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Original Article

Transcatheter closure of tubular type patent ductus arteriosus using *Amplatzer*® ductal occluder II: a case report

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Patent ductus arteriosus (PDA) is a common congenital heart disease, accounting for 5-10% of all congenital heart diseases. The incidence of PDA is even higher in preterm neonates, ranging from 20-60%.[1-4] Closure of PDA is indicated in all cases, except for duct-dependent congenital heart diseases or PDA with Eisenmenger syndrome.[1,5,6] In small asymptomatic PDAs, closure is indicated to prevent the risk of complications, such as endarteritis, endocarditis, aneurysm of ductus arteriosus, or congestive heart failure.[1,2,7]

In recent years, interventional cardiology has become a gold standard therapy for the majority of PDA cases beyond neonatal age. Since its introduction in 1967, many devices and methods have been developed to allow transcatheter closure of virtually all PDAs, regardless of size or configuration. Nevertheless, the tubular shape (type C) PDA, which has the highest residual shunt rate, still poses a great challenge for the interventionist.[8-10] The second generation of *Amplatzer*® device occluders (ADO II), released in 2007, has been suggested to be effective in closing tubular PDAs.[10] The purpose of this study was to report the initial clinical experience using ADO II to close a tubular type PDA in Indonesia.

Keywords: *patent ductus arteriosus, tubular type (type C) PDA, Amplatzer® duct occluder II, interventional cardiology*

The case

A 10-year-old girl was admitted to the Department of Child Health, Cipto Mangunkusumo Hospital on November 17, 2012 with a chief complaint of chest and back pain. The pain was exaggerated by exercise and not related to food or eating behavior. There was no history of trauma to the chest or back, cyanotic episodes, or recurrent respiratory tract infections. She did not complain of dyspnea or fatigue on exertion.

At 4 months of age, the patient was diagnosed with congenital heart disease, confirmed by echocardiographic examination. Surgery was recommended to treat the defect, but her parents did not comply with the advice as she remained asymptomatic. Pregnancy and birth history were unremarkable. She had up-to-date immunizations according to the recommended schedule and her school performance was average.

On physical examination, the patient appeared well, although she was undernourished with a body

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weight of 20.6 kg and height of 70 cm. She was fully alert and her vital signs were stable. There was a grade 3/6 continuous murmur, which was heard best at the upper left parasternal border without changes related to position. Neither liver enlargement nor ascites were found and her peripheral perfusion was good.

Electrocardiogram (EKG) revealed a sinus rhythm with heart frequency of 100 times per minute and left ventricular hypertrophy. Echocardiography showed her to have a dilated left atrium and left ventricle, small-to-moderate PDA with a 4-5 millimeter diameter, showing a left-to-right shunt. She planned to undergo a PDA transcatheter closure using ADO.

At catheterization, before the ductus arteriosus was closed, angiography was performed to precisely assess the duct configuration and hemodynamic profile. Lateral angiography showed a tubular shape moderate PDA with 3.58 - 4.95 mm diameter and 7.47 - 10.04 mm length (**Figure 1**). No pulmonary hypertension was found on hemodynamic assessment. The transcatheter closure was performed using ADO II size 6/6, introduced with a 5F delivery system via the right femoral vein. Post-procedure angiography revealed that the device was in place. Neither residual shunt nor aortic/pulmonary artery obstruction was observed (**Figure 2**).

The patient was stable one day after the procedure. There was no murmur or gallop heard on auscultation and her echocardiogram was normal. She was discharged from the hospital and planned to have a follow-up examination after one week. On follow-up visits at one week and one month after the procedure, the chest and back pain had disappeared. Her vital signs were normal and no murmur was heard on auscultation. The general examination was also unremarkable. Echocardiographic evaluation showed that the device was in place and no residual shunt or flow turbulence in the aorta or pulmonary artery was observed. The patient planned to do further follow-up at three months, six months, and then yearly after the procedure.

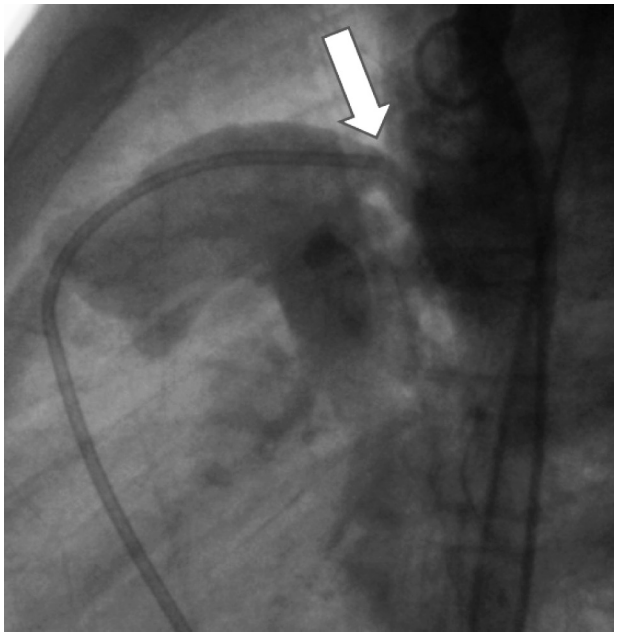

Figure 1. Angiogram before PDA was closed using the ADO II. Arrow shows contrast from the descending aorta entering the pulmonary artery via the PDA

