

学 位 論 文 要 旨

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題 目：

犬の僧帽弁の形態と機能に対する僧帽弁閉鎖不全の影響ならびに僧帽弁形成術の介入効果

Title:

The effects of mitral regurgitation and valve repair on valvular geometry and hemodynamics in dogs

Abstract:

Chapter 1 (Introduction)

Mitral valve repair may be adapted in select dogs with severe myxomatous mitral valve disease (MMVD) in veterinary medicine. There is a paucity of evidence on the effects of repair on the geometry of the mitral valve complex, left heart hemodynamics, and cardiac function in dogs, and a lack of reports relating imaging data with macroscopic measurements. The goals of the present research were therefore (1) to find the differences in mitral valve annulus (MVA) geometry between healthy and MMVD dogs, and to evaluate surgical mitral valve repair (2) for its primary effect in terms of postoperative morphological modification, (3) for its potential to affect relevant hemodynamic parameters, heart size, and cardiac function, (4) for its utility in relieving symptoms and reducing the need for medication, and (5) to obtain information regarding the durability of the repair by determining correlations between real- and imaging-derived data.

Chapter 2 (Research I)

The retrospective study in Chapter 2 aimed to compare the MVA geometry on two-dimensional (2D) echocardiography in healthy dogs and dogs with MMVD and to compare the echocardiographic and intraoperative measurements of the MVA in dogs with MMVD. The study population comprised 59 healthy dogs and 371 dogs with MMVD. In results, the echocardiographic morphometry of the MVA (i.e. mitral annulus area (MAA), and mitral annulus circumference (MAC)) showed a correlation with the intraoperative mitral annulus diameter (IMAD). The MVA of normal dogs was elliptical, with the septal-parietal diameter (SPD) and transverse diameter (TD) as the minor and major axes, respectively. The ratios of the MAA to the aortic annulus area in normal dogs were $1.38 \pm 0.35:1$ and $2.00 \pm 0.42:1$ in the systolic and diastolic phases, respectively. There were linear associations between the body surface area (BSA) converted to a natural logarithm and the area values also converted to natural

logarithms and between the $\sqrt{\text{BSA}}$ and the length values. The MVA in dogs with MMVD was enlarged, showed a reduced contraction ratio during the cardiac cycle, and became round compared with normal dogs. The aortic valve annulus was not affected by MMVD.

Chapter3 (Research II)

The retrospective study in Chapter 3 aimed to elucidate the effects of mitral valve repair on the mitral valve geometry and hemodynamics in dogs with MMVD, and to compare the pre- and postoperative echocardiographic and intraoperative measurements of the MVA. The study population comprised 77 dogs with MMVD. In results, the pre-/post-operative echocardiographic morphometry of the MVA was correlated with the IMAD and repaired IMAD (RIMAD), respectively. The effects of mitral valve repair included the creation of coaptation length (CL), increase in forward stroke volume (FSV), decrease in MAA, regurgitant volume, left atrial pressure, and vertebral heart scale (VHS) at 1-week and 3-months postoperatively than preoperatively. Mitral valve repair also had the clinical effects of relief of symptoms and reduction in the need for medication after the surgery. Postoperatively, mitral valve geometry was completely changed within one week, whereas changes in VHS lasted for three months.

Chapter 4 (Discussion and Conclusion)

The study's findings include:

- (1) In normal dogs, the MVA is oval-shaped with a diameter ratio of 3:4, while in dogs with MMVD, the MVA is more circular throughout the cardiac cycle, with a larger MAA and lower contractility compared to normal dogs.
- (2) Our repair method involved reducing the mitral annulus to the size of the anterior leaflet and adjusting artificial chordae length. This aligned the edge of leaflet coaptation at the newly formed MVA plane, inserting an amount of prolapsed leaflets equivalent to the posterior leaflets area into the left ventricle. The resulting coaptation area was half the area of the posterior leaflets following repair.
- (3) Changes in mitral valve geometry (creation of coaptation area, reduced MAA) and cardiac function (decreased regurgitant volume, increased FSV, and reduced left ventricular preload) were attained after surgery. A delay detected between the direct effect of repair on the mitral valve geometry and the achievement of some functional recovery. The aortic annulus was neither affected by MMVD nor by mitral valve repair.
- (4) The measurements of MVA in 2D echocardiography (SPD, TD, CL) allowed noninvasive quantification of the effects and durability of mitral valve repair, and cardiac function both before and after mitral valve repair. Additionally, the MAA and MAC were found to be good predictors of the IMAD and RIMAD both preoperatively and postoperatively.
- (5) This study has limitations such as potential confounding factors, lack of error

verification, lack of blinding, and lack of data on the effects of medical treatment, which need to be verified in future studies.

- (6) The present results will provide new insights into the development of treatment strategies for MMVD, indications for mitral valve repair, verification of the effects and durability of surgical intervention on valve geometry and cardiac function, observation of the functional recovery process and prognosis, and consideration and improvement of surgical techniques.