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# Emergency surgery for prosthetic mitral valve dysfunction: risk factors and technical consideration

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## Abstract

### Objective

Prosthetic mitral valve dysfunction remains a devastating complication in heart surgery. This study aims to assess the risk factors and the technical approaches to reach the best way to deal with and improve the outcome in these patients.

### Patients and methods

Between January 2002 and March 2005, 60 patients underwent emergency reoperation for prosthetic mitral valve dysfunction, where 36 (60%) patients were in New York Heart Association class III, and 24 (40%) patients were in New York Heart Association class IV. There were 33 (55%) male and 27 (45%) female patients. The mean age at operation was  $32.4 \pm 6.3$  years. Nine (15%) patients presented with fever. Hemodynamic status was unstable in 18 (30%) patients. Surgery has been carried out through repeat sternotomy or right anterolateral thoracotomy.

### Results

The 30-day mortality rate was 12 (20%) patients. Analysis of preoperative, intraoperative, and postoperative factors revealed that significant predictors of early mortality were the surgical approach, time until surgical intervention, and depression of left ventricular function. The cause of prosthetic mitral valve malfunction was valve thrombosis in 39 (65%) patients, pannus formation in nine (15%) patients, paravalvular leakage in three (5%) patients, and prosthetic valve endocarditis (PVE) in nine (15%) patients. Right anterolateral thoracotomy ( $24.3 \pm 8.5$  min) proved to be faster than median sternotomy ( $63.1 \pm 63$  min) from skin incision to on bypass with a significant reduction of intraoperative complications and postoperative wound infections.

### Conclusion

Hospital mortality can be reduced in patients with prosthetic mitral valve dysfunction if the surgery is carried out before cardiac dysfunction develops, with excellent results. Right anterolateral thoracotomy is feasible and safe for selected patients and should be considered whenever repeat median sternotomy could prove to be hazardous especially in the prominent right ventricle and pulmonary hypertension.

**Keywords:** Complication, risk factor, thoracotomy

## INTRODUCTION

Surgery for rheumatic mitral valve lesions is palliative. Despite the advances in the techniques, myocardial protection, and valve design, the problem of reoperation remains. This is owing to the following reasons:

- (1) The young age of patients
- (2) Progressive nature of the disease
- (3) Thrombogenicity of the prosthetic valve
- (4) Degeneration of the valve.

Reoperations are technically more demanding and are associated with higher mortality than primary valve operation [1]. These

operations represent a challenge for the cardiac surgeon and the hospital system [2]. Emergency operations are performed in a functionally compromised group of patients. These patients tolerate complications poorly [3]. Reoperations are associated with overall mortality than in the primary operation. Our observations suggest that the factors responsible for higher mortality rate are prosthetic valve endocarditis (PVE) and higher New York Heart Association (NYHA) class [1].

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Earlier reoperation is often the key to success before severe cardioexoskeletal damage occurs [4].

Median sternotomy is safe for reentry using the oscillating saw and careful lysis of pericardial adhesions. Some authors describe reoperations without mobilizing the heart from the pericardium by opening the left pleural cavity [5]. Many other surgeons now recommend right anterolateral thoracotomy. They report reduced blood loss, minimized dissection of the adhesions, and avoidance of injury to the right ventricle [6].

## Aim

This study aims to assess the risk factors and technical approaches in prosthetic mitral valve emergency surgery in an attempt to save more patients, improve the success rate, and minimize the perioperative complications.

## PATIENTS AND METHODS

Between January 2002 and March 2005, 60 patients with prosthetic mitral valve dysfunction in the National Heart Institute have been operated upon on an emergency basis.

### Preoperative

All patients have been subjected to full clinical, ECG, and echocardiography (transthoracic and transesophageal) in the ICU after admission and managed accordingly whether by pharmacological inotropes and/or antibiotics by intravenous infusion. Preoperative data analysis is presented in Table 1. Preoperative echocardiography causes of valve dysfunction are given in Table 2.

### Operative management

The emergency surgical intervention was decided for the 60 patients. The duration of admission to hospital and start of the surgery was between 4.30 and 24 h, with a mean of 9.30 h.

