Al-Azhar International Medical Journal

Volume 5 | Issue 4 Article 4

4-30-2024

Section: Cardiology

Effect of Transcatheter Closure of Atrial Septal Defect on Right Ventricle Size and Function and Tricuspid Regurgitation Between Variable Age Groups Assessed By 2D Transthoracic Echocardiography

Sami Hassan Nouh
Cardiology, Faculty of Medicine, Al- Azhar University, Cairo, Egypt

Hani Abdulshafouk Khalaf
Cardiology, Faculty of Medicine, Al- Azhar University, Cairo, Egypt

Mohamed Ahmed Qiati
Cardiology, Faculty of Medicine, Al- Azhar University, Cairo, Egypt, mohamedahmedkiaty@gmail.com

How to Cite This Article

Nouh, Sami Hassan; Khalaf, Hani Abdulshafouk; and Qiati, Mohamed Ahmed (2024) "Effect of Transcatheter Closure of Atrial Septal Defect on Right Ventricle Size and Function and Tricuspid Regurgitation Between Variable Age Groups Assessed By 2D Transthoracic Echocardiography," *Al-Azhar International Medical Journal*: Vol. 5: Iss. 4, Article 4.
DOI: https://doi.org/10.58675/2682-339X.2348

ORIGINAL ARTICLE

Effect of Transcatheter Closure of Atrial Septal Defect on Right Ventricle Size and Function and Tricuspid Regurgitation Between Variable Age Groups Assessed By 2D Transthoracic Echocardiography

Sami H. Nouh, Hani A. Khalaf, Mohamed A. Qiati *

Department of Cardiology, Faculty of Medicine, Al- Azhar University, Cairo, Egypt

Abstract

Background: ***An ostium secundum defect (ASD) is the most common type of atrial septal defect. Percutaneous transcatheter closure only works for ostium secundum anomalies and is less risky for the patient.***

The work aims : ***to evaluate the short-term impact of percutaneous catheter closure of ASD on right ventricular (RV) size, volume, and function, as well as on tricuspid regurgitation, across a range of age groups of patients with secundum ASD.***

Patients and methods: ***We conducted this prospective observational study on 30 patients diagnosed with secundum ASD who visited the outpatient clinic and echocardiography laboratory of the cardiology department at El-Sayeed Galal University Hospital from August 2022 to June 2023.***

Results: ***A statistically significant drop occurred between the start of the study and three months after its closure. When comparing groups II and III, group I's RV basal, mid, and longitudinal diameters were smaller than those of groups II and III. We found a significant gap [p-value = 0.003] in TR across the several investigated groups. On the other hand, we did not discover any statistically significant variations amongst the three groups in accordance with FAC%, TAPSE, or TASV.***

Conclusion: ***The early percutaneous closure of ostium second ASD at a young age leads to a higher rate of RV remodeling reversal and better functional status.***

Keywords: Transcatheter Closure; Atrial Septal Defect; Tricuspid Regurgitation; 2 D Transthoracic Echocardiography

1. Introduction

Congenital cardiac defects and ASDs have become more common in newborns during the past half-century. Less than one in a thousand infants in the 1930s was born with a congenital cardiac defect. Atrial septal defects were identified in less than 0.5 per 1,000 live births between 1945 and 1949. 1

The prevalence of ASD has notably increased, and this is actually not due to an increase in disease as much as improvements in imaging modalities and practitioner training. The increased incidence of congenital cardiac disease has been linked to several causes, one of which is advancing mother age.2

From the most common to the least common, below are the five different kinds of ASD: ostium secundum defect, ostium primum defect, sinus venous defect, and coronary sinus defect. 3

In order to prevent consequences like stroke, dysrhythmias, and pulmonary hypertension, ASD closure may be necessary for large defects that do not close spontaneously. Both percutaneous and surgical procedures are available modalities to close an ASD. 4 Evidence of pulmonary to systemic flow equal to or more than 1.5:1 or right heart chamber dilatation constitutes indications for closure. Percutaneous transcatheter closure is only effective for repairing ostium secundum defects. 5

This study aims to assess the effect [3 months post-procedural] of percutaneous catheter closure of ASD on RV size, volume, function and tricuspid regurgitation between variable age groups of patients with secundum ASD.

