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Transcatheter Closure of Patent Ductus Arteriosus with a Amplatzer® Vascular Plug in Two Dogs

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Abstract : A 9-month-old, intact female Maltese dog and one-year-old, intact female beagle dog were presented with continuous heart murmur. These 2 dogs were diagnosed as patent ductus arteriosus (PDA) based on the two-dimensional echocardiography and angiography. Due to the large shunt size, commercially available ductal occlude device was used for transcatheter occlusion of PDA. After Amplatzer® vascular plug placement, cardiac murmur was abruptly disappeared in Maltese dog and mildly decreased in beagle dog. Complications and safety after the procedure were evaluated regularly in these 2 dogs. This is first clinical application of Amplatzer® vascular plug for transcatheter closure of PDA in two dogs in Korea.

Key words **:** Amplatzer® vascular plug, patent ductus arteriosus, transcatheter closure.

Introduction

Patent ductus arteriosus (PDA) is the most common congenital cardiac anomaly in young, female dogs and the abnormal vessels form between the aorta and pulmonary artery (2,9). Diagnosis of PDA is based on evidence of left atrial and ventricular dilation with continuous turbulent flow in the main pulmonary artery using two-dimensional and color Doppler echocardiography (2,9,12). Correction of PDA traditionally involves surgical ligation; however, the use of interventional therapy has become more common (6,9). Transcatheter coil embolization is the most commonly employed method of interventional therapy and traditionally have been accomplished via catheterization of the femoral artery (4). Other occluding devices including Amplatzer® ductal occluder, Amplatzer® vascular plug and Amplatz® Canine Duct Occluder have been reported for PDA occlusion and need relatively large delivery system (8,11). Noninvasive, accurate understanding of PDA morphology is important for uncomplicated transcatheter occlusion.

We report the first application of transarterial application of Amplatzer® vascular plug for closure of PDA in two dogs.

Case

A 9-month-old, 2.46 kg, intact female Maltese dog (Case 1) and one-year-old, intact female beagle dog (Case 2) was admitted due to continuous heart murmur. Both dogs had unremarkable clinical signs. Thoracic auscultation revealed a grade V/VI continuous heart murmur at the left heart base in both dogs. Evaluation of the electrocardiogram showed sinus rhythm with prolonged P wave in case 1 and tall QRS amplitude in case 2. In both dogs, dilation of the pulmonary arteries and veins were shown through thoracic radiographs. Echocardiography demonstrated left atrial and ventricular dilation. The color Doppler echocardiography revealed continuous turbulent flow in the main pulmonary artery and patent ductus arteriosus was shown at the heart base through the left parasternal thoracic view. Based on the physical and clinical examination, both dogs were diagnosed as patent ductus arteriosus (PDA). PDA morphology were demonstrated through multi-detector computed tomography (MDCT; Asteion 4®, Toshiba, Japan) and volume rendering 3D reconstructed image was obtained (Fig 1. A & C). In both dogs, interventional treatment was elected.

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 0.02 mg/kg acepromazine (Sedaject; Samumedian Co., Ltd, Seoul, Korea). Anesthesia was induced with intravenous 4-6 mg/kg propofol (Anepol; Ha Na Pharm Co., Ltd., Seoul, Korea) and maintained with 2.5% isoflurane (Forane Soln; Choong Wae Pharm, Seoul, Korea) in oxygen. For vascular access, femoral artery was obtained by surgical isolation in right lateral recumbency posion. After insertion of 5 Fr vascular introducer sheath in femoral artery, 4 Fr angiographic catheter (Boston scientific corporation, MA, USA) was advanced into the descending aorta using fluoroscopic guid-

