

## CAUSES OF MORTALITY IN CARDIAC SURGERY REOPERATIONS

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### ABSTRACT

From March 1990 to May 1993, 309 patients underwent redo cardiac surgery operation at the Shahid Rajai Heart Hospital in Tehran. Early mortality rates in these patients showed a significant increase in comparison to patients undergoing open heart surgery for the first time. Late mortality (at least one month after surgery) in the patients was slightly increased also but less than early mortality rates. The causes and factors involved in mortality of the patients are discussed in detail. Comparison of mortality rates in our patients with that reported in the literature reveals similar mortality in these patients, and thus the presence of definite and irrefutable factors which influence this risk. These factors consist of the patients' function class, age, surgical procedure, number of prosthetic valves in place, duration of cardiopulmonary bypass, degree of hypothermia and duration of myocardial ischemia. These factors are evaluated in this report.

**Keywords:** redo cardiac surgery, mortality rate.

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### INTRODUCTION

Due to its certain anatomical and physiological characteristics, open heart surgery has always been associated with a certain percentage of mortality and morbidity.<sup>1</sup> Similarly redo cardiac surgery, due to factors such as severe adhesion of the heart to surrounding tissues and myocardial compromise as a result of the underlying illness leading to reoperation, has been associated with a certain percentage of increased morbidity and mortality, such that in some reports, this rate is two to three fold and in cases with severe myocardial injury due to advanced disease or delay in operation, may reach 50%. Nevertheless, the most important factor in prevention of the increased morbidity and mortality

is the technical proficiency of the surgeon, who on some occasions may specialize in redo cardiac surgery.<sup>1,2,3</sup>

Therefore it is important for cardiac surgeons to be familiar with those factors which play a role in the increased morbidity and mortality associated with cardiac surgery reoperations.

Nearly all patients who undergo open heart surgery have a chance of developing complications which may require resurgery.<sup>5</sup> Virtually all patients who undergo valve replacement with biological heart valves will require reoperation after an average period of ten years.<sup>8</sup> Formation of thrombosis of the left atrium and around prosthetic heart valves are complications which arise due to malfunction of the prosthetic and metallic valves and require reoperation. Patients who undergo mitral valve commissurotomy due to mitral stenosis will require valve replacement in 50% of the cases within the next ten years. Also intracardiac infections in any type of heart valve disease or congenital heart disease in which prosthetic material is used are conditions which

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mandate cardiac surgery reoperation.<sup>4, 5, 6</sup>

Occasionally reoperation is not confined to the second time as we recently had a patient who underwent open heart surgery for the fifth time, although such cases are rare.

Patients who undergo redo cardiac surgery face the greatest risk of mortality and morbidity in the operating room and the intensive care unit.<sup>3</sup> Although this mortality rate decreases after discharge from the ICU, it is still present but continues to decline until the patient is discharged from the hospital and in all stages continues to be higher than primary open heart surgery patients. After three months have elapsed from the patient's discharge from the hospital it can be said that the mortality rate of these patients is no different from that of other patients.<sup>6, 7</sup>

### MATERIAL AND METHODS

From 309 patients who underwent redo cardiac surgery, there were 21 cases of early mortality (6.79%). Nine of these patients could not be removed from cardiopulmonary bypass due to heart failure: four due to right heart failure, three due to complete heart failure and two due to left heart failure. One mortality was due to rupture of the right ventricle during sternotomy due to adhesion. 12 mortalities occurred in the intensive care unit as follows:

- extensive and uncontrollable hemorrhage in four patients (due to rupture of right atrium and right ventricle in two patients)
- ventricular arrhythmias refractory to treatment in two patients
- low cardiac output in three patients
- cerebral embolism in one patient
- sudden death of unknown etiology in two patients

### RESULTS

#### Factors affecting mortality

##### 1) Preoperative NYHA function class of patients.

As depicted in Table I, it is clear that the preoperative New York Heart Association function class of the patient is an important factor in predicting surgical mortality and morbidity. The highest mortality rates were seen in patients with higher preoperative NYHA function class ratings. In function class IV and V mortality and morbidity rates as high as 50% and greater have been reported.

