Effectiveness of Preservation of the Mitral Valvular Apparatus During Mitral Valve Replacement Surgery for Rheumatic Severe Mitral Regurgitation

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Abstract

Background: Conventional mitral valve replacement (MVR) even with preservation of the posterior mitral leaflet is associated with higher incidence of postoperative low cardiac output syndrome due to myocardial failure. Preservation of the mitral valvular apparatus ensuring sparing chordae tendinae and thus maintaining annular-papillary muscle continuity is the best adorable technique to guarantee better postoperative results. There is proved existing evidence that it reduces postoperative mortality and morbidity in addition to better preservation of the left ventricular (LV) function. But plenty of surgeons hesitate to practice this technique for fears of complexity and prolonged time of the surgical maneuver, inability to implant adequate large mitral prosthesis and possible consequences of the residual native anterior mitral valve leaflet causing prosthesis dysfunction, systolic anterior motion (SAM) and left ventricular outflow tract obstruction (LVOTO).

Aim of Study: This study primarily aims at assessment of the effectiveness of preservation of the mitral valvular apparatus technique during the surgery of MVR for rheumatic severe mitral regurgitation (MR) on restoration of LV function by tracing the changes in the postoperative LV performance over one year follow-up. Secondary outcomes include estimation of mortality, major cardiac problems, functional status and quality of life at one-year postoperatively.

Patients and Methods: This retrospective observational non-randomized study included 79 patients who presented with rheumatic severe MR and had undergone MVR by preservation of the mitral valvular apparatus technique. Postoperative mortality, morbidity outcomes, overall hospital complications, left ventricular ejection fraction (LVEF%), left ventricular end-diastolic diameter (LVEDD), left ventricular end-systolic diameter (LVESD), tricuspid annular plane systolic excursion (TAPSE), pulmonary artery pressure (PAP), New Yok Heart Association (NYHA) classification and the overall one-year survival were evaluated.

Results: Mean age was 30.11±3.98 years. The incidence of postoperative low cardiac output syndrome was 6.32%. The overall hospital complication rate was 25.31%. No intra-operative deaths occurred, and no mortality happened during the follow-up period (overall one-year survival rate was 100%). The cumulative duration of the study was 4.167 years. Statistically significant improvement in NYHA class ($p<0.001$), LVEF% ($p<0.001$), LVEDD ($p=0.0412$) and LVESD ($p=0.05$) was observed. Although there was improvement in PAP and TAPSE, the results were statistically insignificant.

Conclusion: Preservation of the mitral valvular apparatus proved to have many pros other than conservation of the LV function. It preserves LV size and geometry, decreases intra-operative mortality, reduces the rate of the lethal postoperative low cardiac output syndrome, improves survival rate, doesn't hinder implantation of adequate large mitral prosthesis, doesn't necessarily causeLVOTO, doesn't represent complex techniquewith a limited time expenditure and it may enhance right ventricular function. We recommend applying a technique of preservation of the mitral valvular apparatus in patients with rheumatic severe MR undergoing MVR.

Key Words: *Preservation of the mitral valvular apparatus – Severe rheumatic mitral regurgitation – Conservation of LV function.*

Introduction

MITRAL valve replacement (MVR) is primarily done for cases with severe mitral regurgitation (MR), especially of rheumatic pathology when trial of repair is not feasible [1]. MVR even with preservation of the posterior mitral leaflet (PML) is associated with higher incidence of postoperative low cardiac output syndrome due to myocardial failure [2].

Therefore, preservation of the mitral valvular apparatus ensuring sparing chordae tendinae and thus maintaining annular-papillary muscle conti-

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nuity is the best adorable technique to guarantee better postoperative results [3,4].

Previous studies had assured superiority of preservation of the mitral valvular apparatus for maintaining better postoperative left ventricular (LV) function due to the suggested theory of preserving the configuration of the papillary muscles and its role in maintaining spherity of the LV and shortening of its long axis by bringing the mitral valve ring towards the LV apex resulting in better ventricular ejection [5].

