



ORIGINAL ARTICLE

## Feasibility of transcatheter device closure of secundum atrial septal defect under transthoracic echocardiography guidance.

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**ABSTRACT... Objective:** To determine the usefulness and safety of transthoracic echocardiography (TTE) imaging for real time guidance in transcatheter device closure of atrial septal defect (ASD) secundum. **Study Design:** Cross-sectional study. **Setting:** Department of Paediatric Cardiology, CPEIC, Multan, Pakistan. **Period:** January 2022 to December 2023. **Material & Methods:** Patients of both genders aged above 3 years with clinical and echocardiographic evidence of ASD secundum with significant left to right shunt were analysed. All cases had morphologically suitable margins of defect confirmed on TTE. Usefulness and safety of intra-procedure and immediate post-procedure transcatheter device closure of secundum ASD were noted. **Results:** In a total of 34 patients, 20 (58.8%) were female and 14 (41.2%) male. The mean age was  $21.32 \pm 17.21$  years. The TTE findings revealed that the mean ASD side was  $17.47 \pm 4.32$  mm. Aortic margins were deficient among 28 (82.4%) cases. The mean fluoroscopy and procedure time were  $9.29 \pm 6.98$  minutes and  $49.91 \pm 39.76$ . Residual leak was noted in one (2.9%) cases while none of the cases were observed to have superior vena cava, inferior vena cava or pulmonary vein obstructions. Post-procedure, transient supraventricular tachycardia (SVT) arrhythmia was the most common type of complication reported among 2 (5.9%) cases. None of the cases needed any kind of emergency surgical exploration. No cases of pericardial effusion were found. No mortality was reported. **Conclusion:** Transcatheter device closure of secundum atrial septal defect was found to be effective and safe using TTE.

**Key words:** Arrhythmia, Atrial Septal Defect, Pericardial Effusion, Transcatheter, Transthoracic Echocardiography.

### INTRODUCTION

Atrial septal defects (ASD) constitute 6-10% of congenital heart defects (CHDs) at birth.<sup>1</sup> ASDs are the most common congenital lesions presented undiagnosed in adulthood.<sup>2</sup> With growing advancements in interventional paediatric cardiology, device closure of ASD secundum has become safe and preferable treatment option in many national and international centres.<sup>3</sup>

Recently Amplatzer septal occluder (ASO) is the standard practical treatment for secundum ASD.<sup>4</sup> Conventionally, transthoracic echocardiography (TEE) is used to monitor the deployment of ASD device mandating general anaesthesia and intubation of patient resulting in long procedural time and its related complications.<sup>5</sup>

Real time TTE is safe and easy alternative imaging tool for assistance in ASD device closure as it is non-invasive, cost effective, safe and no need of general anaesthesia, and intubation especially in defects with good anatomical rims.<sup>6</sup> Its significance has also magnified during Covid-19 era where the anaesthetists avoid unnecessary intubation and extra exposure to patient with unknown Covid infection status. This study was aimed to determine the usefulness and safety of TTE imaging for real time guidance in transcatheter device closure of ASD secundum.

### MATERIAL & METHODS

This observational study was performed at the Department of Paediatric cardiology, Chaudhary Pervaiz Elahi Institute of Cardiology (CPEIC),

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Multan, Pakistan from January 2022 to December 2023. Approval from “Institutional Ethical Committee” was acquired (letter number: 207, dated: 15-02-2022). Sample size of 34 cases was calculated considering 95% confidence level with 8% margin of error and the proportion of ASD in all CHDs as 6%.<sup>1</sup>

We analysed patients of both genders aged above 3 years with clinical and echocardiographic evidence of ASD secundum with significant left to right shunt. All cases had morphologically suitable margins of defect confirmed on TTE. All children below 5 years of age or having ASD with severe or irreversible pulmonary hypertension were not included. Children having ASD with other associated congenital heart disease or ASD with deficient rims unsuitable for device stability were also excluded. Written and informed consents were obtained from patients or their parents/guardians.

