

肺動脈狭窄症犬の経心室的肺動脈弁拡大形成術(ブロック法)による外科的修復

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Surgical Correction of Pulmonic Stenosis Using Transventricular Pulmonic Dilation Valvuloplasty (Brock) in a Dog

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ABSTRACT. A two-month-old male long coated Chihuahua, which had symptoms including anorexia and decreased growth, was diagnosed with pulmonic valvular stenosis. Echocardiography showed the severe progression of pulmonary arterial velocity (6.29 m/s, Pressure gradient (PG); 158 mmHg). Transventricular pulmonic dilation valvuloplasty (Brock) was conducted, and stenosed valve was dilated by the oto forceps. Pleural effusion was observed postoperatively, however, it was diminished under the intensive care for five days after the surgery. The right ventricular systolic pressure was decreased to 60mmHg in angiocardiology conducted two months postoperatively and the dog has kept a good general condition with recovered vigor and appetite.

KEY WORDS: Brock, pulmonic stenosis, transventricular pulmonic dilation valvuloplasty.

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Pulmonic stenosis (PS) is a congenital narrowing of the right ventricular outflow tract. It is a relatively common cardiac defect, occurring in approximately 1 in 1,000 dogs [11]. A survey of the records listed congenital pulmonic stenosis as the third most commonly diagnosed congenital cardiac defect in dogs, several specific dog breeds were identified as being predisposed to this defect, including the English bulldog, mastiff, Samoyed, miniature schnauzer, cocker spaniel and West Highland white terrier [12]. Types of PS are classified into three categories (supravalvular, subvalvular and infundibular) and the most common type of PS in dogs is valvular dysplasia [3]. Doppler echocardiography has made it possible to identify PS and determine its severity noninvasively. There is general agreement that dogs with resting pressure gradients (PG) between right ventricle and pulmonary artery in the severe category (>80 mmHg) are at increased risk for syncope, congestive heart failure, or sudden death, therefore surgical intervention is usually recommended for these dogs [2, 3, 5, 10]. This case report describes the surgical intervention and its postoperative course in a case of PS.

A two-month-old male long coated Chihuahua was pointed out with cardiac murmur in a veterinary clinic. Medicines were not administrated at the time. The owner requested a thorough examination and the dog was referred to the Veterinary Medical Teaching Hospital, Tokyo University of Agriculture and Technology for the definitive diagnosis.

The dog weighed 0.8 kg, anorexia and decreased growth were appeared in the first medical examination. Auscultation identified a grade Levine IV/VI systolic murmur with its point of maximum intensity in the left heart base. Blood examination showed no abnormal findings except for high value of alkaline phosphatase (837 U/L). Thoracic radiography revealed dilatation of right ventricle, pulmonary artery and left ventricle. Cardiothoracic ratio (CTR) and

Vertebral heart size (VHS) were 77.1% and 10.9 V respectively. Electrocardiography showed normal sinus rhythm, however, tachycardia (250 beat/min), right axis deviation (mean electric axis of +165°), increased S-wave amplitudes (-1.2 mV) and depression of the ST segment were revealed. Echocardiography showed the severe progression of pulmonary arterial velocity (6.29 m/s, Pressure gradient (PG); 158 mmHg), pulmonary regurgitation, right ventricular hypertrophy and ventricular septum flattening. Moreover, tricuspid regurgitation was complicated (Regurgitation velocity; 6.63 m/s, PG; 175.7 mmHg). Based on the above findings, the diagnosis was confirmed as severe pulmonic valvular stenosis (Fig. 1).

It was seemed that surgical intervention using a cardiac catheter or cardiopulmonary bypass was difficult to be performed because of its low body weight [2] and the severity of PS [1, 4, 7]. Therefore, transventricular pulmonic dilation valvuloplasty (Brock method) was planned when the dog grows up. However, on the 68th day, the dog showed abdominal respiration, blood examination revealed the increase in alanine aminotransferase (ALT; 180 U/L). Moreover, echocardiography revealed increase of the pulmonary arterial velocity (6.42 m/s, PG; 164.9 mmHg) (Fig. 2). Brock method was conducted on the 76 th day. The dog was premedicated with atropine sulphate (0.04 mg/kg subcutaneously) and diazepam (0.5 mg/kg intravenous). Anesthesia was induced by intravenous administration of propofol (0.6 mg/kg), and the dog was then intubated. Anesthesia was maintained with a combination of isoflurane in oxygen; suxamethonium chloride was administered intermittently for muscle relaxation. Moreover, an analgesic (morphine 1 mg/kg) was administered intravenously during the operation. Respiration was controlled by intermittent positive pressure ventilation. A median sternotomy was performed, at this time, pleural effusion was observed. Then a pericardial cradle was created. The right outflow

