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OPTIMIZING OUTCOMES IN PERCUTANEOUS TRANSVENOUS MITRAL COMMISSUROTOMY

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ABSTRACT

In developing countries rheumatic heart disease (RHD) still awaits to be eliminated. It remains as is one of the leading causes of cardiac morbidity and mortality. Mitral valve is the most frequently afflicted valve in rheumatic heart disease. Mitral valve area reduces to 1.5cm^2 it should be considered as severs and intervention should be planned early. Trans Esophageal echocardiography (TEE) offers unrestricted access to evaluate appendage and should be performed in all patients being considered for intervention. Symptoms of Mitral Stenosis can be effectively mitigated by controlling heart rate regardless of patient being in sinus rhythm or atrial fibrillation. Percutaneous transvenous mitral commissurotomy (PTMC) is safe, effective and durable procedure. Careful selection of valves and patients - Intervene early - low Wilkins Score. All patients must be screened for LA/LAA thrombus. It is a patient friendly procedure. Patients who derive maximal benefit are young, females, pregnant, those who require repeat procedure after CMV or PTMC and those who have contra indications to general anesthesia. It has documented salutary acute and long term results. One has to have supervised training to learn to avoid complications. LV function may be compromised therefore LV function shall be monitor diligently.

Key Words: Rheumatic Heart Disease, Mitral Stenosis, PTMC

INTRODUCTION

In developing countries rheumatic heart disease (RHD) still awaits to be eliminated. It remains as is one of the leading causes of cardiac morbidity and mortality. Recent reports have documented incidence of RF as high as 206/100,000 and RHD prevalence as high as 18.6/1000. There are variations in the different geographical areas and prevalence of RHD was found to be 22/1000 in inner Lahore and 5.7/1000 in rural Pakistan in recent studies.[1-3] Mitral valve is the most frequently afflicted valve in rheumatic heart disease. The commonest presentation of rheumatic heart disease is affliction of mitral valve presenting as Mitral stenosis. RHD affects mitral valve solely in 25% and in combination with other valves in 40% of patients.[4,5] In Pakistan, RHD remains endemic like other developing countries.

WHEN TO INTERVENE?

How severe is severe Mitral stenosis that warrants intervention? An extensive echocardiography based study concluded that when mitral valve area decreases to 1.5 cm^2 left atrium has enlarged and pulmonary arterial hypertension has developed. Hence it was recommended that as mitral valve area reduces to 1.5cm^2 it should be considered as severs and intervention should be planned early.[6]

DOES EVERYONE REQUIRE TEE?

Left atrial and atrial appendage clots are common occurrences in Mitral Stenosis and are classified according to the anatomical location in left atrium and left atrial appendage. **Type Ia:** LA appendage clot; **Type Ib:** LA appendage clot protruding into LA cavity; **Type IIa:** LA roof clot limited to a plane above the plane of rhythm; **Type IIb:** LA roof clot extending below the plane of fossa; **Type III:** Layered clot over the interatrial septum (IAS); **Type IV:** Mobile clot which is attached to LA free wall or roof and **Type V:** Ball valve thrombus (Free Floating).[7]

Trans Esophageal echocardiography (TEE) offers unrestricted access to evaluate appendage and should be performed in all patients being considered for intervention. A total of 176 patients with mitral stenosis were divided into two groups: 110 patients in group I having sinus rhythm and 66 patients in group II having atrial fibrillation. In group I, 40 (36.36%) were males compare to group II having 14 (21.21%). Mean age of patient in group I was 33.13 years ± 13.82 as compared to 30.97±8.86 years in group II. In group I, 29 (26.36%) had LA/LAA thrombus as compared to 32(48.48%) in group II on TEE(p=0.003). In group I, 60(54.54%) patients had spontaneous echo contrast as compared to 58(87.87%) in group II on TEE (p=0.000). Mean left atrial size in group I was 4.2±0.52cm as compared to 5.3±0.71cm in group II (p-value=0.000). In patients with AF, LA/LAA thrombus was visualized in 10 (15.15%) on TTE as compared to 32(48.48%) on TEE (p = 0.001). Most patients have type I to IIa clots and require anticoagulation before the decision is made for intervention. Type IIb to V are contraindications to percutaneous intervention.[8]

