Retrospective Study Of Redo Cardiac Surgery In A Single Centre

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Abstract

Background: An increasing number of patients are being referred to tertiary referral centre for re-do cardiac surgery and will continue to increase. Though it is a sign of improving medical care and better management, it is a challenge for every cardiac anesthesiologist in handling this subset of patients. This subset of patients pose specific set of problems both for the surgeon and the anesthesiologist such as in gaining sufficient exposure to enable repair, limiting blood loss, associated pulmonary hypertension, valvular dysfunction and requires special attention at all stages of management. Also this subset of patients is frequently compromised and has little reserve to compensate for the surgical related stress and other evolving problems.

Aim: To study the in hospital outcome of patients undergoing re-do cardiac surgery in a single tertiary referral centre.

Methods: Data was collected from 42 patients who underwent re-do cardiac surgery between January 1, 2005 to December 31, 2006. All patients who had sternotomy at least three months before were included in the study. Both congenital and adult re-do's were included in this retrospective study. The following factors were collected in the retrospective study: duration since previous surgery, intraoperative complications, postoperative complications, duration of ventilation, amount of blood transfused, aprotinin usage, route of establishment in cardiopulmonary bypass (femorofemoral or right atrial aortic), elective or emergency cardiopulmonary bypass, surgical approach- sternotomy or thoracotomy, intra aortic balloon pump insertion, tracheostomy and total circulatory arrest.

Result: Unexpected injuries to the heart or great vessels occurred in 4 patients during repeat median sternotomy (9.5%). The mean duration of surgery was 210 minutes (90-340 minutes), mean cardiopulmonary bypass time was 83 minutes (20-160 minutes), mean cross clamp time was 49.6 minutes (15-100 minutes). The duration of total circulatory arrest ranged from 20-30 minutes (mean duration 22 minutes) The mean duration of ventilation was about 35 hours (6hrs to 168hrs). Re-exploration was required in 2 patients. Mean chest tube drainage was about 434 ml (60 – 1000 ml). Two patients developed stroke (4.7%). Mean duration of ICU stay was 7 days (3 days to 42 days). Tracheostomy was done in two patients (4.7%). The mortality rate was 7.1% (3 out of 42 patients).

Conclusion: Modifications in all aspects of the re-do cardiac surgery will continue to evolve as surgeons and anesthesiologists are confronted by an ever-increasing number of patients requiring re-operation. Recently a definite trend has been observed toward reduction of operative risk. Improvements in postoperative intensive care probably contributed to this tendency. Special attention to cannulation techniques, perfusion conditions, valve exposure and de-airing maneuvers are all important to ensure good clinical results.

INTRODUCTION

Cardiac surgery requiring resternotomy (so called redo surgery) is technically difficult and carries a higher operative risk than a first time operation. The problems are well recognized and include difficulty in accessing the heart, prolonged surgical time and increased post operative mortality and morbidity [1]. Sudden massive blood loss, emergency cardio pulmonary bypass, particularly femoro femoral bypass with inadequate flows and low perfusion pressure, compromised cardiac function, previous surgeries,

extended postoperative stay, total circulatory arrest and difficulty in arterial and intravenous access due to previous punctures make cardiac anesthesiologist's job equally tough.

METHOD OF STUDY

Data was collected from 42 patients who underwent re-do cardiac surgery between January 1, 2005 to December 31, 2006. All patients who had sternotomy at least three months before were included in the study. Both congenital and adult re-do's were included in this retrospective study. (Table 1) Majority of the adult re-do were re-do CABG

presenting with blocked grafts and mitral valve replacement who had undergone mitral valve repair earlier.(Table 2) Congenital surgeries mainly include redo RV-PA conduit, Glenn coming for completion fontan and central shunts coming for intra cardiac repair.(Table 3)

Figure 1

Table 1: Number of patients

ADULT	27
CONGENITAL	15
TOTAL	42

Figure 2

Table 2: Adult

PROCEDURE	NUMBER OF PATIENTS
Redo AVR	2
Pannus excision in replaced aortic valve	1
Redo MVR	12
Redo CABG	9
Post-op ASD for MVR	1
Post-op ASD for Biventricular pacing for heart failure	1
Post-op ASD for Sub Aortic Membrane Resection	1

