Mini Sternotomy versus Full Sternotomy for Aortic and Subaortic Valve Surgery

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Abstract

Background- Mini sternotomy approach for aortic valve surgery is an alternative to median sternotomy to minimize surgical trauma. In this study, we report our experience with mini sternotomy and compare it with full sternotomy in patients undergoing aortic valve operations.

Methods- From March 2002 to December 2003, 20 aortic and subaortic operations were performed by one group of surgeons through partial upper sternotomy approach. Fifteen patients had primary isolated aortic valve replacement, two patients had aortic valve commissurotomy and three patients had subaortic membrane resection. A comparison group included twenty matched patients operated on through a full median sternotomy from 2001.

Results- There were 16 male and 4 female patients with a mean age of 37±19 years in each group. There was no difference in the patients' demographics between both groups. Mean cardiopulmonary bypass (CPB) and aortic cross–clamp times were significantly longer in the mini sternotomy group (0.01). Minor complications were comparable, and hospital stay was longer in the full sternotomy group (0.03). Right internal mammary artery damage occurred in two cases in the mini sternotomy group.

Conclusion- Despite longer CPB and aortic cross – clamp times in our initial experience, mini sternotomy for aortic valve surgery is a safe and effective approach with some technical difficulties ***(Iranian Heart Journal 2004; 5(4): 30-33).***

Key words: aortic stenosis ■ aortic subvalvar stenosis

During recent years, different minimal approaches to aortic valve surgery have been described.[1-5] In some techniques, standard equipment for cardiopulmonary bypass (CPB) without requiring peripheral cannulation has been used. Some advantages, such as less postoperative pain, less bleeding, faster recovery and shorter hospital stay associated with lower costs have been reported.

However, due to the surgical problems of operating through a small incision, these approaches have failed to establish routine practice.[6-9] in this study; we report our experience with the mini sternotomy approach and compare it with full sternotomy in patients undergoing aortic and subaortic valve surgery.

Methods

From March 2002 to December 2003, 20 consecutive patients underwent aortic and subaortic operations through a partial upper sternotomy approach. Primary isolated aortic valve replacement was performed in fifteen patients, aortic valve commissurotomy in two patients and subaortic membrane resection in three patients. A comparison group comprised 20 matched patients, operated on via a standard full sternotomy from 2001. All of the patients were informed about the two surgical approaches so as to help them make a decision between partial or full sternotomy. Contraindications to the partial sternotomy approach were redo surgery and associated procedures.

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Surgical techniques: All of the operations were performed by one group of surgeons. Standard instruments, cannulas, heart – lung machines and operation techniques were the same for partial and full sternotomy patients, and only the surgical approaches differed between the two groups.

In the partial sternotomy patients, before surgery, external defibrillation paddles were fixed to the skin. A midline skin incision 7-9 cm long was made starting from 2 cm inferior to the sternal notch. A reversed "L" mini sternotomy from the sternal notch to the right third or forth intercostal spaces was common in all the patients (Fig. 1).

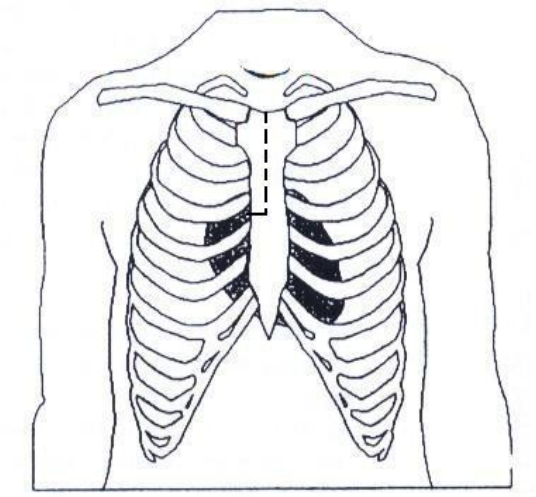

Fig. 1. Reversed "L" ministernotomy

The ascending aorta and right atrial appendage were cannulated as usual. The venous cannula was brought out through a skin incision in the fourth or fifth intercostal space on the right side. The chest incision was later used for the insertion of a chest tube for postoperative drainage. After cross–clamping of the ascending aorta, a left ventricular vent was inserted through the right superior pulmonary vein. Antegrade crystalloid cardioplegia (Martindale Pharmaceuticals) was infused directly through the coronary ostia, and further doses were infused at intervals of 20 minutes. In fifteen patients, the aortic valve was excised and replaced with amechanical valve prosthesis. In others, aortic valve commissurotomy or subaortic membrane resection was performed.

After aortotomy repair and de-clamping of the aorta, air was withdrawn from the aortic root through a vent connected to the suction. Upon the completion of the operation, two chest tubes were left in position: one in the mediastinum and the other in the right chest.

Table I. Preoperative characteristics of the patients in both groups.