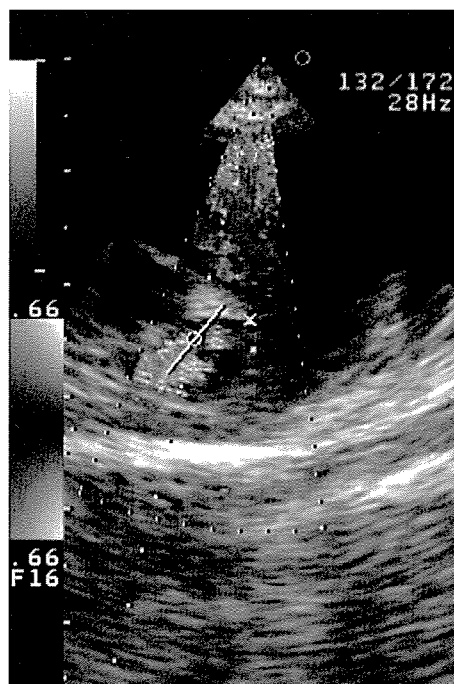


Fig. 1. Echocardiography of right ventricular outflow tract. This finding showed the pulmonic valvular stenosis.

tract was buttressed mattress sutured by 3-0 braided silk, and 18 gauge intravenous catheter was inserted for a measurement of the right ventricular pressure (Table 1). Small incision was made in the right outflow tract and buttressed mattress sutured was tied to prevent bleeding. Mattress sutured was then loosened and an oto-forceps was inserted through the small incision into pulmonary arterial valve, then the stenosed valve was dilated by the forceps [8]. After pulmonic dilation valvuloplasty, the right ventricular pressure was measured again (Table 1). The right ventricular

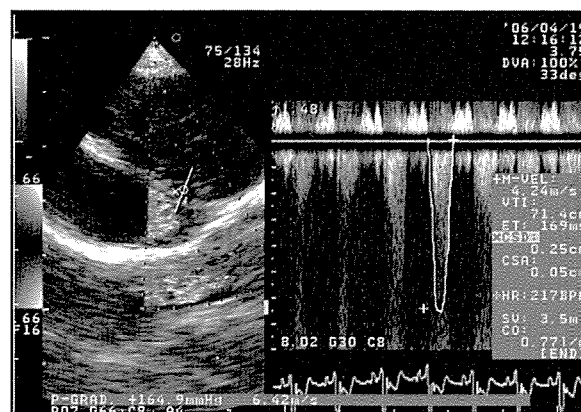


Fig. 2. Echocardiography of right ventricular outflow tract. Pulmonary arterial flow velocity of 6.42 m/second was observed on 68 days, corresponding to a pressure gradient of 164.9 mmHg.

outflow tract was closed by tying buttressed mattress sutured. A pericardial membrane was sutured and thoracic drain was inserted. Then, the chest was closed routinely.

Postoperatively, an antibiotic (cefazolin 50 mg/kg), an analgesic (morphine 1 mg/kg), diuretics (furosemide 0.71 mg/kg) and cardiac stimulant (milrinone 0.4–0.8 μ g/min) were administered intravenously. Pleural effusion was removed from the thoracic drain by 7.8 ml/hr during twelve hours postoperatively. Then, the blood examination showed hypoalbuminemia (2.3 g/dl) and hypokalemia (3.0 meq/l). On the other hand, serum sodium (142 meq/l), chloride (111 meq/l), hemoglobin (15.8 g/dl) concentration and hematocrit (45.7%) were normal. Therefore, a dog plasma, which was prepared at 14.6 meq/l of potassium, was transfused by 3 ml/hr and the removal of pleural effusion was continued. Five days postoperatively, pleural effusion was diminished and the thoracic drain was then taken off. A general condition of the dog was good and, the dog left hospital seven days postoperatively.