Figure 3

Table 3: Congenital (less than 12 years)

PROCEDURE	NUMBER OF PATIENTS
VSD closure following patch dehiscence	2
Redo RV-PA conduit	6
Completion Fontan	3
ICR following Central Shunt	4

Two cases were redone twice and three cases were redone thrice. The two cases which were redone twice were RV-PA conduits. Out of the three cases which were redone for the third time, two were RV-PA conduits and one was mitral valve replacement who had undergone open mitral valvotomy twice. (Table 4)

Figure 4

Table 4: Number Of Sternotomy

NUMBER OF STERNOTOMY	NUMBER OF PATIENTS
1	37
2	2
3	3

Sternotomy was used in all patients except in two mitral valve replacement where thoracotomy was used. The age dispersion was very varied with the lowest being two years coming for intra cardiac repair after having central shunt in the newborn period and the highest being 69 years old coming for redo CABG.

The following factors were collected in the retrospective study: duration since previous surgery, intraoperative complications, postoperative complications, duration of ventilation, amount of blood transfused, aprotinin usage, route of establishment of cardiopulmonary bypass (femorofemoral or right atrial aortic), elective or emergency cardiopulmonary bypass, surgical approach- sternotomy or thoracotomy, intra aortic balloon pump insertion, tracheostomy and total circulatory arrest.

The interval from the duration of the last surgery was documented (Table 5)

Figure 5

Table 5: Interval From The Duration Of Last Surgery

DURATION FROM THE PREVIOUS SURGERY	NUMBER OF PATIENTS
<1Year	2
1-3Years	5
3-6Years	12
6-9Years	8
>9Years	15

The two cases which were done in less than a year were a central shunt coming for intra cardiac repair and mitral valve repair coming for replacement of the valve. Majority of the redo's were after 5 years.

In addition to the usual investigations a lateral chest X-ray and computed tomography- thorax was done. Disposable external defibrillator paddles was placed on all patients. Aprotinin was avoided in re-do coronaries and those patients who had already received it in the previous surgery. Monitors included electrocardiogram (Lead II & V5), pulse-oximetry, invasive blood pressure (both radial and femoral), central venous pressure, temperature, urine output, and end tidal carbondioxide. Pulmonary artery pressure monitoring was used in CABG's.Transoesphageal probe was put in all

adult patients. Usually right femoral artery and vein were kept exposed before the sternotomy. Oscillating saw was used for sternotomy.

INTRA-OPERATIVE COURSE

Unexpected injuries to the heart or great vessels occurred in 4 patients during repeat median sternotomy (9.5%). Catastrophic hemorrhage did not occur in any patients and no death was related to re-entry injury. However in 3 of the 4 patients emergency femorofemoral bypass were instituted. Two were RV-PA conduit tear, one was aortic tear and the other was a right ventricular tear. (Table 6) In another 4 patients, elective femorofemoral bypass was instituted due to adhesions underneath the sternum. In the remaining 27 cases, right atrial aortic bypass was instituted. Total circulatory arrest was required in 5 cases. Of the 9 CABG's, 7 were done on beating heart. Intra aortic balloon pump insertion was required in 1 CABG and 1 mitral valve patient. (Table 7)

Figure 6

Table 6: Intra-operative events

EVENTS	NUMBER OF PATIENTS
RV-PA Conduit Tear	2
Aortic Tear	1
Right Ventricular Tear	1
IABP Insertion	2

Figure 7

Table 7: Type of bypass

ON/OFF CPB	NUMBER OF PATIENTS
Emergency Femoro-Femoral Bypass	3
Elective Femoro-Femoral Bypass	4
Regular Right Atrial Aortic Bypass	27
Beating heart without CPB for biventricular pacing	1
Beating Heart CABG without CPB	7
Total circulatory arrest	5

The mean duration of the surgery was 210minutes (90-340 minutes), mean cardiopulmonary bypass time was 83minutes (20-160 minutes), mean cross clamp time was 49.6minutes (15-100 minutes). Aortic cross clamp and cardioplegia was used in valve replacement, ventricular septal defect closure, sub aortic membrane resection, pannus excision in the aortic valve and intracardiac repair. -

4-RV-PA conduit and two CABGs were done on beating heart under cardio pulmonary bypass.Seven CABG's and biventricular pacing was done on beating heart without bypass. The duration of total circulatory arrest ranged from 15-30 minutes (mean duration 20 minutes). Blood prime was used in congenital and clear prime was used in case of adults. Fresh blood was transfused if the hemoglobin dropped below 10gm%.

