Original Article

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Mini-thoracotomy Approach for Heart Surgery in Tertiary Care Hospital of Nepal

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ABSTRACT

Background: The usual surgical technique for heart surgery has been median sternotomy, which provides excellent exposure of all cardiac structures and facilitates the establishment of cardiopulmonary bypass with central cannulation. A number of alternative surgical techniques, including the right anterolateral thoracotomy, posterolateral thoracotomy, and partial sternotomy, have been suggested. We want to share our experience with right anterior mini-thoracotomy versus right axillary mini-thoracotomy for closing an atrial septal defect.

Methods: The study was a retrospective cross-sectional study conducted in a hospital. The study comprised patients with atrial septal defect admitted to Green City Hospital in Kathmandu, Nepal. From May 2016 until September 2021. Data was extracted to MS excel sheet, and then transported to the STATA version 17 for analysis. First, we computed descriptive analysis which included calculation of frequency, percentage, mean and median for presentation of socio-demographic variables. Continuous data were tested for normality using Shapiro-Wilk test.

Results: A total of 25 patient were included in the study with median age 26 years (20-32). The median aortic cross clamp time was 25 minutes ranging 20-35 min. The median duration of cardiopulmonary bypass time ranging from 31to 161 minutes. The median time of Ax was 25 minutes and 26 minutes for right anterior mini-thoracotomy and right axillary mini-thoracotomy respectively. The median duration of hospital stay was 4 days ranging from 3-4 days. Nearly 36% study participants were associated with abnormal body mass index. (Either under nutrition or over nutritional status).

Conclusions: There were no significant differences between the duration of intensive care unit and hospital stays, aortic cross clamp time, and complications between the two groups. However, the possibility of less blood loss during surgery and of cosmetic appearance in axillary incision is of special importance.

Keywords: Heart surgery; mini-thoracotomy; Nepal; right anterior; right axillary.

INTRODUCTION

The rates of mortality and complications after congenital heart surgery have decreased due to improvements in surgical methods and medical treatment.[1-3] The usual surgical technique for heart surgery has been median sternotomy (MS). The invasive nature of MS, however, leaves a scar that is clearly visible on the chest of developing infants and cause psychological suffering that lasts a lifetime.[4-6] As a results other technique, like right anterolateral thoracotomy,[7,8] posterolateral thoracotomy[9,10] and partial sternotomy,[3,11] have been suggested. However, they have been discovered to be less preferable, sometimes due to the scar's appearance, sometimes due to long-term effects like loss of thoracic integrity.[12,13]

Mini thoracotomy method has already been used by several institutions to treat ASD, VSD, and partial atrioventricular septal defects (PAVSD).[6,14-18] However, in Nepal no such studies has been published so far hence,

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we want to share our experience with right anterior mini-thoracotomy (AnMT) versus right axillary mini-thoracotomy (AxMT) for closing an ASD.

METHODS

The study was a retrospective cross-sectional study conducted in a tertiary hospital.

The study comprised patients with ASD admitted to Green City Hospital in Kathmandu, Nepal. From May 2016 until September 2021, the patient was involved.

The Institutional Review Committee (IRC) of the Yeti Health Sciences' research ethics committee provided its ethical approval. Official letter of cooperation from IRC was written to respective study center. The hospital administration provided informed authorization for the use of anonymous patient and personal information in research. De-identification effectively maintained the information's confidentiality. This study has been reported as per STROCSS 2021 criteria.[19]

All the patients above 20 years of age, requiring ASD closure were included in the study. However, patients weighing less than 25 kg, those requiring other concomitant cardiac procedures and those with previous thoracic surgery/infection will be excluded from study. The record of the patient with incomplete data was excluded from the study.

All together 25 patients undergoing closure via right anterior mini-thoracotomy (AnMT) and right axillary mini-thoracotomy (AxMT) were selected for comparison after age and sex matching. No sampling was required for the study.

For the patients, standard intensive care was provided. Every essential factor, including drain volume, was recorded in the questionnaire. The surgical team decided to discharge the patient from the critical care unit and hospital based on the patient's overall health, the amount of drain, the need for inotropes, and the results of the X-rays. The surgical site was examined for any local complications.

The patients were intubated, anesthetized, and maintained supine. The anesthesiologist used the Seldinger technique with ultrasound for placement of the internal jugular venous cannula on the right side. The patients were maintained to a supine position with the right side 30 degrees up. On the right side i, a sub-mammary incision of five centimeters or less was made, and dissection continued. The fourth intercostal space was used to enter the right pleural space. There was heparinization. Cannulas were placed in the femoral artery and vein. There was a vertical percardiotomy. Patches for the pericardium were made. Cardiopulmonary bypass was established. There was aortic cross clamping. The heart was stopped in diastole after receiving ante-grade cardioplegia. The cavae were snugged. The right atrium was opened 2 cm lateral to the atrioventricular groove, which ran from the superior right atrium appendage to the anterior inferior vena cava. An autologous pericardial patch was used to close ASD. In two layers, RA was closed. Heart was deaired and the root was vented. weaned off from Cardiopulmonary bypass. Decannulation of the veins and arteries was performed. Protamin given, Hemostasis was maintained. Right pleural drain was placed. Groin wound was closed.

