE for experienced operators. In contrast, 2) it seems to provide a more accurate qualitative assessment of commisural opening. The prognostic value of this new modality of commissural assessment deserves additional studies.

Three-dimensional echocardiography: an improved technique for the assessment of mitral valve postendocarditis lesions

A.T Ionescu 1, S. Pascuca2, C. Monos3, A. Dragulescu1, D. Cozma4, M. Gaspar4, S.I. Dragulescu1, F. Timsaroaia, Romania, Victor Babes Univ Med Pharm, Timisoara, Romania, Victor Babes Univ Med Pharm, Timisoara, Romania

Background: Three-dimensional (3D) echocardiography is a new and rapid evolving technique, offering far more information than conventional two-dimensional (2D) echocardiography. Moreover 2D echocardiography requires mental integration of imaging planes. 3D echocardiographic reconstruction facilitates the judgment of the mechanism and a better understanding of the lesions, helping the surgeon to plan the surgical procedure. One of such circumstances is the evaluation of mitral valvular lesions that appear in the evolution of infective endocarditis.

Aim: To evaluate the feasibility of 3D transesophageal echocardiographic (TEE) for reconstruction of mitral valve in patients with infective endocarditis.

Material and method: 29 adult patients (p) with infective endocarditis and involvement of mitral valve apparatus were studied. The 3D-echocardiographic study was performed using an ultrasound imaging system Vingmed Sonos 5500. All patients were investigated with a multiplane TEE probe. The echocardiographic results were compared with the intraoperative findings.

Results: An interpreter's 3D image was obtained in all patients, and the correlation with intraoperative data was excellent (r=0.95). 3D TEE reconstruction correctly identified the lesions, as confirmed intraoperatively. The mitral valve lesions were: vegetations in 13 p, ring abscesses in 4 p, ruptured chordae in 3 p, leaflet abscess in 2 p and leaflet perforation in 2 p. Six patients had successful mitral valve repair and 16 patients required valve replacement. Based on intraoperative findings, sensitivity for the diagnosis of mitral valve lesions using 3D TEE was 97.7% and specificity 100%.

Conclusion: 3D TEE reconstruction is the method of choice in evaluating postendocarditis mitral valve lesions allowing precise preoperative planning when reconstruction is considered.
Abstracts $5

Magnetic resonance imaging in the evaluation of the aortic stenosis
Hradec Kralove, Czech Republic

Introduction: Measurement of aortic valve area (AVA) is especially important in patients with suspected low gradient aortic stenosis. Magnetic resonance (MR) imaging is a newer technique that can be used in this indication. We decided to compare it to AVA calculated from cardiac catheterization (KAT).

Methods: The study enrolled patients with isolated aortic stenosis and no more than minimal aortic insufficiency according to aortography. Gorlin formula was used for the calculation of AVA from hemodynamic data. Cardiac output was determined by thermodilution method and the pressure measurements were performed simultaneously in the left ventricle and the aorta. True FISP (fast imaging with steady-state precession) sequence with voxel size 1.1 x 1.3 x 5 mm was used for the MR imaging of the aortic valve. AVA was determined by planimetry (figure 1).

Results: 21 patients were enrolled in the study. The correlation in the assessment of AVA between both methods was good (r=0.85). The mean AVAs determined by KAT and MR were 0.96 (± 0.45) and 1.13 (± 0.36). The observed difference was statistically significant (p=0.0016) and the agreement in diagnosing severe aortic stenosis (AVA<0.5cm²/m²) was poor (kappa =0.33).

Conclusion: MR imaging is a new technique that can be used for the assessment of aortic stenosis. AVA determined by MR correlates well with KAT. The slight MR overestimation of AVA in comparison to hemodynamic method will probably not be important in clinical decision-making.