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# A rare complication of patent ductus arteriosus coil occlusion involving a foreign body migrating rapidly from the femoral vein to the right ventricle

*Femoral venden sağ ventriküle hızlıca kayan yabancı cisim ile seyreden patent duktus arteriozus koil oklüzyonunun nadir bir komplikasyonu*

**Süreyya Talay, Derih Ay, Bilgehan Erkut**

Department of Cardiovascular Surgery, Erzurum Region Education and Research Hospital, Erzurum, Turkey

In this article, we report a four-year-girl case with a complication of patent ductus arteriosus (PDA) during coil occlusion. Coil as a foreign body was reported by the attempting invasive pediatrist to separate from its device which served to connect the ends of adjacent parts at the initial phase of femoral vein application. Preoperative radiological scopy in the operating room demonstrated the coil which migrated from iliac vein to right ventricle during short transport time. Patient underwent an emergent aortobicaval cannulation with sternotomy and removal of the coil under cardiac arrest via right atriotomy. Iatrogenic foreign body embolization is a potentially fatal complication of percutaneous treatment approaches of congenital heart defects. Consequently, we strongly advocate that these percutaneous techniques can only be performed in circumstances with backup possibilities by cardiovascular surgeons.

*Key words:* Aortobicaval cannulation; coil embolization; foreign boby removal; patent ductus arteriosus.

Bu yazıda koil oklüzyonu sırasında patent duktus arteriozus (PDA) komplikasyonu görülen dört yaşında bir kız olgu sunuldu. Yabancı cisim olarak koil, femoral ven uygulamasının başlangıç fazında komşu kısımların uçlarını birleştirme görevi gören cihazdan ayırmak üzere, invaziv pediatri uzmanı tarafından bildirildi. Ameliyathanede cerrahi öncesi radyolojik skopide kısa taşınma süresi sırasında iliyak venden sağ ventriküle hareket eden koil izlendi. Hastaya sternotomi ile acil aortobikaval kanülasyon yapıldı ve sağ atriyotomi ile kardiyak arrest altında koil çıkarıldı. İyatrojenik yabancı cisim embolizasyonu, doğuştan kalp defektlerinin perkütan tedavi yaklaşımı sırasında görülen muhtemel ölümcül bir komplikasyondur. Bu perkütan tekniklerin yalnızca kalp damar cerrahları tarafından yedekleme olanakları olması halinde yapılmasını önemle önermekteyiz.

*Anahtar sözcükler:* Aortobikaval kanülasyon; koil embolizasyonu; yabancı cismin çıkarılması; patent duktus arteriozus.

The first successful surgical patent ductus arteriosus (PDA) ligation was reported by Dr. Robert E. Gross in 1939,[1] and a left posterolateral thoracotomy was the standard surgical approach in PDA cases for decades afterwards.[2] In addition, median sternotomies were also administered by a smaller group of surgeons. Over the past several years, treatment of PDA has considerably evolved through the use of less invasive techniques such as percutaneous transcatheter coil occlusion, video-assisted thoracoscopic surgery (VATS), and non-surgical indomethacin treatment. Despite the modern tendency toward less invasive and therapeutic options with smaller incisions, the morphology and location of the PDA, the age and size of the patient, and the experience of the surgeon determines the technique of choice.

## CASE REPORT

A four-year-old girl was admitted to the pediatric department with a history of dyspneic episodes and frequent attacks of pneumonia. The initial physical examination in conjunction with transthoracic

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Correspondence: Süreyya Talay, M.D. Erzurum Bölge Eğitim ve Araştırma Hastanesi, Kalp ve Damar Cerrahisi Kliniği, 25240 Erzurum, Turkey.
Tel: +90 505 - 261 24 65 e-mail: suereyyatalay@gmail.com

echocardiography demonstrated a PDA that was typically located between the left pulmonary artery and aorta. Following the routine clinical evaluation, hematological tests and a chest roentgenogram were performed. The attending pediatrician decided to occlude the PDA percutaneously by using a coil. Catheterization was initiated via the artery, and venous access was gained. A pediatric anesthesiologist provided sedation. A 4 French (F) sheath and a 5F sheath were inserted into the femoral artery and femoral vein, respectively, and adequate heparin and cefazolin antibiotic prophylaxes were given as the case progressed. An estimation of the diameter of the PDA was obtained by angiography, which identified a moderate diameter of less than 2 mm along with a flow pattern through the PDA. A 5F venous sheath was used to deliver the coil and its adjacent guide wire to the aortic side. The differences in diameter between the sheath and adjacent coil resulted in a lack of adaptability and compatibility, which led to the separation of the coil on the femoral vein side. However, the disconnected part of the coil was observed to be stable in the femoral vein sheath. At that point, the catheterization was ended, and the child was referred for surgery.

On the operating table, a physical examination presented the appearance of respiratory distress with cyanotic limbs. In addition, an electrocardiogram revealed sinus tachycardia at a rate of 180 per minute. The transcutaneous oxygen saturation and arterial blood pressure were routinely monitored throughout the surgery, and another electrocardiogram was performed. Preoperatively, a radiological scope determined that the coil had migrated from the iliac vein to the right ventricle during the short transport time to the operating room (Figure 1).

