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Minimally Invasive Right Infra-Axillary Approach for Mitral Valve Replacement: Our Initial Experience

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ABSTRACT

Introduction

Minimally invasive approach for cardiac surgery is getting popular as compared to the traditional median sternotomy due to various benefits associated with the approach. Right vertical axillary approach for mitral valve replacement with peripheral cannulation was recently introduced in our center. We share our initial experience of the approach.

Methods

A retrospective, descriptive study including eleven patients undergoing minimally invasive mitral valve replacement via right infra-axillary approach from June, 2024 to October, 2024 for rheumatic mitral valve disease was conducted. Data on patient demographics, clinical characteristics, echocardiographic findings, intra-operative variables and post-operative outcomes were evaluated. Statistical analysis was performed using Microsoft Excel 2016. Frequency, percentage, mean and standard deviation were calculated.

Results

Among 280 cardiac surgeries, 11 patients underwent minimally invasive mitral valve replacement in five months at our institute. The mean age of the patients was 47.63 ± 12.40 years (range 23- 62 years). Six patients were in 50-60 years age group. The majority of the patients (81.81%) were females. The main presenting symptoms were shortness of breath and palpitation. The mean Aortic cross clamp time was 81.36 ± 24.73 minutes and cardiopulmonary bypass time was 105.63 ± 32.23 minutes. There were no re-explorations and conversions to median sternotomy. There was no perioperative mortality.

Conclusion

Minimally invasive mitral valve replacement through right vertical infra-axillary approach is feasible and safe in our setting and offers favorable post-operative outcome.

Keywords

Axillary thoracotomy, minimal invasive cardiac surgery, mitral valve replacement, peripheral cannulation

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INTRODUCTION

Mitral Valve replacement (MVR) is one of the commonly performed cardiac procedures in any cardiac center around the world. Median sternotomy has remained the gold standard approach in cardiac surgery for decades, as any complex procedures can be performed easily through widely separated sternal halves. However, the drawbacks like a large surgical sternal wound, bleeding from bone marrow, increased blood transfusion rates and risks of mediastinitis have always inspired the clinicians and surgeons to look for alternate approaches. Minimally invasive approaches like right infra-axillary approach, anterior thoracotomy approach with peripheral cannulation of femoral artery, femoral vein and internal jugular vein are getting popular because of the associated benefits of smaller scar, excellent cosmesis, expeditious recovery, shorter hospital stay and low cost. However, minimally invasive mitral valve replacement (MI-MVR) through right infra-axillary approach is in an early phase of development, in low resource countries. In Nepal, this approach was recently introduced in MCVTC in June, 2024 and is currently practiced by our institute only. Hence, this study was aimed to evaluate the early outcomes of mitral valve replacement through infra-axillary approach.

METHODS

A retrospective, single-center descriptive study was conducted to investigate the outcomes of MI-MVR in adult patients at the Manmohan Cardiothoracic Vascular and Transplant Centre (MCVTC), Institute of Medicine, Kathmandu, Nepal. All the patients who underwent MI-MVR with total peripheral arterial cannulation at MCVTC from June, 2024 to October, 2024 were included in the study. Data were extracted from the hospital medical records and following variables were collected: age, gender, cardiac diagnosis, left ventricular ejection fraction, cardiopulmonary bypass time, aortic cross-clamp time, length of ICU and hospital stay, postoperative complications and mortality. Descriptive statistics was used to analyze the data. The need for informed consent was waived due to the retrospective nature of the study. Confidentiality was ensured by de-identifying the patient's data.

Operative Procedure

Surgery was performed by the same team of surgeons. Under standard general anesthesia, patients were positioned in left lateral decubitus with a soft roll under patient's back to raise it off the operating table by almost 20°. Right groin crease incision was made and deepened with exposure of femoral artery and vein. Right vertical infra-axillary incision of 7 cm (Figure 1) or less with lateral thoracotomy through fourth intercostal

