J Vet Clin 28(2) : 236-239 (2011)

Journal of Veterinary Clinics
www.ksvc.or.kr

Transcatheter Closure of Patent Ductus Arteriosus with a Coil Embolization in a Dog

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(Accepted: April 04, 2011)

Abstract : A 10 month-old female (intact) Maltese dog was presented due to continuous heart murmur. The dog was diagnosed with patent ductus arteriosus (PDA) based on two-dimensional echocardiography, computed tomography (CT) and angiography. Transarterial coil embolization was used for transcatheter occlusion of the PDA. A single coil was placed successfully and effectively occluded the blood flow through the ductus. Continuous heart murmur disappeared immediately the coil placement and no residual flow was detected. Complications and safety following the procedure were evaluated regularly based on clinical signs, cardiac examinations and serum troponin-I concentrations. This is the first clinical application of coil embolization for transcatheter closure of PDA in a dog in Korea.

Key words **:** coil embolization, patent ductus arteriosus, transcatheter closure.

Introduction

Patent ductus arteriosus (PDA) is the most commonly corrected congenital cardiovascular defect in dogs (1,7). According to a report described earlier (1), it occurs frequently in small breed dogs and there is higher prevalence in females. Although the traditional treatment is surgical ligation via thoracotomy, minimally invasive transcatheter PDA occlusion therapy has been gaining popularity (3). Transarterial coil embolization is the most commonly employed transcatheter PDA occlusion methods, and is usually employed for closure of small PDA (2). Other occluding devices, including the Amplatzer® ductal occlude and Amplatzer® vascular plug, have been evaluated, and the Amplatz® Canine Duct Occluder has been developed especially for dogs (4,6,9).

Here, we report the first application of transarterial coil embolization for closure of PDA in a dog in our country.

Case

A 10-month-old, 1.7 kg, intact female Maltese dog was referred due to abnormal heart sound which was noted by the referring veterinarian. No clinical signs of heart failure were observed and vital signs were within normal limits. A grade V/VI heart murmur was ausculted at the left heart base and demonstrated to be a continuous murmur by phonocardiography. Evaluation of the electrocardiogram showed a sinus rhythm with a prolonged P wave and tall QRS amplitude. Increased pulmonary circulation was presented in thoracic radiographs (Fig 1A and C), and two-dimensional echocardiography revealed left atrial and ventricular dilation. Color Doppler echocardiography revealed continuous turbulent flow in the main pulmonary artery. Based on the physical and clinical examination, the dog was diagnosed with PDA. The PDA size and morphology were demonstrated through multi-detector computed tomography (MDCT; Asteion 4®, Toshiba, Japan) with contrast (Fig 2A-C). A volume rendering 3D reconstructed image was obtained for more information. PDA was clearly demonstrated between the descending aorta and pulmonary artery (Fig 2D). The adjacent structural anatomic position (heart and great vessels) were also displayed well. Therefore, interventional treatment using a transarterial coil embolization was attempted. Initial treatments with furosemide (1 mg/kg, twice daily PO; Handok, Seoul, Korea), and angiotensin converting enzyme inhibitor, ramipril (0.125 mg/kg, once daily, PO; Sandoz Korea, Seoul, Korea) were made for one week before interventional treatment to stabilize the dog.

The dog was premedicated with subcutaneous 0.04 mg/kg atropine (Atropine sulfate; Jeil Pharm, Seoul, Korea), 0.1 mg/kg butorphanol (Butophan; Myung Moon Pharm, Seoul, Korea) and 0.03 mg/kg acepromazine (Sedaject; Samumedian Co., Ltd, Seoul, Korea). Anesthesia was induced with intravenous 4 mg/kg propofol (Anepol; Ha Na Pharm Co., Ltd., Seoul, Korea) followed by endotracheal intubation with a cuffed endotracheal tube and maintained with 2.5% isoflurane (Forane Soln; Choong Wae Pharm, Seoul, Korea) in oxygen. In right lateral recumbency, the femoral artery was obtained by surgical cutdown.

