ORIGINAL ARTICLE

MINIMALLY INVASIVE CONCOMITANT AORTIC AND MITRAL VALVE SURGERY - INITIAL EXPERIENCE OF A SINGLE CENTRE

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Abstract

***Introduction**: Valve surgery through a median sternotomy has been the standard approach, but in the past decade various minimally invasive procedures have gained increasing traction among physicians and patients.*

***Materials and Methods:** We present a series of three patients submitted to minimally invasive combined aortic and mitral valve surgery, performed through right lateral thoracotomy.*

***Results:** We report no postoperative complication or mortality. Mean length of stay was 5 days, with a self-reported pain score 2/5 (mild/annoying pain).*

***Conclusions:** We report our initial experience, describing surgical technique and postoperative results, showing this technique to be safe, reproductible and comparable to conventional surgery.*

***Keywords:** Minimally Invasive Surgery, Aortic Valve, Mitral Valve, Thoracotomy*

INTRODUCTION

Minimally invasive double valve surgery through minithoracotomy is an alternative technique for concomitant aortic and mitral valve surgery. The pioneers of minimally invasive valve surgery, Navia., et al. in 1996 and Cohn., et al. in 1997, have shown that this approach provides numerous benefits[1,2] such as less surgical bleeding, less pain, lower morbidity, a decrease in transfusion requirements, early recovery in the intensive care unit, and a shorter in-hospital stay. These benefits tend to be even more significant in patients with chronic kidney disease[3], chronic obstructive pulmonary disease (COPD)[4] and in patients requiring redo mitral valve surgery[5] or aortic valve surgery[6], as these patients can be offered more aggressive postoperative cardiac rehabilitation without fear of sternal dehiscence. As such, mortality has been shown to be reduced, particularly in the elderly and obese subpopulations[7,8].

Minimally invasive isolated mitral or aortic valve surgery is the standard method in many centers, however, few perform this minimally invasive approach to concomitant treatment of mitral and aortic valves. The aim of this paper was to report our initial experience with minimally invasive concomitant aortic and mitral valve surgery.

METHODS

From January to December 2019, three consecutive patients without prior cardiac surgery underwent minimally invasive double valve surgery.

The patients were positioned with 30º right hemitho-

rax elevation with right arm placed laterally with posterior fixation. Selective ventilation and transesophageal echocardiography (TEE) were used in all patients. Two defibrillator pads were placed across the chest wall.

Cardiopulmonary bypass (CPB) was established through peripheral femoral cannulation guided by TEE, with vacuum-assisted venous drainage.

The "working port" is through a 5-centimeter muscle-sparing incision in the third or fourth right intercostal space. A wound protector and a rib spreader were used. A 10mm port, in the second intercostal space, midaxillary line, is needed for video assistance. The pericardiotomy is executed above the phrenic nerve. The aorta is cross clamped with CardioVision© MIC-Aortic Glauber Clamp, through the incision. The myocardium is protected using a single dose of antegrade intracellular crystalloid cardioplegia (Custodiol©).

The aortic valve exposure is facilitated by the subtotal circumferential aortotomy, which allows a complete visualization of the aortic annulus and prevents compromising mitral valve exposure. The native aortic valve is first excised and the annulus is decalcified. Afterwards, mitral valve repairment/replacement is performed through a left atriotomy. Sutureless valve prosthesis facilitate aortic valve replacement, however their use is not mandatory for this approach. Temporary pacing wires were placed before aortic unclamping and the pericardium was approximated with two to three single sutures. A 24Fr silicon drain, placed through the 10mm port, will efficiently drain the pleural cavity. After weaning the patient from CPB, the chest is closed in a routine manner.

Two of the three patients were female, the mean age was 74 years and the mean EuroSCORE II was 4.5%.

Pre- and post-procedure echocardiography were performed for the assessment of cardiac function and complications.

Pre-operative clinical and echocardiographic characteristics are presented in Table 1.

RESULTS

One patient underwent aortic valve replacement (sutureless prosthesis) and mitral valve repair (annuloplasty and Gore-Tex neo-chordae implantation with loop technique). The other two patients underwent aortic and mitral valve replacement, but only one of the aortic valves was replaced using a sutureless valve prosthesis. The mean total bypass time was 141 minutes, and the mean aortic cross-clamp time was 112 minutes.

Figure 1 *Study flow chart.*

Average length of hospital stay (LOS), hours of mechanical ventilatory support, length of ICU stay, pain score (visual analog scale - VAS), mortality, wound infection, stroke, myocardial infarction and renal failure were assessed. Mean ventilation time was 7 hours, length of ICU stay was 2 days and LOS was 5 days. No wound infections, myocardial infarction, renal failure, stroke or surgical mortality were observed. The mean pain score was 2 (mild/annoying pain).

