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RESEARCH ARTICLE

RESULTS OF MITRAL VALVE REPAIR IN RHEUMATIC VALVULAR HEART DISEASE

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ABSTRACT

Aim: This retrospective study was planned to evaluate the various outcomes of mitral valve repair in rheumatic mitral valve disease.
Methods: Between January 2007 to July 2015, 238 rheumatic mitral valve repair was done at our institution. The data was collected retrospectively and various post-operative outcomes were analysed in term of mortality, rate of survival, re-operation rate, NYHA class and thromboembolism & bleeding complications. Mitral valve was assessed by transthoracic echocardiography and various results were analysed.
Results: Mean age of study population was 32.17±11.90. 56.72% were female patients. Early mortality was 5.62% and late mortality was 3.13%. Mean follow up was 71±23 months. Survival at mean follow up was 91.59%. Freedom from re-operation was 95%. The rate of re-do procedure was 4.12%. Residual pathology was present in 6.25%. The post-operative mean NYHA class, mitral valve area, mean gradient across mitral valve were 1.34±0.741, 3.17±0.58, 3.81±0.92 respectively.
Conclusion: Mitral valve repair in Rheumatic heart disease is possible in majority of patients with excellent results when comprehensive repair techniques are used.

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INTRODUCTION

Rheumatic heart disease is still a significant health problem in developing countries according to World Health Organisation (WHO) estimates. (Carapetis *et al*., 2004; Carapetis *et al*., 2005; Carapetis, 2007) The disease is especially prevalent in younger population (Saxena *et al*., 2011). Because of non availability of ideal mitral valve prosthesis as described by Harken, mitral valve replacement has its own inherent limitation. Mechanical prosthesis has lifelong anticoagulation and thromboembolism related issues. Bioprosthetic valve has limited durability. (Harken, 1989) Alain Carpentier in the 1970s described a functional classification of mitral valve disease and various reparative techniques. His landmark "French correction" article illustrated the various mitral valve repair techniques (Carpentier, 1983). Mitral Valve repair is acknowledged superior to replacement with respect to the preservation of LV function, lower risks of infective endocarditis, thromboembolism, durability, avoidance of anticoagulants and bleeding complications (Gillinov *et al*., 2008; David *et al*., 1993; Gillinov *et al*., 1998).

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Mitral valve repair is known to be superior to mitral valve replacement in terms of operative mortality, functional outcomes and long-term survival primarily in degenerative mitral valve disease (Enriquez *et al*., 1995). Mitral valve repair has become the procedure of choice in non rheumatic mitral valve disease. The appropriateness of mitral valve repair in rheumatic etiology remains controversial in term of feasibility and durability of repair due to complexity of pathology and chronic and progressive nature of disease. (Yankah *et al*., 2011) Mechanical prosthesis has attending complications of life-long anticoagulation and non-compliance of patient for oral anticoagulants. (Cannegieter *et al*., 1994) Several studies have shown better outcome of repair in rheumatic patients in comparison to valve replacement (Kumar *et al*., 2006; Kim *et al*., 2010; Nguyen *et al*., 1998; Chauvaud *et al*., 2001; Pomerantzeff *et al*., 2009; DiBardino *et al*., 2010). In the present study, we present our experience of mitral valve repair in rheumatic mitral valve disease.

MATERIALS AND METHODS

Between January 2007 to July 2015, 238 rheumatic mitral valve repairs was done at our institution. Mitral valve disease secondary to pathological processes other than rheumatic heart

disease were excluded. The patients who had undergone concommittant aortic valve surgery and tricuspid valve repair were not excluded. This study was approved by ethics committee of our institute and prior written informed consent was taken from the patients. The medical and surgical records of all the patients were retrospectively reviewed.A standardized data collection sheet was used as per guidelines for reporting the results in valve intervention to retrieve relevant information (Akins *et al*., 2008).