However, some obstacles have been faced hindering widespread implementation of the different techniques created for preservation of the mitral valvular apparatus routinely during MVR in spite of the proved existing evidence that it reduces the postoperative mortality and morbidity in addition to better preservation of the LV function particularly if it's done for cases of severe MR. First, it isn't always easily possible to preserve the sub-valvular apparatus adequately. Second, preservation of the mitral valvular apparatus might prevent seating of the proper prosthetic valve size. Third, the problem of left ventricular outflow tract obstruction (LVO-TO) that interferes with the valve prosthesis [6]. Finally, the drawbacks of some techniques used like size mismatch between the mitral valve annulus and the strip of the anterior mitral leaflet (AML) with its attached chordae [7].

This study primarily aims at assessment of the effectiveness of preservation of the mitral valvular apparatus technique during the surgery of MVR for severe rheumatic MR on restoration of LV function by tracing the changes in the postoperative LV performance over one year follow-up. Secondary outcomes include estimation of mortality, major cardiac problems, functional status and quality of life at one-year postoperatively.

Patients and Methods

Study design:

This retrospective observational non-randomized study included 79 patients who presented with rheumatic severe MR and had undergone MVR by preservation of the mitral valvular apparatus technique. All surgeries were carried out in Egypt (conducted in the operating theatre of the Department of Cardiothoracic Surgery, Faculty of Medicine, Cairo University, that of Beni-Suef University and in El Borg Hospital, Mohandiseen, Giza) using standard open-heart surgical procedures. Data of the study was collected for the operated-upon patients in the period between October 2018 and December 2022. The data of the

study population was collected from the cardiothoracic sections' computers database supplemented by a review of hospitals' records. All the data were studied and thoroughly evaluated in the preoperative, intraoperative, and over one-year postoperative periods. The study was approved by the Research Ethics Committee (REC) and its approval number is FMBSUREC/09042023/ Elbatanony.

Inclusion and exclusion criteria:

Included population were those with rheumatic severe MR necessitating MVR. Patients with associated functional tricuspid valve regurgitation necessitating concomitant repair were involved. All candidates had normal coronaries. The excluded patients were those with echocardiographic evidence of organic tricuspid valve disease requiring concomitant replacement, patients with associated ischemic heart disease (IHD) requiring concomitant coronary artery bypass grafting (CABG) surgery, mitral valve re-do and emergency-listed cases, patients with mitral valve disease liable for repair, patients with associated aortic valve disease requiring concomitant intervention, infective endocarditis victims, and extremes of age (less than 17 and more than 70 years).

Management regimen:

Preoperatively:

The assessed preoperative variables were age, sex, smoking, history of rheumatic fever, functional class according to the New Yok Heart Association (NYHA) classification, complete general and local cardiological clinical evaluation, hypertension, diabetes mellitus, chronic obstructive pulmonary disease (COPD), atrial fibrillation (AF), routine preoperative laboratory investigations (complete blood count (CBC), liver and renal function tests, coagulation profile, serum electrolytes (sodium and potassium), fasting blood glucose (FBG), measurement of body surface area (BSA), resting 12-lead electrocardiogram (ECG), plain chest X-ray, cardiac catheterization, preoperative baseline transthoracic echocardiography (TTE) (for Abascal's "Wilkin's" echocardiographic score, LV ejection fraction per cent "LVEF%", left ventricular end-diastolic diameter "LVEDD", left ventricular end-systolic diameter "LVESD",tricuspid annular plane systolic excursion "TAPSE" and pulmonary artery pressure "PAP").

Ntraoperatively:

The analyzed operative variables included intraoperative mortality, aorticcross-clamping (ischemic) time, cardiopulmonary bypass (CPB) time, and inotropic support demand.

Operative technique:

Operative technique was always the same for all the study population. All the patients were routinely scrubbed and draped exposing the chest. After standard median sternotomy, pericardiotomyand suspension of the pericardial edges, the ascending aorta was cannulated followed by bicaval cannulation for venous drainage with application of tapes around the superior (SVC) and inferior (IVC) vena cava (to be snared if the right atrium was accidentally injured to prevent occurrence of massive air embolism). A two-way cannula was inserted in the aortic root for venting. After the institution of CPB, cooling started to achieve systemic core body temperature of 28-30°C. The ascending aorta is then cross-clamped and proper myocardial protection was achieved by intermittent antegrade infusion of cold crystalloid cardioplegia initially for 45 minutes then every 30 minutes for the subsequent doses.

