TRADITION AND MODERNITY IN VETERINARY MEDICINE, 2024, vol. 9, No 2(17): 21–25

LINEAR CORRELATIONS OF HEART MEASUREMENTS IN DOGS WITH DEGENERATIVE MITRAL VALVE DISEASE DEPENDING FROM THE STAGE OF THE DISEASE

Atanas Pankov

University of Forestry, Faculty of Veterinary Medicine, Sofia, Bulgaria
E-mail: pannkov@abv.bg
ORCID: 0000-0001-5566-8751 A.P.
(Submitted: 13 May 2024; Accepted: 8 November 2024; Published: 25 November 2024)

ABSTRACT

The assessment of the left ventricular (LV) function in critically ill dogs with degenerative mitral valve disease (DMVD) can help and guide the clinician in choosing the most appropriate treatment. This gave us reason to test the hypothesis that the degree of correlations of the cardiac MEASUREMENTS with the E-point of the septal separation of the mitral valve and the degree of correlations of the same measurements with the fraction of left ventricular shortening depend on the degree of the disease. We found more correlations in the cardiac measurements of dogs in stage B of the disease compared to those in stage C.

Key words: dogs, mitral valve, linear correlations, Aow.

Introduction

Systolic heart failure is classically characterized by reduced EF and SF and subjectively by reduced radial shortening (fractional area shortening). Significant MR increases LV preload and reduces afterload. These alterations foster a normal to hyperdynamic ventricular contraction, even in the presence of impaired myocardial cell contraction (Bonagura and Schober 2009). Indices of systolic function, such as the FS, EF, and ESVI, are obtained often by using M-mode shortaxis measurements of the LV, but they assume a uniform systolic contraction in all planes, which may not be true (Borgarelli *et al.* 2007).

Mitral valve E point septal separation (MV-EPSS) is reliable and easily measurable index of assessment of left ventricular systolic function (Faeq *et al.* 2022), but due to nodular degeneration of the valvular leaflets, the valvular tip may locate closer to the interventricular septum, causing shortening of EPSS (Hyun, C. 2005).

Progressive MR induces cardiac remodeling characterized by left atrial (LA) and left ventricular (LV) dilatation, eccentric myocardial hypertrophy, and extracellular matrix alteration, but other remodeling patterns may also be observed (Bonagura and Schober 2009). One study found slightly increased left ventricular wall thickness at systole and diastole (LVWs and LVWd) with decreased left ventricular diameter at diastole (LVIDd) indicating mild left ventricular hypertrophy (Hyun 2005).

These facts, related to the complex nature and many conditions in the course of the disease, gave us the opportunity to formulate the purpose of our study: to check the relationship between the values of the functional systolic indices Fractional shortening and MV-EPSS with the changes in the measurements of the left ventricle in dogs with MVD depending on the stage of the disease.

Materials and methods

To achieve this goal, dogs with apical left systolic murmur were radiologically and sonographically examined. Latero-lateral chest radiographs were obtained with a direct digital X-ray (Sedecal – DR X-ray system) from the right supine position. The ultrasound examination was performed with a My Lab 70 vet XV device (Easote Vet, Cremona, Italy). Patients were examined with specialized cardiac phasometric transducers PA023E (frequency 4-11MHz) and PA122E (frequency 3-7 MHz) suitable for cardiac patients of the small dog breeds in the right parasternal position. In addition, hematological and biochemical tests were performed on the dogs to rule out concomitant diseases. The parasitological examination was performed with a rapid blood test – IDEXX 4D.

Based on the obtained results, they were divided into two groups according to the classification of Häggström *et al.* (2009). First group – dogs with DMVD stage B_2 without pulmonary edema, and second group – dogs with DMVD stage C_2 with pulmonary edema.

The group without pulmonary edema included 9 (6 male and 3 female) patients aged 7 to 18 years, weighing 3.1 to 12.5 kg. Breed composition – Shih Tzu – 1, Bichon Frize – 1, Pinscher – 1, Bolonka – 1, Dachshund – 2, Poodle – 1, Yorkshire Terrier – 1 and mix breed – 1. Of these, there were 3 dogs with mitral prolapse, and without mitral prolapse – 6. Flail leaflet – without 6, with 3 patients.

The pulmonary edema group was formed by 11 dogs (8 males and 3 females) aged 8 to 15 years, weighing 4.5 to 10 kg. Breed composition – Dachshund – 1, Shih Tzu – 1, Cavalier King Charles – 1, Pekingese – 2 and mix breed – 6. All animals in the second group had mitral prolapse and Flail leaflet.

