

Original Research Article

The effect of mitral valve replacement on atrial fibrillation behaviour

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ABSTRACT

Background: Atrial fibrillation (AF) persisting after mitral valve surgery reduces survival due to heart failure and thrombo-embolisms and impairs quality of life. Restoration of the sinus rhythm might lead to a lower incidence of thrombo-embolism and valve-related complications in the postoperative period.

Methods: This non-randomized prospective study was carried out between period April 2015 to December 2018 in the Department of Cardiothoracic and Vascular Surgery, Government General hospital, Guntur, Andhra Pradesh, India. A total of 80 patients underwent mitral valve replacement during the study period. 50 patients out of these were with atrial fibrillation and were part of this study, who underwent mitral valve replacement.

Results: All fifty patients were in atrial fibrillation based on clinical examination and the echocardiogram. 13 patients preoperatively were in atrial fibrillation with fast ventricular rate. These patients were placed on antiarrhythmic drugs to control the ventricular rate prior to mitral valve replacement. After surgery twenty out of fifty (40%) patients reverted to NSR and maintained the same rhythm till the 6 months of follow-up. Twenty-nine (58%) patients continued in atrial fibrillation after surgery.

Conclusions: The results of the present study showed that preoperative atrial rhythm strongly determines postoperative rhythm. In view of the promising results of combined mitral valve and anti-atrial fibrillation surgery, the inescapable conclusion is that the anti-arrhythmic procedure should be offered routinely to all patients with a history of preoperative AF.

Keywords: Atrial fibrillation, Mitral valve replacement, Outcome, Surgery

INTRODUCTION

The association between rheumatic mitral valve disease, especially mitral stenosis and atrial fibrillation (AF) is well known but few data exist regarding the impact of AF after mitral valve replacement (MVR) on NYHA functional class.¹ Atrial fibrillation (AF) persisting after mitral valve surgery reduces survival due to heart failure and thrombo-embolisms and impairs quality of life.²

Restoration of the sinus rhythm might lead to a lower incidence of thrombo-embolism and valve-related complications in the postoperative period. Although previous studies on mitral valve surgery demonstrated a high prevalence of persisting postoperative AF.^{3,4} Few studies have revealed prevalence of AF in patients undergoing mitral valve surgery varies from 30 to 50%.^{5,6} An increased left atrial size and rheumatic disease-causing mitral valve pathology are frequently associated

with preoperative chronic AF.⁷ Mitral valve surgery causes decline in left atrial postoperative pressure and volume and more especially when reduction techniques were employed. Late left atrial remodeling depended on the type of atrial rhythm and postoperative gradients across the mitral valve.⁸

Combination of MV replacement and the surgical maze procedure were adopted but only had disadvantage of having prolonged period of cardiac ischemia and cardiopulmonary bypass time will increase early morbidity and mortality because addition of the Maze procedure to MV surgery complicates the operation, inevitably resulting in prolonged cardiac ischemic and cardiopulmonary bypass times. Later mitral valve replacement was concomitantly performed with radio frequency ablation which decrease the cardio pulmonary bypass time and cardiac ischemic time. Thus, declining the morbidity and mortality associated with previous mitral valve replacement and surgical Maze but the long term outcome of either of the maze procedure accompanying mitral valve replacement was questioned as studies revealed that patients undergoing maze procedure be it surgical or radiofrequency have had decline in cardiac function which had bearing on the long-term survival.

METHODS

This non-randomized prospective study was carried out between period April 2015 to December 2018 in the department of cardiothoracic and vascular surgery, Government General Hospital, Guntur, Andhra Pradesh, India.

A total of 80 patients underwent mitral valve replacement during the study period. 50 patients out of these were with atrial fibrillation and were part of this study, who underwent mitral valve replacement. The data (demographic, hemodynamic and perfusion data) of the patients underwent mitral valve replacement are mainly collected from the hospital records.

