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Original Article

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Comparison between minimal invasive thoracotomy and standard median sternotomy for repair of atrial septal defects

Abstract

Aim: Concerns remain that minimally invasive atrial septal defect (ASD) repair may compromise patient outcomes. We compared clinical outcomes of adult patients undergoing ASD repair via a minimally invasive thoracotomy approach versus a "gold standard" sternotomy.

Material and Methods: We retrospectively reviewed the clinical outcomes of 166 consecutive patients who underwent ASD patch repair at our institution between 2010 and 2016. We compared inhospital/30-day mortality, postoperative complications, required analgesic therapy, length of stay in hospital and in the intensive care unit and blood product requirements between patients who underwent right Minimally invasive thoracotomy (MT) and those who underwent conventional sternotomy.

Results: During the study period, 166 consecutive patients underwent ASD repair at our institution: 72 (age 29.97±3.84 yr, 62.5% women) in the MT group and 94 (age 35.93±14.78 yr, 66.6% women) in the sternotomy group. All of the patients were diagnosed with secundum type ASD. There were no statistically significant differences in cardiopulmonary bypass time (p=0.11), aortic cross-clamp time (p = 0.10), and total operation time (p=0.10) between the two groups. There were no significant differences in any postoperative complications or blood product requirements. Compared with the sternotomy group, patients who received thoracotomy were mobilized earlier, required less analgesic therapy, and had a shorter intensive care unit stay and hospitalization. Mean intensive care unit (MT 1.0 ± 0 d ,v.sternotomy 1.27±0.8 d, p = 0.17) and hospital length of stays (MT 4.93±1.07 v.sternotomy 5.54±1.07 d, p = 0.17). No patients in the MT group suffered retrograde aortic dissection or leg ischemia.

Conclusion: Repair of ostium secundum type ASD can be performed safely via Minimally invasive thoracotomy approach with similar outcomes as sternotomy. Our results suggest that thoracotomy may be an alternative approach in closure of atrial septal defects due to its favorable cosmetic results and a more rapid patient recovery.

Keywords: Congenital heart disease, atrial septal defect, surgery, minimally invasive

INTRODUCTION

Atrial septal defect (ASD) repair is the most commonly performed operation among all congenital heart surgeries. In recent years, there's been a lot of advances in the thoracoscopic and robotic surgical approaches. While median sternotomy technique used to be the preferred method for ASD repair, minimal invasive thoracotomy, which has much better cosmetic outcomes and high success rates has become an important option. Our study has been designed to compare the early and late outcomes of ASD operations performed through minimal invasive thoracotomy and conventional sternotomy and establish advantages and disadvantages of both techniques based on results. Materials and methods.

MATERIAL AND METHODS

Patients

We operated 166 patients who had isolated secundum-type

ASD between January 2010 and July 2016. Of 166 patients, 94 underwent median sternotomy (group I), 72 underwent thoracotomy (group II). Clinical files of all the patiens were scanned retrospectively. All patient data was analyzed and evaluated as per demographic features such as gender and sex, concomitant disease, ASD diameters from pre-operative period, presence of a residual shunt after surgery, length of hospital stays, duration of cardiopulmonary bypass (CPB) and cross clamp time (CC) , intraoperative and post-operative complications, time of extubation, length of hospital stay, post-operative pain, need for inotropes and post-operative mortality. Postoperative pain was defined as the need for analgesics in the post-operative 2 days and time till discharge from the hospital.

Surgical technique

In thoracotomy group, patients were intubated with a double-lumen endotracheal tube for one-lung ventilation after the standard anesthesia induction. 2mg/kg heparin (half-dose) was applied for preparation. Transesophageal echocardiography (TEE) was performed after percutaneous right internal jugular vein cannulation with either a 17 or 19 F arterial cannula. A 2-cm incision was made in right groin following visualization of femoral artery and vein through Doppler USG. Cannulas were chosen according to patients' vein and artery diameter and body mass index . (Figure 1)

Figure 1. Femoral artery and vein cannulation

Cannulation was performed through Seldinger method and guide wire visualization by TEE . Patient was placed in 45 degree left lateral decubitus position and underwent a 4-6 cm length right anterolateral mini thoracotomy in the 4th intercostal space. (Figure 2) A special soft tissue retractor (Heartport Inc. Redwood City U.S.A.) was used to avoid rib traction, and resection of tissues. In order to visualize middleposterior axillary line, a 5mm camera port (Storz, Kolt Storz Gmblt and Co Tuttingen – Germany) was inserted through the 4th intercostal space. Cardioplegia cannula was inserted into ascending aorta and its extension was passed through 3rd intercostal space where also transthoracic clamp was placed.

