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Transvenous Balloon Valvuloplasty through Femoral Vein in a French Bulldog with Pulmonic Stenosis

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Abstract : A 9-month-old castrated male French Bulldog (13 kg of body weight) was presented with the primary complaint of loud heart murmur and exercise intolerance. Diagnostic imaging studies found severe pulmonic stenosis (peak velocity > 5 m/s) with right ventricular hypertrophy. Because of higher pressure gradient between right ventricle and right ventricular outflow tract (> 100 mmHg), the dog was underwent balloon valvuloplasty through femoral vein. After procedure, the peak pulmonic velocity was reduced to 2.1 m/s (PG = 18 mmHg). Further follow-up study found no further deterioration, for 6 months to date. This is the first case report of pulmonic stenosis treated by transvenous balloon valvuloplasty through femoral vein in Korea.

Key words **:** pulmonic stenosis, balloon dilation, valvuloplasty, dog.

Introduction

Pulmonic stenosis (PS) is narrowing of right ventricular outflow tract (RVOT) causing right ventricular (RV) hypertrophy and right atrial (RA) dilation from pressure overload in RVOT (7). It is predominantly occurred by congenital heart defects (CHD) in dogs. Typical clinical signs are right sided heart failure signs including ascites and hepatomegaly. It is the second most common CHD in dogs and is more common in Beagles, Boxers, French Bulldogs, Schnauzers and Samoyeds (1). Depending on location of stenosis, it is subdivided into supravalvular, infundibular (valvular) and subvalvular. Almost 90% of PS found to be infundibular type in dogs. Although mild PS is not required for therapy, moderate to severe PS is necessary to treat either by surgical correction or balloon valvuloplasty (1-5,7). If surgical correction is not applicable, medical management including calcium channel blockers and diuretics is option for improving clinical signs associated with right-sided heart failure. Prognosis is dependent on the severity of PS. In dogs with severe PS, if left uncorrected, may die early in life, due to right-sided congestive heart failure (7).

Case

A 9-month-old castrated male French Bulldog (13 kg of body weight) was referred at Veterinary Teaching Hospital of Kangwon National University with primary complaints of loud heart murmur and exercise intolerance. In physical examination, the dog had grade IV/VI left basal systolic murmur. The mucosa in lips was pink and moist. Systolic blood pressure measured by Doppler detector (811B, Parks medical, USA) was 150 mmHg. Electrocardiographic (ECG) studies revealed normal sinus rhythm with right ventricular enlargement (presence S wave in lead I, II, III, V4-V6; ≥ 0.6 mV of S wave in V3). Complete blood cell count (CBC) and serum chemistry profiles have no significant abnormalities.

Thoracic radiography revealed typical reverse 'D' shape right cardiac enlargement with prominent main pulmonary artery bulging and under-circulated lung fields on ventrodorsal projection and cardiomegaly (4 intercostal spaces) with increased cardiac contact to the sternum and dorsal displacement of trachea enlargement on right lateral projection, suggesting right cardiac enlargement pattern (Fig 1). The 2-dimensional echocardiography in right parasternal short axis view revealed narrowing of RVOT (aortic to pulmonary ratio 1.3; Fig 2B), although the pulmonic valve itself was intact. There was fibrotic ring around pulmonary infundibulum. Color image (Fig 2C) and continuous wave Doppler (Fig 2A) echocardiographic studies revealed turbulent systolic jet flow with velocity of 5.0 m/s (pressure gradient between RV and RVOT 100 mmHg), indicating severe infundibular type pulmonic stenosis. Further the 2-dimensional echocardiography in right parasternal short axis view found RV hypertrophy and interventricular septal flattening, due to pressure overload in the RV (Fig 2D). Because the pressure gradient between RV and RVOT indicated severe PS, we decided balloon valvuloplasty for widening the RVOT.