Typically for all patients, left atriotomy was done and left atrial retractor was applied. Through visualization of the mitral valve apparatus, pathomorphological changes were assessed to confirm the preoperative TTE description. The AML was incised in its central part starting from its free edge up to the anterior annulus. 2/0 pledgetedethibond mattress sutures passing from the left atrial side through the annulus around the free edge of the AML plicating it and back through the annulus were used to fix the metallic bileaflet prostheses in place. The PML was incised (if needed) in its central portion and reefed by the sutures. Special attention was given to spare the papillary muscles and chordae tendinae during taking of the native valve sutures [8,9]. After the prosthetic valve was seated well on the annulus, the sutures tied, the valve was tested. Then, closure of left atriotomy with 4/0poly-propylene suture and insertion of LA vent were done. The aorta then was declamped after de-airing maneuvers and the patient was completely re-warmed to 37°C and all electrolytes and acid-base imbalances adjusted and properly corrected. Tricuspid valve repair was attempted for the needed cases on warm beating hearts through right atriotomy after snaring both cavae.

The patient was then weaned off CPB. Protamine was then administered, followed by decannulation, meticulous hemostasis, placement of epicardial pacemaker wires and closure over widepore 32-36F retrosternal and maybe pleural drains (if either pleura was opened). All monitoring lines and hemodynamic support were maintained during the transfer of the patient to the intensive care unit (ICU). All the patients were transferred mechanically ventilated.

Postoperatively:

The assessed postoperative variablesincluded hemodynamic status in the ICU, duration of mechanical ventilation, duration of inotropic support, total ICU stay, immediate postoperative mortality, morbidity, and adverse complications during hospital stay(the overall hospital complication rate was calculated on the basis of the number of patients with at least one hospital complication),total duration of hospital stay, routine prior-to-discharge TTE (stressing on assessment of the replaced valve function, LVEF%, LVEDD, LVESD, TAPSE and PAP), postoperative one-year morbidity, mortality, complications, complete general and cardiological assessment with NYHA functional class, and one-year follow-up TTE (for assessment of the replaced valve function, LVEF%, LVEDD, LVESD, TAPSE and PAP).

Statistical analysis:

The collected data were organized, tabulated and statistically analyzed using statistical package for social sciences (SPSS) version 21 (SPSS Inc., Chicago, USA). For qualitative data, frequency and percent distributions were calculated using Chi-square test or Fischer's exact test when appropriate. For quantitative data, mean, standard deviation, minimum and maximum were calculated and were compared using *t*-student test. Correlation between parameters was performed using Spearman's rank correlation coefficient. In all tests, *p*-value was considered significant when $p<0.05$, highly significant when $p<0.01$ and extremely significant when $p<0.001$.

Results

Preoperative data:

The study population were 47 (59.49%) females and 32 (40.51%) males whose ages ranged from 21 to 48 years with a mean age of 30.11±3.98 years. Smokers were 25 (31.64%). Rheumatic fever history was 100% positive. Hypertensives were 18 (22.78%). Diabetics were 11 (13.92%) and their mean FBG level prior to surgery was 153.54±9.98 mg/dl. Patients with COPD were 5 (6.33%). Preoperative AF was diagnosed in 17(21.52%). 71 (89.87%) patients were in NYHA class III and the rest 8 (10.13%) were in NYHA class IV. The mean estimated time from onset of symptoms to surgery was 37.22±15.11 months. The mean BSA was 1.5±0.25m^2. The mean Abascal's (Wilkin's) score was 9.97±0.56. Mean LVEF% was 54.36±3.89%. The mean LVEDD was 6.21±1.45 centimeter (cm)

and the LVESD was 4.51±0.45cm. The mean TAPSE was 1.9±0.87cm and the mean PAP was 31.07±2.22mmHg.

Operative data:

Mechanical bileaflet prostheses St.Jude #27 mm were implanted in 63 (79.74%) and the rest 16 (20.25%) received St.Jude #29 mm prostheses. No intraoperative mortality occurred. The mean total bypass time was 85.21±6.78min. and the mean total cross clamping time was 60.35±7.95min. All patients transferred to ICU on epinephrine infusion 5-10 microgram/kg/min. and norepinephrine 5-10 microgram/kg/min. was added to 25 (31.64%).

