



Manuscript ID ZUMJ-2108-2307 (R2)
DOI 10.21608/zumj.2021.89057.2307

ORIGINAL ARTICLE

Aortic valve Replacement: J-Shaped Upper Sternotomy Versus Conventional Sternotomy

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Submit Date 2021-08-03

Revise Date 2021-08-26

Accept Date 2021-09-02

ABSTRACT

Background: Aortic valve replacement is routinely performed through full sternotomy. Minimal invasive approaches including J-shaped upper sternotomy were introduced to achieve advantages concerning postoperative pain, duration of mechanical ventilation, blood loss and cosmetic state.

Methods: From January 2015 to December 2017, isolated aortic valve replacement was performed through full median sternotomy (group I) in 40 patients (41.2%) and through J-shaped ministernotomy (group II) in 57 patients (58.8%). We retrospectively analyzed the preoperative characteristics, operative and postoperative variables with emphasis on clamping time, bypass time, duration of mechanical ventilation, blood loss, postoperative pain, ICU stay, total hospital stay, morbidity and mortality.

Results: Clamping time and total bypass time were longer in group (II): 64.4 minutes vs. 48.08 minutes and 83.61 minutes vs. 66.97 minutes respectively. Duration of mechanical ventilation was significantly longer in group (I): 10.48 hours vs. 8.04 hours. The amount of blood loss was less in group (II): mean 277.3 mL vs. 464.7 and need for blood transfusion was significantly higher in group (II): 26 (65.0%) vs. 9 (15.8%). Postoperative pain was less in ministernotomy group as reflected by shorter duration of epidural analgesia: 2.79 vs. 6.23 days.

No significant difference was found between the two groups regarding sternal wound infection, re exploration for bleeding or mortality.

Conclusion: J-shaped ministernotomy for aortic valve replacement is a safe technique that has the advantages of less postoperative pain, less blood loss, shorter period of mechanical ventilation and better cosmetic results when compared to conventional full sternotomy.

Key words: minimal invasive aortic valve replacement, ministernotomy, J-shaped sternotomy.

INTRODUCTION

Aortic valve replacement is performed routinely through conventional full sternotomy.

Sternal wound infection although decreased but its deep form mediastinitis still carry higher mortality up to 40% (1) Also the higher requirements of analgesia post-operative and increased risk of bleeding and need to transfusion with its drawbacks on different systems(2)

Over last three decades sternal sparing incision have been growing up and widely used with

comparable outcome to standard median sternotomy.(3)

Minimal invasive approaches, including upper sternal split were introduced to decrease the length of the wound and improve cosmetic and functional outcome.(4)

Additional advantages of less blood loss, shorter period of mechanical ventilation, ICU stay, and total hospital stay were assumed (5).

AIM OF WORK

Our aim was to present our experience in aortic valve replacement via ministernotomy and to compare this approach with conventional

sternotomy so as the safety and advantages could be evaluated.

PATIENTS AND METHODS

Since 2002 we started to perform minimal invasive valve surgery. Our preferred minimal invasive approach for isolated aortic valve replacement is J-shaped upper sternotomy. With increasing experience it became more popular. However, still the choice of incision is based upon surgeon preference. Exclusion criteria for ministernotomy were additional cardiac surgical procedures, redo cases, emergency situations, and infective endocarditis. Our technique for ministernotomy started with incision 2 cm below the suprasternal notch extending down to level of 4th interspace. The sternum was incised by the ordinary saw in the midline till the 4th interspace where the incision was extended to the right in a J-shaped fashion sparing the right internal mammary artery. In all patients arterial cannulation was performed in distal ascending aorta and venous cannulation was through appendage of right atrium. Ante grade warm cardioplegia was used for myocardial protection in all patients. Exposure of the aortic valve is facilitated by traction sutures taken in the edges of the aortotomy as well as the commissures of the valve. We evaluated preoperative patient characteristics including: age, gender, aortic valve pathology, and diabetes. Intraoperative variables were recorded including clamping time, bypass time, prosthetic valve size, intraoperative transfusion of packed RBCs, and rate of conversion to full sternotomy. Postoperative variables included period of mechanical ventilation, amount of blood loss, need for blood transfusion, and period of epidural analgesia, ICU stay and hospital stay. In addition complications were recorded including reexploration for bleeding, sternal wound infection, cerebrovascular accident, chest infection and arrhythmias.

Written informed consent was obtained from all participants, the study was approved by the research ethical committee of Faculty of Medicine, Zagazig University. The study was done according to The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

STATISTICAL ANALYSIS

Data obtained from medical records were compiled in an Excel spreadsheet. Data were then imported into Statistical Package for the Social Sciences (SPSS version 20.0) software for analysis.

Categorical variables were presented as frequency and percentage.

Chi-square test (χ^2) was used to test differences for categorical variables. *P* values were set at <.05 for significant results

DISCUSSION

Minimal invasive aortic valve replacement is increasingly performed with safety and favorable results (6). Since anterolateral minithoracotomy is associated with more complications, upper hemisternotomy is now the most commonly performed minimal invasive approach for aortic valve replacement (7). The mean age of our patients was . Even in patients older than 75 years minimal invasive aortic valve replacement is recommended by Lamelas and colleagues with lower rate of morbidity and mortality (8). We excluded redo cases from our study. Byrne et al reported encouraging results about ministernotomy in reoperative aortic valve replacement with the advantages of reducing bleeding and operative time (9).