Two echo machines E-19 and Vivid 7 (GE healthcare) were used for 2D and colour flow mapping studies. Deep sedation was employed and all patients underwent pre-intervention TTE. We added 2-6 mm in the largest ASD diameter for device selection. Aspirin was given as antiplatelet 3-5mg/kg 1 day before intervention and all cases were asked to continue it for 6 months following the procedure. Sedation and local anaesthesia were used in all patients undergoing intervention. Heparin 100 IU/kg was administered during the procedure. During intervention, TTE was used for real time assessment of proper closure of defect, any residual shunt, occluder holding all septal margins with no impingement on surrounding structures (tricuspid, mitral valves and aorta) and obstruction to SVC, IVC, right pulmonary veins and coronary sinus flow. All the procedures were performed under SIEMENS MEGALIX Cat plus 125/40/90 (Siemens Healthcare GmbH Erlangen, Germany) Fluoroscopy Machine guidance. Device deployment was done after checking stability of device using wiggle manoeuvre and real time echo. Post procedure stability of patients including ECG and vital signs were documented. Echocardiography was repeated on day-1 following the procedure and patients

were discharged if no complications observed. A special format was developed to record study data.

Data was analysed adopting “Statistical Package for Social Sciences (SPSS)”, version 26.0. Frequencies and percentages were calculated for categorical data. Mean and standard deviation (SD) were shown for numeric data. Comparison of qualitative data was made using chi-square test while quantitative variables were compared utilizing independent sample t-test. P value below 0.05 was taken as significant.

## RESULTS

In a total of 34 patients, 20 (58.8%) were female and 14 (41.2%) male. The mean age was  $21.32 \pm 17.21$  years, ranging between 3 to 65 years. Socio-economic status of 21 (61.8%) cases was low. Residential status of 22 (64.7%) patients was rural (Table-I).

Characteristics		Number (%)
Gender	Male	14 (41.2%)
	Female	20 (58.8%)
Age (years)	1-5	3 (8.8%)
	6-10	8 (23.5%)
	11-15	5 (14.7%)
	>15	18 (52.9%)
Socio-economic status	Low	21 (61.8%)
	Medium	10 (29.4%)
	High	3 (8.8%)
Body weight (kg)	<15	3 (8.8%)
	15-30	10 (29.4%)
	>30	21 (61.8%)
Residential status	Rural	22 (64.7%)
	Urban	12 (35.3%)

**Table-I. Demographic characteristics of patients (n=34)**

The TTE findings revealed that the mean ASD side was  $17.47 \pm 4.32$  mm ranging between 7 to 26 mm. Aortic margins were deficient among 28 (82.4%) cases. The mean catheter pulmonary artery pressure was  $32.62 \pm 10.41$  mmHg ranging between 15 to 59 mmHg. The mean fluoroscopy and procedure time were  $9.29 \pm 6.98$  minutes (ranging between 3 to 38 minutes) and  $49.91 \pm 39.76$  (ranging between 20 to 212

minutes). Residual leak was noted in one (2.9%) cases while none of the cases were observed to have superior vena cava, inferior vena cava or pulmonary vein obstructions. None of the cases

had intro-procedure or post-procedure local site bleeding. Table-II is showing overall TTE findings with respect to gender distribution.

Clinical Parameters		Total (n=34)	Male (n=14)	Female (n=20)	P-Value
Atrial septal defect size (mm)		17.47±4.32	16.92±4.11	17.84±4.52	0.563
Right ventricular dominant (mm)		1.97±0.17	2.00±0.00	1.95±0.22	0.411
Aortic Margin	Absent	2 (5.9%)	-	2 (10.0%)	0.078
	Deficient (<5mm)	28 (82.4%)	14 (100%)	14 (70.0%)	
	Adequate (≥5mm)	4 (11.8%)	-	4 (20.0%)	
Mitral regurgitation	Trivial	13 (38.2%)	4 (28.6%)	9 (45.0%)	0.332
	No	21 (61.8%)	10 (71.4%)	11 (55.0%)	
Tricuspid regurgitation	Trivial	19 (55.9%)	7 (50.0%)	6 (30.0%)	0.341
	Mild to moderate	2 (5.9%)	-	2 (10.0%)	
	No	13 (38.2%)	7 (50.0%)	6 (30.0%)	
Catheter Pulmonary artery pressure (mmHg)		32.62±10.41	33.73±10.72	31.94±10.47	0.663
Fluoroscopy time (minutes)		9.29±6.98	10.71±8.84	8.30±5.35	0.329
Procedure time (minutes)		49.91±39.76	61.21±58.97	42.0±14.36	0.169

