The Effects of Cardiac Dyssynchrony in Dogs

Abstract of Doctor Thesis

Yohei Mochizuki

Graduate School of Veterinary Medicine and Life Science
Nippon Veterinary and Life Science University

In human medicine, it was reported in number of clinical trials that prolonged QRS duration, such as left bundle branch block (LBBB), has been associated with survival time in patients with heart failure. The prolongation of QRS duration could be caused by lack of electrical activation synchronicity (i.e. electrical dyssynchrony). It is supported by the significant effect of cardiac resynchronization, which only corrects electrical activation timing using pacing devices. Therefore, cardiac dyssynchrony has been thought as important prognostic factor of heart failure.

While in veterinary medicine, the effects of cardiac dyssynchrony have not been clear. The aims in this study are to determine the effects of cardiac dyssynchrony to cardiac function of dogs, and the factor to influence the effects of cardiac dyssynchrony.

In normal beagles, echocardiographic dyssynchrony indices, included in two-dimensional speckle-tracking echocardiography (2D-STE), were measured. The time difference between first inward motion peak of interventricular septum and left ventricular posterior wall (first SPWMD), maximal difference of time to peak radial strain for 6 segments, standard deviation of time to peak radial strain for 6 segments, and the percentile of segment deformed opposite direction in systolic phase (DysSR) were thought as suitable indices for identify cardiac dyssynchrony in dogs. In a canine model of LBBB, these indices were useful for identifying mechanical dyssynchrony induced by LBBB.

In a beagle induced LBBB, the left ventricular ejection fraction did not change significantly in non-exercise group, but significantly decreased in treadmill exercised group (13 km/hour, for 15 minutes, once in a day). Therefore, mechanical dyssynchrony induced by LBBB could not cause deterioration of cardiac function independently, mechanical dyssynchrony with exercise stress, however, could cause impairment of left ventricular pump function. In both groups,

dyssynchrony indices, included in MaxD-TpSR, 6SD-TpSR, and DysSR, were increased with time. This finding might support the theory of “dyssynchrony begets dyssynchrony”.

In a larger mongrel dog induced LBBB, the left ventricular ejection fraction was decreased significantly without exercise stress. The heart size would be associated with the degree of impairments of cardiac function by mechanical dyssynchrony. In this study, synchronicity of myocardial contraction was deteriorated by exercise. Thus, exercise stress which does not affect cardiac function directly might deteriorate dyssynchrony in large dogs.

Therefore, in a case suspected presence of cardiac dyssynchrony, the risk of heart failure depending on body size of patients, and assessment of dyssynchrony and consideration whether exercise restriction should be imposed would be necessary. In veterinary practice, although the prevalence of LBBB is lower than human, dogs with dilated cardiomyopathy and dogs undergoing right ventricular pacing could show similar electrical behavior. Further research of prognosis in dogs suspected dyssynchrony was hoped.