The Egyptian Journal of Hospital Medicine (January 2021) Vol. 82 (2), Page 186-189

Early Outcome of Minimally Invasive Versus Median Sternotomy Mitral Valve Replacement In Patients With Severe Chronic Obstructive Pulmonary Disease

Ahmed S. Mahmoud[1], Rafik F B. Solima[2], Amira I. Alamaldeen[3], Passant M. Hassan[4], Fouad M. Rasekh[1]
Departments of [1]Cardiothoracic Surgery, [3]Chest Medicine and [4]Anesthesia, Faculty Medicine - Cairo University
Department of [2]Cardiothoracic Surgery, Faculty Medicine - Menofia University
Corresponding author: Ahmed Sayed Hussein, **Mobile:** 00201090991111, **E-mail:** drahmed 755@gmail.com

ABSTRACT

Background: Minimally invasive valve surgery is considered much more beneficial than routine median sternotomy in patients undergoing open heart surgery with sever chronic obstructive pulmonary disease (COPD).

Objective: To compare between early outcomes of minimally invasive versus routine median sternotomy in patients with severe COPD undergoing isolated mitral valve replacement (MVR).

Patients and Methods: 100 patients with severe COPD between October 2016 and September 2019 underwent isolated MVR. Patients were divided into 2 groups: Group (A): 50 patients underwent surgery via minimally invasive approach and group (B): 50 patients underwent surgery via median sternotomy. Early postoperative complications, Intensive Care Unit stay and total hospital stay were compared in both groups.

Results: The mean age was 60 ± 9 years for Group (A) and 61 ± 10 years for Group (B), (P = 0.29). Combined postoperative complications were significantly lower in Group (A) [8 (16%) versus 12 (24%), P < 0.05]. The median postoperative mechanical ventilation time was 10 hours in group (A) versus 22 hours in group (B) (P < 0.05). The median ICU stay in group (A) was 1.5 days versus 3 days in group (B) (P < 0.05). The median length of total hospital stay was 7 days in group (A) versus 13 days in group (B) (P < 0.05). The overall hospital mortality was 2 patients (4%) in group (A) versus 1 patient (2%) in group (B) P < 0.05.

Conclusion: Minimally invasive had better early outcome than routine median sternotomy in patients with severe COPD undergoing MVR and should be considered as a good option in these patients.

Keywords: Minimally invasive, Median sternotomy, Mitral Valve replacement, Chronic obstructive pulmonary disease.

INTRODUCTION

Median sternotomy is considered one of the major traumas in open heart surgery in addition to cardiopulmonary bypass (CPB) [(1)]. Minimally invasive as an approach for MVR has many advantages over routine median sternotomy as: less blood loss, less incidence of reopening, less pain, better respiratory function and rapid [(1-4)]. Although minimally invasive approach has the previous advantages over median sternotomy, yet it is technically more difficult and requires a good training for use of long instruments used in minimally invasive approach and also needs more CPB time [(2-3)]. Many studies hypothesized that patients with severe COPD undergoing open-heart surgery via minimally invasive approach will have many benefits over the routine median sternotomy approach [(2-4)].

Aim of study was to compare between early outcomes of minimally invasive versus routine median sternotomy in patient with sever COPD undergoing isolated MVR.

PATIENTS AND METHODS

Through the period between October 2016 and September 2019, a 100 patients with sever COPD undergoing MVR in Cairo University Hospitals were selected and divided into 2 groups; **group (A)** 50 patients underwent MVR through minimally invasive approach and **group (B)** 50 patients underwent MVR through routine median sternotomy. All patients of both groups were diagnosed as severe COPD by the pulmonologist after pulmonary function test (PFT) and arterial blood gases after their receiving of intense medical treatment for 2 or 3 weeks before surgery to improve chest condition of patients before surgery as possible. Once the pulmonologists gave approval to go for surgery, patients were prepared by proper history taking, routine laboratory investigations, echocardiography, computerized tomography (C.T) of chest and diagnostic coronary angiography.

Patients with isolated MVR were selected and patient was considered severe COPD with forced expiratory volume 1 (FEV 1) < 50% in the first minute in PFT, PO_2 < 55, PCO_2 > 50 and oxygen saturation < 93% in arterial blood gases in room air.

Ethical approval and written informed consent:

An approval of the study was obtained from Cairo University Academic and Ethical Committee. Every patient signed an informed written consent for acceptance of the operation.

