Late Amplatzer device displacement after percutaneous PDA embolization: case description

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Summary

A 6-month-old, 17 kg, male Labrador Retriever was presented for an evaluation of a suspected patent ductus arteriosus (PDA). Transthoracic echocardiography confirmed a left-to-right shunting PDA with a minimal ductal diameter of 3.5 mm. A transcatheter PDA occlusion was performed, and a 16 mm Amplatzer Vascular Plug II was selected for the procedure. Within 13 days of discharge, the dog developed sudden lethargy, tachypnea, and coughing after physical activity. Thoracic radiographs showed the Amplatzer device to be abnormally positioned in the lumen of the pulmonary artery with a distinct alveolar pattern. Given the progressive cardiopulmonary distress of the dog, the owners opted for euthanasia. In the present case study, the authors have not been able to satisfactorily explain why the device migrated several days after the procedure. In order to avoid device migration, greater emphasis should be placed on strict activity restriction in dogs after percutaneous PDA occlusion.

Keywords: congenital, dog, interventional, cardiology

A 6-month-old, 17 kg, male Labrador Retriever was presented for an evaluation of a suspected patent ductus arteriosus (PDA). Two weeks prior to presentation, the dog had an episode of weakness, dyspnea, and coughing. Thoracic radiographs showed left-sided cardiomegaly and mild pulmonary edema. Hence, the referring veterinarian administered furosemide at 3 mg/kg PO q 12 h and benazepril at 0.6 mg/kg PO q 24 h. The examination performed at the cardiology unit of the Department of Internal Diseases with Clinic for Horses, Dogs, and Cats of the Faculty of Veterinary Medicine at the Wrocław University of Environmental and Life Sciences, Wrocław, Poland, revealed a grade V/VI left basilar continuous murmur. Transthoracic echocardiography confirmed a left-to-right shunting PDA with a minimal ductal diameter of 3.5 mm. Additionally, mitral regurgitation and an enlargement of the main pulmonary artery with mild pulmonary valve insufficiency was reported. Blood work did not show any abnormalities, so a decision was made to perform a transcatheter PDA occlusion.

Case description

The dog was premedicated with a mixture of 0.1 mg/kg midazolam (Midanium 5 mg/ml, WZF Polfa S.A. Warsaw, Poland) and 0.02 mg/kg medetomidine (Cepetor 1 mg/ml, CP-Pharma Handelsges, Burgdorf, Germany) administered intramuscularly. The cephalic vein was catheterized with a 20 G cannula (Vasofix Certo, B.Braun, Melsungen, Germany), and anaesthesia was induced with an intravenous bolus injection of propofol 1-2 mg/kg (Propofol 1% MTC/LCT Fresenius Kabi AG, Bad Homburg, Germany). Anaesthesia was continued with isoflurane (Aerrane, Baxter, Deerfield, USA), an inhalation anesthetic, at a concentration of 1.5-1.8 vol% and fentanyl administered intravenously at a dose of 2 µg/kg/h (Fentanyl WZF 50 µg/ml, Warsaw, Poland). Vital signs were monitored with a Lifepak 12 defibrillator/monitor (Medtronic, USA). The procedure was performed after an 8 French sheath (Avanti, Cordis, USA) had been placed on the right femoral artery. Cineangiography was obtained with a digital mobile Ziehm 8000 C-arm. Aortography was carried out by injecting 1 ml/kg of Iomeron 350 (Bracco Imaging, Germany), an iodinated contrast agent, through a 5 French pigtail catheter. The angiographic assessment confirmed a IIa type of PDA (12) with a minimal ductal diameter of 4 mm and

Fig. 1. Angiography performed prior to the procedure; arrows – patent ductus arteriosus (PDA)

a 10-mm-wide ampulla (Fig. 1). A 16 mm Amplatzer Vascular Plug II was selected for the procedure, which gave the disc-to-ampulla ratio of 1.6. The first distal disc was expanded and placed in the lumen of the main pulmonary artery. The second and third discs were expanded in the ductal ampulla. Angiography was used to confirm the position of the device and a complete occlusion of the PDA prior to its release (Fig. 2). Additionally, its stability was confirmed by maneuvering the delivery cable back-and-forth. Following the release of the device, systolic and diastolic pressure increased from 86 mmHg to 113 mmHg and from 29 mmHg to 60 mmHg. The femoral artery was then ligated, and Synulox (Pfizer, New York, USA) and Metacam (Boehringer Ingelheim, Ingelheim am Rhein, Germany) were administered at 12 mg/kg and