Postoperative data:

The mean total duration of mechanical ventilation was 8.11±5.79 hours, mean duration of inotropic support was 24.10±1.25 hours and mean total blood loss was 520.36±380.21ml. The mean period of the total ICU stay was 49.23±6.54 hours. Neithercerebro-embolism nor deep surgical wound infectionwas faced. Low cardiac output syndrome was faced with 5 (6.32%). Respiratory adverse eventswere faced in 2 (2.53%). Hemorrhagic complication was faced with 5 (6.32%), superficial surgical wound infection was encountered in 16 (20.25%) and temporary heart block was faced in 9 (11.39%). Postoperative AF was diagnosed in 17 (21.52%), the same population with preoperative AF.The overall hospital complication rate was 20 (25.31 %). No mortality happened in the ICU period or during the hospital stay period. The mean duration of the total hospital stay was 11.81±3.55 days. Routine prior-to-discharge TTE confirmedwell-seated well-functioning replaced prostheses with a mean gradient of 3.56±1.43mmHg. The mean LVEF% was 48.36±1.51%. The mean LVEDD was 6.09±1.31cm and the mean LVESD was 4.32± 0.24cm. The mean TAPSE was 1.9±0.52cm. The mean PAP was 30.11±0.56mmHg (Table 1).

Table (1): Postoperative prior to hospital discharge TTE findings. Continuous variables are expressed as mean and SD.

Variable	Preoperative	Postoperative prior to discharge	p-value
LVEF (%)	54.36±3.89	48.36±1.51	0.434
LVEDD (cm)	6.21±1.45	6.09±1.31	0.223
LVESD (cm)	4.51±0.45	4.32±0.24	0.312
PAP (mmHg)	31.07±2.22	30.11±0.56	0.664
TAPSE (cm)	1.9±0.87	1.9±0.52	0.679

LVEF: : Left ventricular ejection fraction.
LVEDD : Left ventricular end-diastolic diameter.
LVESD   : Left ventricular end-systolic diameter.
PAP   : Pulmonary artery pressure.

The mean period for return to work was 60.11±5.55 days. Neither mortality nor major cardiac problems (including low cardiac output syndrome) happened during the follow-up periodand the overall one-year survival rate was 100%. Significant improvement in the NYHA functional clinical status, LVEF%, LVEDD and LVESD were observed (Table 2). The cumulative duration of the study was 4.167 years.

Table (2): One-year follow-up postoperative NYHA clinical status and TTE findings. Categorical variables are expressed as numbers and percentages and continuous variablesas mean and SD.

Variable	Preoperative	One-year Postoperative	p-value
Functional Status:			
NYHA class I	0	75 (94.93%)	<0.001
NYHA class II	0	4 (5.06%)	<0.001
NYHA class III	71 (89.87%)	0	<0.001
NYHA class IV	8 (10.13%)	0	<0.001
TTE Findings:			
LVEF (%)	54.36±3.89	60.10±2.69	<0.001
LVEDD (cm)	6.21±1.45	5.71±0.29	0.0412
LVESD (cm)	4.51±0.45	3.99±0.64	0.05
PAP (mmHg)	31.07±2.22	28.64±1.13	0.473
TAPSE (cm)	1.9±0.87	1.8±0.65	0.583

NYHA   : New York Heart Association.
LVEF: : Left ventricular ejection fraction.
LVEDD : Left ventricular end-diastolic diameter.
LVESD : Left ventricular end-systolic diameter.
PAP   : Pulmonary artery pressure.

Discussion

Because of the high rates of mortalities and morbidities including low cardiac output syndrome complicating conventional MVR [2], multiple techniques of preservation of the mitral valvular apparatus were invented [4]. Preservation of the mitral valvular apparatus fulfills the everlasting targets of surgery to the incompetent mitral valve accomplishing its competencywith preservation of the LV function. These targets might be reached by a skilled mitral valve repair technique too. Thus, the group of patients suffering from severe MR and the trial of repair is not feasible for them can benefit greatly from applying a technique of preservation of the mitral valvular apparatus [10].