Accepted 14 April 2024.
Available online 30 April 2024

* Corresponding author at: Department of Gastroenterology, Hepatology, and infectious diseases Faculty of Medicine, Al-Azhar University
E-mail address: mohamedahmedkiaty@gmail.com (M. A. Qiati).

https://doi.org/10.58675/2682-339X.2348

2. Patients and methods

From August 2022 to June 2023, the Cardiology Department at El-Sayeed Galal University Hospital conducted this prospective observational study on 30 cases with a diagnosis of second ASD who presented to the outpatient clinic and echocardiography laboratory. Patients were classified into three groups: Group I: cases aged less than 10 years; Group II: patients aged from 10 to 30 years; and Group III: cases aged above 30 years.

The study evaluated patients with second ASD who were 3 years or older, had a left-to-right shunt Qp/Qs ratio of less than 1.5:1, and had dilatation of the right heart chamber for percutaneous ASD closure.

2.1.Exclusion Criteria: ASD Patients not eligible for percutaneous closure include those with depressed right and left ventricular function, cardiomyopathy, rhythm, and conduction issues (atrial flutter, atrial fibrillation, AV block, and left bundle branch block), refusal or absent follow-up, and poor echo imaging.

2.2.Ethical considerations: This study was approved by the Al-Azhar University Hospitals Ethical Committee. All enrolled subjects provided informed consent. The World Medical Association's Code of Ethics [Declaration of Helsinki] for human experimentation guided the creation of the study protocol. [6]

2.3.Methods:

We subjected all cases to a full medical history general and local examination. We looked for signs of pulmonary hypertension, RV volume overload, 12-lead electrocardiogram, chest x-ray, CBC, and serum creatinine. We obtained standard echocardiographic measurements in accordance with the recommendations of the American Society of Echocardiography. [7]

We conducted standard 2D TTE exams on a "Philips Infinity 50" [Philips Medical Systems, Andover, USA] ultrasound machine, equipped with "S5-1" matrix array transducers fitted with STE technology and using a multi-frequency [1–5 MHz]. Using an apical 4-chamber view, we obtained the highest values for the basal, mid, and longitudinal dimensions of the RV at the end-diastole. We then calculated the diameter ratio of the right ventricle to the left ventricle (RV/LV). It was also possible to determine the size of the right atrium (RAA).

It was possible to record the movements of the RV endocardium during diastole (RVEDA) and systole (RVESA) by following it from the annulus along the free wall to the apex and back through the interventricular septum.

We used body surface area (BSA) as the index for all measured metrics. The Bernoulli equation calculated the estimated systolic pulmonary artery pressure (ESPAP) as follows: [ESPAP] = 4 [TR velocity] 2 + RA pressure.

We evaluated the systolic and diastolic functions of the RV after the measurement analysis. With the help of M-mode lateral annulus data, we determined the tricuspid annular plane systolic excursion (TAPSE) with M-mode lateral annulus data. We determined the RV fractional area change (FAC%) by dividing the difference between the RV end-diastolic area and the RV end-systolic area by the RV end-diastolic area and then multiplying that number by 100.

We also determined the annular velocities of the tricuspid valve in systole (referred to as TASV or S) and early diastole (referred to as e/) using pulsed-wave [PW] Doppler tissue imaging. We determined the early diastolic flow velocity (E), the late diastolic flow velocity (A), and the deceleration time (DT).

We used the latest version of the Statistical Package for the Social Sciences (SPSS) to analyze the data statistically. We represented the qualitative data using percentages and frequencies. We presented the numbers as a median [IQR] because they did not follow a normal distribution, as tested by the Kolmogorov-Smirnov and Shapiro-Wilk tests. We conducted the Kruskal-Wallis test, chi-square test, and P-value.

3. Results

Table 1. Description of demographic data in all studied patients.

