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Original Article

Comparison of Short-Term Outcomes of Transcatheter versus Surgical Closure of Atrial Septum Defect at a Tertiary Cardiac Care Facility

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ABSTRACT

Objective: To compare the short-term outcomes of transcatheter versus surgical closure of atrial septal defect (ASD) at a tertiary cardiac care facility in South Punjab, Pakistan.

Study Design: Prospective comparative study.

Place and Duration of the Study: Department of Paediatric Cardiology and Paediatric Cardiac Surgery, Chaudhary Pervez Elahi Institute of Cardiology, Multan Pakistan, from Jul 2019 to Jun 2021.

Methodology: A total of 110 patients with moderate to large isolated secundum ASDs without severe pulmonary hypertension and planned to undergo closure of secundum ASD by either surgical approach or device closure were included. All surgical and transcatheter procedures were performed adopting standard techniques. Intra-procedural or post-procedural outcomes were noted.

Results: In a total of 110 patients, 59(53.6%) underwent transcatheter closure of ASD, while surgical closure was done in the remaining 51(46.4%) patients. Post-procedural complications were significantly more in the Surgical Closure Group in comparison to the Transcatheter Closure Group, [14(27.5%) vs 5(8.5%) (p=0.026)]. None of the cases in the Transcatheter Closure Group required inotropes in the post-procedure period in comparison to 24(47.1%) cases (p<0.001). The total cost of treatment was significantly higher in transcatheter closure patients compared to surgical closure patients (1504±60.4 US$ versus 1448±75.4 US$, p<0.001). Overall, successful closure was noted in 108(98.2%) cases. No mortality was recorded.

Conclusion: Overall, short-term outcomes of transcatheter ASD closure were comparable to the surgical approach, but patients with transcatheter ASD closure had significantly less duration of hospitalization and low rates of post-procedural complications.

Keywords: Atrial septum defect, Mortality, Surgical closure, Transcatheter closure.

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INTRODUCTION

Atrial septal defects account for 7-20% of congenital heart defects (CHD).[1] Secundum types of ASD are the most frequent variants responsible for nearly 77% of all ASD cases.[2] Recent local data revealed that ASD repairs were the 2nd most common septal defects repair procedures performed.[3]

Traditionally, surgical closure adopting median sternotomy employing cardiopulmonary bypass (CPB) has been known to be the standard treatment approach for ASD patients.[4] Surgical closure for ASD patients has been established to be a safe and effective approach yielding good short and long-term outcomes.[5] Transcatheter closure of ASD has been a popular choice among paediatric cardiologists, and outcomes of transcatheter closure of ASD have been comparable with conventional surgical closures.[6,7]

Some researchers have reported no significant difference in neurodevelopmental outcomes among children undergoing surgical or transcatheter closure of ASDs.[8] Some experts endorse transcatheter closure of ASDs as the standard adult treatment.[9,10] Not much local data is available comparing surgical versus transcatheter closure outcomes of ASDs, while no study explored these outcomes among patients of South Punjab, Pakistan. Therefore, the present study was planned to compare the short-term outcomes of transcatheter versus surgical closure of ASD at a tertiary cardiac care facility in South Punjab, Pakistan. The findings of this study were thought to provide helpful information about comparing two commonly adopted approaches for ASD closure.

METHODOLOGY

The prospective comparative study was conducted at The Department of Pediatric Cardiology and Pediatric Cardiac Surgery, Chaudhary Pervez Elahi Institute of Cardiology, Multan Pakistan, from July 2019 to June 2021. Approval from Institutional Ethical Committee was acquired (ERC no.147).

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Inclusion Criteria: All patients with moderate to sizeable isolated secundum ASD with right ventricle volume overload and without severe pulmonary hypertension (TR <70mmHg) and planned to undergo closure of secundum ASD by either surgical approach or device closure were included in the study. Patients with adequate margins of 5mm were included in the Percutaneous Closure Group, while patients with inadequate margins were included in the Surgical Group.

Exclusion Criteria: Patients for a Transcatheter Group with ASD defect very close to the superior vena cava, inferior vena cava, pulmonary vein and atrioventricular valves, as chances of failure/complications were high were also excluded.