Inclusion criteria

Patients with rheumatic mitral valve disease with atrial fibrillation, mitral stenosis, mitral regurgitation, combination of MS and MR, patients with past history of CMV/PTMC and patients with tricuspid regurgitation.

Exclusion criteria

Concomitant valvular disease other than mitral valve, concomitant coronary artery disease requires CABG, congenital mitral valve disease that undergoing mitral valve repair, infective endocarditis, emergency surgery, preoperative arrhythmias other than atrial fibrillation, patients on paced rhythm, Marfan syndrome. All patients underwent median sternotomy to assess the heart. Pericardiotomy was made. Heparin was given in the dose of 3 mg per kg body weight I.V. and the dose was

monitored by activated clotting time (ACT). The aim was to achieve complete hemostatic paralysis. Pulmonary artery and left atrial pressures were recorded pre and post cardiopulmonary bypass. Aortic and bicaval cannulation was done and cardiopulmonary bypass was instituted. Surgeries were carried out under moderate hypothermia (32-28°C). Aorta was cross clamped and cold ante grade intermittent blood cardioplegia was used for arresting the heart which was repeated at every 20 minutes. In addition, topical ice-slush was used for myocardial protection. The mitral valve was assessed in majority of the patients through left atriotomy.⁹ Right atrial trans septal approach was used for patients who either had concomitant tricuspid valve annuloplasty or in redo surgery and in patients with small left atrium.¹⁰ Nine (18%) patients had left atrial/left atrial appendage clot. Which were removed and left atrial appendage exclusion was done. The method of replacement of mitral valve was decided perioperatively on the pliability and extent of calcification of the native mitral valve and the sub valvular crowding. Majority of the patients who underwent conventional mitral valve replacement had severe calcific mitral stenosis. The conventional mitral valve replacement, where complete excision of both anterior and posterior leaflet was carried out in 22 patients. Modified mitral valve replacement with preservation of posterior mitral leaflet was carried out in 38 patients. Mitral replacement was done with TTK chitra tilting disc mechanical prosthesis with interrupted horizontal mattress pledgeted sutures of 2-0 ethibond. Mitral valve was oriented in the anti-anatomical position. Tricuspid valve annuloplasty was done using modified De Vegas tricuspid valve annuloplasty in 4 patients and in 9 patients Teflon felt was used. Left atrial reduction was performed in 48 patients. Exteriorization of the left atrial appendage was performed in 26 patients with left atrium more than 50 mm in size. Closure of left atriotomy was done using 3-0 continuous prolene sutures in two layers. Reperfusion was performed with warm oxygenated blood without potassium. Venting was done through the aortic root. Aortic cross clamp was removed. In majority of patients the heart started beating spontaneously achieving either normal sinus rhythm or controlled atrial fibrillation. Right atrial and right ventricular pacing done as routinely to all cases intraoperatively before decannulation. DC shock was used in eight patients. At this stage if patients reverted into AF fast ventricular rate -I.V. cardarone was used for achieving controlled AF. Once the hemodynamics stabilized, patients were gradually weaned off cardiopulmonary bypass. Decannulation was done.

Heparin reversal was done using protamine infusion in the dose of 1 mg for every 100 units of heparin. Hemostasis was achieved, mediastinal and pericardial drains were kept. Pleural drain was placed when required. Pericardial closure was done using 2-0 silk suture. Sternum was closed with no. 6 stainless steel wires. Wound was closed in layers. Later patient was shifted to CT-ICU on intermittent positive pressure ventilation.

Patient weaned from ventilation once the patient was fully awake, had hemodynamics stabilized, adequate urine output. Acitrom was started 2-3 days following the surgery.

Types of prostheses implanted

MVR -TTK chitra tilting disk mechanical valves for 45 cases. St. Jude mechanical valve for 31 cases and Biocor prosthetic valve for 4 cases. Tricuspid repair -Teflon felt used for repair.