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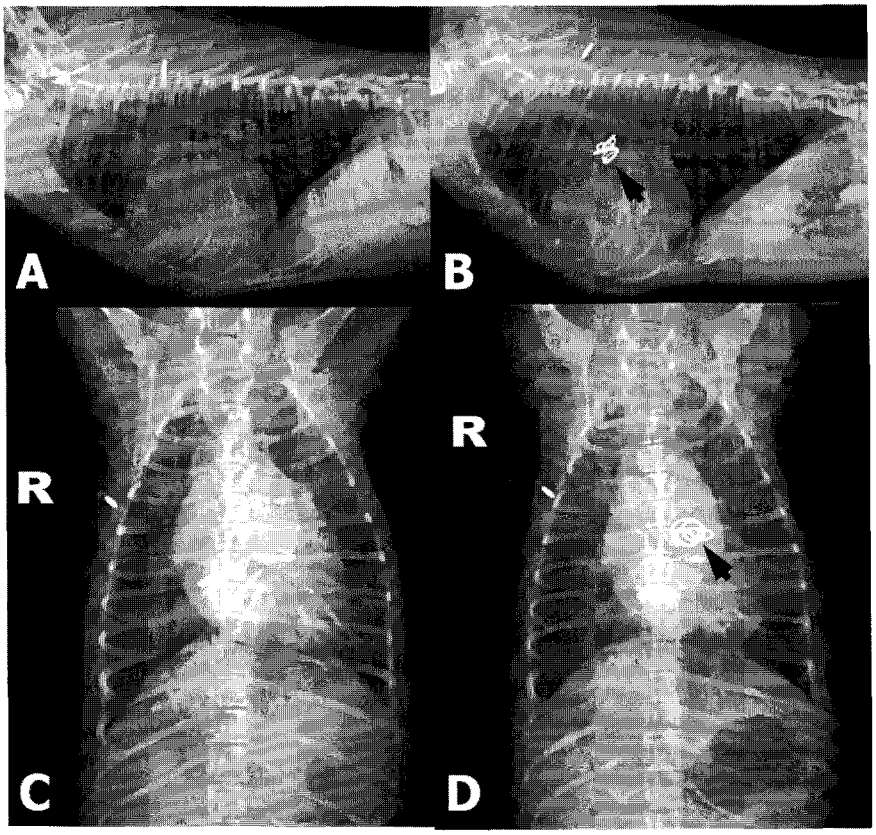

Fig 1. Thoracic radiography obtained before and after the PDA occlusion. Right lateral and dorsoventral radiograph demonstrating cardiomegaly and pulmonary overcirculation secondary to PDA (A, C). After the PDA occlusion, the coil (arrow) is positioned in the ductus and reduction of cardiomegaly and pulmonary overcirculation were noted (B, D).

