



Transcatheter atrial septal defect closure with amplatzer septal occluder experience in a developing country hospital

Mahrus A Rahman ^{1*}, Riza Noviandi ¹, I Ketut Alit Utamayasa ¹

¹ Department of Child Health, Faculty of Medicine, Universitas Airlangga - Dr. Soetomo Teaching Hospital, Surabaya Surabaya 60131, INDONESIA

*Corresponding author: mahrus.a@fk.unair.ac.id

Abstract

Background: Atrial septal defect (ASD) is one of the left to right shunt congenital heart diseases. Transcatheter closure of ASD with amplatzer septal occluder (ASO) is an alternative to surgery. **Purpose:** To describe the experience of transcatheter ASD closure at Dr. Soetomo Regional Public Hospital. **Methods:** Descriptive study done in children who were diagnosed with isolated ASD. Medical records of transcatheter ASD closure patients were reviewed for five years. The data taken included demographic data, type of echocardiography, procedure and fluoroscopy time, complication, and outcomes. **Result:** There were 22 medical records of transcatheter ASD closure patients with 16 male patients (16/22) with a median age of 84 months (21-168 months age-range). Transthoracic echocardiography guiding was conducted in 19 patients (19/22), where as transesophageal echocardiography was conducted in 3 patients (3/22). The median ASD size was 9.4 mm (5-24 mm size range). Multiple ASD was found in 3 patients (3/22). Mild tricuspid regurgitation was found in 9 patients (9/22), with a median pressure gradient of 31.6 mmHg (25-37.8 pressure range). Median procedure time was 45 minutes (30-190 minutes time range), a median of fluoroscopy time was 8.5 minutes (6-143 minutes time range). Sizing balloon was conducted in 17 patients (17/22). **Conclusion:** Most of the transcatheter ASD closures are effective and efficient as an alternative to surgery.

Keywords: transcatheter, ASD, ASO, echocardiography, children

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INTRODUCTION

Atrial septal defect (ASD) is one of the left to right shunt congenital heart diseases (Park, & Goo, 2019). As with the other congenital heart disease, the clinical consequences of an ASD are directly related to the location of the defect, size, and the presence of other cardiac anomalies (Da Cruz, Ivy, & Jagers, 2014). Congenital disabilities of the atrial septum are one of the most common, almost 13 percent of congenital heart disorders, with a birth prevalence of approximately 2 per 1,000 live births (Schwedler, et al. 2011, Wu, et al. 2010). Size decrease, or spontaneous closure, is most likely to occur in younger patients and those with defects less than 7 to 8 mm in diameter. Patients with a persistent moderate or larger defect will usually suffer from left-to-right shunting if the defect is not corrected. The closure is recommended for patients who exhibit significant right shunting, which results in significant right heart overload (Ibrahim, Granton, & Mehta, 2006; Temesgen, & Haile, 2017).

Closure of an isolated secundum ASD can be achieved by either a surgical or percutaneous transcatheter approach (Rahmawati, Yogiarto, & Zulkarnaen, 2018). Sinus venosus defects, coronary sinus defects, primum ASDs, and complex congenital lesions require surgical correction, also in infants with large secundum defects who present with heart failure may also need to undergo surgical correction (Uoc., & Quan, 2015). The decision on whether or not to refer a patient with symptomatic secundum atrial septal defect to catheter device closure or surgery is individualized based on specific defect anatomy and institutional expertise (Zimmermann, et al. 2019, Shaikh, Nabi, 2012). Transcatheter secundum ASD closure can be highly successful in infants and small children, but it seems to have higher complication rates than transcatheter closure of ASDs in older children in the

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Table 1. Baseline characteristics

Characteristics	n (%)
Sex	
• Male	16 (72.7)
• Female	6 (27.3)
Median age at admission (range) months	84 (21-168)
Median ASD Size (range) mm	9.4 (5 - 24)
Type of echocardiography	
• Transthoracic Echo (TTE) only	19 (86.4)
• Also with Transesophageal Echo (TEE)	3 (13.6)
Length of procedure	
• < 1 hour	17 (77.3)
• > 1 hour	5 (22.7)
Median length of fluoroscopy time (range) minutes	8.5 (6 - 143)
Median ASO size used (range) mm	14 (8 - 30)
Outcomes	
• Success	18 (81.8)
• Failed	4 (18.2)

four- to five-year age range when elective closure is typically performed (Du, et al. 2002). Percutaneous closure will avoid cardiopulmonary bypass, thoracotomy, and atriotomy, and is associated with good outcomes (Mazur, et al. 2013). This approach has largely replaced surgery for the closure of small to moderate secundum ASDs that have appropriate anatomic characteristics (Ibrahim, Granton, & Mehta, 2006).

