

## Successful transcatheter balloon dilatation of coarctation of aorta and coil occlusion of patent ductus arteriosus in a single catheterization procedure

Ahmet Çelebi, Yalım Yalçın, Abdullah Erdem, Cenap Zeybek, Celal Akdeniz  
Tuğçin Bora Polat

Department of Pediatric Cardiology, Dr. Siyami Ersek Thoracic and Cardiovascular Surgery Center and Research Hospital, Istanbul, Turkey

**SUMMARY:** Çelebi A, Yalçın Y, Erdem A, Zeybek C, Akdeniz C, Bora-Polat T. Successful transcatheter balloon dilatation of coarctation of aorta and coil occlusion of patent ductus arteriosus in a single catheterization procedure. Turk J Pediatr 2007; 49: 94-97.

Simultaneous transcatheter coil occlusion of patent ductus arteriosus and balloon angioplasty of coarctation of aorta is avoided since intimal tearing after angioplasty is believed to increase the risk for dissection of the aorta during catheter manipulation. We report a 14-month-old boy, with weight of 7.6 kg, with aortic coarctation and patent ductus arteriosus with a large left-to-right shunt who underwent successful simultaneous balloon angioplasty of native coarctation and coil embolization of the patent ductus arteriosus. Coarctation gradient decreased from 30 to 4 mmHg after balloon angioplasty and complete occlusion of the ductus arteriosus was achieved without any complication.

**Key words:** coarctation of aorta, patent ductus arteriosus, balloon angioplasty, coil embolization.

Coexistence of coarctation of aorta (CoA) and patent ductus arteriosus (PDA) is well described<sup>1</sup>. Sequential transcatheter treatment for CoA and small PDA has been reported previously<sup>2-4</sup>. Since intimal tearing after angioplasty is believed to increase the risk for dissection of the aorta during manipulation, there are only a few reported cases of balloon angioplasty of CoA and transcatheter coil occlusion of PDA in the same session<sup>5-7</sup>. We report a 14-month-old boy found to have CoA and PDA who underwent successful balloon angioplasty of CoA and coil occlusion of PDA in a single catheterization procedure.

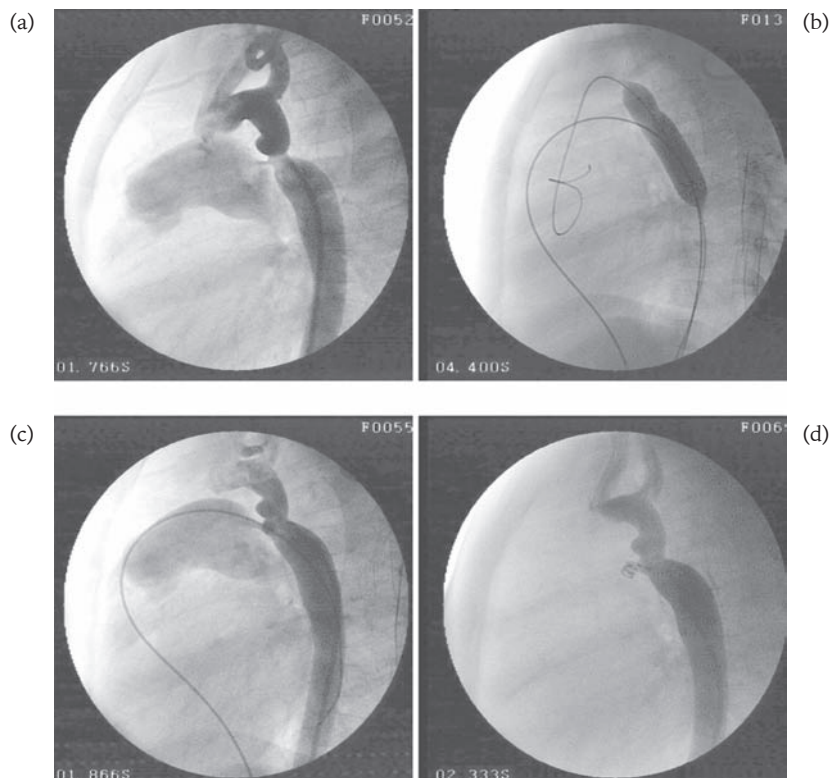
### Case Report

A 14-month-old boy was referred for the assessment of a precordial murmur. Physical examination revealed tachycardia, and a grade 3/6 continuous murmur best heard at the left upper sternal border radiating to the back. Femoral pulses were diminished bilaterally and there was a blood pressure

