

Role of minimally invasive surgery in cardiac valve disease

Potwar S¹, Shende S², Nagle K³, Pohekar P⁴, Nathani R⁵, Nair H⁶

¹Dr Sushrut Potwar, Assistant Professor, ²Dr Shweta Shende, Assistant Professor, ³Dr Kanak Nagle, Professor & Head of Department, ⁴Dr Pankaj Pohekar, General Surgery, Resident, ⁵Dr Rahul Nathani, General Surgery, Resident, ⁶Dr Hari Nair, General Surgery, Resident; all authors are affiliated with TNMC & BYL Nair Hospital, Mumbai, Maharashtra, India.

Address for Correspondence: Dr Sushrut Potwar, Email: sspotwar@gmail.com

Abstract

Introduction: Over the past decade minimally invasive cardiac surgery has gained significant popularity, more cases of valve, bypass and congenital surgery are being done by smaller incisions as experience increases. **Materials & Methods:** Between January 2013 and December 2015 a total of 50 cases were performed using ministernotomy or right thoracotomy. The patients were between 17-58 years of age and included 29 males, 21 females. **Results:** In Minimally invasive surgery average pump time was 20-60 minutes, cross clamp time 30-50 minutes, ventilation <8 hours, ICU stay < 1day, 2 or less units of blood required in majority of patients. **Conclusion:** Minimally invasive cardiac surgery results in smaller incisions, shorter ventilator time, ICU and hospital stay, faster recovery, less pain, lower incidence of infection and bleeding and better cosmesis.

Keywords: Minimally invasive cardiac surgery (MICS), Mitral Valve Replacement (MVR), Aortic Valve Replacement (AVR)

Introduction

Median sternotomy is a conventional approach for correction of cardiac defects. Midline scar maybe unsightly, easily provoke displeasure and psychological distress, especially in young female patients [1,2]. Cosgrove and Sabik described a technique of minimally invasive aortic valve surgery through a right parasternal incision [3]. Others have performed aortic valve surgery via an upper ministernotomy with a lower horizontal T to transect the sternum. We present our experience in minimally invasive cardiac surgery (MICS) for aortic and mitral valve surgery. MICS has been well established in the last decade and has evolved towards smaller incisions with the benefits of less surgical trauma, shorter hospitalisation, decreased pain and better cosmesis [4].

Materials and Methods

Between January 2013 and December 2015 a total of 50 cases were performed using ministernotomy or right

thoracotomy. Ethical clearance from the local review board was obtained and an informed consent from the patients was taken in each case. The patients were between 17-58 years of age. There were 29 males and 21 females.

Patients were diagnosed to have:

- 1) Mitral valve disease -
 - A. Mitral stenosis
 - B. Mitral regurgitation
 - C. Mitral stenosis with regurgitation
- 2) Aortic valve disease -
 - A. Aortic stenosis
 - B. Aortic regurgitation
 - C. Aortic stenosis with regurgitation

The operations performed were Aortic valve replacement (AVR) and Mitral valve replacement (MVR). We compared the results with 50 cases operated through full sternotomy with a similar group of patients.

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Technique- Patient is anaesthetized in the supine position. MVR is performed through the right 3rd or 4th intercostal mini thoracotomy incision. In males 3rd space provides good mitral exposure, easy access to the aorta for cannulation, cardioplegia needle placement and cross clamping. In females sub mammary incision through the 4th intercostal space provides good cosmesis. Typically a 4.5 centimetres incision is made over the chosen intercostal space, skin and intercostal muscles are incised, soft tissue retractor placed, pericardium opened anterior to the phrenic nerve, cardiac cannulation done patient taken on bypass, heart

arrested and MVR performed through left atriotomy. AVR is performed with a j-shaped partial upper sternotomy. A straight skin incision of 5- 7 centimetres is made from the level of the head of the 2nd rib in the midline over the sternum and extended to the level of the 4th rib. Regular pendulum or an oscillating saw can be used for sternotomy. Cardiac cannulation is performed through the incision, patient taken on cardiopulmonary bypass, heart arrested and AVR performed. The sternotomy wound closed with two sternal wires.

Observations

This study includes a total of 50 patients both males and females between 17 – 58 years of age admitted in the cardiothoracic unit between January 2013 and December 2015 who underwent AVR or MVR. Results were compared with 50 patients operated during the same period with a full sternotomy incision. Data analysis is done with the help of open EPI software. Qualitative data is presented with the help of frequency percentage table and association among various study parameters is assessed with the help of chi-square test.

Tables

In our study the majority of patients operated were in the age group between 30 – 40 years, 37 of the patients had mitral valve disease, and in all the patients arterial and venous cannulation was achieved through the same incision. Baseline demographic parameters were comparable in both the study groups MICS and full sternotomy

Table 1: Pump time in minutes.

Pump time	MICS		Full sternotomy	
	Number	Percentage	Number	Percentage
30 – 50 minutes	19	38	21	42
50 – 70 minutes	23	46	20	40
70 – 90 minutes	8	16	9	18

In MICS pump time was between 20 – 60 minutes in the majority of patients which was similar to full sternotomy. Chi square value is 0.368, df =2, p = 0.831(not significant).

Table 2: Cross clamp time in minutes.