The first technique of preservation of the mitral valvular apparatus was introduced by Lillehei et al., [11]. They demonstrated a decline rate of mortality of 14% from 37% similar to the findings of Rushmer et al., [12] who stressed on the importance of the chordal-papillary muscles continuity in LV contraction.Yettoo many conflicts arose against their opinion [13]. In 1981, David et al. [14] and

Hetzer et al., in 1983 [15] re-instituted Lillehei's idea after their conclusions of long-term improvement ofLVEF%, stroke volume (SV) index, cardiac output (COP) and decreased LVEDD and pressure at both rest and while exercising in the group of patients who hadpreservation of the mitral valvular apparatus compared to those whoonly received conventional MVR.

Doces et al., [16] and Hansen et al., [17] also reported superiority of preservation of the mitral valvular apparatus over conventional MVR in regards of better conservation of LV function. They explained that on the basis of reducing the LV afterload and maintenance of the LV shape is due to preservation of the LV long and minor axes preventing LV dilatation and preserving LVEF%. They reported that the adverse effects of the shortened LV long axis and elongated minor axis with resultant LV dilatation besides areas of dyskinesia at the sectioned papillary muscles resulting from chordal transection (especially of the AML rather than that of the PML) in conventional MVR contribute to the deterioration of the postoperative LVEF% and the resultant low cardiac output syndrome.

Moreover, there is higher LV afterload after MVR and the capability of the LV to adapt this greatly depends on the chordal-papillary muscles continuity. This explains the development of the postoperative low cardiac output syndrome after conventional MVR especially if there is some gradient on the mitral prosthesis even if it is functioning well. Also, mitral repair is associated with lower incidence of low cardiac output syndrome in comparison to conventional MVR, and this adds more evidence of the superiority of preservation of the mitral valvular apparatus over conventional MVR for better preservation of LVEF% [18,19].

Our study included 79 patients: more than others' cohorts. El-Safty et al. [20] had 30 patients and David et al. [14] had 54 patients. However, Chowdhury et al. [6] had 257 patients. Our cohort's mean age was 30.11±3.98 years: younger than others' cohorts where Natsuaki et al. [21] reported a mean age 55±10 years, Okita et al. [22] reported a mean age 52.6 years, Chowdhury et al. [6] reported a mean age 35.6±19 years and El-Safty et al. [20] reported a mean age 31.47±5.60 years. Our cohort comprised 47(59.49%) females: similar high incidence of female sex to other studies where El-Safty et al. [20] reported 58% and Okita et al. [22] reported 76%. This demographic distribution criteria can be explained based on the high prevalence of rheumatic fever which was 100% positive in our study population.

Our study was conducted on patients with rheumatic severe MR only resembling a homogenous cohort reflecting more realistic conclusions. Other studies comprised mixed mitral pathologies as that of El-Safty et al. [20] who had 30 cases; (15/30) 50% with isolated MR, (8/30) 26.67% with isolated mitral stenosis (MS) and (7/30) 23.33% with mixed mitral disease.

We had 17 (21.52%) patients with preoperative AF who remained so in the postoperative course. We conclude that preservation of the mitral valvular apparatusdidn't modify the postoperative AF results. This comes in agreement with Chowdhury et al. [6] who had a higher preoperative AF rate of 72% and 42.4% postoperative AFwith statistically insignificant difference ($p=0.61$) and with El-Safty et al. [20] who had (13/30) 43.33% preoperative AF and (10/30) 33.33% postoperative AF. But Straub et al. [23] contradict our conclusion and confirm the positive effect of preservation of the mitral valvular apparatuson elimination of the postoperative arrhythmias.

In our study, we had a mean total bypass time of 85.21±6.78min. similar to other studies. For example, El-Safty et al. [20] had a mean total bypass time of 82.13±6.23min. Again, we had a mean total cross clamping time of 60.35±7.95min. similar to others like Ghosh et al. [2] who had a median cross clamping time of 57min. (range 35-163) and El-Safty et al. [20] who had a mean total cross clamping time of 65.20±9.71min. However, other authors reported shorter times of cross clamping like Giaotto et al. [24] and Hennein et al. [25] who reported a mean cross clamping time of 46±12min and 47±11min. respectively. These shorter periods were explained due to the usage of retrograde coronary perfusion alongside the antegrade intermittent cold cardioplegia.

