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Research Article

Does Redo Valve Surgery after Closed Mitral Commissurotomy have Low Operative Risk than Re-Sternotomy?

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2. Key words

Closed mitral commissurotomy; Redo valve surgery; Re-sternotomy

1. Abstract

1.1. Objective: Redo valve surgery represents a challenge for surgeons due to risk of injury to cardiac and vascular structures. This study compares results of redo valve surgery in patients with prior closed mitral commissurotomy and those with prior sternotomy (re-sternotomy).

1.2. Patients and methods: Between 1994 and 2012, 217 patients who underwent redo valve surgery were retrospectively analyzed. Patients were divided into two groups. Those with previous closed mitral commissurotomy (CMC) via left thoracotomy approach (n=102) and those who required primary valve surgery through median sternotomy (n=115). Preoperative clinical features, dissection time, perioperative data and postoperative complications were compared between groups.

1.3. Results: The studied groups were comparable for several demographic characteristics. 30 day mortality rate was higher in re-sternotomy group but without statistical significance (p=0.077). Dissection time, CPB, operative time were longer in re-sternotomy group. Postoperative renal insufficiency and use of vasoactive drugs were more frequent, also (p=0.005) and p=0.002 respectively. No difference was observed in total blood loss and transfusion. Other adverse events were lower in CMC group but without statistical significance.

1.4. Conclusion: Redo valve surgery through the second median sternotomy needs careful pericardial dissection and must be performed by senior surgeons in order to reduce the morbi-mortality rate.

3. Introduction

There is a serious risk of injury cardiac and vascular structures during redo-sternotomy [1]. Park and associates found 25% mortality when significant hemorrhagic injury occurred to cardiac structures during redo-sternotomy compared with 6.5% mortality when there was no injury [2]. Excessive bleeding is a serious complication related to significant morbidity and mortality increased duration and costs of surgery and prolonged postoperative hospital stay [3]. Until today, no paper is published comparing redo- sternotomy and sternotomy in patients with previous Closed Mitral Commissurotomy (CMC) via left thoracotomy. Limited surgical dissection in those patients may help to reduce the morbi-mortality of redo cardiac surgical procedures, because cardiac structures in patients with previous sternotomy are typically covered with pleuro-pericardial adhesions and are not easily accessible. But after CMC, pericardium was opened just in front of the left atrial appendage, and there is limited adhesions. This study aims to demonstrate if redo-sternotomy independently increases the operative risk than sternotomy after previous CMC.

4. Patients and Methods

Patients: a total of 1376 patients underwent valve surgery between January 1994 and December 2012 in author's institution, of which 217 (15%) were redo valve surgery. This retrospective study was approved by our local ethic committee. Redo cardiac surgery is defined as all cardiac surgery requiring sternotomy in patients with a history of previous pericardiotomy, as defined in Euroscore by all cardiac procedures after previous opening pericardium. Patients were stratified into two study groups.

Those who underwent closed mitral commissurotomy via left anterior thoracotomy as primary valve surgery (n=102) and those who underwent primary valve surgery via a median sternotomy (n=115). Baseline data, peri and postoperative characteristics were collected from medical records. Information included the patient's age, time between primary and second

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cardiac procedure, comorbidities. The study compared hospital morbidity, cardiac pulmonary bypass and aortic cross clamp time, operative time, dissection time, red bleed cells transfusion and adverse outcomes. Operative mortality was defined as patient deaths occurring prior to hospital discharge or within 30 days of operations. Major complications included the composite operative events: stroke, renal failure, low output syndrome, wound infection, Acute Myocardial Infarction (AMI), leading for prolonged ventilatory support and long ICU stay.

Dissection time was defined as the duration from the skin incision to heparin injection and the operative time as the duration from skin incision to the close of the thorax. Surgical procedure: all redo cardiac surgery were performed by senior surgeons. Anesthetic induction used Fentanyl 5μg/kg, Propofol 3mg/kg, Cisatracurium 0.15mg/kg. The maintenance of anesthesia was performed with continuum injection of Propofol 6-12mg/kg/h and Sevoflurane 1 to 2%. CBP was performed with oxygenator membrane and moderate temperature (32˚c). Myocardial protection was performed with antegrade hyperkalemic cristalloid cold cardioplegia before 2000, but since this date until today we use blood cold cardioplegia, completed by ice in pericardium. Tranexamic acid or aprotinin were used to reduce blood lost.

5. Statistical Analysis

Continuous variable are expressed as mean ± Standard Deviation (SD) or median (interquartile range) and categorical variables are expressed as within percentages. Observed differences between groups were determined using student's t test for normally distributed variable or the Mann-Whitney U test for non normally distributed variable. Red blood cell transfusion was indicated when hematocrit was ≤25%.