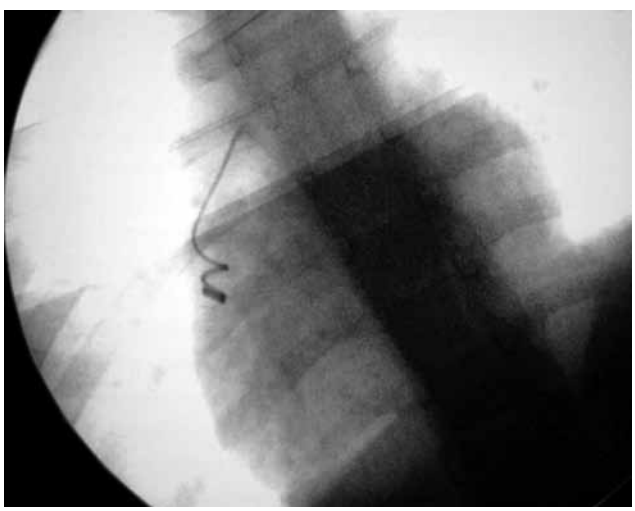

**Figure 1.** Preoperative view from a radiological scope of the coil that immigrated into heart.

Under general anesthesia, a median sternotomy was initially performed. Propofol (2-5 mg/kg/h) and fentanyl citrate (5-10 microgr/kg/h) were given to the patient intravenously, and inhalational sevoflurane was used for general anesthesia. Additionally, heparin (350 units/per kg) was given to reach the activated clotted time (ACT) of over 400 seconds. Following a pericardiectomy, aorto-bicaval cannulation was performed while the patient's body temperature was within 28 °C of the core body temperature. A cross-clamp was then applied to both the aortae and pulmonary artery to prevent the coil from continuing to migrate more distally through the lungs. Cardiopulmonary bypass (CPB) was accomplished with a centrifugal pump and membrane oxygenator. For myocardial protection, we used two steps of cardioplegia: 500 ml of normothermic blood cardioplegia and cold cardioplegia in 10 ml/per kg in 40 mmHg pressure. Additive cardioplegia doses were not necessary due to the short period of cardiac arrest. After securing the caval blood flow with tightened snears over cannulas, a right atriotomy was performed. The coil was observed between the tricuspidal valvular structures and was reaching into the right ventricle with its free end. It was subsequently gently removed to avoid any harm to the tricuspid valve (Figure 2).

The right atriotomy was closed, and the CPB was ended. The total cardiopulmonary time was 41 minutes, and the total cross-clamp time was 17 minutes. Heparin antagonization was maintained by protamine sulfate. The existing PDA between the left pulmonary artery and aortae was occluded via transfiction sutures with clear visualization, and an epicardial pace maker was also replaced. After the hemostasis maneuvers, the surgical drains were replaced, and the sternum was closed. The patient was next transported to the cardiovascular surgery intensive care unit (ICU). The intubation time was 180 minutes, and the total drainage volume was 210 milliliters. Postoperative transthoracic

**Figure 2.** Postoperative picture of the removed coil.

echocardiograms verified the closure of the PDA, and the patient was uneventfully discharged on postoperative day eight.

## DISCUSSION

Fetal circulation is maintained by the ductus arteriosus, which allows most of the blood from the right ventricle to flow to the aorta in circumstances in situations where the immature pulmonary bed is bypassed. The ductus arteriosus normally closes spontaneously during the first 15 hours of the early postpartum period.

Persistent patency of the ductus arteriosus is defined as PDA, a relatively common congenital cardiac abnormality. The overall incidence rate varies between 0.02 and 0.006% of live births, and females are twice as likely to have it. High altitude births, perinatal asphyxia, lower birth weights, and premature births may elevate the risk of PDA, which differs according to the age of the patient and the presenting symptoms. A left to right flow pattern usually is caused by an overload of pulmonary vascular resistance. In addition, an adult may rarely present with a murmur which is caused by a small and tolerated PDA. Morphologically, this defect is mostly located between the left pulmonary artery and proximal part of the descending aortae. However, there have been reports of a few cases that presented between the right pulmonary artery and main pulmonary artery. Atypical localizations tend to be concordant with cardiac and other defects. Mortality rates range from 0.5-4% depending on the severity of the left to right shunt and the patient's age.[2] Differential diagnoses may include sinus of Valsalva aneurysm (SVA), aortopulmonary window, coronary artery fistula, and atypical forms of tetralogy of Fallot.

Treatment of PDA starts with the administration of indomethacin and/or ibuprofen at early diagnosis.[3] The success of treatment with intravenous medication has been questionable in some cases.[3] Thus, over the last three decades, several techniques of catheterization closure have been described.[4] The success rate is significantly higher for PDA if it has a diameter smaller than 2.5 mm. For PDA equal to or larger than 3 mm diameter, other occlusion techniques are needed besides catheterization.

There are risks involved with catheterization, for example embolization of the occlusive device, recurrent PDA, central or peripheral arterial or venous vascular injury, stroke, mild to severe lower limb ischemia, and death. Large ductus treatments include a conventional left thoracotomy and VATS. The thoracotomy approach may result in surgical ligation or surgical ligation with division, but this technique has a very low mortality and morbidity risk when performed by experienced hands and provides excellent results. Video-assisted thoracoscopic surgery is a more difficult technique, especially in patients with calcification or those with a bigger ductus. In those cases, there is a greater risk of hemorrhage and vascular injury.[5] When VATS or a conventional posterolateral thoracotomy are not the best options, a median sternotomy with/without CPB can be performed as a last resort.

In our opinion, percutaneous coil occlusion techniques are cost-effective, safe, and less traumatic for the patient. Furthermore, they have been shown to reduce the recurrence rate.[4] Small to moderate PDA of between 1 and 2 mm diameters are the best candidates for percutaneous transcatheter coil occlusion. Larger PDA and/or cases with insufficient PDA neck morphology require a surgical approach for the best results. Coil occlusions also come with the risk of of complications, as was the case with our patient. Thus, these techniques may only be performed by keeping in mind the possibility of the need for surgical support in case of emergency.

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