		Studied patients (N = 30)	
Age (years)	Mean ±SD	21.1 ± 13.07	
	Min - Max	3 – 45	
Sex	Male	13	43.3%
	Female	17	56.7%
BSA (m^2)	Mean ±SD	1.12 ± 0.41	
	Min - Max	0.6 – 2.0	
BMI (kg/m^2)	Mean ±SD	26.5 ± 4.05	
	Min - Max	21 – 37	

As regards age, the mean age of all studied patients was 21.1 ± 13.07 years, with minimum age of 3 years and a maximum age of 45 years. There were 13 males (43.3%) and 17 females (56.7%) in the studied patients. The mean BSA of all studied patients was 1.12 ± 0.41 m2 with minimum BSA of 0.6 m2 and maximum BSA of 2 m2. The mean BMI of all studied patients was 26.5 ± 4.05 kg/m2, with minimum BMI of 21 kg/m2 and a maximum BMI of 37 kg/m2.

Table 2. Comparison of baseline 2D ECHO Doppler data as regard investigated age groups.

BASELINE ECHO DOPPLER		AGE GROUPS Group I [n = 7]	Group II [n = 13]	Group III [n = 10]	KW	P-VALUE
RV BASAL	Median	3.8	4.2	5	19.8	< 0.001 HS
	IQR	3.6 - 4.3	4 - 4.3	4.8 - 5.25		
RV MID	Median	3.3	3.7	4	11.6	< 0.001 HS
	IQR	3.1 - 3.8	3.45 - 3.8	3.9 - 4.05		
RV LONG	Median	5.8	7.6	8.5	17.7	< 0.001 HS
	IQR	5 - 7	6.5 - 7.95	8.35 - 8.6		
RV/LV RATIO	Median	1	1.1	1.2	4.6	0.099 NS
	IQR	1 - 1.1	1 - 1.15	1.1 - 1.2		
RVEDA [CM²]	Median	15	23	40	16.4	< 0.001 HS
	IQR	15 - 17	14.5 - 25.5	36.5 - 45.5		
RVESA [CM²]	Median	8.7	14	24	20.6	< 0.001 HS
	IQR	8 - 9	9 – 18	24 - 25		
FAC [%]	Median	36	36	36	1.99	0.369 NS
	IQR	36 - 47	34.5 - 40.5	36 - 41		
TAPSE [MM]	Median	23	23	23	0.051	0.975 NS
	IQR	20 - 24	20 – 25	19.5 - 31		
S WAVE [CM/S]	Median	14	13	13	0.37	0.827 NS
	IQR	11 - 15	11.5 - 14.5	11 - 13.5		
TV E/A	Median	1.2	1.2	1.4	3.08	0.214 NS
	IQR	0.9 - 1.6	1.05 - 1.4	1.15 - 1.85		
TV E/E`	Median	6.9	6.8	7	6.4	0.041 S
	IQR	6.7 - 7.2	6.7 - 6.95	6.95 - 7.3		
TV DT [MS]	Median	150	145	148	1.99	0.369 NS
	IQR	140 - 155	140 – 150	142.5 - 150		
DEFECT SIZE [CM]	Median	2.4	2.5	3	9.6	0.008 S
	IQR	2 – 2.5	2.3 – 2.8	2.5 – 3.15		
MAPSE [MM]	Median	15	15	15	0.217	0.897 NS
	IQR	14 - 16	14 – 16	15 - 16.5		
TR	Trivial	2 28.6%	4 30.8%	0 0%	X^2 = 16.1	0.003 S
	Mild	5 71.4%	9 69.2%	4 40%		
	Moderate	0 0%	0 0%	6 60%		

X2: Chi-square test. S: p-value < 0.05 is considered significant. KW: Kruskal Willis test. NS: p-value > 0.05 is considered non-significant.

Regarding baseline 2D ECHO Doppler data, there was a highly significant decrease in RV basal, RV mid, RV longitudinal, RVEDA, and RVESA in group I when matched with group II. There was no significant distinction among the studied groups as regards RV/LV ratio [p-value = 0.099], FAC% [p-value = 0.369], TAPSE [p-value = 0.975], S wave [p-value = 0.827], TV E/A [p-value = 0.214], TV DT [p-value = 0.369], and MAPSE [p-value = 0.897]. There was a significant decrease in TV E/E' [p-value=0.041] in group I when matched with group II and defect size [p-value = 0.008] in group I and group II when matched with group III. There was a significant variance [p-value = 0.003] among the examined groups [I, II, and III] with regard to TR.