POST – OPERATIVE COURSE

The mean duration of ventilation was about 35 hours (6hrs-168hrs). Re-exploration was required in 2 patients both of which are congenital. Re-intubation was required in 4 patients. Interestingly both the patients who had thoroctomy developed phrenic nerve damage and had to be ventilated for a longer time. In another two patient's reintubation was required due to low cardiac output. Mean chest tube drainage was about 434ml (60 – 1000 ml). Two patients developed stroke, both in the posterior circulation. One was redo CABG and another one was completion Fontan. Mean duration of intensive care stay was 7 days (3 days to 42 days). Tracheostomy was done in two patients. The mortality rate was 7.1% (3 out of 42 patients).(Table 8)

Figure 8

Table 8: Post-Operative Complications

EVENTS	NUMBER OF PATIENTS
Mortality	3
Re-Exploration	2
Tracheostomy	2
Phrenic Nerve Damage	2
Stroke	2

DISCUSSION

Re-operative procedures have revealed technical obstacles that differentiate them from primary procedures. These problems include 1) difficulties with re-entry 2) potential for cardiac and conduit injury during dissection 3) non availability of conduit in redo CABG 4) management of patent grafts 5) inadequate myocardial protection 6)bleeding and requirement of blood products 7) low body weight and small cannulas (particularly femoro-femoral bypass) in case of paediatric redo 8) Prosthetic valve dysfunction.

The crude mortality rate in our study was 7.1% which includes redo CABG, redo valve and redo congenital. The mortality rate for redo valve reported in the literatures is about 7% [1,2]. The crude mortality rate for pediatric resternotomy is about 4% [5].

The crude mortality rate for redo CABG is about 7.4% compared to 2.5% for the first time operations [7]. We had three deaths in our 42 cases; one was redo mitral valve replacement, coming for the third time after two open mitral valvotomy. The cause for the death was low output and sepsis. Second was redo CABG with compromised left

ventricular function (ejection fraction 35%), CABG was done on cardio pulmonary bypass and intra aortic balloon bump was inserted post bypass. The patient died on the third post operative day due to low cardiac output. The last case was a completion Fontan who died due to posterior circulation stroke.

Duration from the first surgery did not affect the outcome in our study. Most of our cases are done after five years from the previous surgery. We did not find any literature to substantiate that duration from the first surgery affect the outcome.

The re-operative cardiac surgery after previous coronary artery bypass grafting represents a surgical challenge due to the potential for injury to patent coronary grafts, aorta or right ventricle. Standard preoperative imaging using a coronary angiogram and chest radiograph (CXR) often results in inaccurate assessment of mediastinal anatomy [6]. We found that CT Angiography is superior to chest X-ray and conventional angiography in defining the position of patent grafts and vital structures in relation to the midline and posterior sternum. The 3D CT imaging technique is useful in defining the optimal surgical strategy for re-operative cardiac surgery. Preoperative mapping of patent coronary grafts and the other vital mediastinal structures reduces the morbidity of the re-operation through modification of surgical approaches.

Traditionally blood requirement is said to be more in resternostomy. However in our study the blood requirement was not different from the primary surgery. Study by Byrne et al [4], have shown that thoracotomy have reduced blood requirement. Although we tried thoracotomy in two mitral redo, it ended in phrenic nerve damage requiring longer period of ventilation. Aprotinin was added in all the patients except redo CABG's and in patients in whom it was previously added. We were unable to attach any statistical significance of aprotinin in reducing blood loss. Although the blood usage was not different from the regular case, we had a safe practice of reserving adequate units of fresh blood and plasma.

Improvements of surgical techniques and prolonged life expectancy in the population have increased the frequency of heart valve surgery; redo procedures still carry specific risk factors for inherent technical problems. Traditionally operative mortality for heart valve replacements (HVR) has been reported to be higher in comparison to primary procedures. Furthermore, the patients referred to undergo HVR are noticeably heterogeneous with respect to indications, Special attention to cannulation techniques, perfusion conditions, valve exposure and de-airing maneuvers are all important to ensure good clinical results [1, 2].