CPB

Surgeries were performed under cardiopulmonary bypass using Maquet Jostra HL 20 heart lung machine. Cardiopulmonary bypass was instituted following aortic cannulation and bicaval venous cannulation, moderate hypothermia (32-28°C). Affinity (medtronic)/Nipro vital oxygenator during cardiopulmonary bypass. Prime used - maintaining by pass HCT 21% to 33%. The flow rate was depended on cardiac index.

Myocardial preservation

During cardiopulmonary bypass, once the aorta is cross clamped the myocardial protection was achieved with antegrade cardioplegia delivered through the aortic root. This cardioplegia arrest the heart in diastole. Blood cardioplegia consisting of oxygenated blood added with potassium and magnesium in 4:1 proportion for St thomas and 1:4 proportion for del Nido cardioplegia was given to obtain cardiac arrest. Antegrade cardioplegia delivered every 20 minutes for St thomas and 90 minutes for del Nido cardioplegia. In addition, surface cooling is achieved by using ice slush in the pericardial pouch.

In 22 patients, the cardio pulmonary bypass time was in the range of 50-100 minutes, in 38 patients fell in the range of 100-150 minutes and in 5 patients it was more than 150 minutes. These 5 patients underwent additional procedures as tricuspid valve annuloplasty. In 38 patients the aortic cross clamp time was in the range of 40-90 minutes and in twelve patients it was between 90-140 minutes.

Postoperative management

Postoperatively patients were electively ventilated for 4 to 8 hours. Patients were extubated on the same day of surgery. Adequate post-operative analgesia was maintained with IV tramadol (12th hourly), IV paracetamol (6th hourly). Inotropes were gradually withdrawn and patients were mobilized within 3 to 4 days.

All patients were monitored postoperatively in the CT - ICU with regards to the hemodynamic parameters, ECG, arterial pressure, SaO₂, CVP/LAP, ETCO₂, temperature, respiration rate and urine output.

Patients postoperatively were on inotropic support as dopamine, adrenaline, dobutamine. The dosage of which were titrated as per the hemodynamics and the urine output. Nitroglycerine was used as a vasodilator and after load reducing agent and as patients had pulmonary hypertension. It is believed that it is also beneficial for pulmonary vasodilatation in reducing pulmonary artery hypertension.

Some of the patients were also be on antiarrhythmic drugs. The dosage of which were titrated as per the requirement. If patients need continuous support with antiarrhythmic drugs to maintain a controlled rhythm, then I.V. preparations were changed to oral regimen.

In addition, the initial attempt is made to wean the patients out of the ventilatory support sailing through various modes and finally extubated keeping the conscious levels, haemodynamics, ABG and ventilatory modes/respiratory rate with in normal level. Some patients would also be on pacing mode and rate was maintained around 100/minute. Which is also weaned off once the patient's own rhythm reverts. A 12 patients in present study required initial overdrive pacing.

Follow up protocol

A 10 to 12 days after surgery patients were discharged and advised to come for follow-up in outpatient department after fifteen days then after 30 days. In outpatient department patient history evaluated for features of atrial fibrillation and examined for the same. Once atrial fibrillation felt on radial pulse patients investigated by ECG, echocardiogram for atrial fibrillation and LA clot respectively. At the end of six month all patients were examined as a protocol to divide subgroup as persisted AF and reverted to normal sinus rhythm (NSR) based on clinical and ECG findings. These subgroups were compared to find the cause for the persisted AF and treated accordingly with antiarrhythmic drugs.

Statistical analysis

All data was stored in a Microsoft Access Database. Statistical analysis performs using the SPSS 16 or windows package. Summary descriptive statistics was expressed as (Mean±SD) or percentages. Comparisons of baseline characteristics and differences between the preoperative and postoperative variables were carried out using student's paired t-test. For all comparisons statistical significance assessed at the 0.05 level using p-values.

RESULTS

The age of the patients ranged from 16-64 years. Majority of the patients (28) 56% were in the age range 31-50 years. There was female preponderance in the study population with the M:F ratio of 23:27. Thirty-nine of the

patients were in the New York Heart Association functional class III, two patients in class IV and remaining in class II.