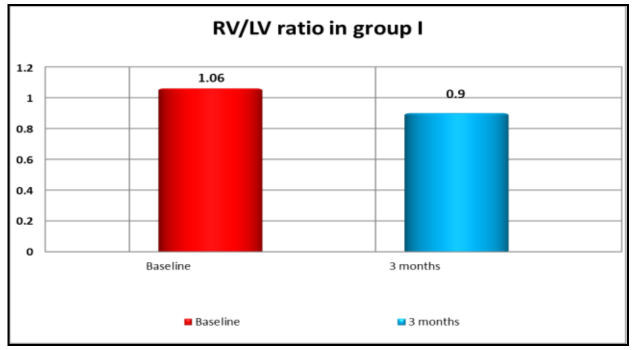

Figure 1. comparison of RV/LV ratio in group I patients.

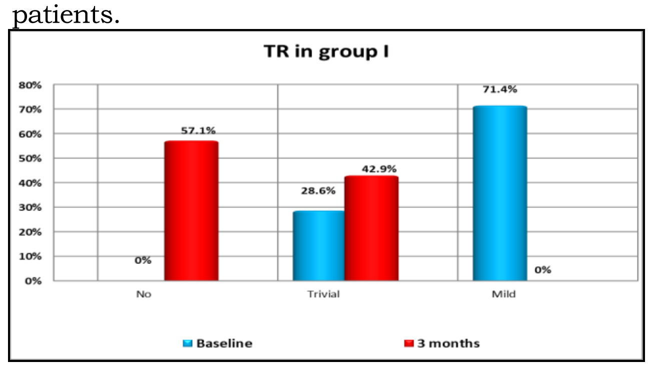

Figure 2. comparison of TR ratio in group I cases.

As regard the RV/LV ratio, there was a significant [p-value = 0.007] decreased RV/LV ratio at 3 months when compared with the baseline ratio.TR, there was a significant [p-value = 0.01] variation among baseline and 3 months ECHO as follows: At baseline and 3 months ECHO.

Table 3. Comparison of studied ECHO data before and 3 months after in group I patients.

		GROUP I Baseline (n = 7)	3 months (n = 7)	T	P-VALUE
RV BASAL	Mean	3.93	3.71	1.19	0.254 NS
	±SD	0.36	0.30		
RV MID	Mean	3.44	3.29	0.85	0.407 NS
	±SD	0.39	0.29		
RV LONG	Mean	5.84	5.73	0.26	0.798 NS
	±SD	0.86	0.77		
RV/LV RATIO	Mean	1.06	0.90	3.26	0.007 S
	±SD	0.08	0.10		
RVEDA (CM²)	Mean	16.50	16.29	0.143	0.889 NS
	±SD	2.63	2.98		
RVESA (CM²)	Mean	8.61	8.83	0.28	0.783 NS
	±SD	0.51	1.95		
FAC (%)	Mean	39.86	45.29	2.03	0.065 NS
	±SD	5.43	4.54		
TAPSE (MM)	Mean	22.86	24.14	0.75	0.465 NS
	±SD	3.24	3.13		
S WAVE (CM/S)	Mean	13.07	13.00	0.069	0.946 NS
	±SD	2.05	1.83		
TV E/A	Mean	1.26	1.26	0.0	1.0 NS
	±SD	0.41	0.28		
TV E/E`	Mean	6.99	6.74	1.87	0.086 NS
	±SD	0.26	0.22		
TV DT (MS)	Mean	151.43	148.57	0.4	0.695 NS
	±SD	10.29	15.74		
MAPSE (MM)	Mean	15.00	15.14	0.15	0.881 NS
	±SD	1.91	1.57		
TR	No	0 0%	4 57.1%	X^2 = 9.2	0.01 S
	Trivial	2 28.6%	3 42.9%		
	Mild	5 71.4%	0 0%		

S: p-value < 0.05 is considered significant. X2: Chi-square test.

