ORIGINAL ARTICLE

Atrial septal defects: Pattern, clinical profile, surgical techniques and outcome at Innova heart hospital: A 4-year review

Daberechi K. Adiele, Josephat M. Chinawa, Ijeoma O. Arodiwe, V. Gouthami[1], K. S. Murthy[1], John C. Eze[2], Egbuna. O. Obidike, Fortune A. Ujunwa

Department of Paediatrics, University of Nigeria Teaching Hospital, Ituku-Ozalla, Enugu, Nigeria, [1]Innova Children's Heart Hospital, Hyderabad, Andhra Pradesh, India, [2]Department of Surgery, Cardiothoracic Unit, University of Nigeria Teaching Hospital, Ituku-Ozalla, Enugu, Nigeria

Address for correspondence:
Dr. Josephat M. Chinawa, Department of Paediatrics, Cardiology Firm University of Nigeria Teaching Hospital, Ituku-Ozalla, Enugu, Nigeria.
E-mail: Josephat.chinawa@unn.edu.ng

ABSTRACT

Background: Atrial septal defect (ASD) is a congenital heart defect that leads to shunting of blood between left and right atria. It may be asymptomatic and sometimes may present with heart failure. Surgical repair is definitive, but currently non-surgical procedure is used to close the defect. **Materials and Methods:** It is a retrospective study of patients who underwent transcatheter closure of ASD at Innova Heart Hospital, Hyderabad, India. Echocardiography was repeated at intervals of 24 hours, then at 1, 3 and 6 months after the procedure to assess complications. The morphological characteristics of the ASD, including its diameter, location, shape and the width of surrounding septal margins, were also evaluated. **Results:** From April 2007 to June 2011, 69 consecutive children (29 males, 40 females) with a median age of 9.0 years (range = 3.2–19 years) registered with diagnosis of ASD. The median weight was 31.5 kg (range = 7.5–39.0 kg). Five patients (7.2%) were young children aged 3–5 years. Forty-four (63.8%) of these children presented with symptoms of heart failure, whereas 47 (68.1%) of the cases repaired with device were large-sized ASD. The most common interventional procedures done were Searcare Heart® and Amplatzer® technique with a highest success rate obtained in 2010. **Conclusions:** ASD is a common congenital heart disease with a high success rate for those who undergo intervention.

Key words: Atrial septal defect, children, echocardiography, India

INTRODUCTION

Atrial septal defect (ASD) is a form of congenital heart defect that enables blood flow between two compartments of the heart called the left and right atria. Normally, the right and left atria are separated by a septum called the interatrial septum. If this septum is defective or absent, then oxygen-rich blood can flow directly from the left side of the heart to mix with the oxygen-poor blood in the right side of the heart, or vice versa.[1]

ASD is one of the most common congenital cardiac defects and accounts for approximately 6–10% of all congenital cardiac defects.[2] Young children with ASD are usually asymptomatic and could wait for elective surgical or catheter-based closure for 3 years or more.[3,4]

Shunts from ASD are usually detected in childhood or young adulthood. The defect is generally well tolerated in infants and young children, but symptoms of mild fatigue, poor growth or dyspnoea on exertion may be present.[5] Therefore, early closure could be beneficial for such infants. If the ASD is small, it may not require any intervention, or it may close on its own. ASD, and therefore the shunt, tends to increase with age, and repair usually takes place when ASD is diagnosed.[5] In asymptomatic patients with a large left-to-right shunt, surgical closure should be performed between 2 and 5 years of age.[6]

ASD is not without morbidity. About 40% of such patients may present with cryptogenic stroke at adulthood; paradoxical embolism has also been reported.[7]

Surgical repair of ASD is a well-established procedure and is very safe, with a negligible mortality rate.[8] Transcatheter occlusion of an ASD was first described by King and colleagues in 1976.[9] Although satisfactory results have been reported

Access this article online	
Quick Response Code:	Website: www.nigeriamedj.com
	DOI: 10.4103/0300-1652.129642

with transcatheter occlusion of these defects with a number of devices, only one of them has received Food and Drug Administration (FDA) approval: The Amplatzer® atrial septal occluder (AGA Medical Corporation; Golden Valley, Minn[10]).

