

Characteristics of Congenital Heart Disease Patent Ductus Arteriosus Patients With a Closure With Occluder Transcatheter at Dr. Soetomo Regional General Hospital Period 2019 - 2021

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Abstract

Background: Persistent Ductus Arteriosus (PDA) is a congenital heart defect which is a closing failure of the ductus arteriosus after birth, it can cause Left to Right shunt due to pressure differences and mixing of oxygen-rich and low-oxygen blood. One of the treatments of PDA is an installation of occluder transcatheter which has been carried out in various hospitals in Indonesia.

Objective: The purpose of this study is to know the characteristics of PDA patients with a closure with occluder transcatheter at Dr. Soetomo Regional General Hospital period 2019 – 2021.

Method: This study is an observational descriptive study using secondary data from medical records of PDA patients in Dr. Soetomo Regional General Hospital from 2019 – 2021, to know the characteristics such as age, body weight, body height, gender, nutritional status, occluder usage duration, effects after using occluder, and type of occluder.

Results: There were 50 samples. The results of this study showed that the most common PDA patients are 1 – 5 years old(52%), female patients(62%), with body weight 5 – 10 kg(54%), body height 0 – 100 cm(70%), normal nutritional status(50%), and already using occluder transcatheter for 6 – 12 months(40%) with type Lifetech ADO I(64%), and with result of closed PDA(94%)

Conclusion: The characteristics of PDA patients with a closure with occluder transcatheter at Dr. Soetomo Regional General Hospital period 2019 – 2021 are majority female patients with age range 1 – 5 years old, body weight 5 – 10 kg, body height 0 – 100 cm, ideal nutritional status, already using occluder transcatheter for 6 – 12 months with closed PDA, and using occluder type Lifetech ADO I.

Keywords: PDA; occluder transcatheter; characteristics; age; gender; body weight; body height; nutritional status

1. Introduction

Patent Ductus Arteriosus (PDA) is a congenital heart defect which is a failure of the ductus arteriosus to close after birth, can cause a *Left to Right shunt* due to pressure difference, oxygen-rich and low-oxygen blood will mix¹. In small PDAs, it is usually asymptomatic with a normal pulse and blood pressure. In moderate PDA, it can cause symptoms such as fatigue, stunted growth and development of children, heart murmurs heard, and increased respiratory rate². In cases of severe PDA, it can cause left heart failure, pulmonary hypertension, and eisenmenger syndrome³.

Patent ductus arteriosus is the most common congenital heart disease, there are 6 - 11% of cases of congenital heart disease patients are PDA. Every one baby born suffers from PDA from 2,500 to 5,000 babies born. In Indonesia, there are an estimated 4,000 babies born with PDA each year. Premature babies have a higher prevalence, namely 8,000 premature babies are born with PDA each year⁴.

Various medications and therapies have been devised to treat patients with patent ductus arteriosus. Indomethacin is

one of the NSAID drugs used to help close the ductus arteriosus⁵.

Another measure to close the patent ductus arteriosus is to insert an occluder transcatheter. This non-surgical intervention procedure has been carried out in various hospitals in Indonesia, so that, researcher were encouraged to conduct this study which aims to obtain information about the characteristics of patent ductus arteriosus patients who were closed with occluder transcatheter at Dr. Soetomo Regional General Hospital for the period January 2019 - December 2021. It is hoped that this research can benefit the community and other colleagues who will or are facing cases of patent ductus arteriosus patients who have been closed with a transcatheter occlusion.

2. Methods

This study is an observational descriptive study using secondary data from medical records of PDA patients in Dr. Soetomo Regional General Hospital from 2019 - 2021, to know the characteristics as age, body weight, body height, gender, nutritional status, occluder usage duration, effects after using occluder, and type of occluder. The data was collected by total sampling that met the inclusion and exclusion criteria.

1. Inclusion Criteria

All of the PDA patients with a closure with occluder transcatheter in Dr. Soetomo Regional General Hospital period 2019 - 2021.

2. Exclusion Criteria

All of the PDA patients without a closure with occluder transcatheter in Dr. Soetomo Regional General Hospital period 2019 - 2021.

3. Results and Discussion

There are 115 patients with congenital heart defects at Dr. Soetomo Regional General Hospital period 2019 - 2021. The total of patients with patent ductus arteriosus using occluder transcatheter are 50 patients.

3.1 Age

Table 1. Characteristics of Patent Ductus Arteriosus Patients Using Occluder Transcatheter Based on Patient's Age

Age	Frequency	Percentage
0 - 11 months	9	18%
1 - 5 years	26	52%
6 - 10 years	7	14%
> 10 years	8	16%
Total	50	100%

Age distribution of PDA patients with a closure with occluder transcatheter at Dr. Soetomo Regional General Hospital period 2019 - 2021 the most were in the age group 1 - 5 years old, with a total of 26 patients (52%) and the least in the age group > 10 years, with a total of 8 patients (16%). The average age of the patients in this study was 4.4 years old with the youngest age was 20 days old and the oldest was 20 years old.