Effect of mitral valve replacement on atrial fibrillation

All fifty patients were in atrial fibrillation based on clinical examination and the echocardiogram. 13 patients preoperatively were in atrial fibrillation with fast ventricular rate. These patients were placed on antiarrhythmic drugs to control the ventricular rate prior to mitral valve replacement. After surgery twenty out of fifty (40%) patients reverted to NSR and maintained the same rhythm till the 6 months of follow-up. Twenty-nine (58%) patients continued in atrial fibrillation after surgery. Antiarrhythmic drugs were used in 100% of

patients to maintain a controlled rate in postoperative period. As per the classification of these 29 patients were in persisted atrial fibrillation. Mitral valve replacement had significant statistical bearing (P = <0.00001). On conversion from atrial fibrillation preoperatively to NSR postoperatively.

Effect of mitral valve surgery on left atrial dimensions

The left atrial size in antero-posterior dimensions ranged from 25 mm to 79 mm in the study population. Giant left atrium is defined as LA dimension more than 60 mm (65) as per these dimensions eleven patients preoperatively had giant left atrium. Seven patients in the persisted AF group and four patients in the reverted NSR had more than 60 mm LA size (Table 1).

Table 1: Factor assessment in the two groups.

Factors assessed	Group: persisted AF 1 (Mean±SD)	Group: reverted NSR 2 (Mean±SD)	Significance (2-tailed p value)
Pre-op LA size	47.83±9.08	48.60±9.08	0.771
Post-op LA size	42.90±6.19	43.70±8.32	0.700

Thirteen patients had left atrial dimension less than 45 mm preoperatively, of these only 3 patients continued to be in atrial fibrillation and 10 patients reverted to NSR. Left atrial size more than 60 mm had significant effect on persistence of atrial fibrillation (P<0.00001). The antero-posterior left atrial dimensions decreased after surgery in the group as a whole (52.32±9.37 versus 41.02±8.33 mm, P=0.001, 95% of CI 8.61 -13.98 mm).

In the antero-posterior left atrial dimension decreased after surgery in the subgroup in the persisted AF as 54.52±8.51 versus 43.86±5.13 mm and in the subgroup in reverted to NSR as 48.80±9.84 versus 38.95±5.90 mm. the preoperative as well as the postoperative P-values were significant in between the subgroups (P=0.035, P=0.003).

Left atrial clot was present in group as a whole in 18% (9/50) of patients. 6 patients with LA clot were in persisted AF subgroup and 2 patients were in reverted NSR subgroup.

TTK chitra tilting disc prosthesis sizes 25, 27 and 29 were used in 8, 25 and 12 patients respectively. St Jude mechanical valve sizes 27, 29 and 31 were used in 12, 18 and 11 patients respectively. Biocor prosthetic valve size 25 were used for 4 patients. All these fifty patients underwent mitral valve replacement. Of these thirteen patients in addition had concomitant procedure as tricuspid valve annuloplasty (13) and left atrial reduction (48). Modified De Vegas tricuspid annuloplasty was performed in 4 (8%) and in 9 (18%) patients tricuspid annuloplasty using Teflon felt.

Left atrial reduction procedure performed in the form of lateral wall reduction in 7 (14%), LA appendage reduction in 2 (4%), interatrial septal reduction in 1 (2%), lateral wall and LA appendage reduction in 26 (52%), and LA appendage and interatrial septal reduction in 12 (24%) patients. 2 patients did not undergo any type of LA reduction procedure (Figure 1).