Induction of anesthesia was done under complete monitoring using ECG, invasive arterial blood pressure, and right arterial pressure while maintaining the hemodynamic support. Aprotinin was given. Draping of the patient while considering exposure of the femoral vessels was done for all patients. The femorofemoral bypass was instituted in fact to 13 (20.33%) patients in seven patients; this was due to severe hemorrhage during dissection of the adhesions and in the six others to support the circulation due to severe hypotension during induction of anesthesia.

In 49 (80.33%) patients, redo median sternotomy was performed with the oscillating saw. Keloid of the previous operation was excised. Cautious combined sharp and blunt dissection of the fibrous adhesions under the sternum until exposure of the aorta and the right atrium to be able for cannulation and institution of cardiopulmonary bypass using membrane oxygenator. Extrapericardial dissection over the left ventricle is performed to release the apex of the heart. This helps for topical cooling of the left ventricle with an iced slash around. In the 11 other patients, right

**Table 1. Preoperative data analysis**

Number of patients	60
Sex [n (%)]	
Males	33 (55)
Females	27 (45)
Age (years)	
Mean±SD	32.4±6.3
Range	24-38
Dyspnea [n (%)]	
NYHA III	36 (60)
NYHA IV	42 (40)
Fever	9 (15)
Rhythm [n (%)]	
Sinus	37 (60.33)
Atrial fibrillation	23 (39.67)
Hemodynamic instability	18 (30)

NYHA, New York Heart Association.

**Table 2. Preoperative echo causes of valve dysfunction**

	n (%)
Thrombosis	37 (65)
Pannus	9 (15)
Paravalvular leaks	3 (5)
PVE	9 (15)

PVE, prosthetic valve endocarditis.

anterolateral thoracotomy was performed. The decision was taken due to the echocardiographic finding of pulmonary hypertension (>65 mmHg) with a prominent bright ventricle by the preference of the operating surgeon. After clamping the ascending aorta, a cardioplegic arrest was achieved by antegrade injection of cold blood cardioplegia every 20 min with moderate general core hypothermia (30–32°C). The left atrium is open. All thrombi, whether organized or newly formed are removed. In case of pannus prosthetic valve endocarditis all pannus tissue. Residual calcium and infected materials are removed with the previously placed pledgets, and suture material and the implanted dysfunctional prosthesis whether bioprosthesis or metallic are excised. In case of a paravalvular leak, resuturing could be successfully attempted in some cases. The new metallic prosthesis is then placed with inverted transverse mattress sutures 2-0 ethibond with Teflon pledgets (Medtronic Parkway Minneapolis, MN). In all cases, temporary pacemaker wires are inserted. Meticulous hemostasis was done, and closure of the pericardium, if possible, is done, draining pericardial and pleural tubes.

### Postoperative

All patients were admitted to the postoperative ICU. They received postoperative care with continuous monitoring of ECG, blood pressure pulse oximetry, jugular venous pressure, and arterial blood gases analysis. Follow-up continued in the ward, and predischarge echocardiography was done. The outpatient clinic follow-up is continued.

## RESULTS

The 30-day survival rate of the 60 patients in our study was 80% (48 patients) with 12 mortalities (20 patients). The time between the first operation and presentation with valve dysfunction ranged between 5 months and 8 years with a mean of  $4.6 \pm 2.37$  years, with earlier presentation of valve thrombosis and PVE. Paravalvular leakage was in the anterior leaflet. Pannus was both on the atrial and ventricular surfaces of the prosthesis hindering its mobility in a semiopen position.

### Mortality

The major causes of early mortality were hemorrhage and low cardiac output. We had three intraoperative mortalities owing to low cardiac output in spite of prolonged cardiopulmonary bypass support and maximal pharmacological inotropes. Two patients died from hemorrhage, the pericardium was found not closed in the previous operation, with a dilated right ventricle. One patient died from excessive bleeding in spite of exploration. These patients were opened via median sternotomy.