Informed consent was sought from all patients or parents/caregivers if the patient was below 18 years. All patients or their parents/caregivers were explained for possible complications, rates of post-procedural morbidities and expected cost of the procedure/ device, and they were given a choice to opt for whichever approach they wanted. The designated team made the final decision on the choice of Surgical or Device Closure Group of cardiologists and cardiac surgeons during the cath conference. We included all patients undergoing either of the procedure during the study period. A special proforma was formed to note all study data.

All surgical procedures were performed adopting cardiopulmonary bypass through median sternotomy. ASD was closed with an autologous pericardial patch technique in all cases.

All transcatheter closures were done using standard procedure protocols.[10] All cases were performed with general anaesthesia. For ASD size and margin assessment, TOE was used, and device size was selected by adding 2-4mm. Access was taken via the femoral vein, and heparin was administered at 100u/kg. ASD was crossed with a multipurpose catheter and anchored with wire in the right upper pulmonary vein. Then using ASD delivery system device was deployed, and the position was confirmed on TOE and fluoroscopy before release.

Patients will be reviewed for residual shunt (significant >2mm) through colour Doppler on echocardiography. Intra and post-procedural mortality were noted until the patients were discharged. Transcatheter and post-surgical complications/morbidities were also noted in all cases. The cost of each studied approach was estimated considering the cost of hospitalization, laboratory investigation charges, medication cost and treatment charges, including the cost of surgical procedures, CPB or occlusion device used.

All the data were analyzed using Statistical Package for Social Sciences (SPSS) version 26.00. Qualitative data were expressed in frequency and percentages, while quantitative data were shown as mean and standard deviation (SD). Qualitative data were compared by chi-square test while an independent sample t-test was used to compare quantitative data, considering *p*-value of ≤0.05 as significant.

RESULTS

Of 110 patients, 67(60.9%) were females. Overall, the mean age was 26.8±16.0 years ranging between 3-65 years. A family history of ASD was noted in 3(2.7%) cases. Mild pulmonary hypertension TR=30-50mmHg was noted in a total of 6(5.5%) patients, while moderate pulmonary hypertension (TR=50-70 mmHg) was observed in 12(10.9%) patients. Of most patients, 75 (68.2%) belonged to NYHA Class-II. 59 (53.6%) patients underwent transcatheter closure of ASD, while surgical closure was done in the remaining 51(46.4%) (Table-I).

Table-I: Comparison of Baseline Characteristics of Patients Undergoing Atrial Septum Defect Closure (n=110)

Characteristics	Transcatheter Closure (n=59)	Surgical Closure (n=51)	*p*-value
Gender			
Male	24 (40.7%)	19 (37.3%)	0.714
Female	35 (59.3%)	32 (62.7%)	
Age in Years (Mean±SD)	26.7±16.0	26.9±16.1	0.951
Weight in Kg (Mean±SD)	50.2±20.7	48.3±20.9	0.643
Height in cm (Mean±SD)	149.7±18.5	145.5±22.3	0.286
Family History of ASD	2(3.4%)	1(2.0)	0.646
Mild Pulmonary Hypertension (TR =30 -50mmHg)	2(3.4%)	4(7.8%)	0.168
Moderate Pulmonary hypertension (TR = 50 -70 mmHg)	4(6.8%)	8(15.7%)	
NYHA Class			
I	21(25.6%)	-	<0.001
II	38(64.4%)	3 (72.5%)	
III	-	14(27.5%)	
ASD Size in mm (Mean±SD)	20.3±4.9	22.6±4.5	0.011

The mean CPB time in the Surgical Closure Group was 65.1±34.1 minutes, while the mean aortic cross-clamp time was 37.8±17.0 minutes. The mean proce-

dure time was 49.2±27.6 minutes in the Transcatheter Closure Group versus 97.0±38.6 minutes in the Surgical Closure Group (p<0.001). In the transcatheter closure group, the mean fluoroscopy time was 9.5±8.1 minutes.

Post-procedural complications were significantly more in the Surgical Closure Group in comparison to the Transcatheter Closure Group, [14(27.5%) vs 5(8.5%) (p=0.026)]. The total cost of hospitalization, laboratory investigation charges, and treatment charges, including the cost of surgical procedure, CPB or device used, was higher in transcatheter closure patients in comparison to surgical closure patients (1504±60.4 US$ versus 1448±75.4 US$, p<0.001).Overall, successful closure was noted in 51(100%) patients in Surgical Group versus 57 (96.6%) in the Transcatheter Group. No mortality was recorded. A comparison of operative and postoperative outcomes in patients undergoing ASD closure in both groups is given in Table-II.

