Original Article

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To Assess the Clinical Value of the RPAD Index in Dogs with Varying Degrees of Pulmonary Hypertension

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Abstract

Background: The gold standard for pulmonary artery pressure measurement is right heart catheterization. The present study was conducted to assess the clinical value of the RPAD index in dogs with varying degrees of pulmonary hypertension. **Subjects and Methods:** The present study was conducted on 40 dogs. Dogs were divided in four groups according to the TRPG value (<36 mmHg, 36–50 mmHg, 51–75 mmHg, or >75 mmHg). In all dogs, presence of signs commonly associated with PH was recorded. **Results:** Out of 40 dogs, male dogs were 25 and female dogs were 15. Common clinical features were coughing in 24, tachypnea in 11, weakness in 18, dyspnea in 27, syncope in 5 and hemoptysis in 34. The mean heart rate in group I was 130.2, in group II was 121.4, in group III was 141.3 and in group IV was 147.5. Clinical score in group I was 2.5, in group II was 3.7, in group III was 5.11 and in group IV was 5.8. Mean radiology score was 1.3 in group I, 2.4 in group II, 2.9 in group III and 3.8 in group IV. Fractional shortening was 46.5% in group I, 50.3% in group II, 55.4% in group III and 53.2% in group IV. The difference was significant (P< 0.05). **Conclusion:** Authors found significant difference in mean heart rate, clinical score, radiology score and fractional shortening in dogs with different pulmonary pressure.

Keywords: Catheterization, Dog, Pulmonary pressure.

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Introduction

Pulmonary hypertension (PH) is defined as increased pulmonary blood pressure. The gold standard for pulmonary artery pressure measurement is right heart catheterization.[1] However, this technique is invasive and requires general anesthesia, which is unacceptable for most owners and compromised patients. Therefore, the diagnosis of PH in a veterinary clinic relies mainly on Doppler echocardiographic estimated pulmonary arterial systolic and diastolic pressure derived from the tricuspid regurgitation (TR) pressure gradient (TRPG) and pulmonary regurgitation (PR) pressure gradient, respectively.[2] A TRPG ≥ 36 mmHg is indicative of PH. In dogs with myxomatous mitral valve degeneration (MMVD), a TRPG ≥ 50 mmHg predicts a poor outcome. When TR and PR are absent or unavailable, diagnosis of PH relies on echocardiographic findings, thoracic radiography, and clinical signs.[3]

The diagnosis of PH is often based on indirect and subjective parameters, specifically when tricuspid regurgitation and/or pulmonary insufficiency are not present, which only help to partially quantify the disease severity.[4] Recently, the Right Pulmonary Artery Distensibility Index (RPAD Index), which is calculated as the difference in diameter of the right pulmonary artery in systole and diastole as measured by M-mode, was validated as a valuable method for estimating the presence and severity of PH in heartworm-infected dogs.[5] The present study was conducted to assess the clinical value of the RPAD index in dogs with varying degrees of pulmonary hypertension.

Subjects and Methods

The present study was conducted on 40 dogs. The experiments were approved by the Ethical Committee. Dogs were divided in four groups according to the TRPG value (<36 mmHg, 36–50 mmHg, 51–75 mmHg, or >75 mmHg). In all dogs, presence of signs commonly associated with PH (syncope, dyspnea, ascites, signs of right heart failure), three points each; presence of clinical signs not strictly associated with PH (lethargy, weakness, weight loss, coughing), 2 points; and abnormalities on clinical examination (e.g., murmur) or other clinical signs unrelated to PH (e.g., polyuria), one point was recorded. Results thus obtained were subjected to statistical analysis. P value less than 0.05 was considered significant.

Results

[Table 1] shows that out of 40 dogs, male dogs were 25 and female dogs were 15.

Table 1: Distribution of dogs

Total- 40		
Gender	**Male dogs**	**Female dogs**
Number	25	15

Table 2: Clinical features in dogs

Clinical features	Number	P value
Coughing	24	0.01
Tachypnea	11	
Weakness	18	
Dyspnea	27	
Syncope	5	
Hemoptysis	34	

[Table 2, Figure 1] shows that common clinical features were coughing in 24, tachypnea in 11, weakness in 18, dyspnea in 27, syncope in 5 and hemoptysis in 34. The difference was significant (P< 0.05).

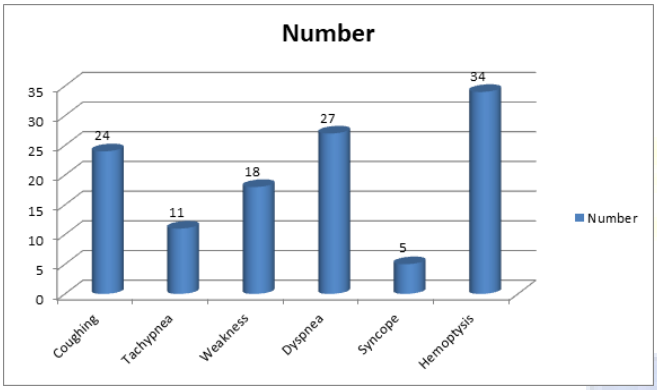

Figure 1: Clinical features in dogs

Table 3: Comparison of parameters

Parameters	Group I	Group II	Group III	Group IV	P value
Heart rate	130.2	121.4	141.3	147.5	0.01
Clinical score	2.5	3.7	5.1	5.8	0.04
Radiology score	1.3	2.4	2.9	3.8	0.01
fractional shortening %	46.5	50.3	55.4	53.2	0.12