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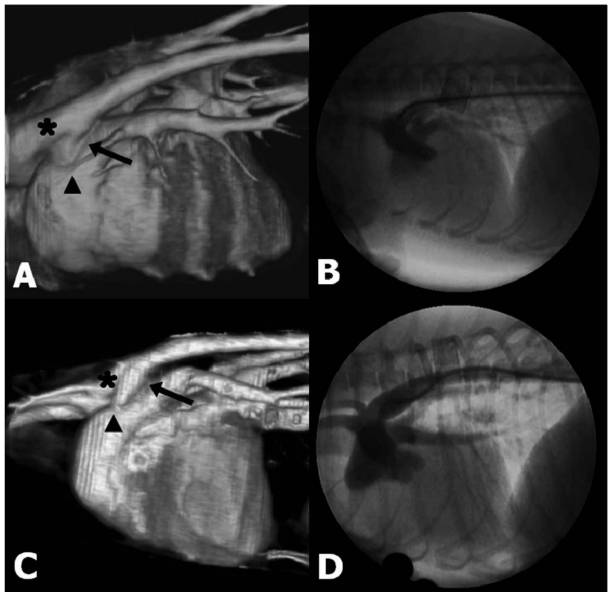

Fig 1. 3D reconstructed CT and fluoroscopic image of a right lateral angiogram before the PDA occlusion. (A & C) PDA (arrow) was demonstrated between the descending aorta (asterisk) and pulmonary artery (arrow head) in 3D reconstructed CT image. (B & D) Descending aortography revealed large shunting vessel (PDA) between descending aorta and pulmonary artery.

ance. Angiogram was obtained by vigorous hand injection of non-ionic contrast medium (Omnipaque; GE healthcare, Milwaukee, Wis, USA, 1-1.5 mL/Kg over 1 second). Angiographically, PDA was clearly demonstrated between descending aorta and pulmonary artery with distal narrowing in ductal diameter in both dogs (Fig 1. B & D). In case 1, PDA was measured 5 mm minimal ductal diameter, 7 mm distal ampullar, and 6.8 mm ductal length. In case 2, minial diameter and distal ampullar was 6.2 mm and 8.8 mm respectively, and length of the PDA was 12.2 mm. Due to the large PDA size, both dogs were treated with transcatheter nitinol mesh vascular occlusion device (Amplatzer® vascular plug; AGA medical corporation, Golden Valley, MN, USA). Based on the measured diameter of PDA, 10 mm and 12 mm Amplatzer® vascular plug were chosen case 1 and case 2, respectively. A 0.038" guiding catheter was placed into the descending aorta and 5 Fr guiding catheter for Amplatzer® vascular plug (AGA medical corporation, USA) was advanced. After removing guiding catheter, Amplatzer® vascular plug was loaded via the Amplatzer delivery catheter to the distal aspect of the ductal ampulla, and then the occluder was advanced to the main pulmonary artery and retracted partially. Once the position was determined, the occluder was fully deployed. After Amplatzer® vascular plug placement, cardiac murmur was abruptly disappeared in case 1 and mildly decreased in case 2. Angiography after the occluding device placement revealed no residual flow in case 1 and moderate residual flow in case 2. Both dogs were recovered from the anesthesia without complications and received cefazolin (30 mg/kg, IV) and butorphanol (0.1 mg/kg, IM) before and after the procedures. The dogs were discharged the following day and oral antibiotics (cephalexin 30 mg/kg, PO, q12h) were administered 5 more days. Adequate occlude position was evaluated through thoracic radiography (Fig 2) and further complications were evaluated regularly.

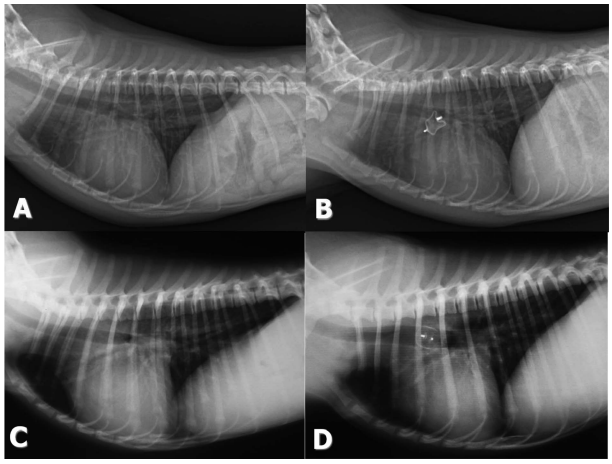

Fig 2. Thoracic radiography obtained before and after the PDA occlusion (A, C) Right lateral radiograph demonstrating cardiomegaly and dilation of the pulmonary arteries and veins secondary to patent ductus arteriosus in two dogs. (B, D) After the PDA occlusion, the device is positioned in the ductus and reduction of the pulmonary trunk, arteries and veins were demonstrated. (A & B; case 1, C & D; case 2).

