TWO-DIMENSIONAL AORTIC VALVE MEASUREMENTS DIFFER THROUGHOUT DIASTOLE

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Echocardiographic aortic valve (Ao) measurements are routinely obtained during cardiac evaluation of patients. Cardiologists commonly use diastolic Ao measurements to obtain ratiometric weight-independent estimates of dimensions of other cardiac structures, most commonly the left atrium (LA). However, no consensus exists about the point in diastole at which Ao measurements should be obtained - immediately after closure of the aortic valve, when LA size is largest (Ao_{MAX}, but often with least distinct margins), during the P-wave of the ECG (Ao_P) and at the onset of ventricular electrical systole, when LA size is smallest (Ao_{MIN}). We examined the linear and area dimensions of the Ao (AoD and AoA) to determine if clinically significant differences exist at 3 distinct diastolic time-points, or if these measurements could be interchangeable.

We examined 130 patients (114 dogs and 16 cats) presented for cardiac evaluations by 2D echocardiography. Three replicates of each time-point linear and area measurement (Ao_{MAX}, Ao_P, Ao_{MIN}) were obtained in each patient and averaged for analysis. Only patients with aortic valve disease and those with atrial fibrillation were excluded from analysis. Beat-to-beat variability of the Ao measurements was determined. Standard and normalized limits of agreement (LoA) plots were generated for each pairwise comparison. The frequency of each Ao measurement being the largest or smallest within-patient measurement was determined, and compared via repeated measures ANOVA.

All pairwise agreement plots of both AoD and AoA demonstrated heteroscedasticity; normalized AoD plots showed 95%LoA to be 15% of the mean AoD measurement, with a bias of approximately 6.5% for AoD_{MAX}-AoD_{MIN}, 4% for AoD_{MAX}-AoD_P, and 3% for AoD_P-AoD_{MIN}. Normalized AoA plots showed 95%LoA to be 20% of the mean AoA measurement, with a bias of approximately 12% for AoA_{MAX}-AoA_{MIN}, 5% for AoA_{MAX}-AoA_P, and 7% for AoA_P-AoA_{MIN}. AoD_{MAX} was the largest measurement in 93/131 (71%) patients and AoD_{MIN} was the smallest measurement in 90/131(69%) patients; AoA_{MAX} was the largest measurement in 96/131 (73%) patients and AoA_{MIN} was the smallest measurement in 95/131 (73%) patients. RMANOVA confirmed that $Ao_{MAX}>Ao_P>Ao_{MIN}$ ($p<0.0001$). Median within-patient within-measurement variability was 5% for AoD and 9% for AoA measurements.

Our data suggest that Ao measurements differ throughout diastole, with $Ao_{MAX}>Ao_P>Ao_{MIN}$. The disparity is greater for area than linear estimates. The degree of disagreement between Ao_{MAX} and Ao_P is small and similar to the within-measurement variability. Thus, using either Ao_{MAX} or Ao_P measurements should result in similar ratiometric estimates of cardiac dimensions.

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