This study is carried out to determine the pattern and clinical profile of children with ASD. It is also aimed at determining the different types of interventions done for these patients and their complications.

MATERIALS AND METHODS

The study was conducted at a paediatric cardiac centre, Innova Heart Hospital, Hyderabad, India, established in 2007. The study was approved by the Research and Ethics committee of the hospital. The hospital records showed that from April 2007 to June 2011, a total of 69 patients underwent surgical closure of ASD. A team of experienced paediatric cardiologists performed all the procedures.

The occluder devices used were as follows: 1. detachable coils, 2. Amplatzer® duct occluders (ADOs) and other duct occluders, including 3. Chinese duct occluder manufactured by Shanghai Shape Memory Alloy Material Co., Ltd,[11] which consists of metal mesh woven by nitinol wires with shape memory function, supper elasticity and polyethylene filled mesh. The occluder device has specifications of 4/6, 6/8, 8/10, 10/12, 12/14, 14/16 and 16/18 mm (diameter of "waist" pulmonary arterial end/diameter of aortic end), with lengths between 7 and 8 mm. The delivery system consists of loading sheath, delivery sheath and control wire, on the top of which there are screw threads. There is a spiral shank at the tail end. The diameter of outer sheath is 6-10 F. Other duct occluders also included 4. Cardiofix, 5. Searcare Heart®, 6. Lifetech and 7. Occlutech.

In 2003, the ADO[12] received FDA approval with the specific indication for nonsurgical closure of patent ductus arteriosus. This device is a self-expandable device made from a nitinol wire mesh and polyester fabric. As the occluder is implanted, it expands outward, and the wires push against the rims of the ASD. The polyester fabric induces thrombosis, which closes the communication.

All patients had clinical evaluation and echocardiographic confirmation of the diagnosis. Cardiac catheterisation was done for hemodynamic assessment and shunt estimation. The operation was performed after puncture and systemic heparinisation (100 IU/kg). Intra-operative, intravenous administration of antibiotics was started and continued for 24 hours to prevent infection. For infants, the operation was performed under general anaesthesia, whereas for older children, it was done under courteous sedation.

Data Analysis: Statistic analysis

Statistic analysis was performed using SPSS version 18 software packet. Measurement of data was expressed as both mean and standard deviation (SD). Student's *t*-test was used for inter-group comparison. Level of significance was taken at $P < 0.05$.

RESULTS

Record showed that 69 patients presented with ASD and underwent interventional closure of the defect during the study period. Forty (58%) patients were females while 29 (42%) patients were males, giving a male to female ratio of 1:1.4. Their age ranged from 3.2 to 19 years, with a median age of 9.0 years. Their weight ranged from 7.5 to 39.0 kg, whereas median weight was 31.5 kg. Five patients (7.2%) were young children aged between 3 and 5 years [Table 1].

Forty-four (63.8%) of these children presented with symptoms of heart failure, whereas 47 (68.1%) of the cases repaired were large-sized ASD. The majority had large-sized ASD, whereas small ASD accounted for 1.4% of cases. Table 2 summarises the ASD sizes among the study population.

The device used for the procedure was further shown to have a success rate of 88.4%, as shown in Table 2.

The most common interventional closure procedures done were Searcare Heart® and Amplatzer® technique with a highest success rate obtained in 2010 [Table 3].

DISCUSSION

From our study, there exists a female preponderance among children with ASD. This is in keeping with other studies.[13,14] The reason for this preponderance could be genetic.