Brown et al performed a systematic review and meta-analysis of studies comparing full sternotomy and ministernotomy for aortic valve replacement. There was no difference in mortality. Cross clamping and bypass times were longer in ministernotomy (mean differences 7.9 minutes and 11.46 minutes respectively) but not clinically important. Ministernotomy had the advantages of shorter ICU and hospital stay (mean differences -0.46 days and - 0.91 days respectively), shorter ventilation time (mean difference -2.1 hours) and lesser blood loss (mean difference -0.79 mL). (2) Our results are concordant with that reported by Brown et al and other investigators (8-11).

COPD may alter relation between the aortic valve and chest wall. We performed CT chest to aid diagnosis and we prefer full sternotomy for this group of patients. No difference was found regarding the size of implanted prosthetic valve among the two groups. We had performed aortic root enlargement in 3

patients through full sternotomy for better exposure.

It has been reported that degree of pain is less with ministernotomy. This may be explained by reduced stretching of sternum and less frequent sternal fractures (12).

We had one patient (1.8%) in ministernotomy group converted to full sternotomy when he was reexplored for bleeding. The conversion rate to full sternotomy was reported in literature as about 3%. Causes of conversion

include poor exposure, ventricular arrhythmias, or bleeding. Tabata et al reported conversion rate 2.6% (24 patients) and 8 of them died which reflected a high mortality associated with conversion to full sternotomy.(4) We prefer distal ascending aortic cannulation to avoid complications of peripheral arterial cannulation e.g. dissection, hematoma, false aneurysm and lymphatic fistula.

Table (1): Preoperative patients characteristics are shown in table (1):

Variables	Group I Ministernotomy	Group II Full sternotomy	p Value
Number	57	40	
Age			
Gender: males	25	25	0.71
females	32	15	
COPD	10	18	0.003
Diabetes	18	16	0.392
Aortic valve pathology			0.474
AS	15 (26.3%)	15 (37.5%)	
AR	20 (35.1%)	13 (35.5%)	
AS+AR	22 (38.6%)	12 (30.0%)	

Table 2. Intraoperative variables

Variables	Group I Ministernotomy	Group II Full sternotomy	p Value
Time			
From incision till	32.47	24.30	0.00
bypass	83.61	66.97	0.00
Total bypass time	64.40	48.08	0.00
Cross clamp time			
Prosthetic valve size			0.935
19	20	13	
21	18	14	
23	19	13	
Aortic root enlargement	0	3	0.067

Table 3. Postoperative results

Variables	Group I Ministernotomy	Group II Full sternotomy	p Value
Post op blood loss	277.37	464.75	0.00
Packed RBCs (>1 unit)	9 (15.8%)	26 (65.0%)	0.00
Re exploration for bleeding	1 (1.8%)	1 (2.5%)	1.00
Duration of MV (hrs)	8.04	10.48	0.00
Prolonged MV	1	3	0.303

Variables	Group I Ministernotomy	Group II Full sternotomy	p Value
ICU stay	1.53	3.6	0.00
Hospital stay	6.6	10.53	0.00
Prolonged ICU stay	2 (3.5%)	5 (12.5%)	0.121
Need for inotropic support	43 (75.4%)	37 (92.5%)	0.03
CVA	1 (1.8%)	2 (5.0%)	0.567
Pneumothorax	3	5	0.268
Chest infection	3	7	0.086
New onset of arrhythmia	2	4	0.226
Sternal wound infection	2	6	0.062
Epidural catheter stay	2.79	6.23	0.00
Long epidural analgesia	9	24	0.00
10-day mortality	1 (1.8%)	2 (5%)	0.567

RESULTS

No difference in patient characteristics was found among the two groups regarding age, gender, and aortic valve pathology. **More patients with DM, COPD were in group 1 since best outcome through ministernotomy.** The intraoperative variables are shown in table (1).

Ischemic and total bypass times were significantly longer in ministernotomy group (64.4 minutes vs. 48.08 minutes and 83.61 minutes vs. 66.97 minutes respectively). Three patients underwent aortic root dilatation through full sternotomy. Postoperative results are shown in table (2).

Postoperative blood loss and transfusion was less in ministernotomy group: mean 277.3 mL vs. 464.7. Duration of mechanical ventilation was significantly shorter in group I: mean 8.04 vs. 10.48 hours. Ministernotomy group had shorter ICU and total hospital stay. Postoperative pain was less in group I as reflected by shorter duration of epidural analgesia. No significant difference was found regarding sternal wound infection and mortality. Postoperative variables are shown in table (3).

CONCLUSION

Aortic valve replacement through J-shaped upper ministernotomy is a safe and adequate approach that has benefits of less bleeding, less need for blood transfusion, better cosmetic result, shorter ICU and hospital stay, with preserved respiratory mechanics.

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