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ASSESSMENT OF COMMISSURAL MORPHOLOGY BY 2-DIMENSIONAL AND 3-DIMENSIONAL ECHOCARDIOGRAPHY TO PREDICT THE IMMEDIATE OUTCOME OF PERCUTANEOUS TRANSVENOUS MITRAL COMMISSUROTOMY IN PATIENTS WITH RHEUMATIC MITRAL STENOSIS

Cardiology

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ABSTRACT

OBJECTIVE: To find various commissural morphologic predictors of immediate outcome of percutaneous transvenous mitral commissurotomy by two and three dimensional echocardiography.

METHODS

Design: Cross sectional study

Setting: Tertiary care hospital

Participants: Symptomatic patients with severe rheumatic mitral stenosis aged more than 12 years without any contraindications for the procedure.

Intervention: 2D and 3D echocardiographic evaluation of commissural morphology was done by measuring commissural thickness score, commissural fusion score, commissural calcification and intercommisural distance.

End point: Predictors of successful procedure.

RESULTS: Sixty-five patients were screened. Ten were excluded because of (commissural calcification 5, > moderate mitral regurgitation 2, thrombus in left atrium 2 and emergency procedure in a pregnant lady 1). Fifty five patients (29 (53%) men and 26 (47%) women), mean age 30.58 ± 9.27 were studied. The procedure was successful in 47 (86%) patients. The following parameters predicted the success; lower commissural fusion score by 3D echo 1.5 (0.5 – 2.0) vs. 2.0 (0.5 -2.0); p ≤ 0.002, higher intercommisural distance by 2D echo 19.0 (12.5 – 21.5) vs. 16.5 (12.0 – 18.5); p ≤ 0.009, lesser commissural thickness score 3D echo 5.0 (0.4 – 10.2) vs. 8.8 (3.9 – 10.0); p ≤ 0.028 as well as by 2D echo 5.1 (1.7 - 9.8) vs 8.5 (4.3 – 9.7); p < 0.037. Commissural thickness score by 2D echo was the best predictor of outcome (r=0.509, P<0.0001).

CONCLUSIONS: Commissural morphology is an important independent predictor of immediate outcome of percutaneous transvenous mitral commissurotomy.

KEYWORDS

Percutaneous Transvenous Mitral Commissurotomy (PTMC), 2 Dimensional Echocardiography, 3 Dimensional Echocardiography, Commissural fusion score, Commissural thickness score, commissural calcification, Intercommisural distance.

INTRODUCTION

Rheumatic Mitral Stenosis (MS) is the commonest cause of valvular heart disease in developing countries.1,2 The Percutaneous Transvenous Mitral Commissurotomy (PTMC) has become a well established procedure for its treatment.3 Various scores and individual parameters have been used to predict its immediate and long term outcome of PTMC.4,5 Commissural morphology has gained importance as commissural splitting is the main mechanism behind surgical and balloon mitral commissurotomy.6 Commissural calcification and commissural fusion have been used as independent predictors of outcome.7 Recently 3 dimensional echocardiography (3D Echo) has evolved as a novel tool for evaluation of mitral valve and commissures. The advantages of 3D is that the image can be adjusted by manipulating various angles and planes and enface view can be seen.8,9 In this study we evaluated some newer commissural parameters like commissural thickness score and intercommisural distance along with commissural fusion score by 2D and 3D echocardiography.

MATERIALAND METHODS

This study was carried out at All India Institute of Medical Sciences, New Delhi, India by a single team after obtaining an informed written consent from the patients or their legal heirs. The study was approved by the institutional ethics committee.

Inclusion Criteria: Symptomatic patients with severe rheumatic MS aged more than 12 years undergoing PTMC.
Exclusion Criteria: Patients having calcific MS, thrombus in left atrium or appendage, mitral or aortic regurgitation > grade 2, acute rheumatic fever within past 3 months, infective endocarditis, emergency PTMC, pregnant females and not consenting for the study.

Echocardiographic Evaluation: A day before the procedure an ECG gated 2D and 3D echo was done in all standard views on Philips iE-33 machine, Phillips Medical System, Hamburg, Germany. Three dimensional echocardiography was done using full volume and live mode and stored on a compatible DICOM system for offline analysis. The commissural morphology was assessed in parasternal short axis end diastolic frames. Commissural thickness of each commissures was measured at the margin of mitral orifice and summed to obtain commissural thickness score. The commissural fusion score was calculated as score 0 = unused/minimally fused commissures, 0.5 as partially fused and 1.0 as fully fused for each commissures and then added to obtain commissural fusion score. The intercommissural distance (ICD) was measured as the distance between two commissures. (Figure 1) Presence of commissural calcification was an exclusion criteria. The mitral valve area (MVA) was measured by 2D and 3D planimetry at the tip of mitral leaflets as well as by pressure half time (PHT) method. Post PTMC echo was done to look for commissural splitting, MVA by 2D and 3D planimetry and for development of mitral regurgitation or pericardial effusion.

Table 1: Demographic profile and clinical characteristics of patients undergoing PTMC

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>No (Percent %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients screened</td>
<td>65</td>
</tr>
<tr>
<td>Excluded</td>
<td>10</td>
</tr>
<tr>
<td>Number of patients for final analysis</td>
<td>55</td>
</tr>
<tr>
<td>Age</td>
<td>30.58 ± 9.27</td>
</tr>
<tr>
<td>Height in (cm)</td>
<td>160.12 ± 9.04</td>
</tr>
<tr>
<td>Weight in (kg)</td>
<td>49.47 ± 10.58</td>
</tr>
</tbody>
</table>

RESULTS

Sixty-five patients were screened by 2D echocardiography. Ten patients were excluded because of commissural calcification in 5, more than moderate mitral regurgitation in 2, left atrium thrombus in 2 and emergency PTMC in a pregnant lady 1. Fifty five patients, 29 (53%) males and 26 (47%) females were evaluated. The mean age was 30.58 ± 9.27 (range 13 - 50) years. The average height was 160.12 ± 9.04 cm, mean weight 49.47 ± 10.58 kg and the mean body surface area 1.49 ± 0.19 (m²).