Congenital heart disease is a disease that is better prevented and treated as early as possible, so as not affecting the growth and development of children. This is why patients in the age group 1-5 years are the most patients. There are fewer patients aged 0-11 months because some parents were not aware of their child's disorder from the beginning.

Small PDAs are asymptomatic. When the child is a little older, the symptoms of congenital heart disease will become more visible, which in turn makes the patient's parents aware of abnormalities that occur in children⁶.

3.2 Gender

Table 2. Characteristics of Patent Ductus Arteriosus Patiens Using Occluder Transcatheter Based on Patient's Gender

Gender	Frequency	Percentage
Male	19	38%
Female	31	62%
Total	50	100%

PDA patients in women are two times more than men⁷. This is proven by research data from table 2, which shows that 62% of PDA patients at Dr. Soetomo General Regional Hospital is female, and 38% of patients are male. However, another study also stated that gender did not affect the prevalence of patent ductus arteriosus in newborns. The pathophysiology also did not show any significant differences between male and female patients⁸.

3.3 Nutritional Status

3.3.1 Body Weight

Table 3. Characteristics of Patent Ductus Arteriosus Patiens Using Occluder Transcatheter Based on Patient's Body Weight

Body Weight	Frequency	Percentage
0 - 5 kg	4	8%
5 - 10 kg	27	54%
> 10 kg	19	38%
Total	50	100%

Body weight distribution of PDA patients with a closure with occluder transcatheter at Dr. Soetomo Regional General Hospital period 2019 – 2021 the most were in the patient group with a body weight of 5 – 10 kg, with a total of 27 patients (54%). The group of patients weighing > 10 kg consisted of 19 patients (38) and the group of patients weighing 0 - 5 kg consisted of 4 patients (8%). The average patient's body weight in this study was 9.4 kg with the lowest body weight was 2.4 kg and the highest body weight was 70 kg.

3.3.2 Body Height

Table 4. Characteristics of Patent Ductus Arteriosus Patiens Using Occluder Transcatheter Based on Patient's Body Height

Body Height	Frequency	Percentage
0 - 100 cm	35	70%
> 100 cm	15	30%
Total	50	100%

Body height distribution of PDA patients with a closure with occluder transcatheter at Dr. Soetomo Regional General Hospital period 2019 – 2021 the most were in the patient group with a body height of 0 - 100 cm, with a total of 35 patients (70%), while the patients with body height > 100 cm consisted of 15 patients (30%). The average height of the patients in this study was 85 cm with the lowest height was 48 cm and the tallest height was 158 cm.

3.3.3 Nutritional Status

Table 5. Characteristics of Patent Ductus Arteriosus Patiens Using Occluder Transcatheter Based on Patient's Nutritional Status

Nutritional Status	Frequency	Percentage
Malnutrition	17	34%
Deficit Nutrition	7	14%
Ideal	25	50%
Excess Nutrition	0	0%
Obesity	1	2%
Total	50	100%

The patient's nutritional status is calculated by comparing the patient's Body Mass Index (BMI) with the patient's age on the Z score percentile chart. BMI is the ratio of body weight to the square of body height. Table 5 shows that 25 (50%) PDA patients who had a transcatheter occluder installed at Dr. Soetomo Regional General Hospital in 2019 – 2021 has normal nutritional status. However, there were 7 patients (14%) experienced deficit nutrition, and 17 patients (34%) experienced malnutrition. Patients who are obese was 1 patient (2%).

Congenital heart disease can accelerate malnutrition, even causing growth failure. This condition of congenital heart disease can affect the level of appetite, which in the future will affect the nutritional status of the patient⁹.

3.4 Occluder Usage Duration

Table 6. Characteristics of Patent Ductus Arteriosus Patiens Using Occluder Transcatheter Based on Occluder Usage Duration (Per July 2022)

Occluder Usage Duration	Frequency	Percentage
0 - 6 months	1	2%
6 - 12 months	20	40%
13 - 18 months	17	34%
19 - 24 months	9	18%
> 24 months	3	6%
Total	50	100%

The number of PDA patients who had a transcatheter occluder installed at Dr. Soetomo Regional General Hospital period 2019 - 2021, the most were those who had used occluder transcatheter for 6-12 months (40%). This means that the patients have had an occluder transcatheter installation since 6 – 12 months ago, by the period time of July 2021 – December 2021. Then followed by patients who have used occluder transcatheter for 13 – 18 months (34%), by the installation period January 2021 – June 2021. Patients who have used occluder transcatheter for 19-24 months, by the installation period from July 2020 - December 2020, are 18%. Patients who have used occluder transcatheter for > 24 months, by the installation period from January 2019 – June 2020, are 6%. Then the least is patients who have used occluder transcatheter for < 6 months, are 2%.