Table-II: Comparison of Operative and Post-Operative Outcomes in Patients Undergoing Atrial Septum Defect Closure (n=110)

Intra-Operative and Post-Operative Outcomes	Transcatheter Closure (n=59)	Surgical Closure (n=51)	p-value
Procedure time in minutes (Mean±SD)	49.2±27.6	97.0±38.6	<0.001
Total duration of hospitalization in days (Mean±SD)	2.1±0.25	5.8±2.6	<0.001
Post-Surgery Blood Transfusion	-	13(25.5%)	<0.001
Post-procedure Complications			
None	54(91.5%)	37(72.5%)	0.026
Arrhythmias	2(3.4%)	6(11.8%)	
Device Embolization	1(1.7%)	-	
Pericardial Effusion	2(3.4%)	8(15.7%)	
Inotropes Needed Post-Surgically	-	24(47.1%)	<0.001
Successful Closure	57(96.6%)	51(100%)	0.1845
Total Cost in PKR (Mean±SD)	255824±10271	246254±12824	<0.001

US$: Price of US Dollars calculated considering 1 US$=170 PKR

DISCUSSION

In the present study, we found that both transcatheter closure and surgical ASD closure had excellent clinical outcomes. Although post-procedural complications were recorded, we did not observe any mortality in the current set of patients in both studied approaches. The overall effectiveness of surgical or transcatheter closure of ASD revealed in the present study is aligned with what has been published in the past.[11,12]

The total duration of hospitalization was significantly less in transcatheter closure patients (p<0.001), but the total cost of treatment, investigations and hospitalization was high in transcatheter closure patients. A study done by Hughes *et al*. from Australia showed that in comparison to surgical closure, device closure of ASD was associated with less duration of hospitalization, low rates of complications, and less familial disturbance.[13]

A local Karachi study concluded that transcatheter and surgical approaches successfully closed ASD. However, transcatheter closure of ASD was associated with lower post-procedural complications and hospitalization rates. In contrast, the cost of the transcatheter closure of ASD was higher than that of surgical closure of ASD, which is relatively consistent with the findings of the present study.[14]

As we revealed that transcatheter closure of ASD does not require cardiac ICU stay, and the overall duration of stay was significantly less when compared to the surgical closure approach (2.1±0.25 days versus 5.8±2.6 days, p<0.001), this could mean that transcatheter closure of ASD might be reducing the societal burden.[15] Patients undergoing surgical closure of ASD might require more in-hospital and post-discharge attention by the family members, limiting the daily routine activities of some close family members.[16] Early discharge among transcatheter closure of ASD patients could mean that affected patients and their family members can resume their usual daily routine activities much quicker than those undergoing surgical closure of ASD.[17,18]

CONCLUSION

Overall, short-term outcomes of transcatheter ASD closure were comparable to the surgical approach, but patients with transcatheter ASD closure had significantly less duration of hospitalization and low rates of post-procedural complications. If cost is not an issue, device closure of ASD secundum is attractive and should be the first line management option in suitable patients.

Conflict of Interest: None.

Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

SS & MY: Conception, data analysis, drafting the manuscript, approval of the final version to be published.

TA & UR: Data acquisition, data interpretation, critical review, approval of the final version to be published.

RT & BM: Study design, drafting the manuscript, critical review, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