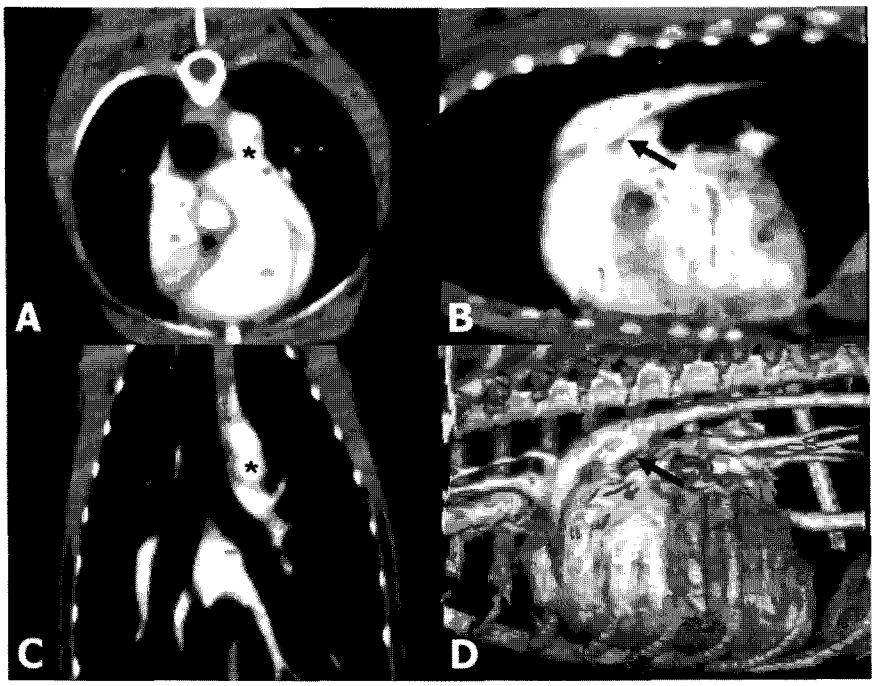

Fig 2. Contrast-enhanced CT and 3D reconstructed CT obtained in a 10-month-old PDA dog. (A-C) A shunting vascular (asterisk) was observed between the descending aorta and pulmonary artery in the trans section (A), sagittal section (B), and axial section (C). A clearly demonstrated shunt (arrow) was detected between the descending aorta and pulmonary artery (D).

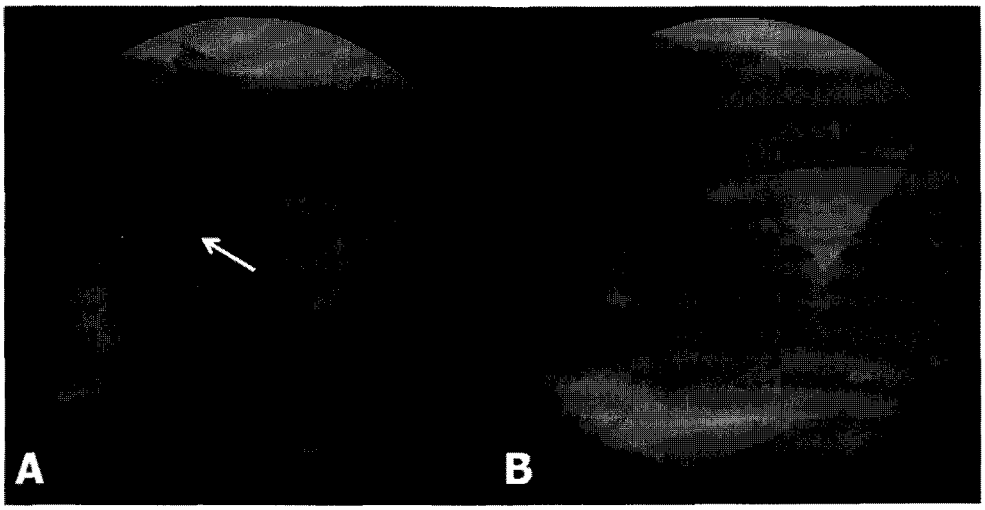

Fig 3. Fluoroscopic image of a right lateral angiogram of a 10-month-old dog. (A) Descending aortography revealed PDA between the descending aorta and pulmonary artery (white arrow). (B) Angiogram following vascular occlusion device placement, showing complete ductal occlusion.

Table 1. Serum cardiac troponin I value before and after the PDA occlusion

Parameter	Day 0*	Day 1	Day 2	Day 10	Day 30	Reference Range
Cardiac troponin I	0.011	0.45	0.21	0.1	< 0.01	0.0-0.07 (ng/mL)

*Day 0 means before the transcatheter occlusion of PDA

Insertion of a 4 Fr vascular introducer (Check-Flo Performer® Introducer Sets, Cook, Bloomington, IN, USA) followed by an angiographic catheter (Boston Scientific Corporation, MA, USA) into the descending aorta using fluoroscopic guidance was conducted. An angiogram was obtained by vigorous hand injection of non-inonic contrast medium (Omnipaque; GE Healthcare, Milwaukee, WI, USA, 1-1.2 mL/Kg). Angiographically, the type II ductal morphology (8) was clearly demonstrated between the descending aorta and pulmonary artery with distal narrowing in the ductal diameter in this dog (Fig 3A). PDA was found to have a 3 mm minimal ductal diameter, 6 mm distal ampullar, and 6.8 mm ductal length.