Surgical general anesthesia with intravenous alfaxalone (2 mg/kg, alfaxalone, alfaxane, Jurox, Australia) induction and 1-3% isoflurane maintenance was achieved. Prior to balloon valvuloplasty, the carotid artery was exposed to insert coronary angiocatheter (5Fr, Torcon NB® Advantage Beacon® series, COOK medical, Bloomington, USA) to check type R2A coronary anomaly in this dog. Fortunately, this dog had

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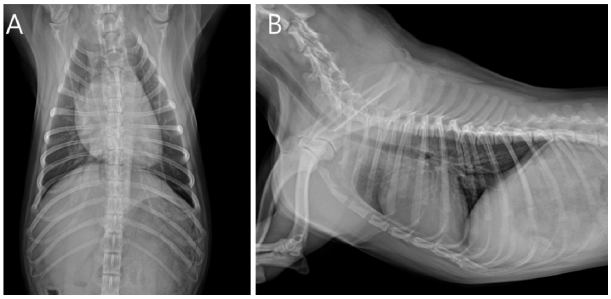

Fig 1. Thoracic radiography of this case. A: Ventrodorsal projection of thoracic radiography revealed typical reverse 'D' shape right cardiac enlargement with prominent main pulmonary artery bulging and under-circulated lung fields. B: Right lateral projection of thoracic radiography revealed cardiomegaly (4 intercostal spaces) with increased cardiac contact to the sternum and dorsal displacement of trachea enlargement.

no this type anomaly. For balloon valvuloplasty through femoral vein, venipuncture was performed at right femoral vein with an 18G needle. A guide wire (Weasel wire®, 150 cm × 0.035" angled, Infiniti medical, Menlo Park, USA) was inserted into the needle and located at pulmonary artery under fluoroscopic guidance (Fig 3A). An introducer sheath (7Fr, Check-Flo Performer® Introducer, COOK medical, Bloomington, USA) is inserted to the right femoral vein with guidance of pre-placed guide wire. The balloon dilatation catheter (Tyshak II Vet Balloon, 16 mm × 4 cm, Infiniti medical, Menlo Park, USA) was then inserted and advanced to the stenotic pulmonic valve (Fig 3B). With inflation device

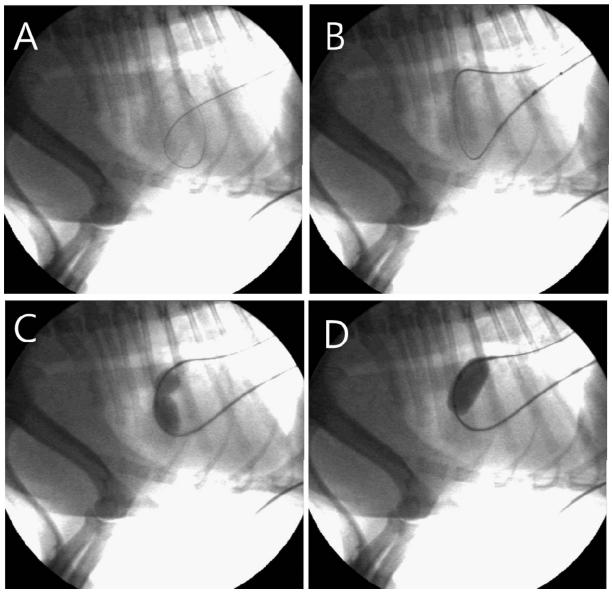

Fig 3. Balloon dilation (valvuloplasty) under the fluoroscopic guidance.
A: A guidewire was inserted into the needle and located at pulmonary artery under fluoroscopic guidance. B: The balloon dilatation catheter was then inserted and advanced to the stenotic pulmonic valve. C: With inflation device, the balloon was then inflated at the stenotic area. D: The balloon was then removed the stenosis.