In axillary group, the right thorax was accessed using a short, vertical right axillary incision was made in fourth intercostal space. Through the right femoral artery and vein, cardio-pulmonary bypass was established. The Cosgrove flex-clamp was used to clamp the ascending aorta. Additionally, other long shafted, less intrusive tools were used. ASD closed with autologus pericardial patch.

Data was extracted to MS excel sheet, and then transported to the STATA version 17 for analysis. First, we computed descriptive analysis which included calculation of frequency, percentage, mean and median for presentation of socio-demographic variables. Continuous data were tested for normality using Shapiro-Wilk test. Normally distributed data were analyzed as means and standard deviation and skewed data as medians (interquartile range). The Chi-square test was used to assess differences in categorical variables. For non-normally distributed data Man-Whitney U test is computed in order to compare between AnMT and AxMT with various continuous variables. The level of significance was considered at 5% with $p< 0.05$ and 95% confidence interval to determine the strength of association between independent variables and outcome variables. We have computed Fischer's exact test to identify significant association between dependent and independent variables. Since our study consists of small sample size and also data is not normally distributed so we have applied non parametric test i.e. Fischer's exact.

RESULTS

The median age of study participants was 26 years with IQR 26(20-32). The age range was 14 to 58 year. The

majority of the study participents were youth (52%). More than half of (52%) the study participants were female. Majority of the study participients were from Bagmati province and majority of the study participants were representive from higher ethinic group (Brahmin/Chhetri). Residenace(p=0.010) was siginificantly assocaiated with modality of operation. The details of socio-demographic varibales is shown in Table 1. Age (p=0.267), sex (p=0.570), and ethinicity (p=1.00) was not stattistically significant with modality of operation. We had six types of cases in this study. Majority of the patients having Ostium secundum (OS) ASD in 14 patients. (Table 2)

Table 1. Socio-demographic characteristics of respondents.

Characteristics	**Total** (Mean±SD)	**AnMT**	**AxMT**	**P value**
Median Age (IQR)	26 (20-32)	26(20-30)	25.5(15-33)	0.826
Young (14-24)	9 (36%)	3 (12%)	6 (24%)	
Youth (25-40)	13 (52%)	8 (32%)	5 (20%)	
>41	3 (12%)	0 (0%)	3 (12%)	
Sex				0.570
Male	12 (48%)	5 (20%)	7 (28%)	
Female	13 (52%)	6 (24%)	7 (28%)	
Residence				**0.010**
Bagmati	10 (40%)	5 (20%)	5 (20%)	
Gandaki	6 (24%)	0 (0%)	6 (24%)	
Lumbani	1 (4%)	1 (4%)	0 (0%)	
Karnali	6 (24%)	5 (20%)	1(4%)	
Sudurpaschim	2 (8%)	0 (0%)	2 (8%)	
Ethnic group				1.00
Brahmin_Chhetri	17 (68%)	7 (28%)	10 (40%)	
Aadibasi_Janajati	6 (24%)	3 (12%)	3 (12%)	
Dalit	2 (8%)	1 (4%)	1 (4%)	

IQR=Intra Quartile Range (Q1-Q3)

Table 2. Types of cases.

Types of cases	N (%)
OA-ASD	20 (80)
ASD-PAPVC	1(4)
DVHD	1(4)
Core-triatriatum	1(4)
RSOV	1(4)
PM-VSD-PDA	1(4)

PAPVC= Partial anomalous pulmonary venous connection rerouting with ASD; DVHD= Degenerative valvular diseases; RSOV=Ruptured sinus of valsalva repair; OS Core triatriatum= Osteum secundum atrial septal defect with core triatriatum; VSD= Ventricular septal defect. A total of 25 patient were included in the study with median age 26 years (20-32). The median aortic cross clamp time was 25 minutes ranging 20-35 min. The median duration of cardiopulmonary bypass time ranging from 31to 161 minutes. The median time of Ax was 25 minutes and 26 minutes for right anterior mini-thoracotomy and right axillary mini-thoracotomy respectively. The median duration of hospital stay was 4 days ranging from 3-4 days. Nearly 36% study participants were associated with abnormal body mass index. (Either under nutrition or over nutritional status).

Table3. Clinical Characteristics of Study Participants.				
Characteristics	**Total**	**AnMT**	**AxMT**	**p-value**
Median time for CPB (minutes), IQR	43(33-52)	40(37-90)	45(32-51)	0.459
Median time for Ax (minutes), IQR	25(20-35)	25(17-50)	26(21-34)	0.721
Mean size of Cannula (mm)	18.32±2.17	19.09±2.42	17.71±1.81	0.112
Median ICU stay (days), IQR	2(1-2)	2(1-2)	2(1-2)	0.310
Median hospital stays (days), IQR	4(3-4)	4(3-4)	4(4-5)	0.189
Complications:				
Present	2 (8%)	0 (0%)	2 (8%)	0.487
Not present	23 (92%)	11 (44%)	12 (48%)	
BMI status:				**0.024**
Normal	16 (64%)	10 (40%)	6 (24%)	
Overweight	4 (16%)	1(4%)	3 (12%)	
Underweight	5 (20%)	0 (0%)	5 (20%)	

IQR=Intra Quartile Range (Q1-Q3)

The median time of Ax was 25 minutes and 26 minutes for AnMT and AxMT respectively. There was no significant association (p=0.098) between AnMT and AxMT. Higher duration of aortic cross clamp was associated with having more chances of complications.