All patients in our study experienced smooth weaning off CPB and were transferred to the ICU on epinephrine infusion 5-10 microgram/kg/min. Norepinephrine 5-10 microgram/kg/min. was added to 25 (31.64%). These results resemble those of Chowdhury et al. [6] who reported the need of inotropic support in 22.5% of their preservation of the mitral valvular apparatus group compared to 75.8% of their conventional MVR group. However, El-Safty et al. [20] reported much lower values. They reported the need of epinephrine infusion 10 microgram/kg/min. in (2/30) 6.7% while only 5 microgram/kg/min. epinephrine infusion was needed in (26/30) 86.7% and (2/30) 6.7% didn't need any inotropic support.

Neither intraoperative nor immediate or in-hospital stay mortalityhappened in our study. Other authors: Tarelli et al. [1], El-Safty et al. [20], Okita et al. [22], Hennein et al. [25] and Kayagioglu et al. [26] reported zero mortality too.

Multiple techniques for preservation of the mitral valvular apparatus had been created like David's technique [14], Feikestechnique [27], Khonsari I and II techniques [28], Miki's technique [29], Rose and Oz technique [30], Hetzer's technique [15] and Vander-Salm [8] and Yu [9] technique [31]. All procedures tried to preserve the subvalvular apparatus adequately hoping to insert a suitable prosthesis to avoid postoperative patient-prosthesis mismatch (PPM) [7] and without causing LVOTO due to the remaining AML causing anterior systolic motion (SAM) [6]. No statistically significant differences were observed among the various techniques in regard to preservation of the LV systolic and diastolic functions [31].

In our study, we adopted Vander-Salm [8] and Yu [9] technique [31]. We chose it beinga simple, easy to practice, limited time-consuming and reproducible procedure. By applying this technique, we could avoid stretching the chordae and the prompt risk of avulsion of the papillary muscles' heads during systole thus ensuring good function of the replaced native valve which now depends on synchronous actions of the prosthesis and the conserved chordal-papillary muscles continuity moderating the LV myocardial muscle during both systolic wall tension and diastolic distension. Moreover, individual patient's suitable prosthesis could be implanted seeking to avoid PPM and the remaining AML didn't show to disturb the prosthesis or cause LVOTO. We could replace St.Jude #27 mm prostheses in 63 (79.74%) and the rest 16 (20.25%) received St.Jude #29mm prostheses: adequate sizes of prostheses suitable for our cohort of patients who had a mean preoperative BSA 1.5 ±0.25m^2 besides that previous reports confirmed no difference between both used sizes as regards prosthesis' pressure gradient at both static and motion states of the individual [32]. This finding in particular proves thatthe commonly convinced-concept of the usage of undersized prosthesisduring preservation of the mitral valvular apparatus seems to be incorrect and practically unnecessary. Other authors aid our conclusion. Chowdhury et al. [6] reported implantation of prostheses sized 29-33mm in 85.6% of their cohort and El-Safty et al. [20] reported implantation of prostheses sized 27mm in 67%, 29mm in 23% and 3 1 mm in 10% of their cohort. Both authors also concluded that implan-tation of large prostheses during preservation of the mitral valvular apparatusis not hindered.

In our study, the preoperative mean LVEF% which was 54.36±3.89% dropped initially postoperatively prior to hospital discharge to a meanof 48.36±1.51% with no statistically significant value (*p*=0.434) then it showed marked improvement with a mean of 60.10±2.69% at one year follow-up with high statistical significance (*p*<0.001). This can be explained due to raised afterload and lowered preload immediately following MVR then gradual better favored LV remodeling (reducing systolic afterload and LV size) enhanced by the preservation of the mitral valvular apparatus.