Rhodes discovered a new gene associated with the disease. According to the report, a common genetic variation near a gene called *MSX1* is strongly associated with the risk of ASD, and females with ASD may have more of this variation near *MSX1* than their male counterpart.[15]

We noted that majority of our patients with ASD presented with symptoms of heart failure. This is due to late

Table 1: Sociodemographics

	Frequency *N* = 69	Percentage (%)
Sex		
Female	40	59.2
Male	29	40.8
Age [years]		
0-9	52	75.3
10-19	17	24.7
Weight [kg]		
0-9	8	11.6
10-19	34	49.3
20-29	12	17.3
30-39	8	11.6
Not indicated	7	10.2

Table 2: Clinical profiles of ASD and procedures used for repair

	Frequency *N* = 69	Percent (%)
Symptomatic		
Yes	44	63.8
No	24	34.8
Not indicated	1	1.4
Sat_category (%)		
Less than 97	25	36.2
Greater than 97	44	63.8
Intervention		
Small ASD repair	1	1.4
Mod ASD repair	23	33.4
Large ASD repair	45	65.2
Name of device type deployed		
Amplatzer	11	15.9
Cardiofix	3	4.4
Chinese	19	27.5
Searcare Heart®	21	30.4
Lifetech	1	1.5
Occlutech Figulla	13	18.8
Not indicated	1	1.5
Catheterisation		
NO CATH	68	98.6
CATH	1	1.4
Outcome of device used		
Success	61	88.4
Failed	8	11.6
Admission year		
2007	10	14.5
2008	18	26.1
2009	10	14.5
2010	10	14.5
2011	21	30.4

Table 3: Showing admission year in relation to the outcome

	Outcome of attempt	
Admission year	Success *N* = 59	Failed *N* = 10
2011	21 [95.2%]	1 [4.8%]
2010	10 [100.0%]	0 [0]
2009	8 [88.9%]	1 [11.1%]
2008	12 [63.2%]	7 [36.8%]
2007	8 [88.8%]	1 [11.1%]

presentation. Majority of young children with ASD are usually asymptomatic and could wait for elective surgical or catheter-based closure for 3 years or more. However, some infants with ASD who suffer from congestive heart failure, frequent respiratory infection, failure to thrive and progressive moderate-to-severe pulmonary hypertension do so because of late presentation.[16]

A good number of our patients had a large-sized ASD, which explains why we have so many symptomatic patients in our study. It is the degree of shunting that predisposes to increased pulmonary flow and subsequent cardiac decompensation.

All the patients seen during the study period underwent interventional closure. The two common techniques that were carried out were Searcare Heart® and Amplatzer® procedures. The ASO is a self-expanding double-disc device with a central connection waist to stent the ASD. Preliminary human experience regarding its safety and efficiency in closing ASD has been very encouraging.[17-19] The ASO is one of the most frequently used devices to close ASD and has been proven to be highly effective and safe in the short term. Previous reports have confirmed that transcatheter closure of ASD with the ASO achieved comparable efficacy and safety to that of surgical closure. It has some additional advantages, which include less complication rate, requirement of a shorter hospital stay and avoidance of a permanent scar.[20] This is true because we had little or no complications in our patients and their hospital stay was short. The procedure is done in the hybrid theatre or cardiac catheterisation laboratory and requires a team that includes an interventional radiologist or interventional cardiologist. The capital outlay may be more expensive than that in open surgical programme, thereby making the unit cost of interventional treatment higher on the average.

CONCLUSION

ASD is a common congenital heart disease with a high success rate for those who underwent surgery. The use of ASO percutaneous closure devices has become the procedure of choice for closure of ASD in suitable patients.

ACKNOWLEDGEMENTS

The authors acknowledge the Almighty God whose assistance and ideas through the course of this work were priceless. The authors are also grateful to all the doctors and nurses who work at both University of Nigeria Teaching Hospital Enugu and Innova Children's Heart Hospital, Hyderabad. India.

REFERENCES

1. Dickinson DF, Arnold R, Wilkinson JL. Congenital heart disease among 160,480 live-born children in Liverpool 1960 to 1969. Implications for surgical treatment. Br Heart J 1981;46:55-62.
2. Bull C, Deanfield J, de Leval M, Stark J, Taylor JF, Macartney FJ. Correction of isolated secundum atrial septal defect in infancy. Arch Dis Child 1981;56:784-6.
3. Diab KA, Cao QL, Bacha EA, Hijazi ZM. Device closure of atrial septal defects with the Amplatzer septal occluder: Safety and outcome in infants. J Thorac Cardiovasc Surg 2007;134:960-6.
4. Baim D, Grossman W. Profiles in congenital heart disease. In: Grossman's Cardiac Catheterization, Angiography and Intervention. 6th ed. Philadelphia: Lippincott Williams and Wilkins; 2006:148-62.
5. American Heart Association. Guidelines for the evaluation and management of common congenital cardiac problems