difference of 30 mmHg between upper and lower extremities. He weighed 7.6 kg (3-10 percentile). Echocardiographic examination showed dilatation of left atrium and ventricle (2.9 cm and 3.5 cm, respectively). Suprasternal view revealed discrete CoA with a systolic Doppler gradient of 40 mmHg. High parasternal ductal view showed a short PDA with a diameter of 2.7 mm by two-dimensional echocardiography. After written informed consent was obtained from the parents, cardiac catheterization was performed under general anesthesia. After right femoral artery and vein were cannulated with 5 Fr sheath, intravenous heparin (100 IU/kg) was given. Aortogram demonstrated juxta-ductal CoA just distal to the left subclavian artery that measured 3 mm in diameter at the narrowest point (Fig. 1A). A short-tubular PDA with angiographically measured diameter of 2 mm with significant left-to-right shunting leading to opacification of the main pulmonary artery and also proximal branch pulmonary arteries were noted. Qp/

Qs was calculated as 1.9. Diameter of the isthmus and descending aorta at the level of diagram were measured to be 8 and 10 mm, respectively. The catheter gradient across the coarctation was 30 mmHg. CoA was dilated using a balloon catheter of 9 mm in diameter and 3 cm in length (Tyshak II, Numed) using previously described techniques (Fig. 1B). Repeat aortogram showed that the diameter of the coarcted segment after angioplasty was increased to 6.8 mm and there was no evidence of aortic dissection or aneurysm formation. The PDA diameter was also increased (2.4 mm) (Fig. 1C). The pressure gradient measured across the coarctation site was 4 mmHg after the procedure. Coil embolization of the PDA was performed trans-arterially with extreme care given to avoid injury to the aorta at the angioplasty site. Without crossing the coarctation site, a 0.014 inch extra-stiff guide-wire with a very soft (floppy) tip was slipped through the PDA with gentle manipulations and

secured in the main pulmonary artery. The coil delivery catheter was then advanced into the main pulmonary artery over the guide-wire. A 3-mm in diameter with 4 loops detachable Cook coil was then placed retrogradely into the PDA, leaving two loops in the left pulmonary artery and the rest at the ductal ampulla. The procedure was completed without any complications. Repeat descending angiogram showed complete occlusion of the duct (Fig. 1D). There was also no protrusion of the coil loops in to the descending aorta. Total procedure time was 90 minutes and fluoroscopy time was 24 minutes. The patient was discharged home the following day. Echocardiographic examination upon discharge showed no residual PDA or coarctation. Blood pressure in the right arm and leg was equal. He gained 1.1 kg during a three-month follow-up with no evidence of residual PDA or CoA. There has been no recurrent coarctation or PDA after one year of echocardiographic follow-up.



**Fig. 1.** Aortogram before balloon angioplasty shows juxta-ductal coarctation and PDA, which is small but short-tubular with a large left-to-right shunt (1A). 1B demonstrates balloon dilation of coarctation. After balloon angioplasty, coarctation site was enlarged, obliterating the anterior projection and decreasing the posterior projection, but PDA enlarged (1C). Figure 1D demonstrates complete occlusion of the ductus arteriosus after placement of the detachable coil.

## Discussion

Aortic coarctation and PDA are common associated defects<sup>1</sup>. The age of the patient, anatomy of the coarctation, and the size and type of the ductus arteriosus all have to be considered in the treatment of the patients with CoA associated with PDA. In infants before six months, the preferred treatment of CoA associated with a PDA is surgery since the incidence of re-coarctation after balloon dilatation is significantly higher in these patients<sup>8,9</sup>. Transcatheter treatment techniques have been effectively applied as non-surgical therapy for each of these defects separately. There are different interventional treatment approaches for these defects when present together. The advantages of interventional treatment are avoidance of thoracic surgery and its morbidity, thoracotomy scar and prolonged hospitalization.

Ing et al.<sup>5</sup> reported a case of a pediatric patient found to have coexisting CoA and PDA who underwent balloon dilation of the coarctation and coil occlusion of the ductus in a single cardiac catheterization. Because aortic angioplasty causes disruption of the intima and a part of the media, manipulation after angioplasty is believed to increase the risk for dissection or aneurysm at the newly dilated coarctation site. On the other hand, dilatation of CoA could also be done in the same session after PDA coil occlusion has been performed, but the risk of coil embolization with this method has not been determined<sup>7</sup>. Sequential treatment of CoA and associated PDA is rational since this approach avoids catheter and wire manipulation resulting in possible aortic dissection as well as coil protrusion<sup>2,3,4</sup>. However, the disadvantages of this method are the cost, and second hospitalization and intervention, which are unpleasant for the child and family.