Early post-operative outcomes are presented in Table 2.

At a mean follow-up of 3 years, all 3 patients are asymptomatic and echocardiographic follow-up has shown continued good surgical results.

Table 1 **Pre-operative clinical and echocardiographic profile**

Variables	Total (N=3)
Age	74 years
Gender	
Male	1
Female	2
EuroSCORE II	4,5%
New York Heart Association Class (NYHA)	
I	0
II	1
III	2
IV	0
Left ventricular ejection fraction (LVEF %)	55,4%
Disease status	
Severe MS with severe AS	2
Severe MR with Severe AS	1
Chronic lung disease	2
Chronic kidney disease	1
Poor mobility	1

Abbreviations: MS - mitral stenosis; AS - aortic stenosis; MR - mitral regurgitation

DISCUSSION

Multiple valve surgery accounts for 8–12% of valve procedures and is associated with high operative risk[9]. Patients requiring multiple valve surgery have a two-fold increase in mortality comparing to single valve patients with some studies reporting a 9.7% mortality-rate for patients undergoing combined mitral and tricuspid valve surgery, 10.7% for those undergoing aortic and mitral valve surgery, and 13.2% for those underdoing aortic and tricuspid valve surgery[10].

Efforts to avoid midline sternotomy have led to the development of alternate ways of exposing the heart valves. A parasternal approach was initially report by the Cleveland Clinic group, but then shifted to an upper midline partial sternotomy and was reported to have similar results as a standard sternotomy[11]. Other partial sternotomy incisions, such as the subxiphoid approach, which consists of a transverse skin incision overlying the xiphoid process with an inverted J-type mini-sternotomy, have also been proposed[12]. Despite these facts, the need for sternal division was not obviated and these incisions are less aesthetically pleasing to patients when compared with right mini-thoracotomy incisions[13,14] (Figure 1). As to relative disadvantages, we faced longer aortic cross clamp and cardio-pulmonary bypass times. Special care should be taken in identifying the correct anatomic reference points and avoid potential exposure problems related to this approach. If done correctly, a minithoracotomy, using the middle of the sternum as a reference point, will allow for any type of complex mitral repair, as well as the replacement of the aortic valve[15].

The safety of this minimally invasive approach was first reported by Sharony et al., with no deep wound infec-

Table 2 **Early post-operative outcomes**

Post-operative outcomes	Total (N=3)	Male (N=1)	Female (N=2)
Mechanical ventilatory support (hours)	6,9	4,2	8,2
Length of ICU stay (hours)	21	26	18
Length of hospital stay (days)	5	6	5
Visual analogue scale (range: 0 to 10)	2	2	2
In-hospital mortality	0	0	0
Morbidity			
Wound infection	0	0	0
Stroke	0	0	0
Myocardial infarction	0	0	0
Renal failure	0	0	0

Abbreviations: ICU - Intensive Care Unit

tions, shorter hospital stays, lesser blood products requirement and better five-year survival compared to median sternotomy[16]. In a series of 169 cases of bivalvular replacement procedures, the Mount Sinai Medical Center group reported a mean 116 minutes of aortic cross-clamp [interquartile range (IQR), 91-138] and a cardiopulmonary bypass time of 145 minutes (IQR) (121-178)[15]. Mihaljevic et al. reported equal or better outcomes with minimally invasive valve surgery as compared to full sternotomy[17]. Modi et al. conducted a systematic review and metanalysis of 11 studies comparing safety and outcomes of minimally invasive approaches against conventional methods, and found no difference in durability or safety of these techniques[18]. Another systematic review by Lucà et al. reported various benefits of minimally invasive mitral valve surgery including improved postoperative respiratory function, decreased postoperative pain and reduced surgical trauma, while also providing comparable long-term efficacy[19].

CONCLUSIONS

Although there are few publications about minimally invasive surgery for the concomitant treatment of mitral and aortic valves, we can say that minimally invasive mitro-aortic surgery through a right minithoracotomy can be performed with low postoperative morbidity and mortality. Our results in terms of mortality, length of ICU and hospital stay and morbidity, reveal that this minimally invasive approach has comparable outcomes with conventional surgery. However, more studies particularly regarding its learning-curve and reproducibility are necessary. Additional experience and long-term results with minimally invasive double valve surgery will be essential to establish this approach as an alternative for a median sternotomy. We hope to continue to utilize what we learned from this initial experience to further expand the use of minimally invasive double valve surgery in the near future.

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Ethical statement: Informed consent was given by the patients, according to institutional review board guidelines.

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