Respiratory failure and inability to get off the ventilator were the cause of death for two patients 6–7 days after the surgery, whereas three patients died 6–10 days postoperatively owing to heart failure. Mediastinitis was the cause of death for one patient 27 days postoperatively.

Predictors of mortality were significantly found to be NYHA class IV, left ventricular failure, and PVE. Table 3 presents the risk factor analysis and the predictors of mortality.

### Morbidity

Postoperatively, two cases of thromboembolism occurred, three cases of wound infection, and two cases of mediastinitis, which were treated with intravenous antibiotics and mediastinal lavage. Early morbidity included excessive postoperative bleeding, low cardiac output, arrhythmias renal failure, chest infection, and sternal dehiscence. Postoperative results analysis are presented in Table 4.

## DISCUSSION

Emergency mitral valve reoperations are technically more difficult because of adhesions around the heart, and it is performed in a functionally compromised group of patients [3]. The causes of emergency surgery in our study were in agreement with other authors [1,7–9]

Emergency surgery is mandatory for those patients before deterioration of their clinical state, as advanced NYHA class has been found to be an independent risk factor. This has been agreed by many other studies [2,10].

Few authors suggest routine exposure of the femoral vessels before sternotomy. This allows the emergency institution of cardiopulmonary bypass in case of catastrophic hemorrhage during redo sternotomy [1]. We performed the same strategy in our study, and fact the femorofemoral bypass has been instituted in 13 (20.33%) patients.

**Table 3. Risk factors analysis and predictors of mortality**

Parameters	n	Mortality	%
Sex			
Male	33	6	18.18
Female	27	6	22.22
Age (mean±SD) (years)	32.4±6.3	36.4±54	-
Time since the first operation (mean) (years)	4.6	5.21	-
Time till operation (mean) (h)	9.30	15.21	-
Valve thrombosis	39	6	15.38
PVE	9	5	55.55
Pannus	9	1	11.11
Paravalvular leak	3	0	0
NYHA			
Class III	36	5	13.88
Class IV	24	7	29.16
Ejection fraction <25%	42	7	16.66
Ejection fraction >25%	18	5	27.77

NYHA, New York Heart Association; PVE, prosthetic valve endocarditis.

**Table 4. Postoperative results analysis**

Number of patients	Median sternotomy (n=49)	Lateral thoracotomy (n=11)
Mortality		
Low COP	2	1
Hemorrhage	2	1
Excessive bleeding	1	0
Respiratory failure	1	1
Mediastinitis	1	-
Heart failure	2	1
Morbidity		
Chest infection	4	4
Excessive bleeding	3	1
Low COP	5	1
Renal Failure	2	0
Cerebral affection	2	2

COP, coefficient of performance.

The most critical risk factors responsible for higher mortality rate are PVE and higher NYHA class [1]. These factors matched with the results of our study.

Right anterolateral thoracotomy approach is preferred in selected patients, and it offers excellent exposure and minimizes the need for cardiac dissection, and thus the risk of injury. Avoiding re-sternotomy increases patient comfort following reoperation [11,12]. In our study, right anterolateral thoracotomy avoided mediastinitis especially in patients with big right ventricle and pulmonary hypertension, but postoperative chest infection was a commoner in this group of patients, particular attention to cannulation techniques, perfusion conditions, valve exposure, and de-airing manoeuvres are all essential to ensure proper clinical results.

Median sternotomy is still safe for reentry into the chest with the use of the oscillating saw and careful lysis of pericardial adhesions. Some authors describe reoperations without

mobilizing the heart from the pericardium by opening pleural cavity [13].

This technique was used in our patients with safe and proper exposure, better topical left ventricular cooling, myocardial preservation, and safer de-airing.

## CONCLUSION

Emergency surgery for prosthetic mitral valve dysfunction can be carried out with better results.

The most important risk factors are NYHA class IV and deterioration of left ventricular function, so the operation should be done as soon as possible to offer optimum outcome.

Regarding surgical approach, median sternotomy is safe and offers excellent exposure. Right anterolateral thoracotomy is preferred whenever in selected cases especially when there is pulmonary hypertension with a large right ventricle.

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## Conflicts of interest

There are no conflicts of interest.

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