As a major conclusion of our study, mortality in redo valvular surgery fundamentally shares the same risk factors as primary procedures. However, conventional valvular surgery as described herein has been progressively optimized in the last few years, and in-hospital risk of HVRs is comparable to that for primary interventions if HVR is not delayed until clinical and hemodynamic deterioration occurs. From a technical point of view, even minor improvements in surgical facilities might improve results in these settings [1,2].

The stroke rate in redo surgeries ranges between8-11% [8].We had two cases of stroke [4.8%] both in the posterior circulation. One was a completion Fontan and the other was a redo CABG done on a beating heart. The Fontan patient died and the redo coronary survived with minor sequale. The average ICU stay for redo was about 10 days [7]. The average stay in our study was seven days which is inclusive of adult and paediatric redo.

Repeat median sternotomy in pediatrics though associated with increased perioperative risks, yet the incidence of injury to the underlying structures during sternal re- entry is poorly quantified. With advances in paediatric cardiac surgery, staged procedures and bioprosthetic conduits to repair complex forms of congenital heart disease are not only used more frequently, but also at a young age. The survival has markedly improved in the last 15 years, therefore an increasing number of patients will require repeat median sternotomy during childhood. Although the approach has facilitated access to the heart and great vessels, repeat median sternotomy represents 8-25% of cardiac surgical procedures and are attended by specific technical problems with increased perioperative mortality and morbidity [3]

Our criteria for femorofemoral bypass were conduits located directly underneath the sternum, lack of retrosternal space, low body weight, difficult access to the femoral vessels and surgeon's decision. We found that a calcified conduit behind the sternum and lack of retrosternal space were the main risk factors. We make every effort to effort to defer cannulating the femoral vessel as it is difficult to obtain proper CPB flow and vessel can be severed more easily.

The most common cause of death was output syndrome

secondary to ventricular dysfunction [3].The cause of death in our study was posterior circulation stroke. The incidence of cardiac lacerations at repeat sternotomy is9.2% [3].We had four cases of cardiac lacerations three in paediatric group and one in adult group. Among four patients, bleeding was controlled without the institution of any emergent femorofemoral bypass in only one patient. Two were RV-PA conduit tear, one was aortic tear and the other was right ventricle tear. The incidence of injuries during sternal re-entry was significantly lower in those patients where pericardial sac was closed initially.

Conventional redo coronary artery bypass grafting is associated with significant morbidity. The danger of re-operation is mainly in the reopening the sternum and in the manipulation of the heart and the old grafts. Therefore off pump, redo, CABG, with the patient specific approach in selected cases seems an ideal technique.[3]

With the increasing number of patients who have undergone CABG the incidence of reoperative CABG is also increasing. As the over all experience with re-operative CABG has increased alternative strategies have evolved in an attempt to lower the operative risks which exceeds those of initial re-vascuarisation. These strategies include different techniques for reentry, strict avoidance of graft manipulation to minimize the risk of graft atheroembolism, and modification in the method of myocardial protection depending on the status of the native coronary circulation and patency of vein or or internal mammary artery grafts. As an alternative method of “myocardial protection” and to obviate the inherent risks of cardiopulmonary bypass, we carried out re-operative CABG without cardio pulmonary bypass in majority of patient.

Reoperative coronary procedures are an increasing part of most practices, with excellent results reported by several investigators. Although the mortality associated with redo operations has decreased the morbidity remains significant, particularly as surgeons and anesthesiologists are asked to take care of more complex patients [3]. Reoperative CABG without cardiopulmonary bypass requires less operating time and a shorter postoperative hospital stay, which translates into a reduction of hospital costs. There were fewer bleeding complications with this technique as almost three fourths of patients in present series required no blood products.

Modifications in all aspects of the re-do cardiac surgery will continue to evolve as surgeons and anesthesiologists are confronted by an ever-increasing number of patients requiring re-operation. Recently a definite trend has been observed toward reduction of operative risk. Improvements in postoperative intensive care probably contributed to this tendency. Special attention to cannulation techniques, perfusion conditions, valve exposure and de-airing maneuvers are all important to ensure good clinical results [1, 2].

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