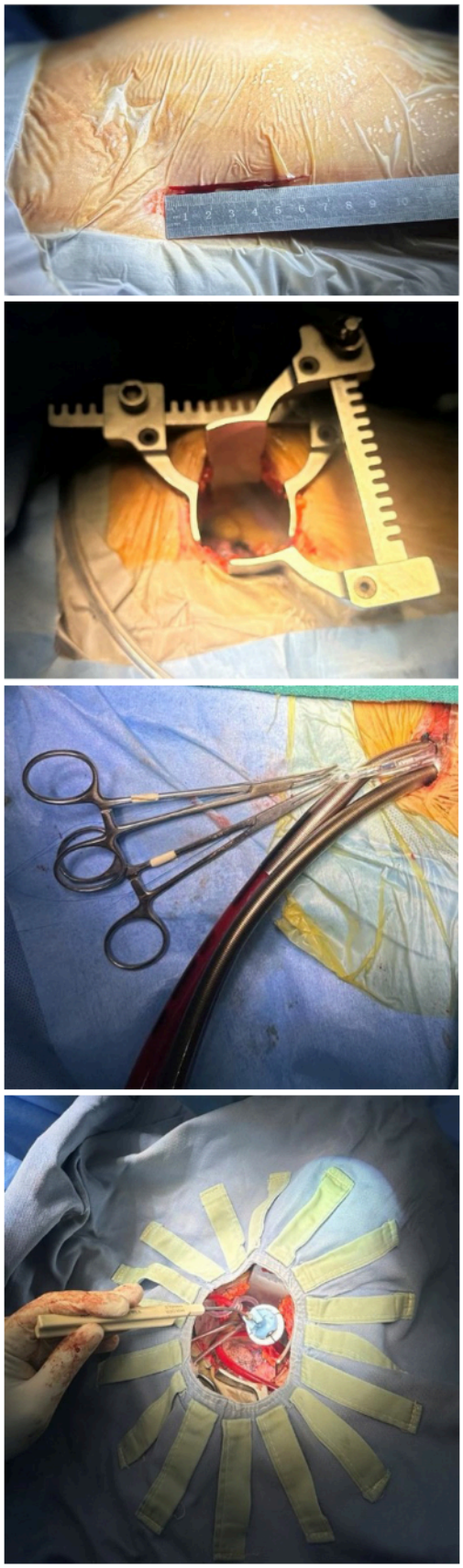

Figure 1a. *Right vertical infra-axillary incision measuring 6.5cm* ***1b.*** *Right lateral thoracotomy through fourth intercostal space with two chest spreaders in place* ***1c.*** *Right femoral artery and vein cannulation* ***1d.*** *Prosthetic mitral valve being implanted*

space was made (Figure 2). Pericardiotomy was performed away from the phrenic nerve and edges of the pericardium was retracted with sutures for better visualization of aorta and left atrium. After heparinization at a dose of 400 units/kilogram of body weight, Femoral artery and vein were cannulated in all the cases (Figure 3). Femoral vein was cannulated with triple stage single cannula in all the patients. Once target Activated Clotting Time was achieved, cardiopulmonary bypass (CPB) was established and the aorta was cross-clamped with administration of antegrade Del Nido cardioplegia solution. The left atrium was opened via the Sondergaard's groove. Mitral valve was assessed, excised with posterior leaflet preservation, sized and replaced with prosthetic valve with the use of interrupted pledgetted 2-0 polyester sutures (Figure 4) and the surgery was completed with standard protocol. All the patients received a uniform standard post-operative hospital care.

RESULTS

Among 280 cardiac surgeries, 11 patients underwent MI-MVR in five months (June, 2024-October, 2024) at MCVTC. The mean age of the patients was 47.63 ± 12.40 years (range 23- 62 years). Six patients were in 50-60 years age group. The majority of the patients were females, with a female to male ratio of 4.5:1. The mean duration of symptoms was 21.09 ± 15.64 months. The main presenting symptoms were shortness of breath, palpitation (Table 1).

All of them had a normal left ventricular ejection fraction. The most common valve lesion was mixed mitral stenosis and mitral regurgitation and the cause was rhematic heart disease in all the patients. Sinus rhythm was seen in only three patients. Three patients had undergone Percutaneous Transluminal Mitral Commissurotomy in the past.

Intraoperatively, SJM Masters Series Mechanical mitral valve was implanted in nine patients, CE Perimount Magna Ease Bioprosthetic valve was implanted in one patient and Edwards Mitirs Resilia Bioprosthetic valve was implanted in one patient. The size of the valve used was 27mm in all the patients. Aortic cross clamp time was 81.36 ± 24.73 minutes and cardiopulmonary bypass time was 105.63 ± 32.23 minutes. The most commonly used femoral artery cannula size was 21Fr (range 17-23Fr) in six patients, whereas the most commonly used femoral vein cannula size was 25Fr (range 21-29Fr) in five patients. Adjunct procedure performed included left atrial clot removal in one patient.

Nine patients were extubated on day of surgery. The mean duration of ventilation was 5.12 ±2.51 hours and they had insignificant mediastinal drainage (246.66 ±79.44ml) in first 24 hour. These patients required right pleural chest drainage for 2.54 ± 0.78 days. None of the cases required conversion to median sternotomy and re-exploration. One patient developed stroke in the postoperative period requiring prolonged intubation, tracheostomy, percutaneous gastrostomy and a long hospital stay (136 days). Another patient had developed Acute kidney injury requiring multiple sessions of hemodialysis, prolonged intubation and prolonged hospital stay (35 days). Excluding these two patients nine other patients had a shorter ICU stay and hospital stay (Table 2).

There was no perioperative mortality (Table 3). Seven (26.92%) of the patients had atrial fibrillation with fast ventricular rate requiring medical management. The median follow-up period was 4 months. None of the patients had a paravalvular leak in the immediate postoperative period, but one patient was diagnosed to have trivial to mild paravalvular leak at five months follow up period.

Patients had small scar in the follow up period and were satisfied with the cosmetic result of this approach (Figure 2).