Surgical techniques: The general anaesthesia was provided according to the standard protocol by endotracheal intubation with both lung ventilation, peripheral femoral arterial cannulation and central jugular venous cannulation. Trans-oesophageal echocardiography (TEE) was done in all patients to assess mitral valve morphology and adequacy of repair. Median sternotomy was done. Systemic heparinization was done at the dose of 3-4 mg/kg to achieve activated clotting time (ACT)>400 Seconds. Cardio-pulmonary bypass (CPB) was established by aorto-bicaval cannulation. Myocardial protection was achieved by antegrade hyperkalemic cold blood cardioplegia solution through aortic root every 20 minutes. The temperature during CPB was maintained at 32^0c. The left atrium was opened parallel and posterior to interatrial groove to access the mitral valve. Thorough evaluation of mitral valve apparatus was done for suitability of repair. Annuloplasty sutures with 2-0 ethibond were taken initially as it provides better assessment and exposure of mitral valve. Mitral valve repair was done according to Carpentier's principle. Autologous pericardial patch was harvested and treated with 0.6% gluteraldehyde in patients where leaflet augmentation was needed. The details of various techniques used are described in Table 1. Commissurotomy was the most commonly performed procedure. Annuloplaty was done with different types of ring. The details of rings used are described in Table 2. Capentier classic annuloplasty ring was most commonly used. Left atriotomy was closed with 4-0 polypropylene suture. Right atriotomy was done in patients in whom tricuspid valve repair was done. Cryocoxmaze III was done in patients of persistant atrial fibrillation (AF).

Patient was weaned off CPB after completion of surgery by standard protocoals of deairing of heart.

Table 1. Different Techniques used in mitral valve repair

Repair Techniques	No of Patients
Commissurotomy	210
Papillotomy &Fenestration	174
Sec. Chordee Cutting	190
Neochordae	35
Leaflet Augmentation	30
Peeling of leaflets/Cusp thinning	20
Cleft closure	25
Chordal transfer	48
Chordal Transposition	20
Cleft closure	30
Magic Stich Commissural Closure	38
Annuloplasty	218
Others	7

Post-operative Protocoal

The patients of mitral valve repair who had undergone ring annuloplasty were given oral anticoagulants for 3 months with target INR between 2-3. All the patients were given penicilline prophylaxis up to age of 40 years.

Table 2. Different Types of Prosthesis/Rings used

Ring/Prosthesis Type	No.
Duran Ancore Ring (Medtronic Inc. MN USA)	28
3D Profile Ring (Medtronic Inc. MN USA)	15
Cosgrove Edwards Band (Edwards Lifesciences, Irvine USA)	25
SJM Tailor Ring (St. Jude Medical Inc. MN USA)	12
Carpentier Edwards Classic Ring (Edwards Lifesciences Inc. Irvine USA)	110
SJM Rigid Saddle Ring (St. Jude Medical, Inc. MN USA)	13
Carpentier-Edwards Physio Ring (Edawrds Lifesciences Inc. Irvine USA).	15

Follow –up

Transthoracic echocardiography was done on each follow up visit. Echocardiographic assessment was done for any residual stenosis or regurgitation. More than mild MS/MR were deemed significant. Mild regurgitation was defined as jet area $<4cm^2$, moderate regurgitation 4-$10cm^2$ and severe regurgitation as $>10cm^2$ on colour Doppler echocardiography mode. Mild stenosis was defined as mean gradient across MV <5mmHg, moderate stenosis 5-10mmHg and severe stenosis as >10mmHg. (Zoghbi *et al*., 2003; Baumgartner *et al*., 2009) Guidelines of the Society of Thoracic Surgeons for reporting mortality and morbidity after cardiac valve interventions was used for the analysis and reporting of postoperative complications (Akins *et al*., 2008).

Statistical analysis

All continuous numerical data were expressed as means ± standard deviation and all actuarial estimates as percentage ± standard error. Univariate analysis of categorical data was carried out with $\chi 2$ or Fisher exact tests. Univariate analysis of continuous variables was carried out with analysis of variance or the Student t test.