In order to be able to compare hearts of different sizes, the Echocardiographic measurements obtained in M-mode were indexed by weight-idealized aortic size (Aow) (Brown *et al.* 2003).

Linear regression analysis was performed with the computer program Statistica, v. 6.0.1. Statistical reliability: C.I. level 0.95; $P < 0.05$. Degree of correlation in linear regression: $(r) > 0.7$ – strong correlation; $0.5 < (r) \leq 0.7$ – average correlation; $0.3 < (r) \leq 0.5$ – weak correlation $(r) < 0.3$ – no correlation.

Results

Table 1: Linear analysis dogs with DMVD without pulmonary edema, independent Fractional shortening (%) and MV-EPSS (mm), dependent on the corresponding heart measurement indexed by Aow.

Dependent	Fractional shortening (%)			MV-EPSS (mm)		
	Correlation Coefficient	Model Selection Criterion	P	Correlation Coefficient	Model Selection Criterion	P
IVSd/Aow	0.018	-0.444	0.9627	0.117	-0.486	0.7833
LVIDd/Aow	0.47	-0.194	0.2012	0.024	-0.499	0.9546
LVFWd/Aow	0.318	-0.337	0.4028	0.488	-0.228	0.2197
IVSs/Aow	0.431	-0.239	0.2466	0.36	-0.361	0.3810
LVIDs/Aow	0.116	-0.431	0.7664	0.061	-0.496	0.8868
LVFWs/Aow	0.343	-0.319	0.3665	0.435	-0.291	0.2818
LA/Aow	0.0267	-0.444	0.9462	0.168	-0.471	0.6896
LA/AO	0.029	-0.444	0.9407	0.113	-0.487	0.7897

Degree of correlation in linear regression $(r)>0,7$ – strong correlation; $0,5 <(r)\leq 0,7$ – average correlation; $0,3 <(r)\leq 0,5$ – weak correlation; $(r)<0,3$ – no correlation.

Table 2: Linear analysis dogs with DMVD with pulmonary edema, independent Fractional shortening (%) and MV-EPSS (mm), dependent on the corresponding heart measurement indexed by Aow.

Dependent	Fractional shortening (%)			MV-EPSS (mm)		
	Correlation Coefficient	Model Selection Criterion	P	Correlation Coefficient	Model Selection Criterion	P
IVSd/Aow	0.274	-0.285	0.4145	0.265	-0.291	0.4306
LVIDd/Aow	0.138	-0.344	0.6861	0.2	-0.323	0.5564
LVFWd/Aow	0.203	0.322	0.5495	0.005	0.364	0.9890
IVSs/Aow	0.027	-0.363	0.9367	0.319	-0.256	0.3388
LVIDs/Aow	0.016	-0.363	0.9618	0.421	-0.168	0.1968
LVFWs/Aow	0.257	-0.295	0.4452	0.122	-0.349	0.7205
LA/Aow	0.212	-0.318	0.5313	0.055	-0.361	0.8717
LA/AO	0.195	-0.325	0.5653	0.041	-0.362	0.9042

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.

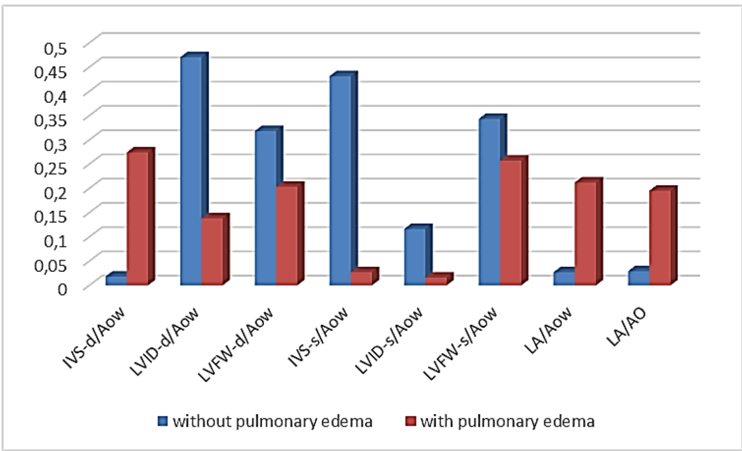

Figure 1: Comparative graphically presented values of correlation coefficients of the indexed heart measurements and Fractional shortening (%).