The dog was treated with transarterial coil embolization. Based on the measured minimum diameter of PDA, a 6.5 mm coil was selected (Flipper® Detachable Embolization Coils, Cook, Bloomington, IN, USA). A controlled release coil system was placed into the descending aorta and the coil was loaded into the ductus via the delivery catheter. The coil was released 5-10 minutes after a satisfactory position was achieved. After complete coil placement, the cardiac murmur abruptly disappeared. Angiography following the coil embolization revealed no residual flow (Fig 3B). The dog recovered from the anesthesia without complications and cefazolin (30 mg/kg, IV, Chong Kun Dang Pharm, Seoul, Korea) and butorphanol (0.1 mg/kg, IM, Myung Moon Pharm, Seoul, Korea) were administered. Adequate occlude position was confirmed through thoracic radiography (Fig 1B and D) and the dog was discharged the following day. Oral antibiotics (cephalexin 30 mg/kg, PO, q 12h, Dong Wha Pharm, Seoul, Korea) were administered for three more days and the dog was re-examined regularly. The serum cardiac troponin-I (cTnI) was elevated immediately after the catheterization, it was then decreased and no further change was detected. (Table 1).

Two weeks after coil placement, two-dimensional echocardiography was conducted. No turbulent flow in the main pulmonary artery or residual shunting was detected. The dog was generally healthy without significant clinical signs and no cardiac abnormalities were detected during a two-month follow-up period.

Discussion

According to reports described previously (1,7), standard treatment for PDA has been surgical ligation via thoracotomy; however, complications including hemorrhage, incomplete ligation and recanalization can occur. Due to the invasiveness of the surgery and such serious complications, transcartheter closure of PDA has been conducted more frequently over the past 10 years (3,4,6,9). Coil embolization of PDA is a commonly used as an alternative method due to it is being less expensive than other methods (3). For successful coil occlusion, the size and morphology of the ductus and diameter of the patient's femoral artery is important. PDA coil embolization requires placement of the sheath introducer into the femoral artery and insertion of a large sheath is not adequate for small dogs.

In the present case, coil embolization was selected due to the small ductal size (< 4 mm). Despite the small patient size

(1.7 kg), femoral artery access using a 4 Fr catheter was available.

Based on the previous results (5,10-12), complications with coil embolization are rare, but dislocation of the coil into the pulmonary artery or the aortic tree, hemolysis and hemorrhage at the vascular access site are possible. In this case, we have used a commercially available detachable coil system. The extruded coil is reposition or removed easily before release and this controllable release system could reduce the possibility of coil dislocation. No complications associated with the embolized coil were detected after the procedures in this dog. The dog was discharged the day after the procedure. Reduced invasiveness and short duration of recovery are advantages of coil occlusion.

The dog was re-examined regularly after the PDA occlusion, and the device after placement, was found to be stable in position during a two-month follow-up period. A cardiac troponin-I (cTnI) was measured on a regular basis before and after the PDA closure for evaluation of further myocardial injury of adverse effects of the device to the heart in this case. Direct heart trauma, such as cardiac surgery, catheterization procedures, and blunt chest trauma can increase cardiac troponins (13). Although the cTnI was elevated immediately after the catheterization, it was then decreased and no further change was detected.

In conclusion, this case report demonstrates that coil embolization appears to be a valuable and safe therapeutic option in the transcatheter closure of dogs with PDA.

Acknowledgement

This study was supported by the Brain Korea 21.