**Table-II. Transthoracic echocardiographic findings with respect to gender (n=34)**

Post-procedure, transient supraventricular tachycardia (SVT) arrhythmia was the most common type of complication reported among 2 (5.9%) cases. None of the cases needed any kind of emergency surgical exploration. No cases of pericardial effusion were found. No mortality was reported.

## DISCUSSION

Chaudhary Pervaiz Elahi Institute of Cardiology is one of the few healthcare facilities in Pakistan providing transcatheter device closure for secundum ASD. Many tools like transoesophageal echocardiography, intra-cardiac echocardiography and cardiac magnetic resonance imaging are adopted to measure ASD defect and size and guidance for the deployment of the device but we considered TTE for the said purpose as we wanted to evaluate its feasibility. The present study disclosed that device closure of secundum ASD proved very useful and safe procedure. Our findings are consistent to what has been reported in the literature regarding the usefulness and safety of TTE imaging in device closure of secundum ASD.<sup>7-9</sup> Sadiq N et al from Rawalpindi in a local study reported TTE imaging for real time guidance in transcatheter device closure of ASD secundum to be very effective and safe in young children.<sup>10</sup> The mean defect size was reported to be 17.47±4.32 mm in the

present study which is somewhat different than the findings of Sadiq N et al where the mean defect size was 12±3.5 mm which could be due to the fact that we considered patients of varying age groups while Sadiq N et al considered children who were below 5 years of age.<sup>10</sup> In this study, 13 (38.2%) patients were aged above 18 years. A study from Egypt by Ali M et al revealed that mean ASD size assessed by TTE was 21.7±7.3 mm as they only analysed adult ASD patients.<sup>11</sup> Transcatheter closure of secundum ASD guided by TTE was found to safe and efficient in their finding.<sup>11</sup>

A recent study done by Han Y et al revealed that transcatheter and intra-procedure device closure of secundum ASD were feasible, efficient and safe approach for children under 3 years of age.<sup>12</sup> Advantages like improved cosmetic effect and relatively shorter length of procedure and post-procedure hospitalization, transcatheter approach adopting TTE imaging could prove very useful in device closure of secundum of ASD. A research from Saudi Arabia noted non-inferior efficacy of TTE in terms of device deployment versus TEE while significant less procedure time was required among cases undergoing TTE versus TEE.<sup>13</sup> Some researchers also exhibited that TTE can decrease procedure time and the chances of radiation exposure but as we had

only a single group of patients in this study so we are unable to compare procedure time with other contemporary approaches.<sup>10</sup> There were few limitations of this study as well. As this was a single centre study conducted on a relatively small size, our findings should be verified in other multi-centric large sample size studies.

## CONCLUSION






Transcatheter device closure of secundum atrial septal defect was found to be effective and safe using TTE. Further prospective studies should also be planned to explore mid-term and long-term outcomes of transcatheter device closure of secundum ASD employing TTE imaging.

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1	Rubina Tousif	Data collection, Drafting.	
2	Muhammad Younas	Critical revisions, Proof reading.	
3	Imran Javaid	Concept and Designing.	
4	Tauseef Asma Chaudhary	Data analysis, Literature review.	
5	Baqir Maqbool	Literature review, Discussion.	
6	Shoaib Saleem	Literature review, Discussion.	