Figure 2. Right anterolateral mini-thoracotomy ,preoperative and postoperative 4.day

Thoracic carbon dioxide insufflation was used to prevent air embolism. Femoral artery and vein were repaired upon termination of cardiopulmonary bypass. The surgery was finalized with the removal of jugular vein cannula. In median sternotomy group, following standard anesthesia induction and mid-sternal incision, aortic and bicaval cannulation was performed and defect was repaired with cardiopulmonary bypass. Warm cardioplegia was applied before cross-clamp removal to protect the myocardium in both approaches. Atrial septal defect was evaluated following standard right atriotomy and if suitable, it was closed without a patch. Operation was finalized after right atrium closure and stopping cardio-pulmonary bypass. The study protocol was approved by the Ankara University Medical Research Evaluation Commission (date: 26.05.2011, no: 213-475). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Statistical Analysis

Patient data was analyzed by SPSS 15.0 software (SPSS Inc, Chicago, Illinois, U.S.A.), and outcome data with a p value below 0.05 was considered statistically significant and thus taken into account. Standard deviation, median, percentage values are used to statistically define the study results and outcomes were made into graphics and tables. Distribution of variables

was checked with Kolmogorov Simirnov test. Measurements between two groups were compared through Mann Whitney U Test and independent-samples T-Test. Fisher Exact Test was used to analyze relative data as chi-square conditions couldn't be met for chi-square test. Results 166 patients who were included in the study were separated into 2 groups. Group 1 and group 2 included 94 patients who underwent median sternotomy and 72 patients who underwent thoracotomy, respectively. The ASD repair was performed with by patchplasty method. Mean follow-up time was 35.8±9.4 months. There was no statistical difference with regard to age and gender. Perioperative features can be seen in the table 1.

Table 1. Preoperative characteristics of the patient

	Group 1 (n=94)	Group 2 (n=72)	P value
Sex			
Female	60 (66.6%)	45 (62.5%)	0.11
Male	34 (34.4%)	27 (37.5%)	
Age (yr)	35.93±14.78	29.97±3.84	0.609
ASD size (mm)	16.41±5.47	12.59±3.63	0.113

While the duration of cardiopulmonary bypass in group 1 was 39.43±5.2 minutes, crossclamp duration was 20.7±6.2. In group 2, cardiopulmonary bypass duration and cross-clamp duration was 45.83±4.6 and 31.7±2.37, respectively. There was no significant difference between the cross-clamp and cardiopulmonary bypass durations. (Table 2)

Table 2. Intra-operative details

Variable	Group 1 (n=94)	Group 2 (n=72)	P value
Cardiopulmonary bypass time (min)	39.43±9.2	48.83±14.6	0.54
Cross clamp time (min)	20.7±7.2	25.15±8.1	0.41
Total operation time (min)	121±13.7	152±11.4	0.12
ASD closure (direct/patch)	65/29	52/20	0.08

The mean follow-up periods in the group 1 and group 2 were 43.6±11.09 and 28.16±7.83 months, respectively. Mortality wasn't seen in the post-operative period. There was no significant difference in respect to post-operative drainage, intubation duration, time spent in intensive care, blood product transfusion and total hospital stay duration. (Table 3)

