Spatial Extent of Postsystolic Thickening During Myocardial Ischemia: Evaluation by Velocity Vector Imaging

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Abstract
Postsystolic thickening is a highly sensitive marker of myocardial ischemia. We examined an open-chest dog with acute coronary occlusion to clarify whether the newly developed velocity vector imaging (VVI) could detect the extent of postsystolic thickening without angle-dependency. During coronary occlusion, the inward motion of the endocardium caused by postsystolic thickening could be clearly demonstrated in the ischemic region using VVI.

Key words: echocardiography, ischemic heart disease, left ventricular wall motion, postsystolic thickening, speckle tracking

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(Figure-A). Fifteen seconds after the LCx occlusion, it was difficult to visually assess the deterioration of systolic contraction in the ischemic region; nevertheless, inward motion of the endocardium caused by postsystolic thickening in the ischemic region could be clearly demonstrated in the latter half of isovolumetric relaxation using VVI (Figure-B).

Discussion

The angle-dependency in Doppler strain and strain rate imaging hampers accurate estimation of the spatial distribution of regional wall motion abnormalities, including postsystolic thickening. Even if the angle-correction technique is used, the radial velocities in the 2-3 and 9-10 o'clock regions of the short-axis view cannot be analyzed by Doppler ultrasound. However, VVI can evaluate the myocardial velocity even in such difficult regions because it does not use the Doppler method.

Myocardial velocity data are always influenced by overall heart motion and tethering effects. The endocardial velocity derived from VVI is also affected by these effects. In this regard, strain and strain rate analyses of the myocardium are superior to the assessment of myocardial velocity because these effects can be canceled in the strain measurement. However, overall heart motion during isovolumetric relaxation is not generally significant. Thus, endocardial velocity analysis using VVI seems to be still useful for detecting postsystolic thickening.

VVI data was acquired at a rate of 81 frames/s in this study. This frame rate is lower than that generally used in the Doppler method. Although a higher frame rate setting is possible in the system, the spatial resolution would suffer. It is still unclear whether postsystolic thickening of short duration can be detected using this technique, and further study is needed in this aspect. However, we believe that the newly developed VVI is useful for the diagnosis of ischemic heart diseases in clinical settings because it permits accurate analysis of the spatial extent of regional wall motion abnormalities, which is difficult to be assessed using conventional methods.

References