Echocardiography was used for noninvasive cardiac output monitoring in children after cardiac surgery (Kusumastuti, & Osaki, 2015; Kalçık et al., 2019). The echocardiogram is produced by soundwaves, which make its images based on different intensity (Aziz, et al. 2018). Dr. Soetomo Regional Public Hospital already adopted this method, but its experience is still not fully described yet. This study is carried out to describe the experience of transcatheter ASD closure at Dr. Soetomo Regional Public Hospital Indonesia as one of the developing country hospitals.

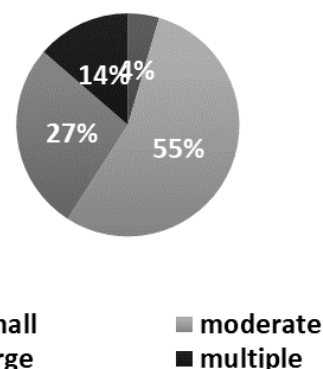
METHOD

A descriptive study was done in children who were diagnosed with isolated ASD and experienced transcatheter closure, based on the medical records for five years. The data taken included demographic data, type of echocardiography, procedure and fluoroscopy time, complication, and outcomes.

A total of 22 patients of ASD pediatric were included in this study. There were 16 male patients (16/22), and six females (6/22) with a median age of 84 months old. Approval was obtained by the authors from the Department of Pediatrics to collect the data and review the records of the included subjects. This study involved the participants in compliance with the ethical research principle based on the research ethic regulation. The study was conducted in compliance with the research principles.

RESULTS

The baseline characteristic can be seen in **Table 1**, where there are 22 medical records of transcatheter

**Fig. 1.** The proportion of ASD types

ASD closure patients. There were 16 male patients (16/22) with a median age of 84 months (21-168 months age range). Transthoracic echocardiography guiding was conducted in 19 patients (19/22), and transesophageal echocardiography was conducted in 3 patients (3/22). The median ASD size was 9.4 mm (5-24 mm size range). Multiple ASD was found in 3 patients (3/22). Mild tricuspid regurgitation was found in 9 patients (9/22), with a median pressure gradient of 31.6 mmHg (25-37.8 pressure range). The median procedure time was 45 minutes (30-190 minutes time range), where the median of fluoroscopy time was 8.5 minutes (6-143 minutes time range). Sizing balloon was conducted in 17 patients (17/22). The median ASO size used was 14 mm (8-30 mm size range). The procedure failed in four patients (4/22) where three patients (3/4) had minimal rim and big size. One patient has residual shunt due to other small defects. From **Figs. 1** and **2**, it can be identified that most of the patients had moderate ASD, and mild tricuspid regurgitation were the most common morbidities. **Fig. 3** suggests that in our hospital, the success of ASD is bigger if the ASD size is smaller.

DISCUSSION

In this study, the experience of ASD transcatheter closure in Dr. Soetomo General Hospital can be observed. Most patients were male, with a median age of more than seven years. The majority of isolated small