Received:4 /10 /2020
Accepted:22 /11 /2020

Technique for MVR via minimally invasive valve approach:

Patient lying on supine position with right chest is slightly up, induction of anesthesia with double lumen endotracheal tube and probe of trans-esophageal echo (TEE) was inserted. A small incision about 2 cm was done in the right groin region to expose femoral vessels and 2 purse sting sutures of prolene 5\0, which was put one for the femoral artery and one for the vein. Heparin is given to get ACT between 400 and 600 then a wire passed through the purse string of femoral vein and it should be visualized in the superior venacva by the anesthesiologist via the TEE. Then femoral vein was cannulated by 25 french multistage cannula followed by cannulation of femoral artery in the same way. An incision 5 to 7 cm was made in the right inframammary region to open thoracotomy in the 4th intercostal space, the right lung was deflated and CBP was established and start systemic cooling to 28 °C. The pericardium was opened 2 cm away from phrenic nerve and pericardium is hold by 3 stay sutures. Cardioplegia cannula is inserted at lowest point of the ascending aorta and aortic clamp introduced through a separate small opening about 1 cm in the 2nd intercostal space at midaxillary line to clamp the aorta horizontally. 2 liters of ante grade crystadiol cardioplegia solution was given over 10 minutes to arrest the heart. Left atriotomy was done, mitral valve was explored, and in all cases, anterior mitral leaflet was excised with preservation of posterior mitral leaflet. The valve whether metallic or tissue was inserted by interrupted Ethibond 2/0 on Teflon pledge in an interrupted way and in annular position and sutures were tied by knot pusher. Closure of left atriotomy in one layer by continuous prolene 3/0 stich, then heart was deaired, aorta was declamped and patient was rewarmed again to 37 °C. After recirculation, patient was weaned from CBP, 2 pleural chest tubes and 2 ventricular pace maker wires were inserted. Heparin is reversed by protamine, proper hemostasis, removal of femoral cannula of both femoral artery and vein and then closure of thoracotomy and femoral wound by TEE. The mitral valve was assessed as well as cardiac contractility.

Technique for MVR via median sternotomy approach:

Patient lying on supine position with induction of anesthesia with single lumen endotracheal tube and a probe of trans-esophageal echo (TEE) was inserted and then routine median sternotomy. Pericardium was opened and hold with stay sutures, heparin is given to get ACT between 400 and 600, aorto-bicaval cannulation, vent was put in the right superior pulmonary vein and CBP was established and systemic cooling to 28 °C and aortic cross clamped was started. Blood cold ante-grade cardioplegia given every 30 minutes with local ice slush to arrest the heart. Left atriotomy was done, mitral valve was explored and in all cases, anterior mitral leaflet was excised with preservation of posterior mitral leaflet. The valve whether metallic or tissue was inserted by interrupted Ethibond 2/0 on Teflon pledge in an interrupted way and in annular position. Closure of left atriotomy in one layer by continuous prolene 3/0 stich, then the heart was deaired, aorta declamped and patient was rewarmed again to 37 °C. After recirculation patient was weaned from CBP. Heparin was reversed by protamine, removal of aortic and venous cannula, proper hemostasis, insertion of 2-mediastinal drainage tube and 2 ventricular pacemaker wires and then closure of sternotomy wound by TEE. The mitral valve was assessed as well as cardiac contractility.

Statistical analysis

Recorded data were analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean ± standard deviation (SD). Qualitative data were expressed as frequency and percentage. Independent-samples t-test of significance was used when comparing between two means. Chi-square (x^2) test of significance was used in order to compare proportions between two qualitative parameters. P- $\leq$ 0.05 was considered significant. P-value < 0.001 was considered as highly significant. P-value > 0.05 was considered insignificant.

RESULTS

100 patients with severe COPD who underwent isolated MVR, of these 50 patients done through minimally invasive approach (**group A)** and 50 patients done through routine median sternotomy (**group B).** In group (A) the mean age group was 60 ± 9 and in group (B) was 61 ± 10, which statistically was insignificant. Female gender was 35 (70%) in group (A) and was 32 (64%) in group (B), which was statistically insignificant. Diabetic patients were 6 (12%) in group (A) and 8 (16%) in group (B), which was statistically insignificant. Mean ejection fraction (EF) in group (A) was 55 ± 12 and in group (B) was 57 ± 14, which was statistically insignificant. Mean size of left atrium (LA) in group (A) was 5 ± 1.2 and in group (B) was 4.9 ± 0.9, which was statistically insignificant. Mean Pulmonary artery pressure (PAP) in group (A) was 45 ± 13 while in Group (B) was 42 ± 11, which was statistically insignificant. Patients with preoperative atrial fibrillation (AF) was 14 (28%) in group (A) and in group (B) was 12 (24%), which was statistically insignificant and mean Euroscore for patients in group (A) was 4.2 ± 1.9 while in group (B) was 3.9 ± 1.6, which was statistically insignificant (Table 1).