Complications with the procedures were not detected in both dogs. The Maltese dog was generally healthy without significant clinical signs during 10 months follow-up period. No hematologic abnormalities were detected. In the beagle dog, slight residual flow through the ductus was observed through color Doppler echocardiography 6 months after interventional treatment. However, the dog was generally healthy without significant clinical signs and laboratory abnormalities.

Discussion

PDA is the most common correctable congenital cardiac anomaly and result in left side heart failure (2). If PDA left uncorrected, the survival rate was less than 40% of their first year of life (3). PDA can be closed by surgical ligation via thoracotomy or less invasive transcatheter occlusion (9). Transvascular closure of PDA has been conducted more frequently over the past 10 years (5,6,8,11). Various occlusion devices for PDA have been used in veterinary medicine and the device selection was based on the ductal dimension, morphology of PDA, dog's body weight and size of the femoral arteries (5,7,8,10). Traditionally, smaller dogs less than 2.5 kg are recommended surgical ligation because of the limitation of the femoral arterial access; however, due to the invasiveness of the surgery and complications including hemorrhage, incomplete ligation and recanalization, transvascular closure is

more frequently elected recently (1,7). Thrombogenic vascular coil is a commonly used occlusion device and it is less expensive and can be delivered comparatively small dogs than other occlusion devices (4,6). Other occluding devices including Amplatzer® ductal occluder, Amplatzer® vascular plug and Amplatz® Canine Duct Occluder can be used for large PDA occlusion and need specific delivery system (5,7,8,11). Recently, transvascular occlusion through the venous approach is performed to overcome the limitation of arterial access in very small dogs and reduces the risk of femoral arterial tearing (1).

In the present cases, commercially available human duct occluder, Amplatzer® vascular plug, was chosen instead of coil embolization due to the large ductal size. According to the previous report (8), the device should be only 1-2 mm wider than the distal ductal ampullar diameter due to prevent dilation of the PDA by the device. However, to prevent the migration of the device into the pulmonary artery, the device should be enoughly oversized the PDA. The author chose Amplatzer® vascular plug according to the manufacturer's recommendation, that the device should be 130-150% the size of the vessel to be occluded. These 2 cases were re-examined regularly after the PDA occlusion, the device was stable in position and no complications were noted through a 10-month and 6-month follow-up period, respectively case 1 and 2.

In conclusion, the Amplatzer® vascular plug appears to be a valuable and safe therapeutic option in the transcatheter closure of PDA in dogs.

Acknowledgement

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개에서 Amplatzer® vascular plug를 이용한 동맥관개존증의 폐쇄 2 증례

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요 약 : 9개월령의 암컷 말티즈견과 1년령의 암컷 비글견이 지속성 심잡음을 주증으로 내원 하였다. 두 환축은 2차원 심초음파 및 심혈관조영술을 통해 동맥관개존증 (PDA)으로 진단되었다. 평가된 환축들의 동맥관 사이즈는 비교적 큰 편이었으며, 혈관 폐색장치 중 Amplatzer® vascular plug를 통한 동맥관의 폐쇄술이 시도 되었다. 말티즈 견의 경우, Amplatzer® vascular plug를 이용하여 동맥관의 완전폐쇄가 이루어 졌으며, 폐쇄직후 지속성 심잡음이 사라졌다. 비글견의 경우, Amplatzer® vascular plug 삽입 후 심잡음이 줄어들긴 했지만, 심혈관 조영검사에서 잔류혈류가 관찰되었다. 시술의 안전성 및 시술 후 합병증은 두 환자 모두에서 지속적으로 모니터링 되었다. 본 2 증례는, Amplatzer® vascular plug를 이용한 성공적인 동맥관개존증 폐쇄술에 대한 국내 첫 증례보고이다.

주요어 : Amplatzer® vascular plug, 동맥관개존증, 경도자적폐쇄술