(Sphere™ Inflation device, COOK, Bloomington, USA), the balloon dilation procedure was performed with careful moni-

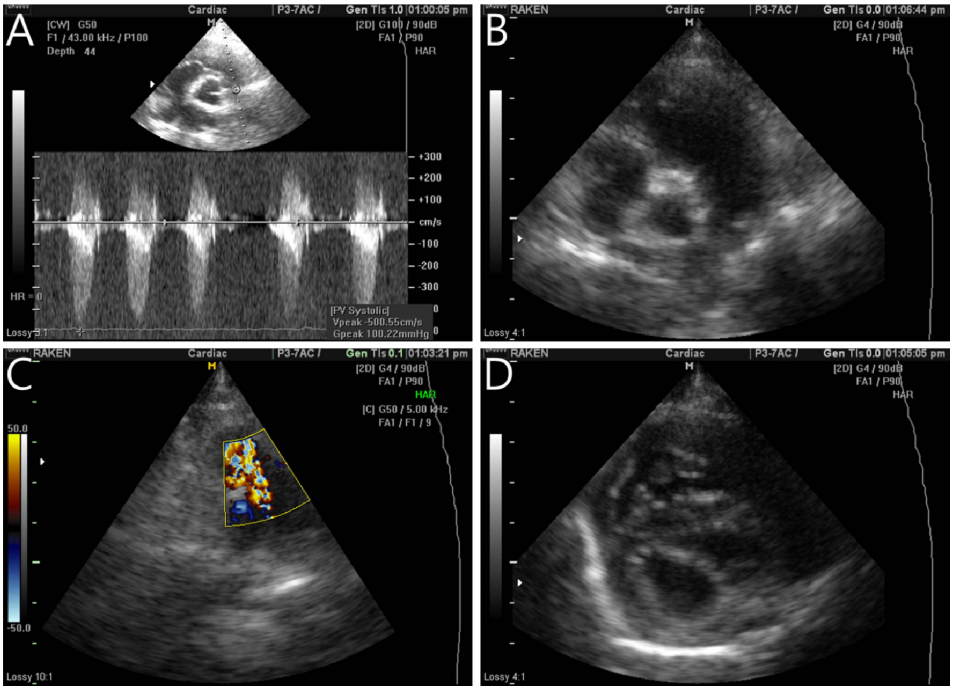

Fig 2. The echocardiography of this case. A: Continuous wave Doppler echocardiography revealed systolic jet flow with velocity of 5.0 m/s (pressure gradient between RV and RVOT 100 mmHg), indicating severe pulmonic stenosis. B: The 2-dimensional echocardiography in right parasternal short axis view revealed narrowing of RVOT (aortic to pulmonary ratio 1.3). C: Color image echocardiography revealed mosaic pattern turbulent jet flow around RVOT. D: The 2-dimensional echocardiography in right parasternal short axis view found RV hypertrophy and interventricular septal flattening, due to pressure overload in the RV.
RV, right ventricle; RVOT, right ventricular outflow tact.

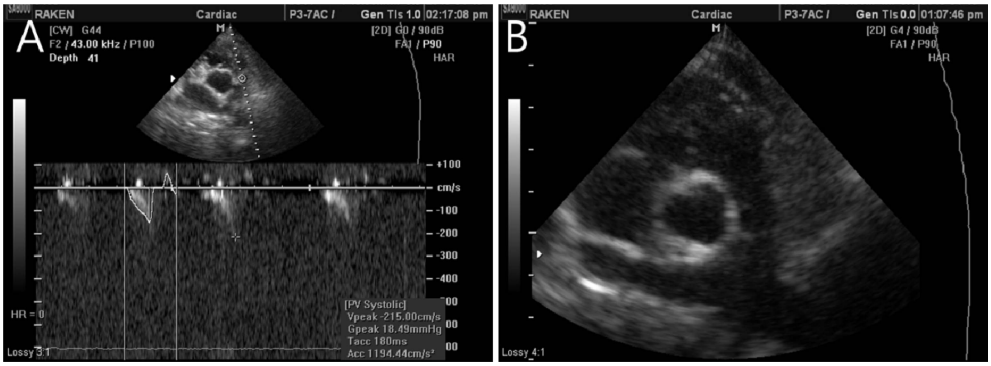

Fig 4. Echocardiography of this case. A: Continuous wave Doppler echocardiography taken one day after procedure revealed mild systolic jet flow with peak velocity of 2.1 m/s (PG = 18 mmHg). B: The 2-dimensional echocardiography in right parasternal short axis view taken one day after procedure revealed the RVOT was much wider and the fibrotic ring around pulmonic infundibulum was not clearly visible.

