ELSEVIER

Accuracy of Doppler echocardiographic estimates of pulmonary artery pressures in a canine model of pulmonary hypertension

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Abstract *Objectives:* To compare noninvasive estimates of pulmonary artery pressure (PAP) obtained via echocardiography (ECHO) to invasive measurements of PAP obtained during right heart catheterization (RHC) across a range of PAP. To examine the accuracy of estimating right atrial pressure via ECHO (RAP_{ECHO}) compared to RAP measured by RHC (RAP_{RHC}), and determine if adding RAP_{ECHO} improves the accuracy of noninvasive PAP estimations.
Animals: 14 healthy female beagle dogs.

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Methods: Comparison of ECHO and RHC measures of PAP, both at normal PAP and increased PAP generated by microbead embolization.

Results: Noninvasive estimates of PAP were moderately but significantly correlated (*r* of 0.68–0.78; $p < 0.0006$) with invasive measurements of PAP. Wide variance was noted for all estimations, with increased variance at higher PAP. The addition of RAP$_{ECHO}$ improved correlation and bias in all cases. RAP$_{RHC}$ was significantly correlated with RAP$_{ECHO}$ ($r = 0.38$; $p = 0.04$) as estimated by the ellipse area method. Median RAP$_{RHC}$ was significantly different between 3 subjective assessments of right atrial size ($p = 0.037$).

Conclusions: Spectral Doppler assessments of tricuspid and pulmonic regurgitation are imperfect methods for predicting PAP as measured by catheterization despite an overall moderate correlation between invasive and noninvasive values. Noninvasive measurements may be better utilized as part of a comprehensive assessment of PAP in canine patients. RAP$_{RHC}$ appears best estimated based on subjective assessment of RA size. Including estimated RAP$_{ECHO}$ in estimates of PAP improves the correlation and relatedness between noninvasive and invasive measures of PAP, but notable variability in accuracy of estimations persists.

Abbreviations

ECHO	echocardiography
EMB	embolization
dPAP$_{ECHO}$	diastolic pulmonary artery pressure estimated by echocardiography
dPAP$_{RHC}$	diastolic pulmonary artery pressure obtained by right heart catheterization
mPAP$_{ECHO}$	mean pulmonary artery pressure estimated by echocardiography
mPAP$_{RHC}$	mean pulmonary artery pressure obtained by right heart catheterization
PAP	pulmonary artery pressure
PAP$_{ECHO}$	pulmonary artery pressure obtained by echocardiography
PAP$_{RHC}$	pulmonary artery pressure obtained by right heart catheterization
PH	pulmonary hypertension
PR	pulmonic regurgitation
RA	right atrium
RA size$_{subj}$	subjective right atrial size obtained by echocardiography
RAP	right atrial pressure
RAP$_{ECHO}$	right atrial pressure estimated by subjective right atrial size obtained by echocardiography
RAP$_{RHC}$	mean right atrial pressure obtained by right heart catheterization
RHC	right heart catheterization
RV	right ventricular
sPAP$_{ECHO}$	systolic pulmonary artery pressure estimated by echocardiography
sPAP$_{RHC}$	systolic pulmonary artery pressure obtained by right heart catheterization
TR	tricuspid regurgitation

Introduction

In veterinary patients, pulmonary hypertension (PH) may be caused by heartworm disease, left-sided heart disease resulting in elevated pulmonary venous pressure, chronic pulmonary diseases, congenital cardiac diseases causing pulmonary overcirculation, thromboembolism, or it may be idiopathic.[1–9]

The gold standard test for diagnosis of PH is right heart catheterization (RHC) and direct measurement of pulmonary arterial pressure (PAP). In veterinary patients, procedural costs, associated risks and lack of availability often preclude performing RHC. While echocardiography (ECHO) serves as a preliminary screening tool in human patients, it is often the only diagnostic modality employed in veterinary medicine when confirming