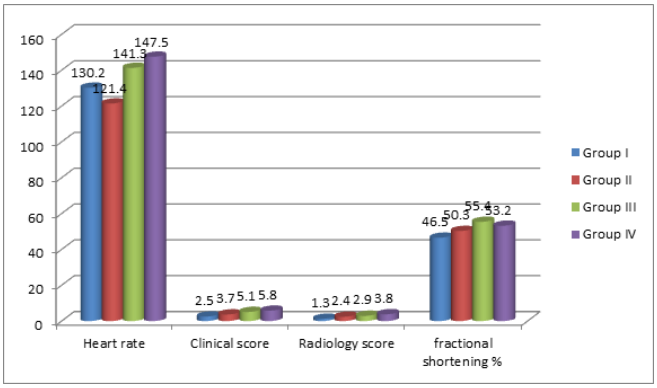

Figure 2: Comparison of parameters

[Table 3, Figure 2] shows that mean heart rate in group I was 130.2, in group II was 121.4, in group III was 141.3 and in group IV was 147.5. Clinical score in group I was 2.5, in group II was 3.7, in group III was 5.11 and in group IV was 5.8. Mean radiology score was 1.3 in group I, 2.4 in group II, 2.9 in group III and 3.8 in group IV. Fractional shortening was 46.5% in group I, 50.3% in group II, 55.4% in group III and 53.2% in group IV. The difference was significant (P< 0.05).

Discussion

The characteristics of the PA are related to PH severity, and serve as noninvasive indices of PH in humans because they are quantifiable by echocardiography, computed tomography angiography, and magnetic resonance imaging. These indices are reliable early indicators of PH and predict mortality and response to medication in humans.[6]

The right pulmonary artery distensibility (RPAD) index correlates strongly with non-invasive and invasive PA pressure measurements in dogs with PH secondary to heartworm infection; its predictive ability has also been demonstrated in PH caused by other diseases, such as MMVD and right-to-left or left-to-right patent ductus arteriosus.[7] The advantage of the RPAD index is that it is easily acquired, not technically difficult to derive, and measurable in the absence of TR or PR. However, there is no radiographic evidence of its correlation with clinical signs.[8] The present study was conducted to assess the clinical value of the RPAD index in dogs with varying degrees of pulmonary hypertension.

In present study, out of 40 dogs, male dogs were 25 and female dogs were 15. Kasai et al,[9] found that the right pulmonary artery distensibility (RPAD) index has been used in dogs with pulmonary hypertension (PH) caused by heartworm infection, myxomatous mitral valve disease, or patent ductus arteriosus. The RPAD index and the ratios of acceleration time to peak pulmonary artery flow (AT) and to the ejection time of pulmonary artery flow (ET) were recorded for each dog. The owners were contacted for follow-up assessments. The findings indicated that the RPAD index was correlated with the TRPG (R2 = 0. 362, p < 0.001). The survival time was significantly shorter in dogs with an RPAD index ≤ 21% that were followed up for 3 months and in dogs with an RPAD index ≤ 24% that were followed up for 1 year. Thus, the RPAD index was correlated with the TRPG and could predict the clinical outcome in dogs with PH caused by various diseases.

We found that common clinical features were coughing in 24, tachypnea in 11, weakness in 18, dyspnea in 27, syncope in 5 and hemoptysis in 34. The mean heart rate in group I was 130.2, in group II was 121.4, in group III was 141.3 and in group IV was 147.5. Clinical score in group I was 2.5, in group II was 3.7, in group III was 5.11 and in group IV was 5.8. Mean radiology was 1.3 in group I, 2.4 in group II, 2.9 in group III and 3.8 in group IV. Fractional shortening was 46.5% in group I, 50.3% in group II, 55.4% in group III and 53.2% in group IV.

Abel et al10 compared some echocardiographic parameters commonly used to estimate PH in 93 dogs infected by D. immitis and evaluated the impact of the parasite burden,

microfilaremia, sex or origin of the dog (client-owned/shelter). None of the studied echocardiographic variables seemed useful in the estimation of the evaluated clinical aspects, except for the PA/Ao ratio for parasite burden. The RPAD Index was determined in 88 of the dogs; of these, 70.4% had PH (mild: 37.5%, moderate: 19.3%, severe: 13.6%). This Index showed non-significant differences according to microfilaremia, sex, origin or parasite burden. Symptomatic dogs showed PH more often and displayed more severe PH, in addition the presence of symptoms was greater among dogs with high burden; on the other hand 64.4% of asymptomatic dogs had some degree of PH according to the RPAD Index. Apart from the PA/Ao ratio, the other evaluated echocardiographic variables were not useful in evaluating of the hypertensive status of the heartworm-infected dog compared to the RPAD Index.

Conclusion

Authors found significant difference in mean heart rate, clinical score, radiology score and fractional shortening in dogs with different pulmonary pressure.

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