Percutaneous device versus surgical closure of patent ductus arteriosus

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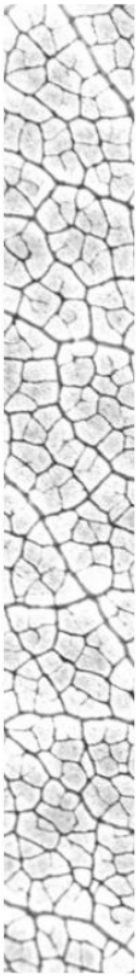

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Percutaneous device versus surgical closure of patent ductus arteriosus

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Abstract

Background: Various devices have employed for percutaneous closure of Patent Ductus Arteriosus (PDA). Although effectiveness of device closure has been determined, a few studies focused on the cost-effectiveness and postoperative complications comparison with open surgery. **Purpose:** Evaluate of PDA occlusion by Amplatzer Ductal Occluder in comparison with open surgical closure. **Method:** A reviewed study from medical record in children with PDA whom underwent interventions for three years. The interventions including Amplatzer Ductal Occluder and open surgical closure. Cross sectional analysis from medical record was done. Data of demographic, characteristic PDA, lenght of stay, costs, interventions, outcome, and complication were collected. Difference were analyzed using Mann Whitney test. **Result:** Eighteen children (4/18 male) were diagnosed with PDA. The median age was 6.0 years, (SD 9.98). Most of patient with moderate PDA (13/18) and large PDA (5/18). Interventions including Amplatzer ductal occluder (9/18) and open surgical closure (9/18). In surgical group have experienced to be cared in ICU during hospitalized (9/18, median 0.5 day, p<0.01). The lenght of stay during hospitalized was longer in surgical group (median 5.5 days, p<0.01). The calculated costs were higher in surgical group median 28.099.500 IDR, p=0.04). No event of mortality was observed in both of group. However in surgical group, one patient experienced pneumonia, and one patient suffered electrolyte abnormality including hypokalemia. **Conclusion:** Amplatzer Ductal Occluder was more preferable because of its lower inexpensive and complication than surgical technique.

Keywords: patent ductus arteriosus, amplatzer ductal occluder, open surgery closure

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INTRODUCTION

Cardiovascular is currently a disease of high urgency in the world (Widiyanti, et al. 2016). Patent Ductus Arteriosus occurs in 5% to 10% of all Coronary Heart Disease, excluding premature infants. It is more common in females than in males (male-to-female ratio of 1:3). PDA is a common problem in premature infants (Rhee, et al. 2019).

Most surgeons of PDA may be related to a variety of factors including the perceived risk of deep sternal wound infection (Royse, Aet al. 2018). After cardiac surgery, patients with heart failure and critically ill also require titration of cardiovascular drugs and fluid interventions (Kusumastuti, & Osaki, 2015). The Amplatzer duct occluder has been recently introduced as a device that is more appropriate for larger sized ducts and also has a high rate of success and safety for occlusion of PDA by the percutaneous approach (Faella, & Hijazi, 2000). Furthermore, this procedure results in high occlusion rate and a low rate of procedure-related complications (Bilkis, et al. 2001). Some recent studies have shown an occlusion rate higher than 99% during 6 months of device deployment(Pass, et al. 2004.) Even, the majority of occlusions may have occurred within a day of device implantation. Moreover, although open surgical treatment of the PDA is a low-risk procedure, because of the necessity for general anesthesia, occurrence of surgery-related complications, and longer hospital stay, developing a catheter-based technique such as Amplatzer duct occlude and implantation of coils by this technique has gained more interest recently(Behjati-Ardakani, et al. 2014; Teymoorian, & Babaei, 2014).

In this regard, although the high effectiveness of this technique has been clearly determined, few studies have focused on the cost-effectiveness and postoperative complications of this procedure in comparison with common applied treatment methods such as open surgery. The present study aimed to

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Table 1. Characteristics of children with Patent Ductus Arteriosus

Characteristics	Value (n = 18)
Sex	
Male	4 (22.2 %)
Female	14 (77.8%)
Age	
Median	6 (1-33) months
PDA Size	
Median	5 (4 - 8) mm
Interventions	
Open surgery closure	9 (50 %)
Device Closure	9 (50 %)
Costs	
Median *	28.09 (9.06 - 83.06)
* Data in million	

evaluate the clinical outcome and cost-effectiveness of PDA occlusion by Amplatzer and coil device in comparison with open surgery.

METHOD

The cross sectional study was analyzed from medical record. The study conducted for three years at Division of Cardiology Department of Pediatrics Dr. Soetomo Hospital, Indonesia.