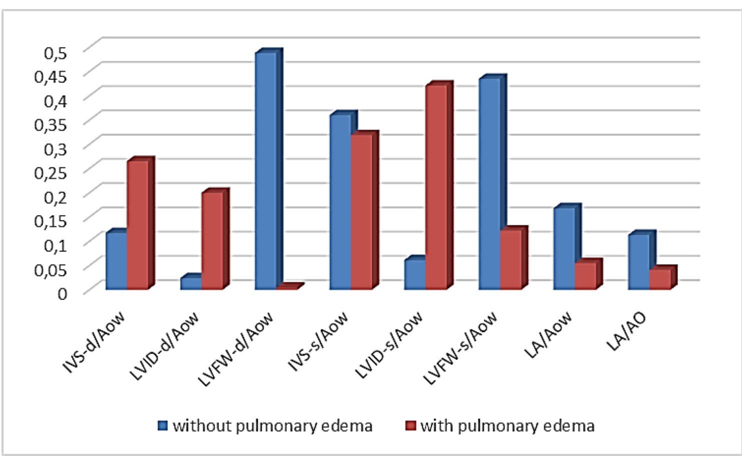

Figure 2: Comparative graphically presented values of correlation coefficients of the indexed heart measurements and MV-EPSS (%).

Discussion

The linear regression analysis between Fractional shortening (%) used as independent and corresponding echocardiographic measurements, appearing as dependent, in dogs with MMVD stage B included in the study (Table 1) showed a weak correlation with the echocardiographic left ventricular measurements LVID-d/Aow, LVW-d/Aow, IVS-s/Aow and LVW-s/Aow. A weak correlation was also found between independent MV-EPSS (mm) and LVW-d/Aow, IVS-s/Aow and LVW-s/Aow. In the direct examination of the strength of the relationship between the two echocardiographic measurements, which are directly related to the systolic function of the chamber, we found an average degree of correlation between them. The model selection criterion has a negative sign, which indicates that as MV-EPSS increases, Fractional shortening decreases. The same negative sign correlation pattern was found for all echocardiographic measurements in relation to systolic function indices. This tendency is also preserved in stage C dogs, where, despite the lack of correlation, most left ventricular measurements have a negative model selection criterion in relation to both systolic indices. In this stage, unlike stage B, we also found a positive model selection criterion, again with no correlation, and two measurements (IVS-s/Aow and LVID-s/Aow) that have a low negative correlation with MV-EPSS. This, we believe, is due to the different patterns of remodeling of the left ventricular myocardium depending on the progression of the disease. Progressive MR induces cardiac remodelling, characterised by left atrial (LA) and left ventricular (LV) dilatation, eccentric myocardial hypertrophy and alteration of the intercellular matrix (Bonagura and Schober). However, another study in a Cavalier King Charles Spaniel found slightly increased left ventricular wall thickness at systole and diastole (LVWs and LVWd) with reduced left ventricular diameter at diastole (LVIDd), indicating mild left ventricular hypertrophy (Hyun 2005). Additionally, it should be kept in mind that the indices of systolic function, such as the FS, EF, and ESVI, are obtained often by using M-mode shortaxis measurements of the LV, but they assume a uniform systolic contraction in all planes, which may not be true (Borgarelli *et al.* 2007). Due to nodular degeneration on valvular leaflets, the valvular tip may locate closer to interventricular septum, causing shortening of EPSS (E ponit to septal separation) (Hyun, C. 2005).

Conclusion

1. The linear correlations of the two systolic indices with left ventricular measurements were greater in dogs in stage B compared to dogs in stage C.
2. The functional systolic indices Fractional shortening and EPSS in dogs with DMVD stages B and C are not reliably associated with left ventricular measurements.

Acknowledgments

Special thanks to the staff at Central Veterinary Clinic for their help and support.

References

1. Bonagura, J. D. and K. E Schober (2009). *Can ventricular function be assessed by echocardiography in chronic canine mitral valve disease?* Journal of Small Animal Practice, 50, 12–24.
2. Borgarelli, M. *et al.* (2007). *Decreased systolic function and inadequate hypertrophy in large and small breed dogs with chronic mitral valve insufficiency.* Journal of veterinary internal medicine, 21(1), 61–67.

3. Brown, D. J. *et al.* (2003). *M– mode echocardiographic ratio indices in normal dogs, cats, and horses: a novel quantitative method.* Journal of veterinary internal medicine, 17(5), 653–662.
4. Faeq, K. A. *et al.* (2022). *The Value of Mitral valve E point septal separation as an index of assessment of left ventricular systolic function.* AMJ (Advanced Medical Journal), 6(2), 24–31.
5. Häggström, J., K. Höglund, M. Borgarelli, 2009. *An update on treatment and prognostic indicators in canine myxomatous mitral valve disease*. Journal of Small Animal Practice, 50, 1, 25–33.
6. Hyun, C. (2005). *Mitral valve prolapse in Cavalier King Charles Spaniel: a review and case study*. Journal of Veterinary Science, 6(1), 67–73.