	Mini sternotomy	Full sternotomy
Age (yr)	37±19	36±19
M/F (no)	16/4	16/4
LVEF (%)	54±10	54±12
AI (no.)	10	10
AS (no.)	3	3
AS+AI (no.)	4	4
SAS (no.)	3	3
AS gradient (mmHg)	81±32	85±17

M/F: Male / Female, **LVEF**: Left ventricular ejection fraction,
AI: Aortic insufficiency,
AS: Aortic stenosis,
SAS: Subaortic stenosis.

Statistical analysis

Data are given as mean ± standard deviation (SD). Differences of variables between both groups were calculated using Mann–Whitney or Fisher exact test. P values <0.05 were considered significant.

Results

There were 16 male and 4 female patients with a mean age of 37±19 years in each group. Table I shows preoperative characteristics of the patients in both groups with no significant difference. There were no intraoperative complications requiring conversion from partial to full sternotomy. Exposure of aortic and subaortic valve area was acceptable in mini sternotomy cases. Comparison of the operative data demonstrates that the mean CPB time and mean aortic cross–clamp time were significantly longer in the mini sternotomy group (Table II).

Table II. Operative and postoperative data of patients in both groups

	Mini sternotomy	Full sternotomy	P value
Total operating time (min)	305±51	267±81	0.08
CPB time (min)	110±32	85±31	0.01
Aortic cross-clamp time (min)	82±29	60±24	0.01
RIMA damage (no.)	2	-	-
Ventilatory support (hr)	8.9±4.4	10±3.6	0.4
Total drainage (ml)	650±210	850±180	0.09
ICU stay (hr)	38±11	53±13	0.001
Minor morbidity (no.)	6	8	-
Mortality (no.)	0	1	-
Hospital stay (days)	8.7±1.9	10.4±2.8	0.03

CPB: Cardiopulmonary Bypass
RIMA: Right Internal Mammary Artery

All the patients were successfully weaned off CPB with low dose inotropes in some cases. ICU stay was significantly less than that observed in the full sternotomy group. Six patients in the mini sternotomy group suffered minor complications, as compared to eight patients in the full sternotomy group. Two patients in each group had postoperative bleeding, which required re-exploration. In each group, one patient had right upper lobe atelectasis, which recovered with chest physiotherapy. Right internal mammary artery damage occurred in two cases in the mini sternotomy group. Hospital stay was significantly longer in the full sternotomy group. There was one hospital death in the full sternotomy group. The patient died after sudden ventricular arrhythmia secondary to malfunction of an external pacemaker 5 days after aortic valve replacement.

Discussion

Several techniques have been reported using minimal access approaches to the aortic valve. These include transverse sternotomy, right parasternal incision with femoral cannulation and internal mammary artery ligation, right anterior mini thoracotomy and port access.[1,10-13]

In this prospective series, upper sternotomy with an inverted L – incision was performed by using standard instruments, cannulas, retractors and myocardial protection techniques, without femoral cannulation. The advantage of this technique is feasible access to the great arteries, right atrium and right superior pulmonary vein for venting.

Disadvantages are impossible immediate access to the entire heart, difficulty in placing a retrograde cardioplegia catheter for myocardial protection and in some cases damage to the right internal mammary artery.

In our initial experience with this technique, mean CPB time and mean cross–clamp time were definitely longer. The resultant prolongations may have deleterious effects on patient safety and outcomes. Several authors have reported longer ischemic and CPB times for minimally invasive aortic valve replacement, but they have not mentioned low cardiac output cases or other complications related to long ischemic times.[14-16] Although the surgical field in mini sternotomy is smaller, gaining surgical experience can decrease the duration of CPB and ischemic times, as was the case in our last series. In addition, outcome analysis in both groups showed that the mini sternotomy approach did not compromise the quality of the operation. There was no case of paravalvular leak or any early reoperation in this group.

The skin incision is shorter in the mini sternotomy group, but its location is in the upper part of the anterior chest. From the cosmetic aspect, it is difficult to hide the incision; nevertheless, this disadvantage was not important for most of our patients.

Ventricular fibrillation (VF) during surgery remains a problem in the mini sternotomy group. Because there is limited access to the heart in mini sternotomy, protection of the myocardium to restore spontaneous sinus rhythm is important. In cases of VF, external defibrillator paddles were more effective than small internal paddles. Difficulty in

placing temporary ventricular pacemaker wires and de-airing are other problems in the mini sternotomy approach. Although through different maneuvers for de-airing in the mini sternotomy group we had no neurologic complications, it can lead to longer CPB times. Reduction in surgical trauma is one of the advantages of a small incision. Since the left and right ventricles are not exposed during mini sternotomy, this is advantageous for reoperation, particularly in coronary artery bypass surgery. There was no statistically significant difference in hospital morbidity and mortality between the two groups. Hospital stay was longer in the full sternotomy group.

In conclusion, mini sternotomy approaches for aortic and subaortic valve operations with standard instruments, cannulae and myocardial protection techniques are safe and effective. Although this method has many potential advantages, longer CPB and aortic class – clamp times, difficulties in de – airing and potential risk of injury to the right internal mammary artery are operation limitations.

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