Table (1): Preoperative data.

Variables	Group (A)	Group (B)	P value
Age (years)	60 ± 9	61 ± 10	NS
Female gender	35 (70%0	32 (64%)	NS
Diabetes mellitus	6 (12%)	8 (16%)	NS
EF	55 ± 12	57 ± 14	NS
LA	5 ± 1.2	4.9 ± 0.9	NS
PAP	45 ± 13	42 ± 11	NS
A.F	14 (28%)	12 (24%)	NS
Euro score	4.2 ± 1.9	3.9 ± 1.6	NS

Intraoperative data, mean CBP in minutes was 95 (85-105) in group (A) and in group (B) was 68 (51-86) with P value < 0.05. Ischemic time in minutes in group (A) was 70 (62-87) while in group (B) was 42.5 (40-45) with P value < 0.05. Tissue valve used in group (A) was in 22 patients (44%) while in Group (B) was in 24 (48%) which was statistically insignificant. Metallic valve used in group (A) was in 28 patients (56%) while in group (B) was 26 (52%), which was statistically insignificant (Table 2).

Table (2): Intraoperative data.

Variables	Group (A)	Group (B)	P value
CPB time in minutes	95 (85-105)	68.5 (51-86)	< 0.05
Ischemic time in minutes	70 (62-78)	42.5 (40-45)	< 0.05
Tissue valve	22 (44%)	24 (48%)	NS
Metallic valve	28 (56%)	26 (52%)	NS

Postoperative data:

In group (A), combined postoperative complications was in 4 patients (8%) while in group (B) was 12 patients (24%) with P value < 0.05. Postoperative bleeding with reopening in group (A) was no patients while in gfroup (B) was 2 patients (4%), which was statistically insignificant. In group (A), 2 patients (4%) needed temporary renal dialysis while in group (B) was 1 patient (2%), which was statistically insignificant. Postoperative AF occurred in group (A) in 3 patients (6%) while in group (B) was 2 patients (4%) which was statistically insignificant. Postoperative pneumonia occurred in group (A) in 3 patients (6%) while in group (B) was 5 patients (10%), which was statistically insignificant. Mean postoperative mechanical ventilation in hours was 10 (8-12) in group (A) while in group (B) was 22 (12-22) with P value < 0.05.

Mean total ICU stay in days in Group (A) was 1.5 (1-2) while in Group (B) was 3.5 (2-5) with P value, 0.05. Mean total hospital stay in days in group (A) was 7 (6-8) while in group (B) was 13 (10-16) with P value < 0.05. Postoperative hospital mortality was 2 (4%) in group (A) and in group (B) was 1 (2%), which was statistically insignificant (Table 3).

Table (3): Postoperative data

Variables	Group (A)	Group (B)	P value
Number of patients with combined complications	4 (8%)	12 (24%)	<0.05
Bleeding with reopening	0	2 (4%)	NS
Renal dialysis	2 (4%)	1 (2%)	NS
A.F	3 (6%)	2 (4%)	NS
Pneumonia	3 (6%)	5 (10%)	NS
Mechanical ventilation time in hours	10 (8-12)	22 (12-32)	<0.05
ICU stay in days	1.5 (1-2)	3.5 (2-5)	<0.05
Hospital stay in days	7 (6-8)	13 (10-16)	<0.05
Mortality	2 (4%)	1 (2%0	NS

DISCUSSION

COPD as a clinical disease is present in 4-27% of patients undergoing cardiac surgeries [5-7], and of course, those patients are associated with increased incidence of postoperative chest complications and subsequently increased postoperative morbidity and mortality [6, 8 & 9]. Over many years, cardiac surgeons used to perform cardiac surgeries through median sternotomy approach, however lately the minimally invasive approach showed better outcome and less postoperative complications especially in high-risk patients as obese and elderly patients [6].

There are 6 controlled randomized studies to detect the pulmonary complications associated with minimally invasive cardiac surgery comparing it with routine median sternotomy approach [11]. In the previously mentioned studies the total number of patients encountered was 340, with 170 patients underwent cardiac surgery through minimally invasive approach and 170 done via routine median sternotomy. The minimally invasive surgeries were done for isolated MVR as well as aortic valve replacement (AVR). The results of 4 of them showed that minimally invasive surgery were associated with less postoperative pulmonary complications, less mechanical ventilation time, less ICU stay and less total hospital stay [11, 13, 15, 16]. Two of the previously mentioned studies showed no statistical difference in postoperative mechanical ventilation or pulmonary complications between minimally invasive versus median sternotomy [12, 14].