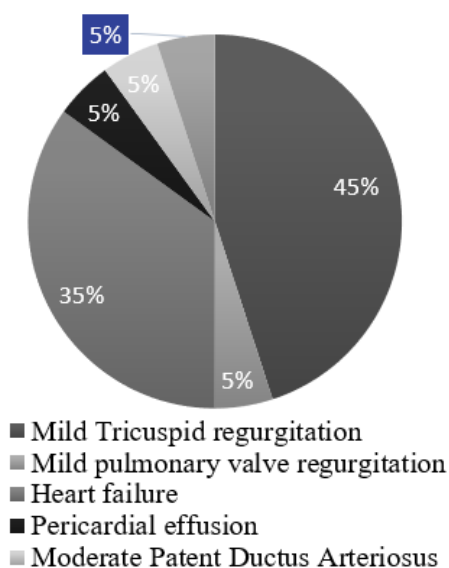


Fig. 2. Proportion of comorbidities

secundum ASDs (<6 mm diameter) would close spontaneously in two until five years. In the absence of associated symptoms, early closure is not indicated for these defects. Defects of moderate (between 6 and 8 mm in diameter) and large (>8 mm in diameter) secundum defects, and other forms of ASDs, would least likely close spontaneously. The closure of even moderate and large isolated secundum ASDs is not recommended in asymptomatic patients before the age of two due to the possibility of spontaneous closure, however how slight it is (Ibrahim, Granton, & Mehta, 2006). The given size of a defect is related to overall heart size, so that an ASD that is 6 mm in diameter would be insignificant in an adult, but would be of moderate size in a newborn. Nevertheless, for patients with a small ASD, no large randomized trials have demonstrated a benefit of the closure of small ASDs in asymptomatic patients (Du, et al. 2002).

The proportion of ASD type was dominated by moderate size. For patients with a persistent moderate or larger defect, left-to-right shunting usually increases

with age if the defect is not corrected. In these patients, closure is recommended for patients who exhibit significant shunting (Ibrahim, Granton, & Mehta, 2006). Comorbidities that happened the most was tricuspid regurgitation, followed by heart failure. The main indication for ASD closure has been the presence of a shunt, which results in significant right heart overload. This situation typically occurs in patients with moderate to large ASDs.

The rate of success was more than 80%. Short-term outcomes of transcatheter closure using all three devices have been excellent, with reported procedural success rates of 88 to 98 percent (Wu, et al. 2010). Long-term outcome data are still limited. In one series of 100 children and young adults (mean age 13 years), the amplatzer device was successfully implanted in 93 patients with a procedure time ranging from 30 to 180 minutes. The total ASD occlusion rate for three months reached 99 percent. Long-term outcomes with the use of the Amplatzer device are also excellent, as was illustrated in a review of 151 children and young adults with a mean age of 11.9 years, who were followed by a median of 78 months after successful closure. There were no deaths or significant complications, and all defects were completely closed for three years and remained closed after that (El-Said, et al. 2015). However, due to the limited sample size and the inability to compare the results with the data from other institutions, further research on this topic is recommended.

CONCLUSION

Most transcatheter ASD closure is effective and efficient as an alternative to surgery.

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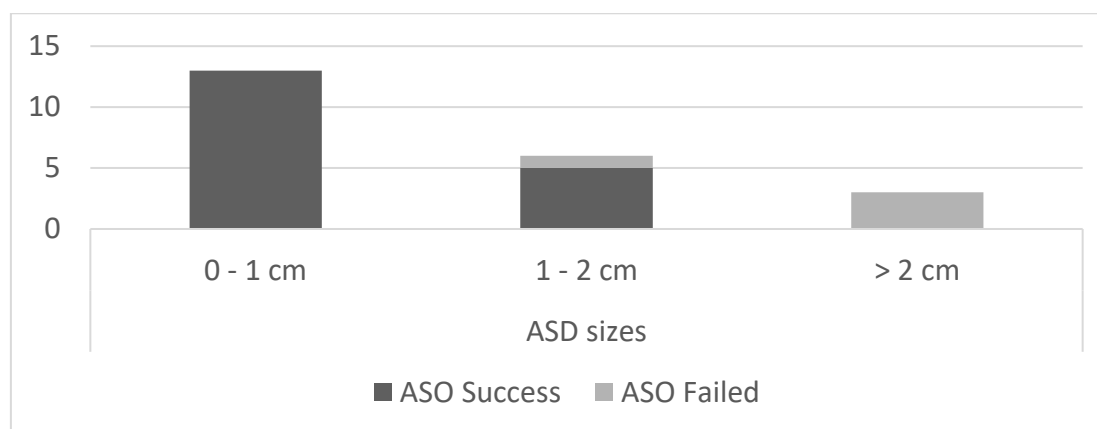