EFFECT OF HEART RATE

Symptoms of Mitral Stenosis can be effectively mitigated by controlling heart rate regardless of patient being in sinus rhythm or atrial fibrillation. By reducing heart rate mitral valve gradient can be reduced. A total of 60 patients were studied, females were 57 (78%) and mean age was 31± 9 years. Mean slow and fast HR was 77±12bpm and110±13 bpm, respectively. Peak mitral valve gradient (PMVG) slow vs. fast HR was 12.8±4.80 and 14.93±7.18 mm Hg (p=0.000). Mean mitral valve gradient (MMVG) at slow vs. fast HR was 6.62±3.29 and 8.15±4.88 mm of Hg (p=0.000). E pulse Doppler (E) at slow vs. fast HR was 168±35 and 181±40 cm/s (p=0.013), while E/Tissue Doppler (E/) velocity was 10.47±2.81 and 10.97±2.38 cm/s (P=0.098), respectively. E/E/ ratio for slow and fast HR was 17±5.63 vs. 17±5.41 (P=0.792). Right ventricular systolic pressure (RVSP) at slow vs. fast HR was 44±16 vs. 49±17.05mm of Hg (p=0.001). The above parameters had insignificant change with the HR when there was accompanying more than mild MR. Slowing HR in patients with MS significantly decreased PMVG, MMVG and RVSP. LV function did not change significantly with HR. Rate control drugs may be used to improve symptoms even in moderate and severe MS.[9]

TECHNICAL ASPECTS OF THE PROCEDURE

The advent of balloon based procedures revolutionized the way physicians have been treating this ailment. PTMC started as an alternative to closed mitral valvotomy using single balloon, then double balloon and later Inoue balloon.[10,11] Inoue technique has been asserted as more operator friendly and safe for the patients in terms of left ventricular perforation and cardiac tamponade. Most catheterization laboratories switched to this variety having used single, bifoil, trifoil, two balloons with separate punctures and multi-track balloons.[12-16] As compared with other balloon techniques Inoue balloon was found to be equally effective and with lesser complications. Technique of Percutaneous Transmitral Metallic Commissurotomy was introduced by Cribier. This metallic device was similar toTubb's dilator used by Cardiac Surgeons for Mitral Commissurotomy. It was mounted on the shaft of 13F Catheter and placed at Mitral Valve level just as in the technique of Innoue Balloon.[17,18]

INNOVATIONS

Success rate of the procedure is more than 90% in most centres in experienced hands. Local experience showed that in many patients interatrial septum could be crossed using PFO without the need to puncture septum. This reduced procedure time and improved safety of the procedure. From 1998 to 2011 a total of 1818 patients underwent PTMC. Out of 1818 patients 1345 (73%) were females and mean age was 26.51± 7.82 years. PFO was probed and crossed in 1636/1818 (90%) patients. All PFO's were crossed within15 ± 04 minutes of commencement of probing. Spending a longer time searching for PFO did not increase the yield. Mean valve area was 0.9 ± 0.19 cm^2, which increased to 1.82 ± 0.17 cm^2 immediately after PTMC ($p < 0.05$). The mean mitral valve gradient decreased from 18 ± 4.04 to 7 ± 0.25 mmHg immediately after PTMC ($p < 0.005$). During the procedure 0.5% patients died due to cardiac tamponade and acute mitral regurgitation. Cerebrovascular accident developed in 27 patients (1.5%). Acute mitral regurgitation requiring surgery developed in 72 patients (4 %). The above complications were more common in those patients who had interatrial septal puncture compared to the PFO group. The time to cross mitral valve was significantly reduced while accessing through PFO as compared to interatrial septal puncture.[19-21]

IMMEDIATE RESULTS

Results were assessed and compared with each other, documenting single balloon to be as effective as CMV. Double balloon technique produced better haemodynamic results with further increase in mitral valve area. Success of the procedure is assessed by reduction of mitral valve peak and mean gradient by half, significant fall in pulmonary arterial pressure andincrease by double in mitral valve area assessed by direct planimetry on echocardiography and calculated by Doppler.[22-24] PTMC results in immediate drop in MVG and pulmonary vascular resistance, and a slight increase in cardiac index and LV diastolic volume. Pulmonary vascular resistance drops in the first 24 hours, and continues to decrease on a long term basis. Improvement in the left atrial appendage peak doppler velocity decreases echo contrast in the LA. This has a beneficial effect on blood stasis and thrombo-embolism.[25,26]

LONG TERM RESULTS

Palaciocs 15 years follow up (mean 4.2 ± 3.7 years) of 879 patients submitted to 939 PTMCs. Rate of major events (death, surgery, new PTMC) were low in first 5 years, it progressively increased after this reaching a total of 47.2% combined events by the end of the study. Of the 446 event free patients, 94% were at FC I or II.[27]

COMPLICATIONS

Major complications of PTMC are acute mitral regurgitation, cardiac tamponade, cerebral or systemic embolism, deathand failure to open the valve. Initial complications like being unable to enter femoral vein, puncture interatrial septum, cross interatrial septum through puncture or PFO and cross mitral valve reduce as the experience builds up. Mortality ranges between 0- 3%. The major causes of death are cardiac tamponade, severe MR. In the NHLBI's registry PTMC- related mortality clearly related to patient selection: comparing patient at high and low surgical risk, the immediate and 30 day mortality rate was 2% vs. 0.5%, and 8% vs. 0.6%, respectively. Complications can be reduced by careful working up of patients employing TEE to screen for clots, documenting Mitral Regurgitation and evaluating subvalvular apparatus. It is important to exercise utmost caution in carrying out the procedure under tutelage of experienced hands.[15,16,21-23]

