

## COMPARATIVE ECHOCARDIOGRAPHIC EXAMINATION OF DOGS WITH MYXOMATOUS MITRAL VALVE DISEASE DEPENDING ON THE PRESENCE OR ABSENCE OF PULMONARY HYPERTENSION

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### ABSTRACT

We found a lack of significant differences in the echocardiographic sizes LA/Ao, LVID-d/Aow and LVID-s/Aow in the examined dogs with myxomatous mitral valve disease (MMVD) after their division depending on the presence or absence of pulmonary hypertension. For the same echocardiographic sizes, we found a high degree of correlation with Mitral Valve E (m/sec). This shows that the echocardiographic M-mode sizes and Doppler measured speed Mitral Valve E rate, which depend on the left atrial pressure in dogs with MMVD prone to development of pulmonary hypertension, may be similar to the same parameters in dogs with MMVD without a tendency to develop pulmonary hypertension.

**Key words:** dogs, echocardiographic, correlation, pulmonary, hypertension.

### Introduction

The uncomplicated preclinical stage of myxomatous mitral valve disease (MMVD) is a relatively benign condition (2) in which dogs may remain asymptomatic for a long time, but when it occurs with pulmonary hypertension, the development of the disease is accelerated. A study found that in more than 70% of the examined dogs with pulmonary hypertension (PH) due to MVMD, the disease progressed to a higher class (ISACHC class III). (7) Compared to other species, the dog has low pulmonary vascular resistance and reactivity. (10) However, pulmonary hypertension (PH) is common in dogs with myxomatous mitral valve disease (MMVD). (7,1,3) It is caused by increased left atrial (LA) and pulmonary venous pressure. (8) The degree of PH associated with left heart disease also depends on the condition of the right ventricle. If it is chronically exposed to high additional strain, right ventricular hypertrophy will occur, which will allow blood flow to be maintained. However, if the systolic function of the right ventricle (RV) is impaired, obvious signs of right-sided congestive heart insufficiency or clinical signs of low right-sided cardiac output and the associated signs of syncope during exertion, lethargy or weakness may occur. (5) One study found that in dogs with MMVD, the presence of PH might be suspected with a combination of decreased PA AT/DT, increased RVIDDn and LA/Ao, and a small or great LVIDDn. (9) The results of the study gave us reason to investigate the relationship between elevated pulmonary pressure and some M-mode left-sided heart sizes in dogs with MMVD.

### Materials and methods

During the examinations, the dogs were unsedated and kept successively in the right and then in the left lateral position. Measurements of the left-sided heart size were performed in M-mode from the right parasternal short axis view, guided via 2D echocardiography according to the recommendations of the American Society of Echocardiography. The LA/Ao size value was used directly from the M-mode echocardiographic examination. The values for LVID-d/Aow and LVID-s/Aow were obtained after normalizing the obtained M-mode sizes to the weight idealized aortic size. (4)

The dogs were included in the study based on clinical and echocardiographic evidence of MMVD. Doppler tests were performed and blood flow velocities were recorded. The division of the dogs with respect to the absence or presence of pulmonary hypertension was performed on the basis of established higher Tricuspid regurgitation pressure gradient and reduced Pulmonic flow acceleration time. The pulmonary artery flow rate profile was determined from the right parasternal short-axis view. Pulmonic flow acceleration time was measured from the beginning of the flow profile to its peak point. According to the results of the Doppler examination, the dogs were divided into two groups - the group of dogs with MMVD without evidence of pulmonary hypertension and the group of dogs with MMVD with evidence of pulmonary hypertension.

All parameters representing cardiac left-sided echocardiographic M-mode indexed sizes and regurgitant flow rate through the mitral valve determined in the Doppler examination in patients with pulmonary hypertension and those without pulmonary hypertension were analyzed by a computer program (Statistica, v. 6.0). For establishing the reliability of the obtained differences, we used the parametric method (One-way ANOVA) and the nonparametric method (Mann Whitney U-test). The values of the indicators are presented as the mean value and its arithmetic mean standard deviation (SD). Differences were considered statistically significant at  $P < 0.05$ . The linear regression analysis was performed with a computer program (Statistica, v. 6.0.1). The examined dimensions are considered linearly related at  $r > 0.3$ .

## Results

**Table 1: Reliability between some M-mode echocardiographic left-sided heart sizes and Doppler Mitral Valve E (m/sec) in dogs with MMVD, without pulmonary hypertension and with pulmonary hypertension.**

Indicator	Dogs with MMVD without pulmonary hypertension n = 13		Dogs with MMVD with pulmonary hypertension n = 9		Reliability P
	$\bar{X}$	SD	$\bar{X}$	SD	
Mitral Valve E (m/sec)	1,141	0,366	1,317	0,432	0.3152 0.2563
LA/Ao	1,365	0,28	1,616	0,338	0.0728 0.0571
LVID-d/Aow	2,087	0,36	2,368	0,388	0.0968 0.057
LVID-s/Aow	1,121	0,276	1,218	0,26	0.4189 0.2426

*Statistically significant difference determined via the parametric method one way ANOVA:*

$\Delta - p < 0,05$ ;  $\Delta\Delta - p < 0,01$ ;  $\Delta\Delta\Delta - p < 0,001$ .