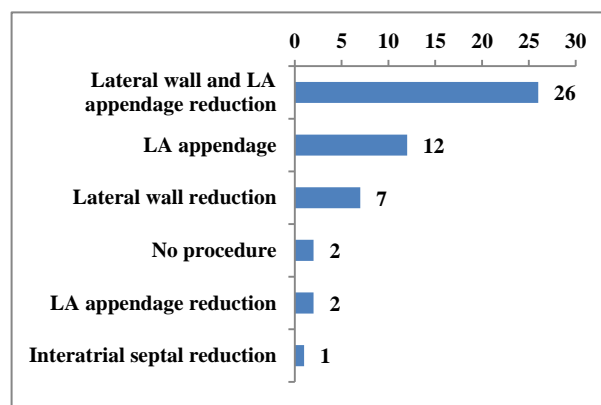


Figure 1: Reveals the techniques adopted for left atrial reduction.

A 23 patients had CPB time between 100 to 150 min. 22 patients had CPB time between 50 to 100 min. only 5 patients had CPB time more than 150 min. 38/50 patients had aortic 'x' clamp time between 40 to 90 min. An only 12 patients had aortic 'x' clamp time more than 90 min.

One female patient who had mitral valve replacement and tricuspid repair in this study was died in early

postoperative period. The early postoperative death in this study was due to malignant hyperthermia.

There was only one death in 2nd post-operative day in present study. Early mortality was defined as death occurring less than 30 days after surgery. The cause of early death was due to malignant hyperthermia.

DISCUSSION

The main findings of the present study were that the 78% of patients with chronic rheumatic severe calcific mitral stenosis, 12% of patients with combination of mitral stenosis and regurgitation and 10% of patients with degenerative mitral regurgitation requiring mitral valve replacement surgery were either in AF persistently or had a history of paroxysmal AF at the time of surgery, and preoperative rhythm strongly influences post-operative rhythm. Atrial fibrillation continued after surgery in all patients with a history of AF for more than 2 months before hand. In patients with a shorter history of persistent AF, or with paroxysmal AF, sinus rhythm was restored by mitral valve surgery without any specific anti-arrhythmic procedure in 40% of patients.

In this study, 20/50 (40%) patients with AF before surgery were in sinus rhythm at six months after surgery. In Raine D et al, study 4/47 (8.5%) patients were in sinus rhythm at six months after surgery.¹¹ Present study reported high rate of restoration of sinus rhythm in compare to said study the reason might be due to more patients might had paroxysmal AF. But due to the lack of ambulatory electrocardiography we could not notified type of AF. That was one drawback in present study.

It has been shown in Chua et al, study at late follow-up, atrial fibrillation was present in 5% of patients with preoperative sinus rhythm, 80% of patients with preoperative chronic atrial fibrillation.¹² Where as in Kalik et al, study at late follow-up (more than 1 year) 26 (26%) patients presented sinus rhythm and 74 (74%) remained in AF after mitral valve replacement surgery.¹³

In Sandoval et al, study sinus rhythm was restored in the immediate postoperative period in 7 patients (35%), and in another 10 patients (50%) before discharge (mean 5.8±2 days).¹⁴ Overall, sinus rhythm was restored before discharge in 17 patients (85%), 3 (15%) patient's required anti-arrhythmic therapy. But patients underwent a modified Cox-maze procedure concomitant with mitral valve surgery. Doppler echocardiography performed 3 months after surgery documented atrial contractility (A and E waves) in 12 patients (71%).

The main limitation of the study was that it is a short duration of follow up. Late deaths and morbid conditions can only be known if there is a long term follow up of at least 5 years. So, it was difficult to comment on late mortality and survivals of our patients.

CONCLUSION

The results of the present study showed that preoperative atrial rhythm strongly determines postoperative rhythm. In view of the promising results of combined mitral valve and anti-atrial fibrillation surgery, the inescapable conclusion is that the anti-arrhythmic procedure should be offered routinely to all patients with a history of preoperative AF.

In present study presence of LA clot, severe calcific mitral valve, past history of closed mitral valvotomy and large LA size had influenced in persistence of AF after MVR alone. Hence, these adverse factors should be evaluated carefully to assess outcome of MVR in patients who had chronic rheumatic mitral valve disease with AF to undergo MVR.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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