The mean size of cannula was 18.32 mm with SD 2.17 mm (the median size of cannula was 19 mm and ranging from 15 mm to 21 mm). The mean size of cannula was 19.09 mm and 17.71 mm minutes for AnMT and AxMT respectively. There was no significant association (p=0.047) found between AnMT and AxMT. The median duration of ICU stay was 2 days with IQR 2(2-3). The median ICU stay duration was 1-7 days. The median duration of ICU stay was 2 days for both AnMT and AxMT respectively. There was no significant association (p=1.00) found between AnMT and AxMT.

The median duration of hospital stay was 4 days with IQR 4(3-4) days. The median duration of hospital was ranging from 2-15 days. The median duration of hospital stay was 4 days for both AnMT and AxMT respectively. There was no significant association (p=0.781) found between AnMT and AxMT. Majority of the study participants were (92%) free from complications. Postoperative complications were reported in 2 patients. One patient complained with right diaphragm palsy. Another patient needed re-exploration due to excessive bleeding and also underwent 21 cycles of hemodialysis.

Nearly two third (64%) study participants were having normal body mass index (BMI). Nearly two in five (36%) study participants were associated with abnormal body mass index. (Either under nutrition or over nutritional status). There was a significant association (p=0.024) found between AnMT and AxMT for BMI.

DISCUSSION

Numerous articles have demonstrated that it is possible and safe to treat congenital heart abnormalities in pediatric patients by the use of a less invasive lateral thoracotomy.[4,5,18,20] When used for congenital heart defects like ASD, VSD, and PAVSD, AxMT promises to deliver superior cosmetic results without compromising the surgical success. AxMT procedures are comparable to traditional MS surgery in terms of aortic cross-clamp, CPB, and operation times, showing acceptable exposure and access to the anatomical structures. Furthermore, common devices for access and the actual correction can be used to carry out AxMT treatments. These results corroborate advantages and outcomes that other groups have previously observed.[4,18-22]

Although studies have done in Nepal to determine the difference between the right anterior minithoracotomy and median sternotomy,[23] no studies have been reported to assess the differences between the AxMT and AnMT incisions.

The median length of stay in the intensive care unit was 2 (1-2) days in both AxMT and AnMT groups, and the length of stay in the hospital was 4 (3-4) days and 4 (4-5) days in the AnMT and AxMT groups respectively. This is the

first study in Nepal to study the ASD closure with a AxMT and AnMT at a tertiary hospital. Similar to our findings Bhattarai et al, had similar mean duration of stays in ICU and overall hospital stay in median thoracotomy group. [23] The complications were however, more among patients who went surgery via right axillary incision and was statistically significant among the two groups.

It is important to note that all of the patients in the AxMT group, whose weights ranged from 36 to 88 kg, were able to undergo the procedure. In fact, according to our experience, axillary vertical minithoracotomies were simpler to execute on smaller patients due to less chest depth and higher skin and chest elasticity. Greater blood loss from the sternotomy compared to the minithoracotomy may be the cause of the decrease in blood products transfusion in the AxMT group of patients. It's also crucial to maintain the sternum's structural integrity. Hemoglobin levels were the same pre-, intra-, and postoperatively, supporting the notion that the AxMT group experienced less intraoperative blood loss.

The high level of experience of the surgeon who completed all surgical steps on this initial group of patients having AxMT may also have had a role in the decreased blood loss during and after surgery. This discovery calls for additional randomized prospective research, although it can be challenging to conduct these studies in populations with a variety of conditions.

This study has few drawbacks. First, as this was a cross-sectional study carried out in a single clinical setting, no conclusions about a causal relationship should be made from our results. Second, because the study subjects were chosen during a brief period of time, there could be selection bias in the results. Due to this study's retrospective methodology, a number of crucial factors were missing. The surgeon's choice will also affect the discharge date. Because there was no long-term follow-up, the complications could not be documented. The most cost-effective method for closing ASD with different types of incision in the Nepalese setting should be determined in the future through a randomized controlled trial with long-term follow-up and a bigger sample size. Being an interventional study, factors like chest wall abnormalities, prior patients' relevant illnesses like bleeding disorders, coagulative disorders, and other congenital deformities that could interfere with the suggested surgical procedure have not been considered.

CONCLUSIONS

There were no significant differences between the duration of ICU and hospital stays, aortic cross clamp time, and complications between the two groups (AxMT and AnMT). However, the possibility of less blood loss during surgery and of cosmetic appearance in axillary incision is of special importance. Long term follow-up studies comparing the cost-effectiveness, and complications is required to confirm the effectiveness between two incisions.

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