6. Results

Preoperative patient's characteristics are presented in **Table 1**.

Table 1: There was no difference in age and gender between groups.

Variable	Group CMC n=102	Group previous sternotomy n=115	p value
Age	43.5±9.6	43.4±11.2	0.93
Male/female	29/73	44/71	0.12
DM (%)	5.8	5.2	0.83
HTA (%)	3.9	4.3	0.87
Smoking (%)	15.6	6.9	0.041
Time (years)	16.7±7.8	10.7±5.3	0.0001
NYHA III-IV (%)	57.8	66.9	0.16
CTI	0.57±0.06	0.60±0.08	0.004
Previous stroke	2.9	10.7	0.047
Preop RF	2.9	6.8	0.27
AF	72.5	66	0.3
Anemia	8.8	23.4	0.004
LVEF	60.7±9.4	58.6±10.6	0.13
PAPS (mmHg)	50.8±20.5	49.7±18.7	0.7
Hemoglobin level	13.8±2.2	12±1.8	0.001
Creatinine	8.5±2.8	9.7±5.5	0.12
Euroscore	4.8±2	6.4±3.3	0.0001
LVEF ≤40%	2.9	8.6	0.075

There was no difference in age and gender between groups. The prevalence of smoking was higher in CMC groups (p=0.041), other cardiovascular risk factors were similar between the groups. Anemia and stroke were frequent in re-sternotomy group: p=0.047 and p=0.004 respectively, the prevalence of other comorbidities are similar between the two groups. Patients with re-strenotomy had more advanced symptoms as indicated by NYHA functional class than patients with previous CMC (NYHA: 2.9±0.7 vs 2.6±0.6, p=0.016).

Left ventricular diameters were large in re-sternotomy group (LVSD: 36.6±10.7mm vs 50.6±7.2mm, p=0.008). But no difference was observed in left ventricular function and pulmonary arterial systolic pressure.

The most reason of reoperation in groups were detailed in **Table 2.**

Table 2: The most reason of reoperation in groups were detailed.

Variable	Group CMC n=102	Group re-sternotomy n=115	P value
No elective surgery (%)	1.1	8.6	0.01
CPB time (min)	103±41.2	119.2±51.3	0.011
Cross clamp time (min)	69.8±34.4	78.6±38.9	0.08
Operative time (min)	206±56	246.5±69.5	0.0001
Dissection time (min)	57.4±26.6	88.7±28.5	0.0001
MV			0.52
MV≥48 hours (%)	6.1	13.9	0.06
ICU	24(22-48)	46.5 (24-72)	0.001
Postoperative stay	12.8±9	15±11	0.13
Lactate level	2.08±0.7	2.7±1.4	0.009
Total blood lost (ml)			0.21
RBC transfusion	40.2	40.8	0.88
Reexploration for bleeding	3.9	6.08	0.47
Postoperative renal failure	3.9	15.6	0.005
Postoperative stroke	0	2.7	0.24
Infection	13.7	11.3	0.57
LOS	10.7	18.2	0.12
MOF	7	11.6	0.26
30 day mortality	7.8	15.6	0.077
Inotropic support (%)	12.7	30.4	0.002

Interval between primary operation and reoperation was longer in CMC group than in re-sternotomy group: 16.7±7.8 years vs 10.7±5.3 years. P=0.0001.

Emergency cardiac surgery was performed in 10 patients in re-sternotomy group but only in 1 patient in CMC group, p=0.01. CBP time and operative time were significantly longer in re-sternotomy group 119.2±51.3 min vs 103±41.2 min, p=0.011, and 246.5±69.5min vs 206±56 min, p=0.0001, but no difference was seen in aortic cross clamp time. CMC group was lower in dissection time (57.4±26.6 min vs 88.7±28.5 min, p=0.0001).

Prolonged mechanical ventilation was more frequent in re-sternotomy group but it did not reach statistical significance. ICU stay and postoperative stay were also longer in re-sternotomy group (p=0.001).

Postoperative renal insufficiency was the most common adverse event developed by re-sternotomy group. Other complications were relatively frequent in re-sternotomy group but without statistical significance.

In hospital mortality rate was higher in re-sternotomy group (15.6% vs 7.8%, p=0.077) but it did not reach statistical significance.

7. Discussion

Conventional median sternotomy is the most approach for repeat cardiac surgery however, sternal re-entry carries a prohibitive risk of injury to cardiac and vascular structures, which often is associated with fatal outcome [1]. Performance of cardiac operations after prior sternotomy confers an increased risk of operative mortality and morbidity. According to recent reports, mortality rate remains elevated for variety of cardiac reoperations [4,5].