in infants, children and adolescents. Available from: www.americanheart.org/presenter.jhtml?identifier=1210 [Last accessed 2013 Jun 29].
6. Fail P. Percutaneous closure of intra-atrial defects: Cryptogenic stroke: An unappreciated problem. Available from: www.cardio.com/powerpoint/CIS_DrFail_Percutaneous Closure Of Intra Atrial Defects_files/frame.htm [Last accessed on 2013 Jun 29].
7. Rigby ML. The era of transcatheter closure of atrial septal defects. Heart 1999;81:227-8.
8. King TD, Thompson SL, Steiner C, Mills NL. Secundum atrial septal defect. Nonoperative closure during cardiac catheterization. JAMA 1976;235:2506-9.
9. Masura J, Gavora P, Formanek P, Hijazi ZM. Transcatheter closure of secundum atrial septal defects using the new self-centering amplatzer septal occluder: Initial human experience. Cathet Cardiovasc Diagn 1997;42:388-93.
10. Magee AG, Huggon IC, Seed PT, Qureshi SA, Tynan M; Association for European Cardiology. Transcatheter coil occlusion of the arterial duct; results of the European Registry. Eur Heart J 2001;22:1817-21.
11. Wang JK, Wu MH, Hwang JJ, Chiang FT, Lin MT, Lue HC. Transcatheter closure of moderate to large patent ductus arteriosus with Amplatzer duct occluder. Cathet Cardiovasc Int 2007;69:572-8.
12. Brickner ME, Hillis LD, Large RA. Congenital heart disease in adults. N Eng J Med 2000;342:256-342
13. Botto LD, Correa A, Erickson JD. Racial and temporal variations in congenital heart defects. Pediatrics 2001;107:E32
14. Rhodes. 'Hole in the heart' disease gene discovered by Manchester researchers could curb childhood deaths. Mancunian Matters.Obtainable from http://en.wikipedia.org/wiki/Atrial_septal_defect. [Last accessed on 2013 June 30].
15. Chen Q, Chen LW, Cao H, Zhang GC, Chen DZ, Zhang H. Intraoperative device closure of atrial septal defect in infants. Ann Thorac Surg 2010;89:1250-4.
16. Sharafuddin MJ, Gu X, Titus JL, Urness M, Cervera-Ceballos JJ, Amplatz K. Transvenous closure of secundum atrial septal defects: Preliminary results with a new self-expanding nitinol prosthesis in a swine model. Circulation 1997;95:2162-8.
17. Masura J, Gavora P, Formanek A, Hijazi ZM. Transcatheter closure of secundum atrial septal defects using the new selfcentering amplatzer septal occluder: Initial human experience. Cathet Cardiovasc Diagn 1997;42:388-93.
18. Thanopoulos BD, Laskari CV, Tsaousis GS, Zarayelyan A, Vekiou A, Papadopoulos GS. Closure of atrial septal defects with the Amplatzer occlusion device: Preliminary results. J Am Coll Cardiol 1998;31:1110-6.
19. Berger F, Vogel M, Alexi-Meskishvili V, Lange PE. Comparison of results and complications of surgical and Amplatzer device closure of atrial septal defects. J Thorac Cardiovasc Surg 1999;118:674-8; discussion 678-80.
20. Du ZD, Hijazi ZM, Kleinman CS, Silverman NH, Larntz K. Amplatzer Investigators. Comparison between transcatheter and surgical closure of secundum atrial septal defect in children and adults: Results of a multicenter nonrandomized trial. J Am Coll Cardiol 2002;39:1836-44.

How to cite this article: Adiele DK, Chinawa JM, Arodiwe IO, Gouthami V, Murthy KS, Eze JC, *et al*. Atrial septal defects: Pattern, clinical profile, surgical techniques and outcome at Innova heart hospital: A 4-year review. Niger Med J 2014;55:126-9.

Source of Support: Nil, **Conflict of Interest:** None declared.