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# Rheumatic mitral valve surgery in low ejection fraction patients

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## Abstract

### Objective

Although, in Mitral valve disease, ischemic heart disease and degenerative etiology have the upper hand in developing countries, rheumatic fever still predominates in developing countries including Egypt. Due to delay presentation some patients had very low EF which made the surgery theoretically risky. Our study aims to emphasize the benefit of surgery in this group of patients.

### Patients and methods

100 consecutive patients with Inclusion criteria: Rheumatic Mitral valve disease +/- Tricuspid valve disease, aging 18 to 75 with Ejection Fraction < 35% Exclusion criteria: Non rheumatic etiology, associated Ischemic Heart Disease, other valvular lesions, redo cases and age less than 18.

### Results

Mean age 49, 57 males, with mean Ejection Fraction 25%, Aortic Cross Clamp time 26 minutes, all patients were weaned with inotropic support, mean Intensive care unit stay 83.7 hours and hospital stay 11 days. After one year 28% regain normal Ejection Fraction above 50% and 44% are living without anti failure treatment.

### Conclusion

Rheumatic Mitral surgery is safe in low Ejection Fraction, by far aortic cross clamp and myocardial protection is key factor in prognosis.

**Keywords:** Cardiomyopathy, mitral stenosis, mitral valve, rheumatic

## INTRODUCTION

Mitral valve is a well-known cause for cardiac disease. Different causes can result in mitral valve affection. Although ischemic heart disease and degenerative etiology have the upper hand in developing countries, rheumatic fever still predominates in developing countries, including Egypt [1].

The mitral valve apparatus is a complex structure composed of the mitral annulus, mitral leaflets, chordae tendineae, papillary muscles, and the left ventricular (LV) and left atrial (LA) walls [2].

The main problem with this group of patients is that these patients do not feel fatigue or dyspnea during ordinary physical activity and therefore are in New York Heart Association functional class I. This in turn causes delay in their seeking medical advice [3].

Mitral regurgitation (MR) causes derangement of hemodynamic volume overload on the LV, which in addition to the underlying

cardiac problem, and in the presence of neurohormonal activation, causes what is known as negative ventricular remodeling, which is the alteration of cardiac structure (such as dimensions, mass, and shape) as well as the heart function [3].

Increased LV sphericity in addition to dilatation of the annulus reduces the closing forces primarily, and this in turn, causes change in tethering forces. Thus, the LA volume index, which is correlated with LV diastolic dimension, is secondarily affected. This is the etiology of LA enlargement caused by advanced diastolic dysfunction that contributes to significant MR by increasing annular dilatation and augmenting dilated cardiomyopathy. However, there is no curative specific

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treatment for the progressive LV dilation, which is one of the strongest predictors of mortality [4].

On the contrary, low ejection fraction (EF) associated with mitral stenosis could be from combined lesions, that is, associated stenosis and regurge or from the rheumatic myocarditis as the primary disease itself, or from rheumatic myocarditis or as a reason for decrease preload on the LV, but the main problem in these patients is the associated very high pulmonary artery pressure [5].

Few studies have targeted mitral valve patients with rheumatic etiology. This may be owing to having small number of patients around the world, but here in Egypt, it is a ghost that affects the country's productive age people, and so targeting it by a lot of studies is definitely feasible. The natural history for patients with late presentation to the clinicians associated with low EF carries high mortality rates. The 5-year survival rates for patients with mild MR range between 70 and 80%, but moderate MR carries 5-year mortality between 30 and 40%, whereas the 1-year survival rates for severe MR are as low as 60% [6].

The aim of this study is to target patients with late diagnosis of rheumatic mitral valve disease and low EF, who in some centers are offered only medical treatment, as the cardiologists fear high mortality rate in the surgical treatment arm. This study clarifies if this belief is true or just a myth.

## PATIENTS AND METHODS

After approval from ethical committee of NHI and taking needed consents a prospective observational single center study. A prospective observational single-center study was conducted in Egypt from 2015 till early 2019, and the mean follow-up was 13 months. The study included 100 successive patients with isolated rheumatic mitral valve disease, which could be associated with functional tricuspid regurge. A follow-up of 1 year with echocardiography is done. The results were compared with the international results of the documented guidelines.