No statistically significant difference (p-value < 0.05) between baseline ECHO data and 3-month ECHO in group I patients except for the RV/LV ratio; there was a statistically significant (p-value = 0.007) decreased RV/LV ratio at 3 months (0.9 ± 0.1) when compared with baseline RV/LV ratio (1.06 ± 0.08). TR, there was a statistically significant (p-value = 0.01) difference between baseline and 3 months ECHO as follows: At baseline ECHO, there were 2 patients (28.6%) with trivial TR and 5 patients (71.4%) with mild TR. At 3 months ECHO: there were 4 patients (57.1%) with no TR and 3 patients (42.9%) with trivial TR.

Table 4. Comparison of studied ECHO data before and 3 months after in group II patients.

		GROUP II				T	P-VALUE
		Baseline [n = 13]		3 months [n = 13]			
RV BASAL	Mean	4.15		3.87		3.2	0.004 S
	±SD	0.26		0.17			
RV MID	Mean	3.62		3.40		2.22	0.035 S
	±SD	0.28		0.23			
RV LONG	Mean	7.22		6.96		0.62	0.541 NS
	±SD	1.06		1.03			
RV/LV RATIO	Mean	1.08		0.90		4.9	< 0.001 HS
	±SD	0.10		0.09			
RVEDA [CM²]	Mean	22.09		20.23		0.66	0.516 NS
	±SD	7.57		6.80			
RVESA [CM²]	Mean	13.85		11.77		1.17	0.252 NS
	±SD	4.83		4.17			
FAC [%]	Mean	37.00		41.92		2.65	0.014 S
	±SD	4.90		4.55			
TAPSE [MM]	Mean	22.08		25.54		1.6	0.122 NS
	±SD	6.86		3.67			
S WAVE [CM/S]	Mean	13.00		13.77		1.16	0.256 NS
	±SD	1.91		1.42			
TV E/A	Mean	1.20		1.12		1.01	0.322 NS
	±SD	0.20		0.19			
TV E/E`	Mean	6.83		6.67		2.06	0.050 NS
	±SD	0.21		0.19			
TV DT [MS]	Mean	140.31		149.69		1.25	0.223 NS
	±SD	18.74		19.50			
MAPSE [MM]	Mean	15.23		15.17		0.11	0.907 NS
	±SD	1.24		1.47			
TR	No	0	0%	7	53.8%	X^2 = 16.4	< 0.001 HS
	Trivial	4	30.8%	6	46.2%		
	Mild	9	69.2%	0	0%		

Except for RV basal and RV mid, there was no significant distinction between baseline and 3-month ECHO data in group II patients. RV basal at 3 months was significantly different from RV basal at baseline (p = 0.004) & RV mid at 3 months was significantly different from RV mid at baseline (p = 0.035). The ratio of RV to LV was likewise significantly significant (p <0.001). There was a significant [p = 0.014] reduction in the RV/LV ratio at 3 months compared to the RV/LV ratio, FAC%, at baseline. When comparing FAC% and TR at baseline and after 3 months, there was a significant rise in FAC% at 3 months. Both at the first ECHO and after three months.

Table 5. Comparison of studied ECHO data before and 3 months after in group III patients.

		GROUP III				T	P-VALUE
		Baseline [n = 10]		3 months [n = 10]			
RV BASAL	Mean	5.01		4.49		2.55	0.02 S
	±SD	0.44		0.47			
RV MID	Mean	4.03		3.67		2.39	0.028 S
	±SD	0.38		0.29			
RV LONG	Mean	8.42		7.99		2.39	0.028 S
	±SD	0.38		0.42			
RV/LV RATIO	Mean	1.14		0.96		6.4	< 0.001 HS
	±SD	0.07		0.05			
RVEDA [CM²]	Mean	38.00		35.10		0.83	0.415 NS
	±SD	7.80		7.75			
RVESA [CM²]	Mean	23.00		20.40		1.54	0.141 NS
	±SD	3.53		4.01			
FAC [%]	Mean	37.50		41.00		1.65	0.115 NS
	±SD	4.43		5.01			
TAPSE [MM]	Mean	22.72		25.10		0.75	0.462 NS
	±SD	9.27		3.78			
S WAVE [CM/S]	Mean	12.80		13.30		0.63	0.533 NS
	±SD	1.99		1.49			
TV E/A	Mean	1.46		1.41		0.34	0.733 NS
	±SD	0.37		0.27			
TV E/E`	Mean	7.09		6.85		3.0	0.008 S
	±SD	0.22		0.12			
TV DT [MS]	Mean	143.30		147.20		0.58	0.563 NS
	±SD	15.74		13.80			
MAPSE [MM]	Mean	15.40		14.90		0.69	0.499 NS
	±SD	1.43		1.79			
TR	No	0	0%	2	20%	X^2 = 11.1	0.011 S
	Trivial	0	0%	3	30%		
	Mild	4	40%	5	50%		
	Moderate	6	60%	0	0%		

