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Extended Abstract
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Cardiology-2018: Comparison of the two dimensional versus three dimensional transthoracic echocardiography in assessment of mitral regurgitation - Kavita Tyagi - Max Superspeciality Hospital

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Introduction:

The mitral valve is a complex structure. Mitral regurgitation is often referred to as organic, if there is an intrinsic valve disease, or functional, if the valve is structurally normal but leaks as a result of an extra valvular abnormality, such as an alteration in left ventricle chamber geometry and/or dilatation of the mitral annulus that adversely affects normal coaptation of the mitral valve leaflets during systole. Ischemic MR may be organic (ruptured or ischemic papillary muscle) and/or functional because of LV chamber dilatation. Nonischemic MR may be organic e.g, rheumatic or functional e.g, dilated cardiomyopathy. In contrast to conventional 2-dimensional echocardiography, which only displays the mitral valve leaflets en face from the left ventricle perspective, 3-D echocardiography enables en face visualization from both left ventricle and left atrial perspectives. The latter view is also known as the ‘‘surgical view’’ because it resembles the intraoperative image of the mitral valve after the surgeon, standing on the patient’s right side, opens the left atrium. Two-dimensional echocardiography is not able to provide data about mitral annular shape, because mental reconstruction from separate 2-D views cannot provide the same information as the volume-rendered 3-D reconstruction. Instead, the oval shape of the mitral annulus is best appreciated from the 3-D surgical view of the mitral valve with the entire annular circumference captured in one data set. Moreover, the saddle shape of the mitral valve is best assessed by offline reconstructions, which depict the saddle shaped contour in three dimensions with high points that are anterior and posterior and low points that are lateral and medial. In addition, dynamic 3 dimensional rendering of the mitral valve can discriminate between normal leaflet mobility and tethered leaflets due to regional wall motion abnormalities or global left ventricular enlargement with increased sphericity (resulting in ischemic or functional mitral regurgitation). Despite proven superiority of three dimensional echocardiography over two-dimensional echocardiography no Indian studies are available comparing the two modalities. Considering above factors we decided to take up this study at our centre to compare the assessment of mitral regurgitation by two dimensional versus three dimensional transthoracic echocardiography.

Methods:

This study was conducted in the Department of Cardiology of ‘Sir Ganga Ram Hospital’, New Delhi from June, 2013 to April, 2015. Sample size of 80 was calculated using the formula $(Z^2 \times p \times q)/d^2$), p=70%, precision error of estimation d=0.10 and alpha=0.05.

Inclusion criteria were patients diagnosed to have mitral regurgitation by clinical and two Dimensional Transthoracic Echocardiography who have given informed consent. Exclusion criteria were non co-operation by the patient, mitral stenosis and congestive heart failure. Patient information was documented in a proforma including presenting complaints, present, past, personal and family history, with details of duration of disease. The diagnosis was on the basis of clinical and two Dimensional Transthoracic Echocardiographic findings. Real-time three dimensional echocardiography was performed and recorded in parallel with a routine, comprehensive two-dimensional (2-D) study, by two separate echo-cardiographers. Both echo-cardiographers were blind to each other’s observations in order to avoid biases. The mitral valve leaflets, annulus, quantification of mitral regurgitation, were studied by both modalities. The three dimensional volumes were sliced offline in the three dimensions to selectively display specific cardiac structures along with real time three dimensional acquisition. Statistical testing was conducted with the statistical package for the social science system version SPSS 17.0.