Excessive bleeding is a serious complication during redo cardiac surgery because of pericardial adhesion due to primary operation [6].

The frequency of bleeding due to reoperation is reported to be 2% to 4% [7,8].

Limited surgical dissection has helped to reduce excessive blood loss, but good visualization of mitral valve can be difficult with limited surgical dissection.

To avoid extensive surgical dissection some surgical approach were developed [9-11].

Redo cardiac surgery is defined in Euroscore as all cardiac procedures that necessitate opening pericardium. But limited opening pericardium during closed mitral commissurotomy via left thoracotomy seems to reduce pericardial adhesion than fully opening pericardium during median sternotomy. Also, use of cardiopulmonary bypass and inflammatory response due to deleterious effects of CPB increases the risk of pleuropericardial adhesion.

Pericardial attachments after CMC were often limited to left side, opposite to left appendage, but after conventional sternotomy particularly if the pericardium was not approximated during the prior surgery, the adhesions concern mediastinum, greats vessels and cardiac structures which becomes adherent to the under surface of the sternum. Additionally, we need large dissection to mobilize all cardiac structures, great vessels and may cause the prolonged dissection time. Our finding is in agreement with medical literature. Mean dissection time is longer in re-sternotomy group 88.7±28.5 min vs 57.4±26.6 min, p=0.0001.

The time from skin incision to establishment of CPB was longer amongst the patients with re-sternotomy because of the difficulty of pericardial dissection. Ohki [12] reported mean dissection time 94±42 min in repeat median sternotomy.

Patients with re-sternotomy were characterized by long CBP (p=0.011), operative time (p=0.0001) and ICU stay (p=0.001). This is might be explained because patients in re-sternotomy group underwent more double valve surgery than CMC group. However, it is important to note that our result showed comparable wound complications, total blood loss, RBC transfusion, postoperative stroke between the two groups.

Low cardiac output syndrome is one of the main perioperative complications following redo cardiac surgery [13].

Despite the absence of statistical significance, patients operated under re-sternotomy approach had high incidence of LOS (p=0.12). LOS after redo cardiac surgery depends on the nature of the redo procedure. Prolonged CPB or prolonged myocardial ischemic time are the independent predictor factor reported in the literature [14]. Other suggested that the entire mobilization of the heart by large incision disconnect all the noncoronary collaterals, which have developed over the years through pericardial adhesions, and myocardial preservation can be compromised [15].

An arterial blood flow rising from the myocardium during the complete cross clamp implicates that repeated cardiac surgery might promote the development of collateral arteries between the pericardium and the myocardium long after the previous surgery. The mortality rate for the reoperation of the heart valve surgery in the past is reported to be 8% to 12.5% [16,17]. The most recent reports show that the hospital mortality rate of redo valve surgery has been declined to less than 7% with the development of surgical techniques and the improvement in postoperative care [18].

In our cohort, higher mortality rate and more complication were occurred in the repeat median sternotomy group compared to sternotomy after prior CMC. This might be related to advanced preoperative cardiac deterioration in re-sternotomy group and high risk condition. In repeat median sternotomy group, the prevalence of preoperative anemia was higher due to hemolysis caused by mechanical valve, and it is reported that anemia had a negative impact in short result after cardiac surgery [19].

Also, .6% of patients in re-sternotomy group underwent no elective reoperation vs 1.1% in CMC group, p=0.01. The mortality and morbidity in patients undergoing emergency cardiac surgery requiring re-sternotomy is high [20].

Goodwin [20] had explored 65 cases who underwent emergency redo cardiac surgery, and the mortality rate was 43%, with half of deaths occurred intra-operatively. It has been reported that blood loss was accentuated in the reoperation, patient who is exposed to extensive tissue dissection a longer CPB time and more intense inflammatory response [21,22]. In our series no statistically difference was observed between the two group in term of total chest tube drainage and RBC transfusion.

8. Limits of Study

Although the data were collected prospectively, this study is prone to the inherent biases of its retrospective nature. It is difficult to compare our result to the publishing reports because our patients were quit heterogeneous in terms of reason of reoperation, number of heart valve disease, and preoperative risk factors. The operative mortality in our series is relatively high compared to recent reports. The main reason to explain this no good result is that the lateness of developing countries in medical management and most of death were in advanced heart disease.

9. Conclusion

Operative mortality and morbidity were relatively high in re-sternotomy group than in patients who underwent redo valve surgery after previous CMC. Careful pericardial dissection is essential and good perioperative care might influence the short operative results.

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