Table 1. Demographic features of the patients

Characteristics	Number (%)
Gender	
Males	2 (18.18%)
Females	9 (81.81%)
Presenting Symptoms	
Shortness of breath	11 (100%)
Palpitation	6 (54.54%)
NYHA Class	
II	7 (63.63%)
III	4 (36.36%)
Valvular dysfunction	
Mitral Stenosis	3 (27.27%)
Mitral Regurgitation	2 (18.18%)
Mixed	6 (54.54%)
Etiology	
Rheumatic	11 (100%)
Degenerative	0
Preoperative Atrial Fibrillation	8 (72.72%)

Table 2. Post-operative variable. (N=9)

Variables	Number (%)
Ventilation support (minutes)	308.33±150.95
Mediastinal bleeding in first 24 hour (ml)	246.66±79.44
ICU stay (days)	2.33±0.81
Hospital stay (days)	7±2.40
Drain placement (days)	2.54±0.78

Table 3. Post-operative complications (N=9)

Complications	Number (%)
Atrial fibrillation with fast Ventricular rate	3 (27.27%)
Cerebrovascular accident	1 (9.09%)
Acute kidney injury requiring hemodialysis	1 (9.09%)
Superficial Surgical site infection	2(18.18%)
Post-operative pneumonia	2 (18.18%)
Mortality	0

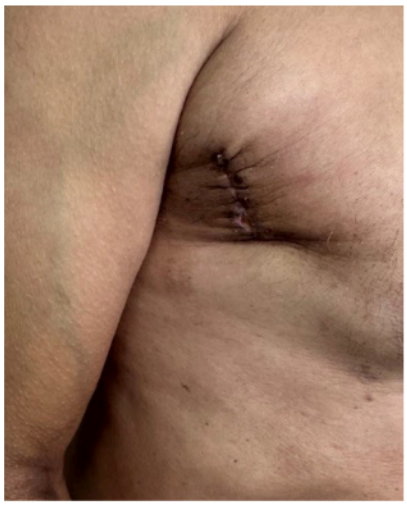

Figure 2. Post-operative scar

DISCUSSION

Mitral valve surgery is one of the commonly performed procedures around the world. Cardiac surgery via median sternotomy has many drawbacks like ugly scar, significant blood loss and transfusion, worse postoperative pain and delayed period of recovery.[1] To avoid these complications, the quest for minimally invasive valve surgery has been unrelenting. Historically, it was first performed by Navia et al. in 1996, and by Cohn et al. in 1997.[2,3] Different access to heart and mitral valve, like left thoracotomy and lower partial sternotomy were utilized with good postoperative outcome. [4,5] Similarly in one of the studies, the right vertical infra-axillary incision employed to perform mitral valve replacement in 256 patients was found to be feasible and safe.[6] Our institute has been performing MVR via median sternotomy for decades. In order to keep up with the recent advances in minimally invasive cardiac surgery, we adopted this technique very recently. In fact, we are the first institute to introduce this technique in Nepal. So far, we have performed eleven surgeries with good postoperative outcome.

Technically, this approach might be difficult to embrace in the beginning, but with time and practice, this is not an impossible skill to master. Since, the right infra-axillary skin incision is located posterior and superior to the right anterolateral thoracotomy exposure of the ascending aorta is adequate.[7] So, this incision has been used for central cannulation in many centers in the past. However, these days, femoral artery-vein cannulation is frequently performed for minimally invasive cardiac surgery.[8,9] We also prefer groin dissection and femoral artery and vein cannulation, so that the thoracotomy incision is not crowded with tubes and cannulas. However, one should be mindful of the possible arterial dissection requiring reconstruction and groin infection.[10] In our series, we didn't have any peripheral vascular and groin complications.

Our infra-axillary incisions are smaller than seven centimeters, similar to a finding reported by Gemalmz et al.[11]In their study, the average age of the patient was 47.5±11.2 years, which was similar to what we found in our study. The cardiopulmonary bypass time and aortic cross clamp time were comparable to their bypass time of 95±11 minutes, and cross clamp time of 61±9 minutes. The mean extubation time was 7± 2.3 hours. In most of the papers, there is no report of perioperative mortality and major morbidity. There was also no perioperative mortality in our early experience. One of our patients had stroke and this too, was not related to the minimally invasive approach to the heart. The hospital stay and ICU stay were slightly longer in our hospital as compared to the study by Gemalmz et al., where they found the ICU stay was 1± 0.5 days and hospital stay was 6± 1.5 days.

CONCLUSION

Minimally invasive right infra-axillary thoracotomy with total peripheral cannulation for mitral valve replacement offers better cosmetic result, shorter hospital and ICU stay, faster recovery. Although this approach may be technically demanding in the beginning and has a longer learning curve, the benefits it provides to the patients, makes it worth practicing. Since there were not re-explorations, conversions to median sternotomy, significant morbidities and mortality associated with this approach in our early experience, we infer it to be safe and feasible in our setting.

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CONFLICT OF INTEREST

The author(s) declare that they do not have any conflicts of interest with respect to the research, authorship, and/or publication of this article.

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