There was no studies found comparing outcomes of patients with severe COPD underwent MVR in minimally invasive versus median sternotomy and only one study found, which reported outcomes of

minimally invasive versus median sternotomy in COPD patients but not in isolated MVR. This study was done over 165 patients with COPD, 100 of them were done by minimally invasive while 65 patients were done by median sternotomy [16]. This study showed that minimally invasive technique associated with significantly lower incidence of postoperative combined complications, mechanical ventilation time, need of reintubation, ICU stay, overall morbidity and total hospital stay compared to routine median sternotomy approach [10, 16]. In our study our results were almost the same as the previous study but our study encountered patients only with isolated MVR and severe COPD while the previous study encountered patients with AVR and MVR and also any patient with COPD whether mild, moderate or severe [16].

In our study, patients underwent minimally invasive approach were associated with significant increase in total CBP time and ischemic time compared to patients underwent surgery via routine median sternotomy, which may be associated with more effect of systemic inflammatory response. However, at the same time those patients with minimally invasive approach had many benefits such as less postoperative pain, better thoracic stability and less respiratory muscle exhaustion. So, the overall outcome regarding pulmonary complications that it was better with minimally invasive approach.

CONCLUSION

From our study we concluded that minimally invasive approach in patients with severe COPD undergoing isolated MVR is more beneficial and is associated with lower incidence of postoperative complications than with routine median sternotomy approach.

REFERENCES

1. **Cohn L, Adams D, Couper G *et al. (1997):*** Minimally invasive cardiac valve surgery improves patient satisfaction while reducing costs of cardiac valve replacement and repair. Ann Surg., 226: 421–6.
2. **Schmitto J, Mokashi S, Cohn L (2010):** Minimally invasive valve surgery. J Am Coll Cardiol., 56: 455–62.
3. **Scarci M, Young C, Fallou H (2009):** Is ministernotomy superior to conventional approach for aortic valve replacement? Interact Cardio Vasc Thorac Surg., 9: 314–7.
4. **Modi P, Hassan A, Chitwood W (2008):** Minimally invasive mitral valve surgery: a systematic review and meta-analysis. Eur J Cardiothorac Surg., 34: 943–52.
5. **Gao D, Grunwald G, Rumsfeld J *et al.* (2003):** Variation in mortality risk factors with time after coronary artery bypass graft operation. Ann Thorac Surg., 75: 74–81.
6. **Samuels L, Kaufman M, Morris R *et al.* (1998):** Coronary artery bypass grafting in patients with COPD. Chest, 113: 878–82.
7. **Kroenke K, Lawrence V, Theroux J *et al.* (1993):** Postoperative complications after thoracic and major abdominal surgery in patients with and without obstructive lung disease. Chest, 104: 1445–51.
8. **Gardner S, Grunwald G, Rumsfeld J *et al. (2001):*** Risk factors for intermediate-term survival after coronary artery bypass grafting. Ann Thorac Surg., 72: 2033–7.
9. **Mächler H, Bergmann P, Anelli-Monti M *et al. (2005):*** Minimally invasive versus conventional aortic valve operations: a prospective study in 120 patients. Ann Thorac Surg., 79: 491–8.
10. **Aris A, Cámara M, Montiel J *et al.* (1999):** Ministernotomy versus median sternotomy for aortic valve replacement: a prospective, randomized study. Ann Thorac Surg., 67: 1583–7.
11. **Dogan S, Aybek T, Risteski P *et al.* (2005):** Minimally invasive port access versus conventional mitral valve surgery: prospective randomized study. Ann Thorac Surg., 79: 492–8.
12. **Weissman C (1999):** Pulmonary function after cardiac and thoracic surgery. Anesth Analg., 88: 1272–9.
13. **Black D, Pearson M (2002):** Average length of stay, delayed discharge, and hospital congestion. Br Med J., 325: 610–1.
14. **Murphy G, Reeves B, Rogers C *et al.* (2007):** Increased mortality, postoperative morbidity, and cost after red blood cell transfusion in patients having cardiac surgery. Circulation, 116: 2544–52.
15. **Grover F, Johnson R, Marshall G *et al.* (1993):** Factors predict- ive of operative mortality among coronary artery bypass subsets. Ann Thorac Surg., 56: 1296–306.
16. **Orlando S, Javier R, Alexandre M *et al.* (2011):** Outcomes of minimally invasive valvesurgery in patients with chronic obstructive pulmonary disease. European Journal of Cardio-Thoracic Surgery, 42: 648–652.