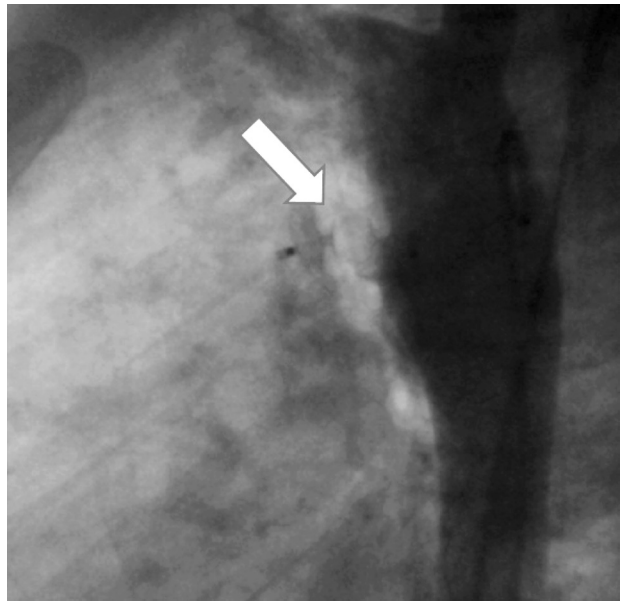

Figure 2. Angiogram after the PDA was closed using the ADO II, with no residual PDA. The arrow shows the ADO II in the proper position at the PDA

Discussion

Definitive therapy to close a PDA is indicated in all cases, except for duct-dependent congenital heart diseases or PDA with Eisenmenger syndrome.[1,5,6] Transcatheter closure has become the treatment of

choice for the majority of cases. Medications, such as indomethacin and ibuprofen, are only effective to close the duct in premature infants.[11,12] Surgical procedure is reserved only for neonates with persistent heart failure that does not respond to pharmacological treatment or patients with very large PDAs.[1,2,4]

We have successfully closed a moderate PDA with an ADO II device in a ten-year-old girl. This treatment approach was in accordance with the Guidelines of the Indonesian Pediatric Society for the management of congenital heart diseases.[13-15] Transcatheter *Amplatzer®* closure of PDAs, as a minimally invasive alternative compared to surgery has been reported to have good long-term safety and efficacy. This procedure has been associated with fewer complications and residual shunts, and is as effective as surgery for the regression of pulmonary hypertension and left ventricular dilation.[16]

There are two main types of devices available in our center for transcatheter closure of PDA, coils and ADO I.[3,17] Generally, coils are used for small/restrictive PDAs and ADO I is used for moderate or large ducts.[5,17] Considering the PDA morphology in our case, which was tubular, we chose the ADO II over other device options. Many studies have been conducted to determine the safety and efficacy of ADO II for tubular shape PDAs. Vencelova et al. reported that all types of PDAs could be closed with ADO II, except for the window shape (type B).[18] Another study by Saliba *et al*. which involved three subjects with tubular PDAs, concluded that ADO II flexibility was an advantage in closing long, tubular ducts. The incidence of embolization after the procedure was lower in ADO II, compared to ADO I.[19] A study by Liddy et al. also showed satisfying results with ADO II, in which from 12 subjects with tubular shape PDAs, there was only one subject whose PDA failed to close. Their findings indicated that ADO II might be a more suitable than ADO I device for tubular PDA.[10]

However, a study by Karagoz *et al*. showed different results. They found that 4/5 subjects' tubular PDAs could not be closed with ADO II. Most of the failures were due to device protrusion into the pulmonary artery. However, all of the subjects in which the procedure with ADO II failed were aged one year or less. Most of the subjects also weighed less than six kilograms and had duct diameters of more than four millimeters.[20] These subject characteristics are known to be ADO II limitations. The current design of ADO II is not suitable for the closure of PDAs with a diameter of more than 5.5 millimeters or a window type PDA. The use of ADO II in small infants (less than six months of age or under 6 kilograms weight) with large PDAs (diameter of more than four millimeters) carries a high risk of protrusion into the descending aorta or pulmonary artery.[19,21]

In our case, no complication was found after the procedure. At the one-week and one-month echocardiography follow-up, the device was in place and there was no residual shunt or flow turbulence in the aorta or pulmonary artery. There is no established guideline for follow-up monitoring after PDA transcatheter closure. Based on previous studies, follow-ups were done every one or two months for at least one year after the procedure.

Based on our experience, we conclude that the *Amplatzer®* ductal occluder II is effective to close tubular-type PDAs in children. However, ADO II utilization in small infants (less than 6 months of age or body weight of less than 6 kilograms) with large PDAs (diameter of more than 4 millimeters) carries a high risk of protrusion into the descending aorta or pulmonary artery.[19,21]

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