The combination of aortic coarctation and PDA may also be treated with implantation of a covered stent in a single procedure, especially in older children or adults<sup>10</sup>. Stent implantation for coarctation and using a separate device for closing the PDA at the same time in a single procedure is another treatment strategy<sup>11</sup>. The advantages of stent implantation are the reduced risk of aneurysm formation and the possibility of redilatation if it is needed. But the efficacy and long-term prognosis of covered stents have not been determined yet in infants and small children. Furthermore, spinal artery

occlusion causing paraplegia and paraparesis is the most important complication of stent implantation<sup>10</sup>.

Our case was 14-months-old and CoA was amenable to balloon dilatation with a low risk of re-coarctation. But as he had a relatively small but short PDA leading to a large left-to-right shunt and congestive heart failure, PDA was thought to be the dominant lesion hemodynamically in our patient and CoA was mild. Furthermore, diameter of the ductus arteriosus increased after balloon angioplasty as reported in the literature<sup>5</sup>. Considering these factors, performing the coil occlusion of the PDA and balloon angioplasty of the CoA in the same session seemed to be more rational. The conventional approach is to use a coil 1.5 to 2 times larger than the smallest diameter of the measured PDA. Since the PDA was fairly short and the ampulla was small, we were concerned about possible stenosis at the left pulmonary artery or descending aorta following coil deployment. We thus selected a smaller coil diameter based on the smallest diameter of the PDA measured on the predilated angiogram in our patient. Recognizing the potential for disruption of the dilated aortic segment, closure of the PDA was accomplished with extreme caution. We used a very soft tip extra-stiff guide-wire slipping through the PDA without crossing the CoA site. The coil delivery catheter is then safely advanced over it into the main pulmonary artery with gentle manipulations. A repeat descending angiogram showed complete occlusion of the duct and also no protrusion of the coil loops into the descending aorta.

In patients with CoA associated with a PDA causing significant left-to-right shunt, single stage transcatheter treatment with extreme caution could be performed as an alternative to surgery.

## REFERENCES

1. Fyler DC, Buckley LP, Hellenbrand WE, Cohn HE. Report of the New England Regional Infant Cardiac Program. *Pediatrics* 1980; 65 (Suppl): 375-461.
2. Galal O, al-Fadley F, Wilson N. Successful transcatheter closure of patent arterial duct six years after balloon dilatation of coarctation of the aorta. *Int J Cardiol* 1992; 35: 123-125.
3. Pavlovic D, Suarez de Lezo J, Medina A, et al. Sequential transcatheter treatment of combined coarctation of aorta and persistent ductus arteriosus. *Am Heart J* 1992; 123: 249-250.

4. Geggel RL, Hijazi ZM, Rhodes J. Interventional cardiac catheterization therapy for combined coarctation of the aorta and patent ductus arteriosus: successful outcome in two infants. *Cathet Cardiovasc Diagn* 1996; 38: 67-70; discussion 71.
5. Ing FF, McMahon WS, Johnson GL, Vick GW, Mullins CE. Single therapeutic catheterization to treat coexisting coarctation of the aorta and patent ductus arteriosus. *Am J Cardiol* 1997; 79: 535-537.
6. Liang CD, Ko SF, Tiao MM. False aneurysm and mediastinal hematoma: complications of simultaneous transcatheter therapy for coarctation of the aorta and patent ductus arteriosus in an infant. *J Invasive Cardiol* 2001; 13: 710-712.
7. Lee ML, Tsao LY, Wang YM. Interventional cardiac catheterization for the coarctation of the aortic arch and patent ductus arteriosus in a 3-day-old neonate with the Holt-Oram syndrome. *Int J Cardiol* 2005;101: 503-505.
8. Kaine SF, Smith EO, Mott AR, Mullins CE, Geva T. Quantitative echocardiographic analysis of the aortic arch predicts outcome of balloon angioplasty of native coarctation of the aorta. *Circulation* 1996; 94: 1056-1062.
9. Rao PS, Kosciak R. Validation of risk factors in predicting recoarctation after initially successful balloon angioplasty for native aortic coarctation. *Am Heart J* 1995; 130: 116-121.
10. Sadiq M, Malick NH, Qureshi SA. Simultaneous treatment of native coarctation of the aorta combined with patent ductus arteriosus using a covered stent. *Catheter Cardiovasc Interv* 2003; 59: 387-390.
11. Hakim F, Hawelleh AA, Goussous Y, Hijazi ZM. Simultaneous stent implantation for coarctation of the aorta and closure of patent ductus arteriosus using the Amplatzer duct occluder. *Catheter Cardiovasc Interv* 1999; 47: 36-38.