There was no statistically significant disparity among baseline ECHO data and 3-month ECHO in group III patients except for RV basal, RV mid, RV long, and TV E/E'. There was a statistically significant decline in RV basal at 3 months when matched with baseline. RV basal [p-value = 0.02], RV mid at 3 months when compared with baseline RV mid [p-value = 0.028], RV long at 3 months when matched with baseline RV long [p-value = 0.028] and E/E’ at 3 months when matched with baseline E/E’ [p-value = 0.011], RV/LV ratio, there was highly significant decreased RV/LV ratio at 3 months when matched with baseline RV/LV ratio and TR, there was significant [p-value = 0.011] variation amongst baseline & 3 months ECHO as follows: At baseline ECHO and 3 months ECHO.

Table 6: Comparison of 3 months 2D ECHO Doppler data as regard studied age groups.

3 MONTHS ECHO DOPPLER		AGE GROUPS			KW	P-VALUE
		Group I [n = 7]	Group II [n = 13]	Group III [n = 10]		
RV BASAL	Median	3.6	3.9	4.3	18.8	< 0.001 HS
	IQR	4-3.4	3.8-4	4.2-4.9		
RV MID	Median	3.2	3.4	3.6	7.6	0.021 S
	IQR	3-3.6	3.3-3.5	3.5-3.8		
RV LONG	Median	5.5	7.5	8	16.1	< 0.001 HS
	IQR	5-6.8	6.3-7.7	7.9-8.4		
RV/LV RATIO	Median	0.9	0.9	1	2.6	0.269 NS
	IQR	0.8-1	0.9-1	0.9-1		
RVEDA [CM²]	Median	15	21	37	16.2	< 0.001 HS
	IQR	14-20	14-23	33.5-42		
RVESA [CM²]	Median	8	12	22	17.3	< 0.001 HS
	IQR	7-11	8-15	20-23		
FAC [%]	Median	45	42	40	3.2	0.198 NS
	IQR	42-49	39-46	38-45		
TAPSE [MM]	Median	23	25	24	0.76	0.681 NS
	IQR	22-26	24-29	22-29		
S WAVE [CM/S]	Median	14	14	13	1.25	0.534 NS
	IQR	11-14	13-15	12-15		
TV E/A	Median	1.1	1	1.4	6.65	0.036 S
	IQR	1.1-1.4	1-1.2	1.15-1.55		
TV E/E`	Median	6.7	6.7	6.8	5.66	0.059 NS
	IQR	6.6-6.9	6.5-6.7	6.75-7		
TV DT [MS]	Median	150	154	150	1.24	0.535 NS
	IQR	130-160	150-160	145-155		
MAPSE [MM]	Median	15	15	15	0.015	0.993 NS
	IQR	14-17	14-16	13.5-16.5		
TR	No	4 57.1%	7 53.8%	2 20%	X^2 = 12.3	0.015 S
	Trivial	3 42.9%	6 46.2%	3 30%		
	Mild	0 0%	0 0%	5 50%		

As regards 3-month 2D ECHO Doppler data, there was a highly significant decrease in RV basal, RV longitudinal, RVEDA, and RVESA in group I when matched to group II. There was no significant disparity among the examined groups regarding RV/LV ratio [p-value = 0.269], FAC% [p-value = 0.198], TAPSE [p-value = 0.681], S wave [p-value = 0.534], TV E/E' [p-value = 0.059], TV DT [p-value = 0.535], and MAPSE [p-value = 0.993]. There was a significant decrease in RV mid [p-value = 0.021] in group I when matched with group II & group III, and TV E/A [p-value = 0.036] in group I & group II when matched with group III. There was a significant disparity [p-value = 0.015] concerning TR among the examined groups.