*Statistically significant difference determined via the nonparametric method Mann – Whitney – U test:*

\* –  $p < 0,05$ ; \*\* –  $p < 0,01$ .

The results of the comparison of the indexed M-mode echocardiographic transverse sizes of dogs with MMVD without and with pulmonary hypertension are shown in Table 1. It shows that Mitral Valve E in dogs without pulmonary edema was statistically insignificantly lower ( $1,141 \pm 0,366$ ) compared with Mitral Valve E in the group with pulmonary hypertension ( $1,317 \pm 0,432$ ). The linearly indexed LA/Ao size in dogs without pulmonary hypertension was statistically insignificantly lower ( $1,365 \pm 0,28$ ) compared with that same size in the group with pulmonary hypertension ( $1,616 \pm 0,338$ ). The size of the weight-indexed LVID-d/Aow was statistically insignificantly lower ( $2,087 \pm 0,36$ ) in the group without pulmonary hypertension ( $2,087 \pm 0,36$ ), compared with that

same size in the group with pulmonary hypertension ( $2,368 \pm 0,36$ ). The size LVID-s/Aow was very similar in both groups, with values statistically insignificantly lower ( $1,121 \pm 0,276$ ) in the group without pulmonary hypertension compared to the group with pulmonary hypertension ( $1,218 \pm 0,26$ ).

**Table 2: Linear regression between the independent Mitral Valve E (m/sec) and some M-mode echocardiographic left-sided heart sizes in dogs with MMVD, n = 22.**

Indicator	R <sup>2</sup>	Correlation Coefficient r	Reliability P
Mitral Valve E (m/sec) – LA/Ao	0,633	0,796	9,502E-006
Mitral Valve E (m/sec) – LVID-d/Aow	0,487	0,698	0,0003
Mitral Valve E (m/sec) – LVID-s/Aow	0,364	0,603	0,003

*Mitral Valve E – independent; LA/Ao, – LVID-d/Aow, LVID-s/Aow - dependent. Degree of correlation in linear regression: (r) > 0,7 – strong correlation; 0,5 < (r) ≤ 0,7 – average correlation; 0,3 < (r) ≤ 0,5 – weak correlation; (r) < 0,3 – no correlation.*

The linear regression analysis between Mitral Valve E and the echocardiographic sizes LA/Ao, LVID-d/Aow and LVID-s/Aow in dogs with MMVD included in the study (Table 2) showed a significantly high degree of correlation between the established with Doppler Mitral Valve E and the M-mode ratio LA/Ao ( $r = 0,796$ ;  $P = 9,502E-006$ ). A significant mean correlation was found between the Doppler's Mitral Valve E and the weight-indexed M-mode sizes LVID-d/Aow ( $r = 0,698$ ;  $P = 0,0003$ ), and LVID-s/Aow ( $r = 0,603$ ;  $P = 0,003$ ).

## Discussion

The results of our study show a lack of statistically significant differences between the echocardiographic left ventricular sizes LA/Ao, LVID-d/Aow, and LVID-s/Aow in dogs without pulmonary hypertension and dogs with pulmonary hypertension. Our results are similar to the results of a study in which the authors dichotomously divided the dogs based on pulmonary hypertension. (9) The mean values of the echocardiographic sizes studied by us are closest to the mean values of the same sizes at the lowest parameters of elevated pulmonary blood pressure. Similar to the authors of this study, for the size LA/Ao with the increasing of pulmonary blood pressure we established a tendency for increasing. A similar statistically significant difference when comparing left ventricular sizes in dogs without and with low-grade pulmonary hypertension has been reported by other authors. (6) They also found higher values for the ratio LA/Ao in the group with pulmonary hypertension. In contrast to them, for this size we found a lack of statistical reliability between the two groups. This, in our opinion, is due to the different onset of pulmonary hypertension in dogs with MMVD, which is not directly related to the stage of development of the disease. The duration of impact of elevated left atrial pressure in dogs with MMVD that are prone to the development of pulmonary hypertension, is likely to be crucial for the progression of pulmonary hypertension. The high degrees of correlation found in our study between Mitral Valve E (m/sec) and the echocardiographic left ventricular sizes LA/Ao, LVID-d/Aow and LVID-s/Aow and also the lack of statistically significant differences between Mitral Valve E, LA/Ao, LVID-d/Aow and LVID-s/Aow in dogs without pulmonary hypertension and dogs with pulmonary hypertension showed that in the two groups we formed, high atrial pressure had the same effect on left-sided heart sizes.

## Conclusion

1. The echocardiographic M-mode sizes and Doppler measured speed Mitral Valve E rate, which depend on the left atrial pressure in dogs with MMVD prone to development of pulmonary hypertension, may be similar to the same parameters in dogs with MMVD without a tendency to develop pulmonary hypertension.
2. The presence or absence of significant differences in dogs with MMVD with data showing normal and elevated pulmonary blood pressure with respect to Mitral Valve E, LA/Ao, LVID-d/Aow and LVID-s/Aow depends on the volume and composition of the compared groups.

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