##### 2) Duration of surgery and cardiopulmonary bypass.

Although duration of surgery per se does not play an important role in mortality rates, it may exacerbate factors such as risk of infection and deranged myocardial metabolism if it exceeds a certain time limit and in this way affect mortality. In this study, all 21 patients had very lengthy

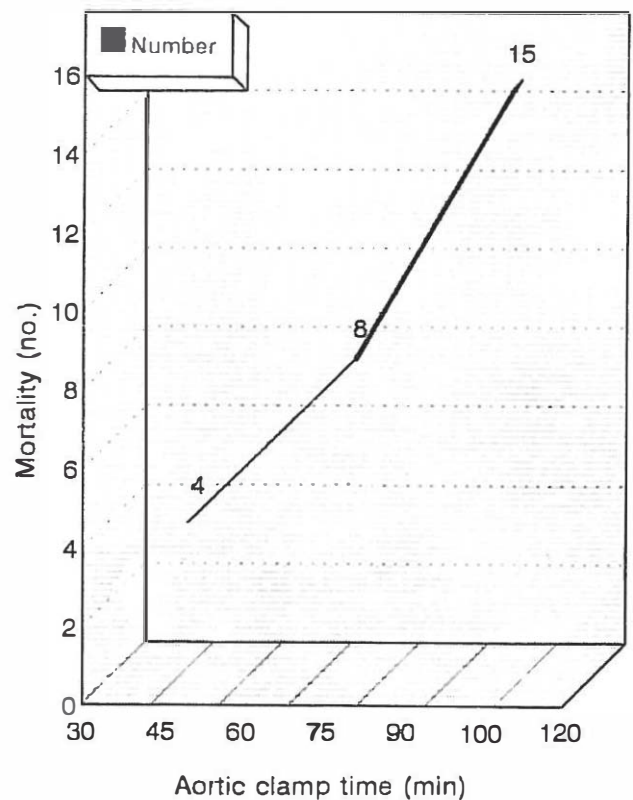


Fig. 1. Relationship between aortic clamp time and mortality

Table I. Effect of preoperative NYHA function class of patients on mortality

NYHA function class	No. of Patients	Mortality	Percent
FC I	0	0	0
FC II	61	1	1.6
FC III	122	5	4
FC IV	89	7	7.8
FC V	37	8	21.6

operative times and average duration of CPB was 120 minutes.

##### 3) Aortic clamping time and myocardial ischemia time.

There is no doubt that the most effective factor in determining mortality and morbidity in patients who undergo cardiac surgery or reoperation is the time during which the myocardium is in total ischemia. This time period is greater in redo cardiac surgery due to the inevitable technical difficulties involved. Although myocardial preservation techniques such as hypothermia and cardioplegic solution were advocated, myocardial ischemia time was the single most important factor in determining mortality rates in this series (Fig. 1). As depicted in Fig. 1, aortic clamp time was

**Table II. Effect of surgical procedure on mortality rate**

Surgical Procedure	No. of Patients	Mortality	Percent
Single valve replacement	163	9	5.5
Double valve replacement	121	9	7.4
Triple valve replacement	25	3	12.0

greater than 100 minutes in 15 patients.

#### 4) Surgical procedure.

In the patients in this series, the type of surgical procedure performed had a significant effect on the mortality rate of the patients. The highest mortality rates were seen in patients who underwent replacement of greater than two heart valves (Table II).

#### 5) Preoperative status of patients.

Preoperative status of the patients also played a role in mortality, such that patients who required emergency surgery had twice the mortality rate of patients undergoing cardiac surgery on an elective basis. 14 of the 21 patients in this series required open heart reoperation on an emergency basis. Another point to consider is the time of day in which surgery is performed. Of the 14 patients who required emergency redo cardiac surgery, nine of them were operated on between 4 p.m. and 7 a.m.

#### 6) Age of the patients.

Old age, while in itself cannot definitely be blamed as a cause of increased mortality, is a factor which can unfavorably affect this mortality rate is the patients preoperative NYHA function class. Catastrophies directly involved in mortality of such patients such as rupture of cardiac chambers or coronary vessels are more common in this group, which aside from adhesions, may perhaps be due to the excessive size of the heart and friability of myocardial tissue which is a direct result of decreased cardiac output for lengthy time periods. In our experience, patients with long-standing mitral stenosis have especially thin and friable myocardial tissue such that should the need arise to suture it, great difficulty is usually encountered.

Duration of aortic clamp time during which the myocardium is deprived of perfusion, despite the use of hypothermia and cardioplegia, plays an important role in determination of mortality rates.

Finally, factors such as preoperative status of the patients and their age, while exerting a minor effect on mortality, should not be considered as major risk factors for mortality in redo cardiac surgery patients.

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## DISCUSSION

Although it is difficult to say with certainty, it can be estimated that nearly 40% of patients who undergo cardiac surgery will require a reoperation in the near or far future, and as stated above, redo cardiac surgery is associated with an increased probability of mortality and morbidity. One