toring the pressure within the balloon (Fig 3C). The balloon was being inflated with a saline/contrast mixture (Fig 3D). After procedure, the peak pulmonic velocity at RVOT was reduced to 2.1 m/s (PG = 18 mmHg; Fig 4A). The RVOT was much wider and the fibrotic ring around pulmonic infundibulum was not clearly visible (Fig 4B). On the next day of procedure, the dog was released with prescription of atenolol (0.5 mg/kg, PO, q12hr, Atenolol, Sandoz, Seoul, Korea) and enalapril (0.5 mg/kg, PO, q12hr, Enalapril, Ildong Pharmaceuticals, Seoul, Korea). The dog is currently healthy and has no further deterioration of PS for 6 months, to date.

Discussion

Balloon valvuloplasty is non-invasive interventional procedure for treating valvular stenosis (1-5,7). Indications for this procedure include PS with clinical signs and any stenosis with pressure gradient higher than 80 mmHg (7). Although balloon valvuloplasty is generally effective for PS with commissural fusion, it is not effective for PS with annular hypoplasia.

PS in English and French bulldogs has a particular type of coronary anomaly (type R2A coronary artery). The type R2A coronary artery anomaly is characterized by single right coronary ostium with anomalous prepulmonic left coronary artery (8). In PS dogs with type R2A coronary artery anomaly often died suddenly by the cessation of coronary flow during the time of balloon inflation (8). Therefore angiographical interrogation is necessary prior to balloon valuloplasty in French bulldogs with PS. Fortunately, the coronary artery of this case was found to be normal. Therefore we proceeded balloon valvuloplasty in this dog.

In practice, balloon valvuloplasty can be performed through either jugular vein or femoral vein (7). Transjugular approach is technically much difficult and is harder to advance the balloon tip catheter into the stenotic area, due to the rigidity of the tip of balloon catheter. Therefore it often causes ventricular tachyarrhythmias and puncture of right ventricular wall, which are catastrophic. Transfemoral approach is technically much easier and safer, because balloon catheter can be advanced into the stenotic area without looping inside RV chamber. Therefore it dramatically reduces the risk of cardiac complications during procedure. However, the transfemoral approach may not be applicable for toy dogs, because they have too small femoral veins to insert larger bore introducer sheath for accommodating balloon tip catheter. In our case, the patient had sufficient diameter of femoral vein for inserting larger bore introducer sheath for balloon valvuloplasty. Advance to stenotic area using this approach was relatively easy. The total procedure time was ~20 min, since the placement of balloon tip catheter was not difficult. Therefore, we found transfemoral approach was a good alternative method for balloon valvuloplasty in dogs, especially if dog has sufficient diameter of femoral veins for placement of 7-8 Fr vascular sheath.

In conclusion, we treated severe PS with transvenous balloon valvuloplasty through a femoral vein and found this approach was safer and reduced procedure time. This approach might be was a good alternative method for balloon valvuloplasty in dogs. To the best of our knowledge, this is the first successful case report describing interventional balloon valvuloplasty through femoral vein for treatment of severe PS in Korea.

Acknowledgements

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대퇴정맥을 통한 풍선확장술로 치료한 프렌치불독의 폐동맥협착증 치료증례

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요 약 : 9개월령 프렌치불독(체중 13 kg)이 심한 심잡음과 운동불내성으로 내원하였다. 영상진단검사상, 폐동맥에서 5 m/s이상의 고속의 젯트와 우심실 비대가 확인되었다. 우심실과 유출로 사이의 압력구배가 100 mmHg이상이여서 풍선확장술로 치료하였다. 치료후 폐동맥에서 젯트속도는 2.1 m/s (PG = 18 mmHg)이하로 감속되었다. 환자는 그 이후에 별다른 진단검사상 악화소견이 관찰되지 않았다. 본 증례는 대퇴정맥으로 폐동맥 협착을 풍선확장술로 치료한 국내 첫 증례이다.

주요어 : 폐동맥 협착, 풍선확장술, 판막성형술, 개