Fig. 2. Control angiography before the release of the Amplatzer device

0.2 mg/kg, respectively. The location of the device and a total occlusion of the PDA were confirmed by echocardiography prior to discharging the patient. It revealed a reduced left ventricular dilatation and no residual ductal flow. The owners were instructed to limit the dog's physical activity to the minimum and to continue to administer benazepril and the antibiotics. Within 13 days of discharge, the dog developed sudden lethargy, tachypnea, and coughing after physical activity. Thoracic radiographs obtained at the local emergency hospital showed the Amplatzer device to be abnormally positioned in the lumen of the pulmonary artery with a distinct alveolar pattern (Fig. 3). Given the progressive cardiopulmonary distress of the dog, the owners opted for euthanasia. No post-mortem examination was performed.

Discussion

PDA is the most common congenital heart disease in dogs (5). Uncorrected PDA usually results in left-sided heart failure and pulmonary hypertension leading to high mortality within the first year of life (7). PDA can be treated surgically and percutaneously. Surgical ligation is cost-effective, but associated with a high risk of complications and a long recovery period, so it is recommended only for either type III PDA (12) or for small breeds, which do not qualify for a percutaneous procedure. For the past ten years, the method of choice for the closure of PDA has been the percutaneous procedure. Over the years, many vascular approaches have been taken and different closure devices developed. Typically, the standard procedure is performed under fluoroscopic guidance. However, PDA occlusion under transesophageal echocardiography guidance has also been proposed (15, 20).

Fig. 3. Thoracic radiographs showing an abnormal position of the Amplatzer device in the lumen of the pulmonary artery (arrow) with a severe alveolar pattern

The percutaneous procedure is usually carried out via the transarterial femoral artery approach (14); otherwise, carotid artery (13) or brachial artery (18) is recommended. Less commonly, a transvenous approach via the femoral (4) or jugular vein (18) is adopted and is typically applied in small breed dogs. The vascular access is chosen depending on the animal's weight, the diameter of the duct, the anticipated type and size of the device, and the surgeon's preferences.

There are two main types of embolization devices: vascular coils (13, 22) and self-expanding devices made of nitinol (1, 14). The coils are either detachable or pushable, and vary in terms of their diameter and number of loops. Detachable coils are placed using a screwing mechanism, and can be retrieved and repositioned in case of an unsuitable position. These are safer, but more expensive, than pushable coils, which are pushed out of the delivery catheter with a stiff guidewire. Pushable coils are difficult to reposition during a single procedure and may increase the risk of an incomplete occlusion, an inadvertent pulmonary artery or aortic embolization.

The Amplatzer Vascular Plug (AGA Medical) was the first self-expanding device used for the percutaneous embolization of PDA. Over the years, many types of devices of different shapes have been designed, all of them based on a nitinol fabric mesh. The Amplatzer Canine Duct Occluder (ACDO) (8, 14) has been available for almost ten years, and was designed for veterinary use. It is the most commonly used device for the PDA embolization in dogs.

A number of complications have been reported in human and animal medicine during percutaneous PDA embolization. These include systemic or pulmonary embolization, hemolysis, residual shunts, hemorrhaging after removing the vascular access, and stenosis of the pulmonary artery (10, 11, 19).

This case study describes one of the possible complications of transcatheter PDA occlusion. To date, many device dislocation have been reported, most of them noticed during the intra-operative and immediate post-operative period (1, 19, 21). In human medicine, 6 (2), 8 (11) and 12 (10) months after the PDA closure procedure, late device displacement was reported for reasons still unknown. To the authors' best knowledge, only one case of device migration following hospital discharge has been reported (6).

In the case of systemic or, more commonly, pulmonary embolization caused by a migrating vascular coil, a transcatheter removal can be attempted using biopsy forceps, a polypectomy loop, or other techniques (9). If these interventional techniques are unsuccessful, the coil may be removed surgically (3). However, in most cases the coil is not removed but moved distally as far as possible. According to numerous reports and the authors' own experience, leaving the coil in the distal part of the pulmonary artery does not induce undesirable symptoms (17, 22). However, in case of the translocation of a large embolization device, such as ACDO, it must be removed surgically (10, 19). This requires cardiac surgery and the

use of extracorporeal circulation, which is unavailable in most veterinary centers worldwide.

In the present case study, the authors have not been able to satisfactorily explain why the device migrated several days after the procedure. In order to avoid device migration, greater emphasis should be placed on strict activity restriction in dogs after percutaneous PDA occlusion.

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