### Inclusion criteria

Patients with rheumatic mitral valve disease +/- tricuspid valve disease aging from 18 to 75 years with EF less than 35% who were able to adhere to the follow-up period were included.

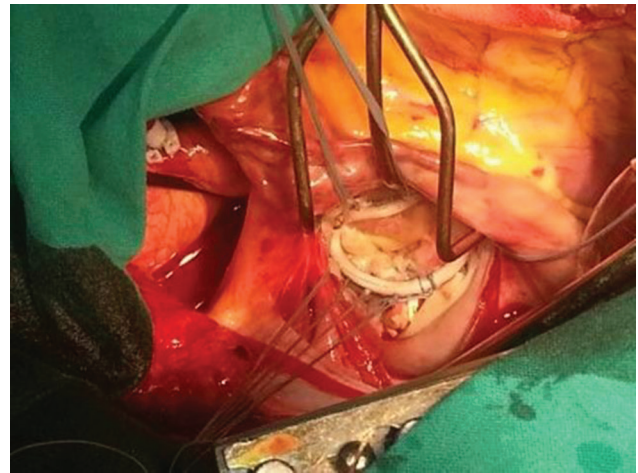
### Exclusion criteria

Nonrheumatic etiology, associated ischemic heart disease, or associated other valvular lesions (apart from functional tricuspid), redo cases, and age less than 18 years old were the exclusion criteria.

The conventional preoperative preparation was done in routine way with history taking and clinical examination including laboratory investigations such as complete blood count, renal and liver function tests, international normalized ratio, fasting and postprandial blood sugar, as well as CRP, ESR, ASOT, and HbA1c. Radiologically, chest radiograph, echocardiography,

and diagnostic coronary angiography for patients above 40 years were done.

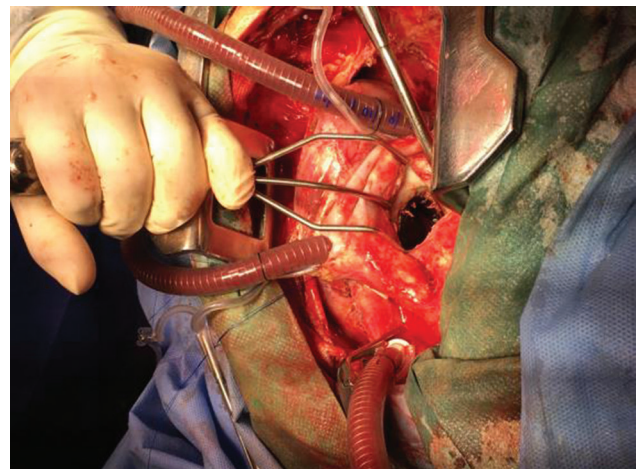
Surgically, through median sternotomy and aortobicaval cannulation with snares in case of planning tricuspid valve



**Figure 1:** Mitral repair by chordal transfer and three-dimensional ring insertion.



**Figure 2:** Excised mitral valve leaving most of chordae tendineae.



**Figure 3:** Mitral valve replacement by mechanical valve.

surgery. Myocardial protection by intermittent antegrade cold crystalloid cardioplegia with topical cooling by ice slush every 25–30 min was done. The mitral valve was exposed through left atriotomy while associated tricuspid valve was done on beating heart, to minimize aortic cross-clamp (ACC) time, through right atriotomy. Inspection of the valve and decision was done to repair or replace in only few minutes. In case of repair, a rigid three-dimensional complete ring was used which could be associated, with various techniques, such as chordal transfer, shortening or artificial chordae (Fig. 1). On the contrary, mitral valve replacement was done by limiting the excision of the valve only to the anterior leaflet, which leaves in place all the chordae and its papillary muscles, and hence the subvalvular apparatus and its function are preserved as much as possible (Figs. 2, 3).