Cross clamp time	MICS		Full sternotomy	
	Number	Percentage	Number	Percentage
20 – 30 minutes	9	18	18	36
30 – 50 minutes	31	62	22	44
50 – 70 minutes	10	20	10	20

In MICS 31 (62%) patients needed cross clamp time of 30 – 50 minutes which was more than full sternotomy. Chi square value is 4.52, df = 2, p = 0.1039 (not significant).

Table 3: Duration of ventilation in hours.

Duration	MICS		Full sternotomy	
	Number	Percentage	Number	Percentage
0 – 8 hours	32	64	17	34
8 – 16 hours	18	36	33	66

64% patients with MICS required less than 8 hours of ventilation which was more than full sternotomy. Chi square was 9.004, $f = 1$, $p = 0.002$ (significant)

Table 4: Chest tube drainage in 24 hours in milliliters.

Drainage	MICS		Full sternotomy	
	Number	Percentage	Number	Percentage
0 – 300 ml	35	70	22	44
300 – 600 ml	13	26	24	48
More than 600 ml	2	4	4	8

With MICS 35 (70%) patients had drainage less than 300 ml as compared to 22 (44%) patients with full sternotomy. Chi square value 6.90, $df = 2$, $p = 0.031$ (significant).

Table 5: Intensive care unit stay in days.

Days	MICS		Full sternotomy	
	Number	Percentage	Number	Percentage
1	38	76	23	46
2	10	20	22	44
3 or more than 3 days	2	4	5	10

With MICS 38 (76%) patients required only 1 day of ICU stay which was more than with full sternotomy. Chi square value is 9.47, $df = 2$, $p = 0.008$ (significant).

Table 6: Requirement of blood transfusion.

Units of blood	MICS		Full sternotomy	
	Number	Percentage	Number	Percentage
1	23	46	6	12
2	22	44	30	60
3	5	10	11	22
4			3	6

With MICS 45 (90%) patients required 2 or less units of blood transfusion as compared to 2 or more units in 41 (82%) patients with full sternotomy. Chi square value is 16.45, $df = 3$, $p = 0.00091$ (significant).

Table 7: Hospital stay in days.

Days	MICS		Full sternotomy	
	Number	Percentage	Number	Percentage
1 – 4	17	34	4	8
4 – 8	30	60	21	42
8 – 12	3	6	25	50

With MICS 47 (94%) patients were discharged in less than 8 days as compared to 25 (50%) patients with full sternotomy who required more than 8 days. Chi square value is 26.92, $df = 2$, $p = 0.0000014$ (significant). 2 patients with MICS needed conversion to full sternotomy, 1 patient needed re exploration for bleeding and there was no incidence old sternal dehiscence. In full sternotomy 3 patients needed re exploration for bleeding and 1 patient had sternal wound dehiscence. There was 1 mortality in our MICS case in a patient with dilated thinned out aorta who also needed conversion to full sternotomy and there was 1 death in our patients with full sternotomy.

$P < 0.05$ is taken as level of significance. Baseline demographic parameters are statistically comparable. The study included parameters like pump time and cross clamp time taken in minutes, duration of ventilation, chest tube drainage, ICU stay, requirement of blood transfusion and hospital stay in days.

Discussion

MICS has been well established in the last decade and has evolved towards smaller incisions with the benefits of less surgical trauma, shorter hospitalisation, decreased pain and better cosmesis [4].

AVR has transformed the elderly patient with severe symptoms into a productive member of society including patients well into their 80's [5]. Mitral valve repair surgery has had a renaissance in the past 10 years and patients with mitral regurgitation are having their valve repaired to effect normal valve function [6].

The incision in MICS is cosmetically more acceptable than median sternotomy. Pain was reduced although differed in character, localised to the anterior chest wall in thoracotomy, well controlled with intercostal block at time of surgery compared with generalised thoracic pain that occurs on retracting the sternum and ribs, leading to debilitating pain and respiratory compromise. Respiratory complications were minimal and led to early recovery, extubation and shorter stay in the intensive care unit.

The lesser amount of bleeding was due to the smaller incision in MICS and decreased contact with the pleuro-pericardial which activates the clotting cascade. Another advantage of MICS is that the pericardium is not opened over the right ventricular outflow tract which is the site most commonly injured during redo surgery [7].

Disadvantages of MICS include injury to one or both internal thoracic arteries, concern regarding the stability of the anterior chest wall, cerebrovascular accidents secondary to inability to completely remove air from the left ventricle and time required to learn a new surgical technique [7].

The port access endovascular cardio-pulmonary bypass system is a closed chest endovascular system that enables aortic clamping, cardioplegic arrest, cardiac decompression and venting of the left side of the heart. F W Mohr has shown that with the use of the port access system, mitral valve surgery including complex repair procedures can be performed through an incision less than 4 centimetres.

The 3 dimensional view provided by the stereoscope facilitates repair procedures [8]. Port access surgery is technically demanding, requires advanced and costly infra structure adding to the cost of surgery. MICS approach provides an alternative approach meeting the advantages of port access in terms of faster recovery, less pain, better and conventional exposure, no added training or equipment.

Conclusions

MICS results in smaller incisions, faster healing, less pain, lower incidence of wound infection, bleeding, faster recovery, shorter intensive care stay, shorter hospital stay, lower respiratory complications, decreased incidence of sternal dehiscence and better cosmesis.

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