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High-pressure balloon valvuloplasty for severe pulmonary valve stenosis: a prospective observational pilot study in 25 dogs☆

Catherine Belanger, DVM [a], Catherine T. Gunther-Harrington, DVM [b], Satoko Nishimura, DVM [a], Maureen S. Oldach, DVM [a], Samantha L. Fousse [b], Lance C. Visser, DVM, MS [b], Joshua A. Stern, DVM, PhD [b],*

[a] *William R Pritchard Veterinary Medical Teaching Hospital, School of Veterinary Medicine, University of California, Davis, One Shields Avenue, Davis, CA 95616 USA*
[b] *Department of Medicine & Epidemiology, School of Veterinary Medicine, University of California, Davis, One Shields Avenue, Davis, CA 95616 USA*

Abstract *Objectives:* We aimed to evaluate safety and efficacy of high-pressure balloon valvuloplasty (HPBVP) for treatment of canine severe pulmonary valve stenosis (PS). A secondary aim was to provide pre-procedure predictors of success.
Animals: Twenty-five dogs.
Methods: Prospective observational study. Dogs with severe PS (echocardiographically derived trans-pulmonary peak/maximum pressure gradient (EDPG) ≥80 mmHg) were recruited. All dogs underwent echocardiography before and 20—24hrs after HPBVP using a high-pressure balloon with rated burst pressures

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* Corresponding author.
E-mail address: jstern@ucdavis.edu (J.A. Stern).

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ranging from 12 to 18 ATM. Procedural success was defined as a post-HPBVP EDPG reduction of ≥50% or reduction into at least the moderate category of PS (50−79 mmHg). Optimal result was defined as a post-procedural EDPG ≤30 mmHg.
Results: Initial median (IQR) EDPG for all dogs was 96 (88, 127) mmHg with a post-operative median of 48 (36, 65) mmHg. The median EDPG reduction provided by HPBVP was 63% (39, 68); procedural success rate was 92% (23 dogs). Optimal results were achieved in 56% (14 dogs). There were no significant correlations between EDPG reduction and valve morphology (Type A and Type B) or severity of right ventricular hypertrophy. Pulmonary valve annulus diameter was the only echocardiographic variable that was significantly correlated to EDPG reduction (p = 0.02; r = −0.46). No dog experienced any anesthetic or surgical complications, and all patients survived the procedure.
Conclusions: In this cohort of 25 dogs with severe PS, HPBVP was safe and effective. The procedural success rate and high number of optimal results achieved with HPBVP suggest future randomized controlled trials comparing HPBVP to conventional valvuloplasty are warranted.

Abbreviations

BV	balloon valvuloplasty
EDPG	echocardiographically derived pressure gradient
HPBVP	high-pressure balloon valvuloplasty
PS	pulmonary valve stenosis
RV	right ventricle
RVOT	right ventricular outflow tract

Introduction

Pulmonary valve stenosis (PS) is one of the most common congenital heart diseases in dogs [1]. Pulmonary valve stenosis is inherited in beagles and is commonly seen in terrier breeds and brachycephalic dogs including bulldogs, french bulldogs, and pit bull terriers [2−4]. Anatomically, PS can occur in subvalvular, valvular, or supravalvular locations; however valvular stenosis is by far the most common in dogs [5]. Morphologically, the valvular lesion of canine PS has been classified as Type A or Type B. Type A represents a systolic doming valve on echocardiogram due to partially fused valve leaflets, along with variable valve thickening, a normal pulmonary valve annular size, and the presence of a post-stenotic dilatation of the pulmonary trunk. Type B represents a variably thickened and dysplastic valve, a hypoplastic pulmonary valve annulus, and rarely a post-stenotic dilatation of the pulmonary artery. In many cases, clear classification may be challenging as the two types are rarely completely distinct entities [6].

Echocardiography is considered the method of choice to diagnose PS and to assess its severity. Trans-pulmonic peak pressure gradients are commonly used to assess PS severity and are considered mild at pressure gradients of 30−50 mmHg, moderate at 50−80 mmHg and severe when exceeding 80 mmHg [7,8]. Dogs with severe PS are more likely to develop signs of exercise intolerance, right-sided heart failure, syncope, and sudden death [4,9].

Balloon valvuloplasty has become the treatment of choice for dogs with severe PS and for dogs with clinical signs [3,10]. Johnson et al. [10] have shown that balloon valvuloplasty (BV) can successfully alleviate clinical signs and prolong survival time in dogs with severe PS. In that study, 40 dogs that underwent BV were compared with 41 that were treated medically. The BV procedures were performed by a single operator with a standard low-pressure balloon. Three dogs did not survive the procedure. Thirty-seven of the 40 dogs that had the BV survived with a median reduction in pressure gradient of 46%. Long-term follow-up showed that of the 37 surviving dogs, 30 had resolution of their clinical signs and 3 had remaining clinical signs [10]. Several other predictors of balloon valvuloplasty success include valve morphology, dog age prior to the procedure, balloon size, and number of inflations [3,5].

It is common practice to perform canine BV with the use of a single, low-pressure balloon. However, this standard technique is associated with lower procedural success in dogs with annular hypoplasia [3]. In 2004, Estrada et al. [11] outlined and described the use of a double-balloon technique to perform BV in large breed dogs or in patients in which the pulmonary valve annulus prevents dilation with standard low-pressure balloons. More recently, the use of cutting balloons followed by high-pressure balloon valvuloplasty (HPBVP) has