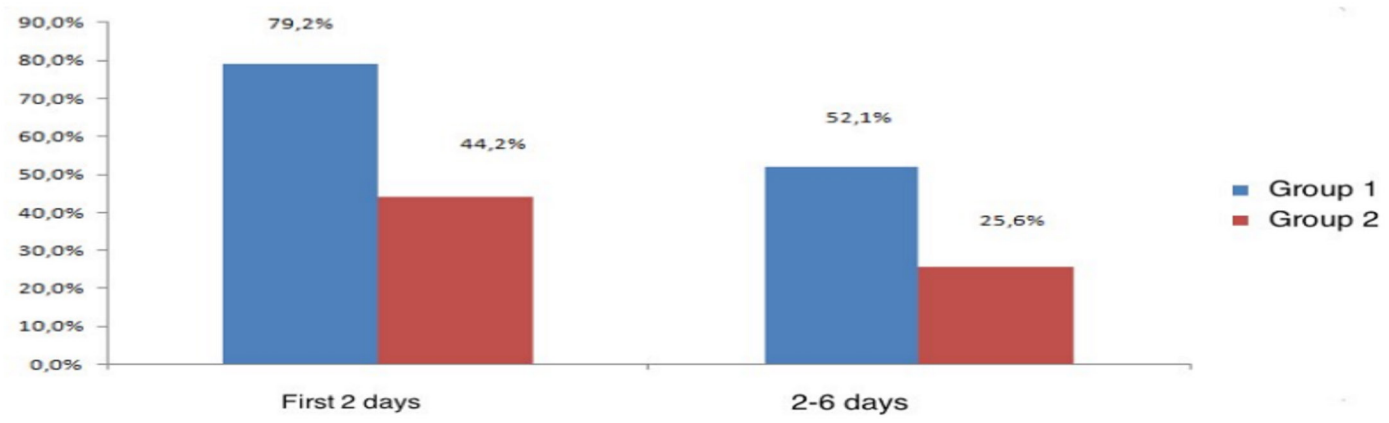
Table 3. Postoperative details

Variable	Group 1 (n=94)	Group 2 (n=72)	P value
Postoperative drainage (first 24 hour) ml	168±95	284±81.98	0.049
Mechanical ventilation time (hr)	6.4±1.5	5.33±1.28	0.20
Intensive care unit (day)	1.27±0.8	1±0.0	0.17
Blood product requirement	9 (9%)	5 (6%)	0.34
Inotropic support	22 (23%)	9 (12.5%)	0.01
Hospital length of stay (day)	5.54±1.07	4.93±1.07	0.6
Residual defect	0	0	
Mortality	0	0	

Pain requiring post operative analgesics

VAS (visual analogue score) has been used to evaluate postoperative pain. Need for analgesics are classified as postoperative first 2 days and duration of use till discharge. In group 1 and 2, post-operative pain requiring analgesics in the first 2 days were seen in 79.2% and 44.2% of the patients, respectively. Pain requiring analgesics after postoperative 2 days in group 1 and 2 were 52.1% and 25.6%, respectively. According to the pain catheter routinely used in thoracotomy group, there was statistical difference between the groups in terms of analgesic use. (p=0.01) (Table 4)

Table 4. Pain requiring analgesics



Complications

There was no clear difference between complication occurrence rates between two groups. (p=0.09) Table 5. While anemia requiring transfusion was the most common complication in group 1 (35.2%), inguinal seroma was the most common in group 2 (15.5%). No cerebrovascular event occurred in either groups. Supraventricular tachycardia, atelectasis and fever were seen in 3 patients in group 1 and in 2 patients in group 2. There was no statistical difference. (p=0.13)

Table 5. Complications

Variable	Group 1 (n=94)	Group 2 (n=72)	P value
Reoperation for bleeding	0	0	
Neurological complications	0	0	
Atrial fibrillation	5	2	0.15
Wound infection	0	0	
Complication of femoral cannulation	-	0	
Arrhythmia	3	2	0.08
Athelectasia	2	3	0.11
Conversion to sternotomy	-	0	
Seroma	-	11 (15.2%)	

DISCUSSION

Atrial septal defect repair is effectively and safely performed through several techniques including conventional sternotomy, cardioplegia and cardiopulmonary bypass. Small incisions of ever-developing mini invasive surgical methods brought new perspectives on elimination of pathology and patient interactions (1). There are extensive material on successful closure of defect through both approaches. ASD, which is responsible for 10-15% of all cardiac disease, is the most common congenital heart diseases seen in adults. It's twice as common in women than men (2). In our study, correspondent with this data, number of female and and male subjects were 55% and 44%, respectively. Michaelve et al., in a study which included 73 patients, found the durations of cardiopulmonary bypass and total operation were shorter in median sternotomy group, and the data was statistically significant, whereas, no difference was seen in the amount of drainage (3). Among the studies in the literature, difference in the volume of drainage demonstrates less blood loss and need for transfusion, hence a better hemodynamic response with a reduced transfusion-related complication rate. In our series of patients, there was no statistical difference in both amount of drainage and need for blood product transfusions. The durations of aortic cross-clamping and perfusion were similar when patients operated through conventional sternotomy and thoracotomy were compared (3). Complication rates were not statistically different among both groups. In contrast to the study which showed there was a 1-2% risk of phrenic nerve and sinus node damage done by Guan Miguel Gil-Jaurena et al., we observed neither in our study (4). No deaths were noted, and mortality rate was similar to literature (5,6). Atrial arrhythmias, pericardial effusion-tamponade, and thrombus formation were the most common middle- or late-term complications in literature. In our study, the most common complication was anemia requiring transfusion. While cardiac tamponade didn't occur, atrial arrhythmias were observed in 3 patients within group I (1.8%), and 2 patients within group II (1.2%). The most frequent respiratory complication is atelectasis, however, pneumonia, pneumothorax and pleural effusion are also common (7). Atelectasis was noted in 1 (0.6%) and 2 (1.8%) patients in group I and group II, respectively. There was no statistical difference in terms of respiratory problems (p=0.12). Although Hafize Yalnız et al. showed the duration of intubation and need for transfusion were less in thoracotomy group, however, we were not able to demonstrate any significant difference among the groups (8). Decreased length of hospital stays is another advantage of minimal invasive cardiac procedures. Rapid mobilization and socio-psychological relief, along with the size and shape of incision are among the benefits of this technique. Short duration of intensive care and hospital stays (4.94 days) in our study support the findings mentioned previously. There also are views on that a better thorax stability can be maintained with minimal invasive procedures, through less post-operative pain and earlier mobilization (6). In our study, pain-directed drug therapy was evaluated during the postoperative first 2 days and throughout the hospital stay. A significant difference was observed in terms of former two parameters; there was a convincing reduction in the need for post-surgical analgesia. Early mobilization, early removal of thorax tubes, short intensive care unit stays, better chest wall stability compared to conventional sternotomy, no bone pain related to conventional sternotomy, the routine use of pain catheter in thoracotomy patients, better treatment response due to early mobilization and quicker psychological recovery may be considered among the reasons for why pain is less complicated in the thoracotomy group. The feasibility of minimal invasive techniques in cardiac surgery led to more extensive cosmetic outcome evaluation of size-limited incisions. Massetti et al. studied how patients who underwent minimal invasive surgery perceived their surgery scars, how it affected their daily-life activities and what they thought of them in cosmetic way, and showed not only its superiority over conventional technique in terms of reduced morbidity, but also patient satisfaction (9). When compared, the difference between the groups with regard to cosmetics were statistically significant. Sternotomy scar, particularly for women, may lead to serious sociological and 6 psychological problems. Great cosmetic outcome, perhaps its biggest advantage, when considered together with reliable and consistent results in ASD repair, and high patient satisfaction, minimal invasive technique may be the first choice in ASD repair, specifically in young female patients (10).