Based on symptoms of recurrence alone, the restenosis rate varies between 2% and 60%. Four years follow up of 269 patients after PTMC showed 13% restenosis rate. Restenosis remains an unconquered frontier. Some patients restenose - more like 'restenosers' after angioplasty and stenting. Some of them require repeat procedure and a few of them as many as four times: each time yielding a good result and then restenosing after a few years. The causes of restenosis are commissure refusion, progressive leaflet thickening, calcification and progressive subvalvular disease.[13,16,23,25]

Development of significant mitral regurgitation remains the Achilles' heel of this procedure and it still remains an unpredictable consequence of the procedure. One should anticipate unfavorable outcomes in patients with calcified valve, subvalvular apparatus involvement and antecedent mitral regurgitation. Careful step wise dilatation of balloon with careful monitoring of the result with special attention to increase of mitral regurgitation helps to reduce complications. Mild mitral regurgitation is not a contraindication to PTMC whereas severe mitral regurgitation is a definite contra indication. Patient presenting with moderate regurgitation present a challenge and a decision has to be made dependenton chambers dimension, LV function and severity of MR evaluated diligently by TEE in multiple planes. In such patients Mitral valve replacement remains a safe and effective strategy but in patients who refuse surgery or cannot afford it, PTMC remains a viable option.[13,16,21,23,25]

EFFECT OF PTMC ON LV & RV FUNCTION

Left ventricular function in MS and effect of PTMC has been an area of interestfor researchers. Interesting work by Yıldırımtürk et al, evaluated deformation parameters-

longitudinal and circumferential strain and strain rate in patients with mitral stenosis and apparently normal left ventricular function with Velocity Vector Imaging.[28] Longitudinal strain and strain rate were reduced at all the levels of the left ventricle: base, mid- ventricle and apex; circumferential strain and strain rate at the mid-ventricular level were significantly reduced. Higher myocardial performance index suggested impaired myocardial performance. This study indicated that the subclinical global left ventricular dysfunction in patients with mitral stenosis is a sequence of rheumatic myocarditis. Subclinical myocardial dysfunction due to rheumatic myocarditis can be responsible for part of the symptoms in symptomatic patients with mild-moderate mitral stenosis.[29,30] In a study on141 patients with severe isolated MS who had undergone successful PTMC, LV systolic dysfunction i.e. EF< 50 % was found in 24 (17.02%) of patients. LV systolic function was mildly impaired in 13 (9.2%), moderately impaired in 7(4.9%) and severely impaired in 4 (3%) of the study group. TTE 24 hours after PTMC showed left ventricular systolic dysfunction being present in 14.3% of patient with mild degree impairment in 10 (7.1%), moderately impaired in 6 (4.2%) and severely impaired in 4 (3%) of the study group. The LV systolic dysfunction which is used as a surrogate of rheumatic myocarditis occurred in about 17% of patients with isolated severe MS and improved in a few patients after successful PTMC.[31]

Velocities recorded before and after PTMC at Mitral annulusemploying Tissue Doppler Imaging in Systole increased Pre PTMC 0.07±0.01 m/s to Post PTMC 0.085±0.01 (p<.001). Early Diastolic velocity was 0.075±0.02 pre PTMC and 0.1±0.02 post PTMC (p <.001). Late Diastolic velocity increased from 0.11±0.02 to 0.12± 0.03 after PTMC (p<.01). There were no significant changes on systolic and early and late diastolic velocities recorded on Tricuspid valve. This documented significant improvement in systolic and diastolic left ventricular function after successful PTMC but no immediate effect on right ventricle. The change in peak annular velocity in early diastole in the lateral wall correlated well with improvement in mitral valve orifice area.[32]

TIPS AND TRICKS

Technical failure rates vary between 0.8% and 2.3 %. This is due to being unable to puncture IAS, in this scenario TEE or Intra Cardiac echo ICE may be used for localization of puncture site. If one is unable to cross mitral valve then one may use fine Terumo wire to cross the valve and later negotiate balloon. In patients with very tight stenosis the balloon may be elongated with wire in place to improve the profile and facilitate crossing the valve. If nothing seem to work it may be better to abandon the procedure and try again on a good day![13,16,21]

Factors that determine success of the procedure are age, functional class IV, previous CMV or PTMC, initial MR > 2, Wilkins score more than 8, gross TR - not responsive to therapy, severe MR post dilation and higher pulmonary artery pressure post dilation.[33]

CONCLUSION

To conclude PTMC is safe, effective and durable procedure. Careful selection of valves and patients - Intervene early - low Wilkins Score. All patients must be screened for LA/LAA thrombus. It is a patient friendly procedure. Patients who derive maximal benefit are young, females, pregnant, those who require repeat procedure after CMV or PTMC and those who have contra indications to general anaesthesia.It has documented salutary acute and long term results. One has to have supervised training to learn to avoid complications. LV function may be compromised therefore LV function shall be monitor diligently.

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