Results:

Out of 80 subjects, 27 (33.8%) were males and 53 (66.3%) were females and the mean age was 54.68 ± 14.02 years. Annulus transverse diameter was found to

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be 37.29 ± 6.68 mm by 2-d echo and 42.75 ± 6.10 mm by 3-d echo p<0.001. Vena contracta width was 5.80 ± 1.59 mm by 2-d echo and by 3-d echo it was 7.66 ± 4.77 mm, p value being 0.001

Discussion:

In the present study Mitral Valve was reconstructed en face from the left atrium (LA). AROA was measured by planimetry from 3-D pictures and compared to the EROA by proximal Isovelocity surface area and proximal MR jet width from 2-D echo. EROA with 2-d echocardiography was 33.17 ± 19 mm and with 3 echo it was 47.97 ± 21.94 mm. This difference was statistically significant p<0.001. Lange et al. studied 38 unselected patients. Transesophageal echo (TOE) 3-D images were acquired; AROA was measured by planimetry from 3D pictures and compared to the effective regurgitant orifice area (EROA) by PISA and proximal MR jet width from 2-D echo. Good correlation was found between EROA and AROA measured from LA (r=0.97, P<0.0001). They came to conclusion that AROA enables quantification of MR with excellent agreement with the accepted clinical method of proximal flow convergence.

Altiok E evaluated direct measurement of anatomic regurgitant orifice area (AROA) by 3-dimensional transesophageal echocardiography. In 72 patients (age 70.6 ± 13.3 years, 37 men) with mild to severe MR, 3-dimensional transesophageal echocardiography and transthoracic colour Doppler echocardiography were performed to determine AROA by direct planimetry, EROA by proximal convergence method, and vena contracta area (VCA) by 2-dimensional colour Doppler echocardiography. AROA determined by direct planimetry was 0.30 ± 0.20 cm², EROA determined by proximal convergence method was 0.30 ± 0.20 cm². Ashraf M Anwar evaluated the feasibility and possible additional value of transthoracic real-time three dimensional echocardiography (RT3D-TTE) for the assessment of cardiac structures as compared to 2D-TTE. Their patients mean age was 45 ± 8.4 years, 75% males. Assessment of native (112 patients) and prosthetic (30 patients) valves morphology and functions was performed. Different shapes of vena contracta were found e.g. oval, circular, and irregular. The RT3D-TTE findings in 3 patient underwent MV surgery were similar to that obtained by intraoperative 2-D TEE and guided towards the proper surgical techniques of repair. de Agustın et al. did a Validation Study of Direct Measurement of PISA by Single-Beat Three- Dimensional Colour Doppler Echocardiography in Mitral Regurgitation. According to authors this was the first study demonstrating that mitral EROA and Rvol can be reliably measured with transthoracic, single-beat, real-time 3-D colour Doppler echocardiography in the clinical setting. A limitation of this study of MR is the lack of a gold standard against which to compare the results of different methods. They concluded that the 3D PISA method may become the standard approach for determining EROA. Paaladinesh Thavendiranathan did a study to test the accuracy of an automated 3-dimensional (3D) proximal isovelocity surface area (PISA) (*in vitro* and patients) and stroke volume technique (patients) to assess MR severity using real-time volume colour flow Doppler transthoracic echocardiography. The mean anatomic regurgitant orifice area (0.35 ± 0.10 cm^2) was underestimated to a greater degree by the 2-D (0.12 ± 0.05 cm^2) than the 3D method (0.25 ± 0.10 cm^2; P<0.001 for both). It led to conclusion that Automated real-time 3-D volume colour flow Doppler based 3D PISA is more accurate than the 2D PISA method to quantify MR. However in our study we have not quantified MR by PISA on 3-d echo.

Conclusions:

Statistical difference in vena contracta width, annulus and effective regurgitant orifice are measurements may enable us to quantify much more moderate regurgitation as severe ones leading to need of more number of early interventions. However more long term studies are required to establish the standard values on 3-D echo. To confirm our findings of different scallops, large studies are required specially confirmation of results during surgery. Further large studies are required for studying various shapes of annulus and its dynamics. Studies are required to differentiate the different dimensions of different shapes of vena contracta and their implications on the assessment of severity and treatment outcomes. Effective Regurgitant orifices are by PISA method should be done by both 2-d echo and 3-d echo for comparison. Despite extensive search we could not find detail morphological and mobility study

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references, which could have helped us for comparative evaluation.

Biography:

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