RESULTS

The demographic and pre-operative patient profile is presented in Table 3. Mitral stenosis was the predominant lesion. The mean age of study population was 32.17±11.90 years. 53.78% patients were in the age group of 21-39 years.23.53% patients were less than 20 year of age. The number of females was more than male. The mean NYHA class was 3.28±0.53. 95% patients were in NYHA class III/IV. Isolated mitral stenosis and isolated mitral regurgitation was present 42.44% and 22.69% of patients respectively. Mixed lesions were present in 34.87% of patients.

Table 3. Demographics and pre-operative clinical characterstics

Variable	Study Population N= 238
AGE (years)(15-70)	32.17±11.90
Gender (male:female)	103(43.28%):135(56.72%)
NYHA (mean±SD)	3.28±0.53
Mitral stenosis (%)	101(42.44%)
Mitral insufficiency (%)	54(22.69%)
Mixed lesion (%)	83(34.87%)
LVEF (%)	50±4.40
Aortic Valve Disease	24 (10.08 %)
Tricuspid valve disease	22 (9.24%)
Atrial Fibrillation	91(38.24%)

Table 4 describes the mean aortic cross clamp time, cardiopulmonary bypass time, the number of accociated aortic and tricuspid valve surgery and atrial fibrillation ablation procedures.

Table 4. Intraoperative data

VARIABLE	Study Population
Aortic valve replacement	24(10.08%)
Tricuspid Repair	22(9.24%)
AF Surgery	47(19.74%)
AC Time (Minute)	110±66
CPB Time(Minute)	131±70

Concomittant aortic valve replacement was done in 24 (10.08%) patients. Eighteen patients received mechanical prosthesis and six partients received bioprosthetic valve. Tricuspid valve repair was done in 22 patients.

Table 5. Post Operative Outcomes

Variable	No (%)
Mortality	
Early	13(5.62%)
Late	7(3.13%)
Survival	91.59%
Freedom from re-operation	95%
Thromboembolic & Bleeding complications	4(2.5%)
Endocarditis	7(2.5%)
NYHA Class	
I/II	199
III/IV	19
Follow up Percentage	95.24%
Redo Procedure	7(4.12%)
Follow Up(months) Mean±SD	71±23
Residual pathology (Significant Mitral Stenosis & Mitral Regurgitation)	17(6.25%)
NYHA (mean±SD)	1.34±0.741
Mitral Valve Area (Mean±SD)	3.17±0.58
Mean Pressure Gradient across mitral valve (Mean±SD)	3.81±0.92
Significant mitral regurgitation	7

Mortality: There were 13 (5.62%) early deaths. None of the patients had significant residual valvular stenosis or regurgitation. The identified causes were pre-operative left ventricular dysfunction and Congestive heart failure. There was 7 (3.13%) late death due to unidentifiable causes at home. At mean follow up of 71±23 months the survival was 91.59%. The all cause re-admission rate was 9.37%. The significant residual pathology was present in 17 patients. The redo procedure was done in 7 patients. Three were due to significant recurrent mitral stenosis, 2 for mitral regurgitation and 2 for mixed lesions. At mean follow up of 71±23 months 199 patients were in NYHA class I/II. 19 patients were clinically symptomatic in NYHA class, III/IV. On follow up trans thoracic echocardiography. The mean pressure gradient across mitral valve was 3.82±0.93 mm of Hg. The mean mitral valve area was 3.17±0.58 cm^2.More than mild significant mitral regurgitation was present in 7 patients.

