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Aortoseptal angle and pressure gradient reduction following balloon valvuloplasty in dogs with severe subaortic stenosis

L. Shen, BSc ^a, A.H. Estrada, DVM ^{a,*}, E. Côté, DVM ^b,
M.A. Powell, CVT ^a, B. Winter, MS ^a, K. Lamb, PhD ^c

^a *Department of Veterinary Clinical Sciences, College of Veterinary Medicine, University of Florida, Gainesville, FL, USA*

^b *Department of Companion Animals, Atlantic Veterinary College, University of Prince Edward Island, Charlottetown, Prince Edward Island, Canada*

^c *Lamb Consulting, West St. Paul, MN, USA*

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KEYWORDS

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Abstract *Introduction:* To determine the relationship between aortoseptal angle (AoSA) and the short- and long-term systolic pressure gradient (PG) reduction following combined cutting and high-pressure balloon valvuloplasty (CB/HPBV) in dogs with severe subaortic stenosis.

Animals: Retrospective study of 22 client-owned dogs of various breeds with severe subaortic stenosis (mean left ventricular to aortic PG = 143 mmHg; range = 80–322 mmHg) that underwent CB/HPBV.

Materials and methods: Initial angiographic and left apical and right-sided parasternal long-axis view echocardiographic video loops were used for measuring the angle between the plane of the interventricular septum and the longitudinal axis of the ascending aorta. The PG reduction ratio immediately after CB/HPBV and 6 and 12 months later were compared with AoSA.

Results: Weak correlations were observed for all instances of PG reduction ratio and AoSA type. Significantly greater mean differences of PG reduction ratio were observed for angles >160° than for angles <160° at 24 h (>160° mean: 54.45, standard error [SE]: ±3.8; <160° mean: 39.88, SE: ±2.09), 6 months (>160° mean: 57.73, SE: ±10.9; <160° mean: 28.22, SE: ±3.42), and 12 months (>160° mean: 76.11, SE: ±17.5; <160° mean: 27.61, SE: ±6.44; $p=0.003$).

* Corresponding author.

E-mail address: estradaa@ufl.edu (A.H. Estrada).

Conclusions: Dogs with AoSA $>160^\circ$ on right-sided parasternal long-axis view echocardiograms responded with a greater PG reduction following CB/HPBV than did dogs with AoSA $<160^\circ$. This suggests that AoSA is associated with long-term outcomes of CB/HPBV, and measurement could help in the evaluation of dogs that are candidates for CB/HPBV.

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Abbreviations

| | |
|---------|--|
| AoSA | aortoseptal angle |
| CB/HPBV | combined cutting and high-pressure balloon valvuloplasty |
| LVOT | left ventricular outflow tract |
| PG | pressure gradient |
| SAS | subaortic stenosis |

Introduction

Subaortic stenosis (SAS) is the most common congenital cardiac abnormality identified in large breed dogs [1]. While the diagnosis of severe forms of this disease is straightforward, treatment and decisions on when to consider interventional therapy remain a challenge [2]. Most cases of SAS are treated medically with beta-blockers, angiotensin-converting enzyme inhibitors, and diuretics, the latter two being used if congestive heart failure is present [2,3]. Other methods of treatment have included surgical resection of the stenotic region [4] and low-pressure balloon valvuloplasty [5]. One study of dogs with severe SAS found that those treated with low-pressure balloon valvuloplasty had a median survival time (55 months) that was not significantly different from that of dogs treated with atenolol (56 months) [5].

A novel combined cutting balloon and high-pressure balloon valvuloplasty (CB/HPBV) recently has been studied as a possible treatment for dogs with severe SAS [6]. Cutting balloon angioplasty was effective as a treatment for pulmonary artery stenosis in humans whose vessels were found to be resistant to low-pressure balloon dilation [7]. However, long-term postoperative outcomes in dogs with severe SAS have varied.^d The cause of the variation in response to the procedure is unknown, but one hypothesis is that the

variation may be due to shear stress on the basalmost interventricular septum immediately apical to the aortic valve, as a result of irregular blood flow caused by an abnormal aortoseptal angle (AoSA).

Parameters such as peak flow velocity through the left ventricular outflow tract (LVOT Vmax) and effective orifice area indexed to body surface area have been studied as predictors of development of SAS later in life in Golden Retriever dogs [8]. It has also been observed that an abnormal AoSA can be identified in some young Golden Retriever puppies, and it has been proposed that the resulting shear stress on the subaortic region may lead to fibrosis and creation or exacerbation of an SAS lesion [9]. An abnormal AoSA, then, may promote the development of SAS and therefore may serve as a useful indicator of the development of SAS later in life [9]. Furthermore, if an abnormally steep (small) AoSA contributes to SAS and is not remedied by ballooning, it is possible that the magnitude of the AoSA may serve as a useful criterion for determining which dogs will respond better to balloon valvuloplasty and are therefore better candidates for the procedure.

The objective of this retrospective study was to determine if there is a correlation between the magnitude of AoSA and short- and long-term success following CB/HPBV in dogs with severe SAS. We hypothesized that a steeper AoSA would be associated with a smaller long-term pressure gradient (PG) reduction following CB/HPBV.

Animals, materials, and methods

Animals

Electronic records of dogs of various breeds that were diagnosed with SAS and enrolled in a previous study [6] were collected. These dogs were 4.5–42 months old, weighed 5.6–53.8 kg, and were owned by clients of the Colleges of Veterinary Medicine of the University of Florida, Cornell University, University of Prince Edward Island, The Ohio State University, and Garden State Veterinary

^d Kleman ME, Estrada AH, Tschosik ML, Maisenbacher HW, Prošek RP, Pogue B, Jones AE, Shih A, Paolillo JA. An update on combined cutting balloon and high-pressure balloon valvuloplasty for dogs with severe subaortic stenosis. Proceedings of the 31st ACVIM Forum; 2013 June 12–15; Seattle, WA.

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