Echocardiographic Data: The mean MVA was 0.79 ± 0.14 cm² by 2D planimetry, 0.75 ± 0.12 cm² by 3D planimetry, 0.81 ± 0.13 cm² by PHT as compared to 0.73 ± 0.16 cm² by Gorlin’s formula. The MVA obtained by 3D planimetry had the best agreement with MVA derived by Gorlin’s formula (r = 0.525, P < 0.0001) suggesting that 3D echo can obtain more accurate MVA exactly at the tips of mitral leaflets. (Figure 2) Overall we did not find any difference between 2D and 3D echo parameters of commissural morphology. (Table 2)

Table 2: Comparison of 2D and 3D Echocardiographic parameters among all patients

<table>
<thead>
<tr>
<th>Parameters of Commissural Morphology</th>
<th>2D Echo (n=55)</th>
<th>3D Echo (n=55)</th>
<th>P - Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commissural thickness Lateral (mm)</td>
<td>2.65 ± 1.02</td>
<td>2.66 ± 1.30</td>
<td>0.98</td>
</tr>
<tr>
<td>Commissural thickness Medial (mm)</td>
<td>2.75 ± 1.08</td>
<td>2.73 ± 1.28</td>
<td>0.61</td>
</tr>
<tr>
<td>Commissural thickness (Lat + Med) mm</td>
<td>5.41 ± 1.99</td>
<td>5.42 ± 2.40</td>
<td>0.92</td>
</tr>
<tr>
<td>Commissural Fusion (Lateral)</td>
<td>0.71 ± 0.28</td>
<td>0.72 ± 0.26</td>
<td>1.00</td>
</tr>
<tr>
<td>Commissural Fusion (Medial)</td>
<td>0.74 ± 0.25</td>
<td>0.73 ± 0.25</td>
<td>1.00</td>
</tr>
<tr>
<td>Commissural Fusion score (Lat + Med) mm</td>
<td>1.45 ± 0.39</td>
<td>1.45 ± 0.40</td>
<td>1.00</td>
</tr>
<tr>
<td>Inter commissural distance (ICD) (mm)</td>
<td>18.02 ± 2.78</td>
<td>18.02 ± 2.83</td>
<td>0.916</td>
</tr>
<tr>
<td>MVA by Planimetry (cm²)</td>
<td>0.79 ± 0.14</td>
<td>0.75 ± 0.12</td>
<td>0.025</td>
</tr>
</tbody>
</table>

Outcome of PTMC: The procedure was successful in 47 (86%) patients. There were 8 (14%) failures; out of which 4 had suboptimal result, 3 developed > grade 2 mitral regurgitation (MR) and one patient who had stroke was managed by percutaneous retrieval of mitral tissue from middle cerebral artery. The mean Gorlin’s derived MVA increased from 0.73 ± 0.16 cm² to 1.69 ± 0.30 (p ≤ 0.00001). The mean LA pressure decreased from 28.6 ± 6.29 to 15.86 ± 6.79; p ≤ 0.0001 and mean cardiac index increased from 2.39 ± 0.36 to 2.81 ± 0.33; P ≤ 0.0001.

Echocardiographic parameters of successful PTMC: The following echocardiographic parameters of commissural morphology were associated with the successfulness of the procedure; the lower commissural fusion score by 3D echo 1.5 (0.5 – 2.0) vs. 2.0(0.5 – 2.0); p ≤ 0.002, higher intercommissural distance by 2D echo 19.0 (12.5 – 21.5) vs. 16.5 (12.0 – 18.5); p < 0.009, lesser commissural thickness score 3D echo 5.0 (4.0 – 10.2) vs. 8.8 (3.9 – 10.0); p ≤ 0.028 as well as by 2D echo 5.1 (1.7 – 9.8) vs. 8.5 (4.3 – 9.7); p < 0.037. The lesser thickness of individual commissures was also significantly related to the success of the procedure. (Table-3)
Bahl et al. also reported a success rate of 93% in their study.

The overall success rate of the procedure was 86% which is consistent with other study results. However, the success rate can vary based on various factors such as patient age, severity of mitral stenosis, and the expertise of the operator. In our study, the MVA by 2D, 3D planimetry, and PHT correlated well with each other as well as MVA obtained by Gorlin's formula, however, the MVA by 3D planimetry was in best agreement with Gorlin's derived MVA. Similar observations were made by Zomarano et al. in their study of 80 patients.

In our study, the MVA by 2D, 3D planimetry and PHT correlated well with each other as well as MVA obtained by Gorlin's formula, however, the MVA by 3D planimetry was in best agreement with Gorlin's derived MVA. Similar observations were made by Zomarano et al. in their study of 80 patients. The reason for this is the ability of 3D echo to adjust the image in a desirable plane regardless of the orientations of acoustic windows.

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**STUDY LIMITATIONS**

The smaller sample size may have limitation in interpreting the results between the groups. The inclusion of the sample size is a limitation as a small study is conducted with a sample size of 60 patients.

**CONCLUSIONS:**

Assessment of commissural morphology using commissural thickness and fusion score, and intercommissural distance appears useful in predicting the immediate outcome of PTMC. The lesser deformed commissures are easier to open than badly deformed commissures. Further larger studies can enlighten more on these scores.

**REFERENCES**