DISCUSSION

Rheumatic valvular heart disease affects younger and predominantly female population. Mechanical prosthetic valve replacement has remained the traditional surgery in majority of these patients, requiring life-long anticoagulants. Anticoagulant related problems such as valve thrombosis, stroke and bleeding leads to significant mortality and morbidity and during pregnancy may threaten the life of both mother and newborn (Iturbe *et al*., 1986). These problems put the cardiac surgeons in a perplexing situation to find the effective solutions (Al Halees, 2007). Bioprosthetic valve replacement has issues of durability especially accelerated degeneration in younger population suffering from rheumatic heart disease. Mitral valve repair has remained a centre specific approach and not being performed by a common surgeon. It has also got issues of disease progression and residual lesion in Rheumatic Heart Disease (RHD). Recommendation and level of evidence for mitral valve repair in rheumatic heart disease was Class IC as per European Heart Society (EHS) valvular heart disease guidelines 2012 (Vahanian *et al*., 2012) but has now been given class IB by AHA valvular heart disease guidelines 2014 (Nishimura *et al*., 2014).

The survival rate and freedom from re-operation at 71 months is 97% and 95% respectively in this study. The literature shows the survival rate and freedom from re-operation in the range of 80-90% and 75-80%. (Antunes *et al*., 1987; Duran *et al*., 1991; Bernal *et al*., 1993; Skoularigis *et al*., 1994; Chauvaud *et al*., 2001; Kumar *et al*., 2006) Survival rate and freedom from reoperation in this study was better as compared to other studies .This was due to comprehensive complete mitral valve repair techniques as described by Carpentier (Carpentier *et al*., 2010). Freedom from reoperations in this study was better or equivalent to other studies probably because of comprehensive reconstructive techniques especially avoidance of custom made indigenous annuloplasty rings. It suggest better durability of repair when complete mitral valve repair techniques are used. There are many factors which affects the long term durability of mitral valve repair in rheumatic etiology. Many studies have shown that the presence of acute rheumatic activity at the time of surgery is associated with high failure rate of repair. The presence of mixed lesion is also associated with high failure rate. (Antunes *et al*., 1987; Duran *et al*., 1991; Bernal *et al*., 1993; Skoularigis *et al*., 1994; Chauvaud *et al*., 2001; Kumar *et al*., 2006) Bernal *et al* and skoularigis *et al* have shown the high rate of freedom from reoperation than other studies (Bernal *et al*., 1993; Skoularigis *et al*., 1994). They considered that the important factors were the severity of mitral valve disease and the repair techniques used. The mitral valve leaflet mobility and subvalvular pathology are the most important factors for the success of mitral valve repair. The differences in results of various studies could be due to non uniformity of surgical techniques in the past era. The most important of which is technique and type of annuloplasty ring used. In the study of Duran *et al* the freedom from reoperation was 77% at 30 months. They have used ring for annuloplasty in 79% of their patients (Duran *et al*., 1991). Bernal *et al* noted that reoperation occurs at two times. The early failure is due to technical reasons. The late failure is due to progression of disease (Bernal *et al*., 1993). Yakub *et al.* has demonstrated that due to better understanding of repair techniques, adherence to the importance of good leaflet coaptation, use of transoesophageal echocardiography and improved medical care, the rheumatic etiology may not be predictor of lesser outcome in current era of mitral valve repair (Yakub *et al*., 2013). The success of mitral valve repair depends on patient selection, favourable valve morphology, adequate use of repair technique, annular stabilization, penicillin prophylaxis for prevention of disease progression.

Conclusion

Mitral valve repair in Rheumatic heart disease is possible in majority of patients with excellent midterm results. The re-operation rate has decreased significantly with the current surgical techniques and uniform use of annuloplasty rings.

Comprehensive Mitral valve repair strategy with annuloplasty gives better freedom from reoperation as compared to open mitral valvotomy alone, hence, should be employed in all mitral valve repair patient to provide improved long term survival. Mitral valve repair avoids the complications of anticoagulation and thromboembolism related to mechanical prosthesis, permit growth and better preserve left ventricular function.

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Conflicts of Interest: All authors declare that there is no conflict of interest in this article

Limitation: The data was collected retrospectively.

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