Table 1. Echocardiographic, angiographic and blood examination findings

	Preoperative	Postoperative			
		Immediately	4 days	15 days	2 months
Echocardiographic					
Pressure gradients (mmHg)	155	–	116.2	104.1	59.3
Tricuspid regurgitation (mmHg)	94.3		91.8	118.2	105.3
Intra cardiac pressure * (mmHg)					
Right ventricle	120/11	89/–10	–	–	60/–14
Right atrium			–	–	6/0
Blood chemical examination					
ALT(U/L)	756	588	23	42	32
AST(U/L)	158	154	26	31	26
ALP(U/L)	245	252	316	383	185
BUN (mg/dl)	39.1	38.5	23.4	26.6	27
Crea (mg/dl)	0.8	0.6	0.4	0.5	0.6

* systolic pressure/ diastolic pressure.

ALT: alanine aminotransferase AST: aspartate aminotransferase.

ALP: alkaline phosphatase BUN: blood urea nitrogen Crea: creatinine.

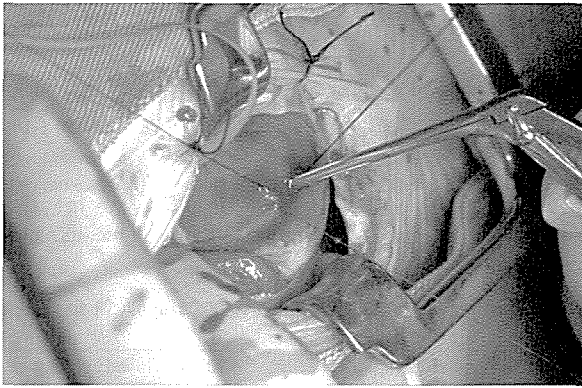


Fig. 3. An oto-forceps was inserted into pulmonary arterial valve, the stenosed valve was dilated by the forceps.

Fifteen days postoperatively, the dog kept a good general condition with a recovered appetite. Values of the hepatic function on the blood examination were decreased down below the preoperative value and close to the normal range (Table 1). Echocardiography also revealed the decrease in the pulmonary arterial velocity. Two months postoperatively, angiocardigraphy was performed. Although poststenotic dilation was still appeared clearly, systolic right ventricular pressure decreased to 60 mmHg (Table 1). The dog was continued administration of 0.55 mg/kg/day furosemide and 0.005 mg/kg digoxin. At the time of writing, three months have passed since the operation and the dog maintains good condition.

Generally, Brock method is selected for a small dog in which balloon valvuloplasty or cardiopulmonary bypass can not be performed. In severe pulmonic stenosis, a surgical therapy is recommended in the stable pathologic status because of a sudden death [3]. However, Brock method was also effective in the case with poor general condition derived from the right heart failure, it was seemed to be possible to improve clinical signs. Only about 30 mmHg of decrease in the pressure gradient was achieved during the surgery, however, a more potent decreases were obtained in both of the pressure gradient and the right ventricular systolic pressure observed on echocardiography and angiocardigraphy conducted postoperatively. In this case, it was seemed that clinical signs were improved by the improvement of the hepatic function derived from the decrease in the right ventricular pressure overload. The severe pleural effu-

sion may be derived from the infection, the inflammatory reaction or the increase in venous blood pressure by the fluid therapy. Moreover, a postoperative pleural effusion is reported in the surgical correction of the double chambered right ventricle [6]. Therefore, it was thought that the increase in the pulmonary vessel flow after the correction of the stenosis contributed to the right ventricular overload, this might induce the transient pleural effusion. Although the event such as the pleural effusion was observed in the dog, it was possible to be controlled by the intensive care. Orton described that the dilation valvuloplasty was relatively low risk for operative mortality or postoperative complications compared with other surgical corrections [9].

Although the severe tricuspid regurgitation remains, the dog is able to return to activities of daily living and owner is content with its current condition. Careful observation should be continued because a restenosis of the valve has been reported.

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