4. Discussion

In our study, we aimed to assess the effect (at 3 months post-procedural) of percutaneous catheter closure of ASD on RV size, volume, and function and on TR severity between variable age groups of patients with secundum ASD (group 1: less than 10 years, group 2: 10–30 years, and group 3: above 30 years). We categorized our patients into three groups based on age to find out if patients with early ASD closure might benefit more than patients with late closure (group I: less than 10 years, group II: from 10 to 30 years, and group III: above 30 years).

In terms of right heart dimensions, in group I (age less than 10 years), we found no statistically significant difference (p-value < 0.05) between baseline Echo-Doppler data and 3-month Echo-Doppler data except for the RV/LV ratio, where there was a statistically significant (p-value = 0.007) decrease in the RV/LV ratio at 3 months (0.9 ± 0.1) when compared with the baseline RV/LV ratio (1.06 ± 0.08).

In group II (age 10–30 years), we found no statistically significant difference (p-value < 0.05) between baseline Echo-Doppler data and 3-month Echo-Doppler data except for RV basal was statistically significant (p-value = 0.004). RV basal decreased at 3 months (3.87 ± 0.17) when compared with baseline RV basal (4.15 ± 0.26). RV mid: there was a statistically significant (p-value = 0.035) decrease in RV mid at 3 months (3.4 ± 0.23) when compared with baseline RV mid (3.62 ± 0.28). There was a highly statistically significant (p-value < 0.001) decrease in RV/LV ratio at 3 months (0.9 ± 0.09) when compared with the baseline RV/LV ratio (1.08 ± 0.1).

In group III (age above 30 years), we found no statistically significant difference (p-value < 0.05) between baseline Echo-Doppler data and 3-month Echo-Doppler data except for RV basal, where there was a statistically significant difference (p-value = 0.02). RV basal decreased at 3 months (4.49 ± 0.47) when compared with baseline RV basal (5.01 ± 0.44). RV mid decreased statistically significantly (p-value = 0.028) at 3 months (3.67 0.29) when compared to baseline RV mid (4.03 0.38). RV long decreased statistically significantly (p-value = 0.028) at 3 months (7.99 ± 0.42) when compared to baseline RV long (8.42 ± 0.38). The RV/LV ratio was highly statistically significant (p-value < 0.001). Decreased RV/LV ratio at 3 months (0.96 ± 0.05) when compared with baseline RV/LV ratio (1.14 ± 0.07).

When comparing the three studied groups, we found a significant decrease in RV basal diameter in group I when compared with groups II and III.

We also found a significant [p-value = 0.021] decrease in RV mid-diameter in group I when compared with group II and group III, as well as a significant reduction in RV longitudinal diameter in group I when compared with group II and group III.

These results disagreed with Humenberger, Michael, et al.[8], who showed that absolute changes in RV size did not differ significantly among different age groups, although they observed a decrease in RV size in all age groups.

Many studies, such as Kaya et al. [9]; Akula et al. [10], have demonstrated the regression of RV dimensions after ASD closure despite not grouping their patients according to age.

In the three groups that were studied, there was no significant increase in FAC% after the intervention. The only group that did have an increase was group II, where the FAC% at 3 months was 41.92 ± 4.55, which was statistically significant [p-value = 0.014].

When comparing the three studied groups, there was no significant disparity [p-value = 0.198] with regard to FAC% among the investigated groups [I, II, and III]. Three months post-device closure, we found no significant variation in TAPSE [p-value = 0.681] or TASV [p-value = 0.534] among the examined groups.

We looked at the 3-month follow-up Echo of the three groups we studied and found that TV E/A was significantly lower in groups I and II compared to group III (p-value = 0.036). There was no statistically significant difference between groups I, II, and III for TV E/E', and there was no significant difference [p-value = 0.535] between groups I, II, and III for TV DT.