Reference

1. Buchanan JW. Prevalence of cardiovascular disorders. In: Textbook of canine and Feline Cardiology, 2nd ed. Philadelphia : WB Saunders. 1999: 457-470.
2. Campbell FE, Thomas WP, Miller SJ, Berger MD, Kittleson MD. Immediate and late outcomes of transarterial coil occlusion of patent ductus arteriosus in dogs. J Vet Intern Med 2006; 20: 83-96.
3. Glaus TM, Martin M, Boller M, Stafford Johnson M, Kutter A, Fluckiger M, Tofeig M. Catheter closure of patent ductus arteriosus in dogs: variation in ductal size requires different techniques. J Vet Cardiol 2003; 5: 7-12.
4. Gordon SG, Miller MW. Transarterial coil embolization for canine patent arteriosus occlusion. Clin Tech Small Anim Pract 2005; 20: 196-202.
5. Gordon SG, Saunders AB, Achen SE, Roland RM, Drourr LT, Hariu C, Miller MW. Transarterial ductal occlusion using the Amplatz Canine Duct Occluder in 40 dogs. J Vet Cardiol 2010; 12: 85-92.
6. Hogan DF, Green HW, Sanders RA. Transcatheter closure of patent ductus arteriosus in a dog with a peripheral vascular occlusion device. J Vet Cardiol 2006; 8: 139-143.
7. Kittleson MD. Patent ductus arteriosus. In: Small Animal Cardiovascular Medicine. St Louis: Mosby. 1998: 218-230.
8. Miller MW, Gordon SG, Saunders AB, Arsenault WG, Meurs KM, Lehmkuhl LB, Bonagura JD, Fox PR. Angiographic classification of patent ductus arteriosus morphology in the dog. J vet cardiol 2006; 8: 109-114.
9. Nguyenba TP, Tobias AH. The Amplatz canine duct occluder: A novel device for patent ductus arteriosus occlusion. J Vet Cardiol 2007; 9: 109-117.
10. Saunders AB, Miller MW, Gordon SG, et al. Pulmonary embolization of vascular occlusion coils in dogs with patent ductus arteriosus. J Vet Intern Med 2004; 18: 663-666.
11. Van Israel N, French AT, Wotton PR, et al. Hemolysis associated with patent ductus arteriosus coil embolization in a dog. J Vet Intern Med 2001; 15: 153-156.
12. Van Israel N, French AT. Retrieval of a patent ductus arteriosus coil following embolisation to the right subclavian artery. J Small Anim Pract 2002; 43: 136-138.
13. Wells SM, Sleeper M. Cardiac troponins. J Vet Emerg Crit Care 2008; 18: 235-245.

개에서 Coil색전술을 이용한 동맥관개존증의 폐쇄 증례

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요 약 : 10년령의 암컷 말티즈견이 지속성 심잡음을 주증으로 내원 하였다. 환축은 2차원 색채 도플러 심초음파 및 검퓨터 단층촬영을 통해 동맥관개존증 (PDA)으로 진단되었다. 심혈관조영술을 통해 동맥관의 형태 및 크기에 대해 정확히 평가한 뒤, 동맥관 폐쇄를 위해 경도관 coil 색전술이 실시 되었다. 환자는 단일 coil을 이용하여 동맥관의 완전폐쇄가 이루어 졌으며, 폐쇄직후 지속성 심잡음이 사라지고 잔류혈류가 관찰되지 않았다. 시술 후 합병증은 발생하지 않았다. 임상증상, 심장검사 그리고 혈청 troponin-I 농도의 정기적인 평가를 통하여 환자의 상태를 관찰 하였는 데, 변화가 없었다. 결론적으로 본 증례의 경우 coil색전술을 이용한 성공적인 동맥관개존증 폐쇄술에 대한 국내 첫 증례보고이다.

주요어 : Coil색전술, 동맥관개존증, 경도자적폐쇄술