Quantification of Left Ventricular Function by Gated Perfusion Tomography: Testing of a New Fully Automatic Algorithm.

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Objective: LV ejection fraction (EF) is commonly measured using gated SPECT perfusion imaging, but certain common image characteristics have been problematic. The purpose of this study was to test a new algorithm (3D-MSPECT) for measuring EF against contrast ventriculography (CVG) and another available SPECT quantification program (QGS) in patients with widely varying image characteristics.

Methods: A new LV surface detector using gradient images to determine initial estimates was developed. Weights based on activity, motion and consistency of the endo- and epicardial surface estimates in space and time are assigned. A series of two-dimensional weighted splines are used to refine the surface estimates. Splines insure that the continuity of the surfaces and the natural curvature of the myocardium is preserved even in the presence of large perfusion defects. Threshold values as a function of position are automatically determined and used in conjunction with a morphological operator to create the segmented image of the LV. The spline interpolators are reapplied to refine the surface estimates utilizing contiguity information. The LV wall activity is fitted to a Gaussian function to estimate the mid-wall position and thickness. The volume curve is estimated to determine the end-diastolic and end-systolic frames. The new algorithm was tested in consecutive patients (N=97, Male= 65) with diverse image characteristics.

Results: The new method was robust in the presence of large infarct-related defects as well as small hyper-contractile hearts. In all cases without user intervention, smooth visually acceptable LV surface estimates were obtained. The correlation between 3D-MSPECT and CVG was very good with a regression line of $y = 0.841x + 8.043$ ($r = 0.873$, $p < 0.001$). In this same population operating in automatic mode, QGS provided a regression line of $y = 0.750x + 7.645$ ($r = 0.841$, $p < 0.001$).

Conclusion: From these studies, we conclude that this new automatic algorithm is robust in providing accurate measurements of LV function independent of the image characteristics in comparison to CVG and QGS.

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