Population and Sample

The population is all patients who were <18 years old hospitalized and got diagnose with PDA at Dr. Soetomo Hospital's Indonesia. Nine patients conducted to device closure and nine patients conducted to open surgery closure.

Data Analysis

Data of demographic, characteristic PDA, length of stay, costs, interventions, outcome and complication were collected. The cost analysis included costs associated with device implantation and open surgery. All costs were calculated in Indonesia's rupiahs. This study endpoint was to evaluate PDA occlusion by device closure comparison with open surgery. P values of 0.05 or less were considered statistically significant. Differences were analyzed using Mann Whitney test.

RESULTS

During the study period, 18 patients with PDA were invited to participate. The basic characteristic in this study (**Table 1**) found that age of children were mostly in 1 until 33 months (median 6 months) old. Female was 14 patients (77.8%). Most of patients with moderate PDA (13/18) and large PDA (5/18). Interventions including Amplatzer Ductal Occluder (9/18) and open surgical closure (9/18). In surgical group have experienced to be cared in ICU during hospitalized (9/18, median 0.5 day, $p<0.01$). The length of stay during hospitalized was longer in surgical group (median 5.5 days, $p<0.01$). The calculated costs were higher in surgical group (median 28.099.500 IDR, $p=0.04$). No event of mortality was observed in both of group. However in surgical group, one patient experienced pneumonia, and one patient suffered electrolyte abnormality including hypokalemia.

DISCUSSION

The device-based closure techniques have achieved a definite place in the armamentarium of the interventional cardiologist for the closure of partially large sized PDAs with an occlusion rate higher than 99% within a mid-term following operation (Boehm, Emmel, & Sreeram, 2007). Along with device closure has proven to be an efficacious method for repairing PDA. By developing these nonsurgical closure procedures for treatment of the PDA, the incidence of residual shunt was gradually reduced, the complexity of treatment was considerably decreased, and the unsuitability of surgery for larger PDAs was resolved (Ahmadi, et al. 2014).

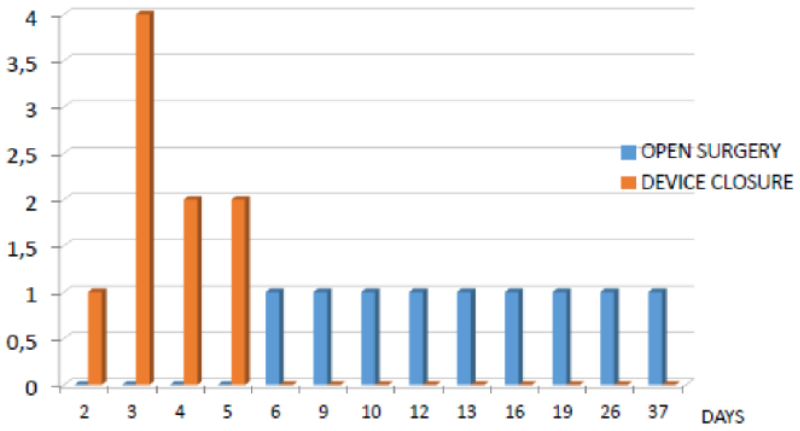

Fig. 1. Length of Stay

This observation could support higher cost-effectiveness of these device-based techniques compared with open surgery; however, postoperative adverse events, including early mortality and morbidity, have been shown to be notably lower following employment of the former techniques. Thus, applying device based closure techniques may be preferable in comparison with open surgeries. The main reason for occurrence of early complications after open surgery may be thoracotomy, and therefore transcatheter methods were evolved to avoid thoracotomy [11].

The rare, but serious, complication of trans-catheter closure of the PDA is device embolization, which is relatively common early in the experience with coils. Followed by this complication, flow disturbance in the proximal left pulmonary artery or descending aorta from a protruding device, hemolysis from high-velocity residual shunting, femoral artery or vein thrombosis related to vascular access, and infection may be consequences of using these devices [11]. Mavroudis et al. reported the surgical procedural success rate to be 100% with a morbidity rate of 4.4% and mortality rate of 0% in a single-institution cohort over a 46-year period (Achyut Sarkar, Neha Rani, Prashant Kumar SC. 2019). As shown in our survey, despite no reported complications related to the device closure group, the open surgical ligation method was accompanied with pneumonia and hyponatremia.

CONCLUSION

In this study conclusion, Amplatzer Ductal Occluder was more preferable because of its lower inexpensive and complication than surgical technique.

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