Regarding RV diastolic function, E and A are load dependent, whereas tissue Doppler e' is less load dependent, so E/e has gained importance for measuring diastolic dysfunction. According to ASE guidelines (Lang et al.), E/e' > 6 signifies diastolic dysfunction. [7]

In our study, we tracked the diastolic functions of all patients and found no statistically significant difference between the baseline echo parameters of RV diastolic function and the same parameters 3 months after closure. The only group where there was a statistically significant difference was group III, where E/e dropped from 7.09 ± 0.22% at baseline to 6.85 ± 0.12% at 3 months.

This was consistent with Vidya Sagar Akula, D.M. ,[10] who found a statistically significant decrease in E/e' (4.7 _ 1.5 vs. 5.9 _ 5.0; P < 0.03), a mild increase in E/A (1.5 _ 0.4 vs. 1.4 _ 0.3; P < 0.03), and no significant difference in DT from baseline to 6 months post-device closure (169.6 _ 46.0 vs. 167.7 _ 49.8 vs. 166.9 _ 31.5). (Note that they did not specify it by age.)

MAPSE refers to the longitudinal displacement of the mitral valve annular plane during LV contraction. We measure it to evaluate longitudinal LV function, and various cardiac conditions can affect it earlier than other parameters like LVEF. Researchers have reported average normal values in the range of 12–15 mm. When comparing the three studied groups, we found no statistically significant difference between baseline MAPSE and 3-month MAPSE.

When we looked at the 3-month Echo-Doppler data of the three age groups we studied, we saw that there was a significant difference (p-value = 0.015) in TR between the three groups (I, II, and III). In group I, there were 3 patients [42.9%] with trivial TR and 4 patients [57.1%] with no TR. In group II, there were 6 patients [46.2%] with trivial TR and 7 patients [53.8%] with no TR. In group III, there were 3 patients [30%] with trivial TR, 5 patients [50%] with mild TR, and 2 patients [20%] with no TR.

5. *Conclusion*

A statistically significant decrease in right heart chamber diameters, with the effect being larger in group I patients (those younger than 10 years old), lending credence to the idea that earlier closure is preferable. Furthermore, we discovered no age-related differences in markers of RV systolic function..

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article

Funding

No Funds : Yes

Conflicts of interest

There are no conflicts of interest.

References

1. Giang KW, Mandalenakis Z, Fedchenko M, et al. Congenital heart disease: changes in recorded birth prevalence and cardiac interventions over the past half-century in Sweden. Eur J Prev Cardiol. 2023;30(2):169-176.
2. van der Linde D, Konings EE, Slager MA, et al. Birth prevalence of congenital heart disease worldwide: a systematic review and meta-analysis. J Am Coll Cardiol. 2011;58(21):2241-2247.
3. Celermajer DS. Atrial septal defects: even simple congenital heart diseases can be complicated. Eur Heart J. 2018;39(12):999-1001.
4. Yang MC, Wu JR. Recent review of transcatheter closure of atrial septal defect. Kaohsiung J Med Sci. 2018;34(7):363-369.
5. Vida VL, Barnoya J, O'Connell M, Leon-Wyss J, Larrazabal LA, Castañeda AR. Surgical versus percutaneous occlusion of ostium secundum atrial septal defects: results and cost-effective considerations in a low-income country. J Am Coll Cardiol. 2006;47(2):326-331.
6. General Assembly of the World Medical Association. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. J Am Coll Dent. 2014;81(3):14-18.
7. Lang RM, Badano LP, Mor-Avi V, et al. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging [published correction appears in Eur Heart J Cardiovasc Imaging. Eur Heart J Cardiovasc Imaging. 2015;16(3):233-270.
8. Humenberger M, Rosenhek R, Gabriel H, et al. Benefit of atrial septal defect closure in adults: impact of age. Eur Heart J. 2011;32(5):553-560.
9. Kaya MG, Baykan A, Dogan A, et al. Intermediate-term effects of transcatheter secundum atrial septal defect closure on cardiac remodeling in children and adults. Pediatr Cardiol. 2010;31(4):474-482.
10. Akula VS, Durgaprasad R, Velam V, Kasala L, Rodda M, Erathi HV. Right Ventricle before and after Atrial Septal Defect Device Closure. Echocardiography. 2016;33(9):1381-1388.