Installation of occluder transcatheter device is a fairly effective procedure for patients with PDA congenital heart disease because patients who have used occluder transcatheter device, after being followed up for one year after insertion, have no signs of complications, device obstruction, recanalization, thromboembolism, or hemolysis¹⁰. In this study, there are 98% of patients are still using the transcatheter device and can carry out daily activities quite well without experiencing any signs of complications.

3.5 Effects and Changes

Table 7. Characteristics of Patent Ductus Arteriosus Patiens Using Occluder Transcatheter Based on Effects and Changes Experienced by The Patients

Effects and Changes	Frequency	Percentage
Closed PDA	47	94%
Bleeding during and after installation	0	0%
Failed occluder installation	0	0%
Dislodged occluder	1*	2%
Partial occlusion	0	0%
Smoky residual	3	6%
Death at the hospital	1*	2%
Total	50	100%

*There was one 2 years old patient who was diagnosed with PDA pro ADO. The ADO was successfully installed and PDA have been successfully closed. One day after installation, the occluder device was dislodged to the Left Pulmonary Artery, so an attempt was made to install the ADO snare but the snare failed to attach. So, there was planning for PDA ligation surgery on the next day. During the operation, the patient was placed in Cardiopulmonary Bypass for almost 6 hours. However, during PDA surgery and device retrieval, uncontrolled bleeding occurred and eventually the patient died in hospital, so the number of data is counted for one patient.

Of the 50 PDA patients who have occluder transcatheter installed at Dr. Soetomo Regional General Hospital in 2019-2021, there were 47 patients whose PDA was successfully closed (94%), 3 patients with smoky residual (6%), and 1 patient experienced dislodged occluder and died in hospital (2%)

Smoky residual can occur due to temporary opening between devices. This residual will close within 2 weeks - 1 month after installation as a result of coagulation and thrombosis stimulation¹¹.

3.6 Type of Occluder Transcatheter

Table 8. Characteristics of Patent Ductus Arteriosus Patiens Using Occluder Transcatheter Based on Type of Occluder

Type of Occluder	Frequency	Percentage
Lifetech ADO I	32	64%
ADO II	9	18%
Konar MF Occluder	9	18%
AVP	0	0%
Total	50	100%

PDA patients at Dr. Soetomo Regional General Hospital in 2019 – 2021 who used the Lifetech ADO I type device was the most amount, with a total of 32 (64%) patients. A total of 9 (18%) patients used the Konar MF Occluder type device. A total of 9 (18%) patients used ADO II type.

The type of occluder transcatheter owned and used by Dr. Soetomo Regional General Hospital are ADO, ASO(Atrial Septal Occluder), and VSO(Ventricular Septal Occluder). So that all PDA patients who are pro-catheterized, have an ADO-type transcatheter occluder installed¹².

The Amplatzer Duct Occluder (ADO) is the main type of occluder transcatheter used in PDA patients. ADO has different types and sizes depending on the diameter of the patient's duct. Several types of ADO include Konar MF Occluder, Lifetech ADO I, ADO II.

Amplatzer Vascular Plug (AVP) can also be used to close PDA, but for larger ductus size (> 4 mm)¹³.

4. Conclusion

Based on the results and discussion of the study on "Characteristics of Congenital Heart Disease Patent Ductus Arteriosus Patients With a Closure With Occluder Transcatheter at Dr. Soetomo Regional General Hospital Period 2019 - 2021", the following conclusions can be drawn:

- 1) Patients with PDA with a closure with occluder transcatheter at Dr. Soetomo Regional General Hospital period 2019 – 2021 who met the inclusion criteria of the study is a total of 50 patients with a distribution based on age group, the most amount age group 1 – 5 years with a total of 26 patients (52%).
- 2) Patients with PDA with a closure with occluder transcatheter at Dr. Soetomo Regional General Hospital period 2019 – 2021 was dominated by female patients with a total of 31 patients (62%), while male patients totaled 19 patients (38%).
- 3) Patients with PDA with a closure with occluder transcatheter at Dr. Soetomo Regional General Hospital period 2019 – 2021 based on body weight category the most were the group of patients weighing 5 – 10 kg, with a total of 27 patients (54%) with an average patient's body weight of 9.4 kg.
- 4) Patients with PDA with a closure with occluder transcatheter at Dr. Soetomo Regional General Hospital period 2019 – 2021 based on the body height category the most were the patient group with a height of 0 – 100 cm, with a total of 35 patients (75%) with an average patient's body height of 85 cm.
- 5) Patients with PDA with a closure with occluder transcatheter at Dr. Soetomo Regional General Hospital period 2019 – 2021 based on nutritional status, the most amount were patients with ideal nutritional status, with a total of 25 patients (50%).
- 6) Patients with PDA with a closure with occluder transcatheter at Dr. Soetomo Regional General Hospital period 2019 – 2021 based on the duration of using the occluder transcatheter at most is 6 – 12 months, by the installation period July 2021 – November 2021, with a total of 20 patients (40%).
- 7) Patients with PDA with a closure with occluder transcatheter at Dr. Soetomo Regional General Hospital period 2019 – 2021 based on the effects and changes experienced by patients after the installation of occluder device, the most common is the closure of the PDA, with a total of 47 patients (94%).
- 8) There was 1 patient with PDA disease who had an occluder transcatheter installed at Dr. Soetomo Regional General Hospital and the occluder was dislodged and the patient died at the hospital.
- 9) Patients with PDA with a closure with occluder transcatheter at Dr. Soetomo Regional General Hospital period 2019 – 2021 used the Lifetech ADO I type device the most, with a total of 32 patients (64%).

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References

1. Huff, T., Chaudhry, R., Arora, Y. and Mahajan, K. (2021). *Anatomy, Thorax, Heart Ductus Arteriosus*. [online] Available at: <<https://www.ncbi.nlm.nih.gov/books/NBK470160/>>.
2. RSUP Dr. Sardjito. (2020). *Duktus Arteriosus Paten pada Anak*. [online] Available at: <<https://sardjito.co.id/2020/01/10/duktus-arteriosus-paten-pada-anak/>>.

3. Basit, H., Wallen, T. and Sergent, B. (2021). *Eisenmenger Syndrome*. [online] Available at: <https://www.ncbi.nlm.nih.gov/books/NBK507800/>.
4. Amelia, P. (2019). *Patent Ductus Arteriosus (PDA)*. Departemen Ilmu Kesehatan Anak Fakultas Kedokteran Universitas Sumatera.
5. Pusat Jantung Nasional Harapan Kita. (2021). *Penyakit Jantung Bawaan (Tipe Nonsianotik)*. [online] Available at: <https://pjnhk.go.id/artikel/penyakit-jantung-bawaan-tipe-nonsianotik>
6. Gillam-Krakauer, M. and Mahajan, K. (2020). *Patent Ductus Arteriosus*. [online] Available at: <https://www.ncbi.nlm.nih.gov/books/NBK430758/>.
7. Thomson, J. (2022). *Patent Ductus Arteriosus (PDA)*. Available at: <https://www.hopkinsmedicine.org/health/conditions-and-diseases/patent-ductus-arteriosus-pda>.
8. Borges-Lujan, M., Gonzalez-Luis, G.E., Roosen, T., Huizing, M. J. and Villamor, E. (2022). *Sex Differences in Patent Ductus Arteriosus Incidence and Response to Pharmacological Treatment in Preterm Infants: A Systematic Review, Meta-Analysis and Meta-Regression*. *Journal of Personalized Medicine*. 12(1143). [online] Available at: <https://doi.org/10.3390/jpm12071143>.
9. Arodiwe, I., Chinawa, J., Ujunwa, F., Adiele, D., Ukoha, M. and Obidike, E. (2015). *Nutritional status of congenital heart disease (CHD) patients: Burden and determinant of malnutrition at university of Nigeria teaching hospital Ituku – Ozalla, Enugu*. *Pak J Med*. [online] Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4641271/>
10. Al-Hamash, S. M., Wahab, H. A., Khalid, Z. H. and Nasser, I. V. (2012). *Transcatheter Closure of Patent Ductus Arteriosus Using ADO Device: Retrospective Study of 149 Patients*. *Heart Views*. [online] Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3385190/>.
11. Putra, S. T., Djer, M. M., Idris, N. S. and Sastroasmoro, S. (2016). *Transcatheter Closure of Patent Ductus Arteriosus in Adolescents and Adults: A Case Series*. *Acta Medica Indonesiana - The Indonesian Journal of Internal Medicine*, 48(4). [online] Available at: <https://lib.ui.ac.id/file?file=digital/2017-5/20450587-169-775-1-PB.pdf>.
12. RSUD Dr. Soetomo. (2022). *Pusat Pelayanan Jantung Terpadu*. [online] Available at: <https://rsudsoetomo.jatimprov.go.id/rn-pusat-pelayanan-jantung-terpadu/#1613525012791-540fd62f-29de>.
13. Wang, J., Lin, Y., Hsieh, M., Wei, Y., Ju, Y. and Wu, J. (2021). *Transcatheter Closure of Patent Ductus Arteriosus in Premature Infants With Very Low Birth Weight*. *Frontiers in Pediatrics*. 8.