The choice between the repair and replacement was not only the feasibility of the repair but also the time needed for repair as complex and multiple staged repair will increase the ACC time and will definitely affect the postoperative course.

When a tricuspid repair is needed, a De-Vega procedure with a 2/0 Ticron was used.

After unclamping the aorta and reperfusion time, all patients received electively 5 mg/kg/min dobutamine. If needed, another inotropic support with adrenaline, noradrenaline, or milrinone (in case of associated pulmonary artery pressure >80 mmHg) was given.

Postoperatively, according to the protocol of the study, the patient remains intubated for 6–8 h. Before extubation, an echocardiography is done, and EF below 15% results in delaying extubation and increasing inotropic support. Before hospital discharge, signs of heart failure should be absent or minimal, and predischarge echo is done. Twelve months after discharge, another echocardiography is done.

**Table 1: Preoperative characteristics of the patients' cohort**

Age	49±16
Males	57
NYHA III or above	88
Diabetes	34
Hypertensive	23
Atrial fibrillation	91
Euroscore II	5.04±3.1
ESD (cm)	6.5±1
EDD (cm)	7.6±1.2
EF	25±9
Severe TR	74
Preoperative ICU admission	29
Urgent cases	9
Mitral stenosis predominantly	47
Mitral regurge predominantly	41
Pulmonary artery pressure (mmHg)	63±2.1

EDD, end diastolic dimension; EF, ejection fraction; ESD, end systolic dimension; NYHA, New York Heart Association; TR, tricuspid regurge.

### Statistical analysis

Results are expressed as mean value and SD using Microsoft Office 2010 (excel) Microsoft Excel 2010 Microsoft corporation (USA) and SSPS, version 15 SSPS from SSPS incorporation IBM.

### RESULTS

The present study was a single-center observational study done at Egypt. The first consecutive 100 patients who were eligible to inclusion and exclusion criteria were enrolled in our study. As shown in Table 1, most patients were males, with mean age of 49 years. Clinical diabetes and hypertension were not predominated, but atrial fibrillation, tricuspid regurge, as well as pulmonary hypertension were.

The mean Euroscore II was high as many patients were done on urgent basis with previous cardiac care unit admission and high New York Heart Association class. The predominant lesion here is stenosis rather than regurge; however, mixed lesions are usually present.

Operatively 47 cases underwent mitral repair, whereas 53 cases received an artificial valve; all of them were mechanical but two. The mechanical valve used was ST Jude Bi-leaflet valve.

Tricuspid valve replacement with tissue valve Perimount happened in three patients owing to unfeasible tricuspid repair.

The heart rate is strictly controlled to below 90 BPM before going on bypass. The mean bypass time was 60 min, whereas the mean cross-clamp time is 26 min. All patients received inotropic support which was started after reperfusion time, and all patients had their chest closed in the operation.

High inotropic support (in the form of more than two inotropic supports with maximum dose) was needed in 37 cases.

Two patients died on table owing to low cardiac output and failure to be weaned from the machine.

In the postoperative period, the mean ventilation time is 18.3 h, whereas the ICU stay was 83.7 ± 30.9. Total hospital stay was 11 days.

Three cases were reopened for bleeding; there were surgical causes in two of them, whereas two cases died in the ICU from low cardiac output syndrome. In the ward, only one case had superficial wound infection.

**Table 2: Operative findings of the patient cohort**

Valve repair/replacement	47/53
Mechanical valve/tissue valve	51/2
Mean ACC time (min)	26±7
Mean CPB time (min)	60±27
Tricuspid replacement	3
Inotropic support	100
High inotropic support	31
Intraoperative mortality	2

ACC, aortic cross-clamp; CPB, cardiopulmonary bypass.



**Table 3: Postoperative findings of the patient cohort**

Ventilation time (h)	18.3±7.6
ICU stay (h)	83.7±30.9
Hospital stay (days)	11±3.9
ICU mortality	2
Re-exploration	3
Wound infection	1
Pulmonary artery pressure (mmHg)	46±0.8
EDD post (cm)	5.4±0.6
EF post (%)	41±12.4

EDD, end diastolic dimension; EF, ejection fraction; ESD, End systolic dimension.