REFERENCES

1. Xuan TH, Phuoc LP, Duy KV, Manh CL,. Trends in the prevalence of atrial septal defect and its asso-ciated factors among congenital heart disease patients in Vietnam. J Cardiovasc Dev Dis 2019; 7(1): 2. https://doi:10.3390 /jc dd7 010002.
2. Martin SS, Shapiro EP, Mukherjee M. Atrial septal defects-clinical manifestations, echo assessment, and intervention. Clin Med Insights Cardiol 2015; 8(Suppl1): 93-98. https://doi:10.4137 /CMC. S15715.
3. Khokhar RA, Gova MA, Bangash SK, Tahir A. The spectrum of pediatric cardiac procedures and their outcomes: A six-month report from the largest cardiac facility in Sindh, Pakistan. Cureus 2019; 11(8): e5339. https://doi: 10.7759/cureus.5339
4. Amaral F, Manso PH, Jacob MFB, Schmidt A. Adult congenital heart disease outpatient clinic. Descriptive analysis of a 12-year experience in Brazil. Braz J Cardiovasc Surg 2020; 35(3): 254-264. https://doi:10.21470/1678-9741-2019-0047.
5. Mills NL, King TD. Non-operative closure of left-toright shunts. J Thorac Cardiovasc Surg 1976; 72(3): 371-378.
6. Jung SY, Choi JY. Transcatheter closure of atrial septal defect: principles and available devices. J Thorac Dis 2018; 10(Suppl 24): S2909-S2922. https://doi: 10.21037/jtd.2018.02.19.
7. Yang MC, Wu JR. Recent review of transcatheter closure of atrial septal defect. Kaohsiung J Med Sci 2018; 34(7): 363-369. https://doi: 10.1016/j.kjms.2018.05.001.
8. Ooi YK, Kelleman M, Ehrlich A, Glanville M, Porter A, Kim D, et al. Transcatheter versus surgical closure of atrial septal defects in children: A value comparison. JACC Cardiovasc Interv 2016; 9(1): 79-86. https://doi: 10.1016/j.jcin.2015.09.028.
9. Warnes CA, Williams RG, Bashore TM, Child JS, Connolly HM, Dearani JA, et al. ACC/AHA 2008 guidelines for the management of adults with congenital heart disease: A report of the American College of Cardiology/American Heart Association Task Force on practice guidelines(writing committee to develop guidelines on the management of adults with congenital heart disease). J Am Coll Cardiol 2008; 52(23): e143–263. https://doi: 10.1016 /j.jacc.2008.10.001.
10. Rosas M, Zabal C, Garcia-Montes J, Buendia A, Webb G, Attie F, et al. Transcatheter versus surgical closure of secundum atrial septal defect in adults: impact of age at intervention. A concurrent matched comparative study. Congenit Heart Dis 2007; 2(3): 148-155. https://doi: 10.1111/j.1747-0803.2007.00091.x
11. Thomson JD, Aburawi EH, Watterson KG, Van Doorn C, Gibbs JL. Surgical and transcatheter (Amplatzer) closure of atrial septal defects: a prospective comparison of results and cost. Heart 2002; 87(5): 466–469. https://doi: 10.1136/heart.87.5.466.
12. Baker SS, O'Laughlin MP, Jollis JG, Harrison JK, Sanders SP. Cost implications of closure of atrial septal defect. Catheter Cardiovasc Interv 2002; 55(1): 83-87. https://doi: 10.1002/ccd.10079.
13. Hughes ML, Maskell G, Goh TH, Wilkinson JL. Prospective comparison of costs and short term health outcomes of surgical versus device closure of atrial septal defect in children. Heart 2002 ; 88(1): 67-70. https://doi: 10.1136/heart.88.1.67.
14. Siddiqui WT, Usman T, Atiq M, Amanullah MM. Transcatheter versus surgical closure of atrial septum defect: a debate from a developing country. J Cardiovasc Thorac Res 2014; 6(4): 205-210. https://doi:10.15171/jcvtr.2014.013.
15. Romanelli G, Harper RW, Mottram PM. Transcatheter closure of secundum atrial septal defects: results in patients with large and extreme defects. Heart Lung Circ 2014; 23(2): 127-131. https://doi: 10.10 16/j.hlc.2013.07.020.
16. Thomson JD, Aburawi EH, Watterson KG, Van Doorn C, Gibbs JL. Surgical and transcatheter (Amplatzer) closure of atrial septal defects: a prospective comparison of results and cost. Heart 2002; 87(5): 466-569. https://doi: 10.1136/heart.87.5.466
17. Rigatelli G, Zuin M, Roncon L, Nanjiundappa A. Secundum atrial septal defects transcatheter closure versus surgery in adulthood: a 2000-2020 systematic review and meta-analysis of intrahospital outcomes. Cardiol Young 2021; 31(4): 541-546. https://doi: 10.1017/S1047951121001232.
18. Suchon E, Pieculewicz M, Tracz W, Przewlocki T, Sadowski J, Podolec P, et al. Transcatheter closure as an alternative and equivalent method to the surgical treatment of atrial septal defect in adults: comparison of early and late results. Med Sci Monit 2009; 15(12): CR612-17.