Fig. 3. Crosstabulation of ASD size and ASO success level

REFERENCES

- Aziz, A. S., Sigit, R., Basuki, A., & Hidayat, T. (2018). Cardiac motions classification on sequential PSAX echocardiogram. *Indones. J. Electr. Eng. Comput. Sci.*, 12(3), 1289-1296.
- Da Cruz, E. M., Ivy, D., & Jagers, J. (Eds.). (2014). *Pediatric and congenital Cardiology, cardiac surgery and intensive care*. Springer London.
- Du, Z. D., Hijazi, Z. M., Kleinman, C. S., Silverman, N. H., Larntz, K., & Amplatz Investigator. (2002). Comparison between transcatheter and surgical closure of secundum atrial septal defect in children and adults: results of a multicenter nonrandomized trial. *Journal of the American College of Cardiology*, 39(11), 1836-1844.
- El-Said, H., Hegde, S., Foerster, S., Hellenbrand, W., Kreutzer, J., Trucco, S. M.,... & Porras, D. (2015). Device therapy for atrial septal defects in a multicenter cohort: acute outcomes and adverse events. *Catheterization and Cardiovascular Interventions*, 85(2), 227-233.
- Ibrahim, R., Granton, J. T., & Mehta, S. (2006). An open-label, multicentre pilot study of bosentan in pulmonary arterial hypertension related to congenital heart disease. *Canadian respiratory journal*, 13.
- Kalçık, M., Yesin, M., Güner, A., Bayam, E., Doğan, T., Yetim, M.,... Çelik, O. (2019). Investigation of Elastic Properties of Aorta in Patients with Coronary Slow Flow. *Journal of Clinical and Experimental Investigations*, 10(2), em00725.
- Kusumastuti, N. P., & Osaki, M. (2015). Electric velocimetry and transthoracic echocardiography for non-invasive cardiac output monitoring in children after cardiac surgery. *Crit Care*, 18(2), 37.
- Mazur, W., Siegel, M. J., Miszalski-Jamka, T., & Pelberg, R. (2013). Percutaneous Closures. In *CT Atlas of Adult Congenital Heart Disease* (pp. 263-268). Springer, London.
- Park, I. S., & Goo, H. W. (2019). Atrial Septal Defect (ASD). In *An Illustrated Guide to Congenital Heart Disease* (pp. 17-32). Springer, Singapore.
- Rahmawati, Y. A., Yogiarto, M., & Zulkarnaen, B. S. (2018). The Effect of Dual Antiplatelet Post Percutaneous Coronary Intervention On Aggregation of Platelet In Myocardial Infarction Patients With Diabetes Mellitus and Non Diabetes Mellitus. *Indonesian Journal of Pharmacy*, 29(1), 44.
- Schwedler, G., Lindinger, A., Lange, P. E., Sax, U., Olchvary, J., Peters, B.,... & Hense, H. W. (2011). Frequency and spectrum of congenital heart defects among live births in Germany. *Clinical Research in Cardiology*, 100(12), 1111-1117.
- Shaikh, K., Nabi, F (2012). Secundum Atrial Septal Defect. *Methodist Debakey Cardiovasc J.* 1;8:55–6.
- Temesgen, N., & Haile, A. (2017). Determinants of Nutritional Status of Under-Five Children in Ethiopia: With Particular Reference to Anelmoworeda, Hadiya Zone, Southern Nations, Nationalities and Peoples Region. *Agriculture and Food Sciences Research*, 4(2), 45-57
- Uoc, N. H., & Quan, P. T. (2015). Heart transplant for dextrocardia situs inversus with very complex congenital lesions a challenge of cardiac surgery. *Int J Clin Cardiol*, 2, 049.
- Wu, M. H., Chen, H. C., Lu, C. W., Wang, J. K., Huang, S. C., & Huang, S. K. (2010). Prevalence of congenital heart disease at live birth in Taiwan. *The Journal of pediatrics*, 156(5), 782-785.
- Zimmermann¹, E., Hussain, H., Worku, B., Dougenis, D., & Avgerinos, D. (2019). Atrial septal defect repair in the age of transcatheter devices.