CONCLUSION

Despite all the discrepancies present in literature, this technique is getting more widespread as it gets better known among surgeons who wants to stay up-to-date with recent techniques and among the patients who are intrigued by better a better cosmetic outcome and opts the hospitals that specialize in this specific approach. Due to the adaptation of technological advances to surgical methods, such new techniques can be performed in various centers with repetitive and reliable results. While thoracotomy is a difficult technique to perform, it dramatically increases postoperative patient comfort. We think this approach should be considered in all cardiac operations due to its ability to result in less post-surgical pain, more rapid recovery of respiratory functions, reduction in surgical wound complications, decreased use of transfusion products, quicker rehabilitation, shorter intensive care unit stays, better cosmetic appearance, more efficient sleep, increased life quality, and better psychological outcome.

Conflict of Interests: The author declares that there are no conflict of interests.

Financial Disclosure: There are no financial supports.

Ethics committee approval: The study protocol was approved by the Ankara University Medical Research Evaluation Commission (date: 26.05.2011, no: 213-475).

REFERENCES

1. Vistarini N, Aiello M, Mattiucci G, et al. Port-access minimally invasive surgery for atrial septal defects: a 10-year single-center experience in 166 patients. J Thorac Cardiovasc Surg. 2010;139:139-45.
2. Kristyn S. Lowery.Atrial Septal Defects . PhysicianAssist Clin 1. 2016;553–62.
3. Chu MW, Losenno KL, Fox SA, et al. Clinical outcomes of minimally invasive endoscopic and conventional sternotomy approaches for atrial septal defect repair. Can J Surg. 2014;57:75-81.
4. Gil-Jaurena JM, Zabala JI, Conejo L, et al. Minimally invasive pediatric cardiac surgery. Atrial septal defect closure through axillary and submammary approaches. Rev Esp Cardiol. 2011;64:208-12.
5. Yaliniz H, Topcuoglu MS, Gocen U, et al. Comparison between minimal right vertical infra-axillary thoracotomy and standard median sternotomy for repair of atrial septal defects. Asian J Surg. 2015;38:199-204.
6. Poyrazoglu HH, Avsar MK, Demir S, et al. Atrial septal defect closure: comparison of vertical axillary minithoracotomy and median sternotomy. Korean J Thorac Cardiovasc Surg. 2013;46:340-5.
7. Wynne R, Botti M. Postoperative pulmonary dysfunction in adults after cardiac surgery with cardiopulmonary bypass: clinical significance and implications for practice.Am J Crit Care 2004;13:384-93.
8. Walther T, Falk V, Metz S, et al. Pain and quality of life after minimally invasive versus conventional cardiac surgery.Ann Thorac Surg. 1999;67:1643-7.
9. Massetti M, Nataf P, Babatasi G, Khayat A. Cosmetic aspects in minimally invasive cardiac surgery. Eur J Cardiothorac Surg. 1999;16:73-5.
10. Vida VL, Tessari C, Fabozzo A, et al. The evolution of the right anterolateral thoracotomy technique for correction of atrial septal defects: cosmetic and functional results in prepubescent patients. Ann Thorac Surg. 2013;95:242-7.