Postoperative echo was done before discharge to exclude any pericardial effusion or valve problem such as paravalvular leak. Another echo was done 6–12 months after the operation. Strangely enough, 28 patients had EF more than 50%. Clinically antifailure treatment was stopped during the first year in 44 patients (Tables 2 and 3).

## DISCUSSION

Although the older studies that compared medical treatment of mitral valve disease with low EF and surgical management showed no definitive benefit from surgery [7], yet newer studies have emphasized the upper hand of surgery in management of these groups [8].

Owing to the good control on rheumatic fever worldwide, most of studies on mitral valve targeted other pathologies rather than rheumatic, which makes researches around rheumatic mitral disease scanty, old, and difficult to find [9].

The natural history of patients with severe low EF is very bad. Mortality has been reported to be around 31% in 1 year; in these patient groups, those with congestive heart failure and MR have a life expectancy of less than 1 year [10].

The first thing to attract attention in this study is that the total hospital mortality is 4%, which is accepted for isolated mitral valve procedures, as stated in the literature [10,11].

Low EF was present in 47 patients with mitral stenosis because atrial fibrillation is common in patients with low EF. Rhythm disturbance is concluded to be related to the decreased LV contraction, this in addition to rheumatic carditis and decrease preload on LV. Nevertheless, the right-sided heart failure occurs from high after load which itself precipitates left-sided heart failure with low EF [11].

Another cause of depressed EF in pure mitral stenosis with preserved sinus rhythm is attributable to LV under filling which seems to be precipitated by other factors in addition to a narrowed mitral orifice, such as decreased passive LV compliance and/or altered interventricular interactions [12].

Although mitral valve repair has gain upper hand than replacement in many studies especially in cardiomyopathy patients, yet we did not target this issue, but we note that

complex repair affecting cross-clamp time affects postoperative course negatively [12].

Elevated heart rate preoperatively has been a predictor of unfavorable outcomes even in noncardiac apparently healthy individuals, so it is worth noting to control our patients' heart rate aggressively [13].

ACC time is noticed to affect the patients postoperatively; the four cases that died had the longest cross-clamp time and also patients with the longest ICU stay. This is not strange as many studies had studied the effect of prolonged cross-clamp time and its deleterious effect on patients even with normal myocardial function [14].

The bypass time in total did not reflect any significance for the postoperative outcome, as many patients took long time of support and high inotropic support to be weaned from the machine [15].

High inotropic support was found in 37% of patients, but this did not show a level of significance on were weaned rapidly of ICU stay, as most of these supports weaned rapidly; in our opinion, the fixed belief of the anesthetic team that the myocardium is weak made them have low threshold to increase the inotropic doses rapidly [16,17].

Our protocol is to avoid enhanced recovery after surgery and to prolong ventilation time. Our philosophy is that the right ventricle is usually affected in patients with prolonged mitral stenosis and its impaired function will cause a negative effect on the already tired LV [18,19].

The 1-year postoperative echo gave us two ideas: first that there is no increase in the mortality after 1-year follow-up, and the second is that 28% of the patients regain their normal EF, and 44% are living without medications (apart from anticoagulant). This encourages us that in spite of stormy immediate postoperative course, yet the longer term effects deserve to use the surgical option as a promising solution [20,21].

## Study limitations

Although preliminary results are optimistic, yet longer follow up will be able to clarify the prognostic effect of surgery in these patients more, especially as myocardial remodeling takes very long time to show unpredicted effects.

A larger sample, although the disease cases are scanty, can emphasize the view in clearer way and can increase or modify our plan in managing these group of risky patients.

## CONCLUSION AND RECOMMENDATIONS

Mitral valve surgery is a good option for patients with low EF with rheumatic mitral valve disease. By far, reducing ACC time is a contributing factor in good prognosis. High postoperative inotropic support is not a predictor for worse postoperative outcome. Late extubation and using the ventilator as mechanical support till myocardial edema subsides improve the postoperative course and make it more smoother.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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