This finding about LVEF% postoperatively was observed and reported by other researchers like Chowdhury et al. [6] who reported return of the LVEF% to its preoperative value after immediate postoperative drop and there wassignificant improvement at four years follow-up, Hansen et al. [17] who confirmed superiority of LVEF% in patients who experienced preservation of the mitral valvular apparatuscompared to those with either anterior or posterior chordal preservation and worst LVEF% is found in whom who lost all their chordae, El-Safty et al. [20] who reported decline of the preoperative LVEF% at the seventh postoperative day then statistically significant improvement at the sixth month postoperatively, Straub et al. [23] who demonstrated slight deterioration of the preoperative LVEF% initially in the immediate postoperative course then obviousrecovery after the third postoperative month, Giaotto et al. [24] who reported marked statistically significant (*p*=0.008) improvement of the LVEF% at the third postoperative month after initial decrease immediately postoperatively in their cohort of end-stage dilated cardiomyopathy, Hennein et al. [25] who stressed on marked improvement of the postoperative resting LVEF% and the exercise capacity in patients with preservation of the mitral valvular apparatus as opposed to patients with conventional MVR but without statistical significance between PMLchordalpreservation only ortotal (AML and PML) chordal preservation and Kayagioglu et al. [26] who reported slight decline of LVEF% immediately postoperatively compared to significant decrease in patients experienced conventional MVR. One author, Alsaddique [33], reported maintenance of LVEF% directly after preservation surgery and improvement afterwards without any decline in the immediate postoperative course.

Again, in agreement to our finding and explanation, David et al. [14] reported better LVEF%

seven years postoperatively in patients with preservation of the mitral valvular apparatus compared to those with conventional MVR and those with total preservation show much better early postoperative results rather than those with partial preservation. Also, Hetzer et al. [15] confirmed early and late LV function betterment with abolishment of LV rupture risk, enhanced prolonged survival rate and significant reduction of intraoperative deaths in candidates who have undergone preservation of the mitral valvular apparatus. Based on these confirmed findings aided by many reports besides the advantages of lower intraoperative mortality (it's nil in our study) and lesser incidence of low cardiac output syndrome (it's 5(6.32%) in our study), authors recommend even re-preservation of the previously cut or torn chordae in reoperations [34].

Alongside significant improvement of LVEF%, functional clinical status was enhanced markedly in our cohort. We had 75 (94.93%) in NYHA class I and 4 (5.06%) in NYHA class II at one year follow-up showing statistically significant results ($p<0.001$). Other authors also demonstrated marked clinical improvement [6,14,15,17,20,23,24,25].

In our study, LVEDD and LVESD decreased from a mean of 6.21±1.45 and 4.51±0.45 preoperatively to 6.09±1.31 ($p=0.223$) and 4.32±0.24 ($p=0.312$) respectively postoperatively prior to hospital discharge and continued to decline significantly to reach 5.71±0.29 ($p=0.0412$) and 3.99±0.64 ($p=0.05$) respectively at one year follow-up. By correlating postoperative changes of LVEF%, LVEDD, LVESD and NYHA clinical status of our cohort, we concluded that LVEDD and LVESD resemble realistic indices of the LV function and the clinical condition of the patientsduring the immediate postoperative course and that their gradual regressions are well-correlated to improvement of the NYHA functional classification. Our results agree with other researchers including El-Safty et al. [20], Giaotto et al. [24] and Kayagioglu et al. [26]. Chowdhury et al. [6] reported statistically significant decrease in LVEDD and LVESD in the immediate postoperative period and up to four years follow-up which is not the case with patients undergoing conventional MVR. Sasaki et al. [35] reported that LVEDD is the best parameter to be relied upon as an index of the LV function in the perioperative period and its reduction is classically correlating with improvement of the clinical condition.

PAP and TAPSE improved from a preoperative mean of 31.07±2.22 and 1.9±0.87 to 30.11±0.56 ($p=0.664$) and 1.9±0.52 ($p=0.679$) respectively postoperatively prior to hospital discharge and 28.64±1.13 ($p=0.473$) and 1.8±0.65 ($p=0.583$) respectively at one year follow-up. Although the right ventricular function and PAP improved secondary to LV function improvement, the recorded changes were statistically insignificant. However, Dubiel et al. [36] reported statistically significant enhancement of the right ventricular function (with documentation by radionuclide studies) and PAP. We can conclude that these findings may raise attention to the pros of preservation of the mitral valvular apparatusin patients with preoperative pulmonary hypertension and right ventricular dysfunction.

There was neither mortality nor major cardiac problems including low cardiac output syndrome happened during the follow-up period and the overall one-year survival rate was 100%. Among the studies that agreed with our results what was reported by Tarelli et al. [1], El-Safty et al. [20], Okita et al. [22], Hennein et al. [25] and Kayagioglu et al. [26]. Muthialu et al. [37] reported 92% survival rate at five years with statistically significant difference as compared to patients with conventional MVR.

Conclusion:

Preservation of the mitral valvular apparatusproved to have many pros other than conservation of the LV function. It preserves LV size and geometry, decreases intraoperative mortality, reduces the rate of the lethal postoperative low cardiac output syndrome, improves survival rate, doesn't hinder implantation of adequate large mitral prosthesis, doesn't necessarily cause LVOTO, doesn't represent complex technique with a limited time expenditure andit may enhance right ventricular function. We recommend applying a technique of preservation of the mitral valvular apparatus (favored by the operator) in patients with rheumatic severe MR undergoing MVR.

Study limitations:

This is a retrospective study with relatively limited number of cases and theduration of follow-up and survival rate estimation was for only one year.

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فعالية الحفاظ على جهاز الصمام الميترالى أثناء جراحة استبداله لحالات الارتجاع الروماتيـزمى الشـديد فى الصمام الميـترالى

ترتبط الجراحة التقليدية لاستبدال الصمام الميترالى حتى مع الحفاظ على السديلة الوريقة الخلفية منه بمعدل عال من متلازمة ضعف تدفق الدم من القلب بعد الجراحة بسبب فشل عضلة القلب، ويعتبر الإجراء الجراحى بالحفاظ على كامل مكونات الصمام الميترالى هو الأفضل للحصول على نتائج أفضل لما بعد الجراحة إذ ثبت فعلياً أفضليته فى تقليل معدلات الوفيات والمضاعفات ما بعد الجراحة بالإضافة إلى التحسن الملحوظ لوظائف البطين الأيسر. ولكن يتردد العديد من الجراحين فى استخدام هذا الإجراء الجراحى تخوفاً من صعوبته وطول زمن الجراحة وعدم المقدرة على وضع الصمام المناسب ومضاعفات بقايا الصمام الطبيعى من التأثير على الصمام الصناعى وضيق مخرج البطين الأيسر للقلب.

أجريت هذه الدراسة بهدف تقييم كفاءة استخدام الإجراء الجراحى بتقنية الحفاظ على كامل مكونات الصمام الميترالى أثناء جراحة استبدال الصمام الميترالى بسبب الارتجاع الروماتيزمى الشديد به فى الحفاظ على كفاءة البطين الأيسر وكذا تأثيره على الوفيات ومضاعفات ما بعد الجراحة والحالة الوظيفية الصحية للمريض على مدار عام بعد إجراء الجراحة.

تم تنفيذ هذه التقنية على تسع وسبعين مريضاً ومتابعتهم على مدار عام بعد إجراء الجراحة. وأظهرت الدراسة عدم حدوث وفيات أثناء أو بعد الجراحة لمدة عام المتابعة كما أظهرت نتائج مقبولة لما بعد الجراحة وتحسنا ملحوظاً ذو دلالة إحصائية فى وظيفة البطين الأيسر للقلب والحالة الصحية للمرضى وقياسات البطين الأيسر للقلب. كما أظهرت النتائج تحسناً فى ضغط الشريان الرئوى وكفاءة البطين الأيمن للقلب ولكن بدون دلالة إحصائية فارقة.

وهكذا يمكن استنتاج أن تنفيذ هذه التقنية الجراحية لم يؤثر سلباً أثناء الجراحة بل وأظهرت العديد من المزايا بخلاف التحسن الملحوظ فى كفاءة وظيفة البطين الأيسر للقلب، حيث أظهرت تحسناً ملحوظاً فى قياسات البطين الأيسر للقلب وتقليل معدل الوفيات الجراحية والمضاعفات ما بعد الجراحة ومعدل النجاة ولا يمنع وضع الصمام المناسب للمريض ولا يسبب بالضرورة ضيق مخرج البطين الأيسر للقلب ولا يمثل إجراءا جراحياً معقداً ويستهلك وقتاً جراحياً محدوداً كما يحسن كفاءة البطين الأيمن للقلب. لذا نوصى باستخدام هذه التقنية الجراحية أثناء جراحة استبدال الصمام الميترالى بسبب الارتجاع الروماتيزمى الشديد به.