Quantitative Dobutamine Stress Echocardiography Based on a New Automatic Analysis Algorithm for Tissue Doppler Data

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The main limitation of dobutamine stress echocardiography (DSE) is its subjective interpretation. Tissue Doppler Imaging (TDI) has been used with promising results for quantitative analysis. However, it requires extensive time consuming analysis.

We analysed a new analysis algorithm which allows acquisition of TDI data in the background of the 2D image during DSE and subsequent instantaneous automatic analysis of TDI information.

Methods: In 30 consecutive patients undergoing coronary angiography DSE was performed with color TDI data being acquired in the background. An analysis algorithm was used which allows automatic comparison of obtained peak systolic tissue velocities with expected ‘normal’ peak systolic tissue velocities and subsequent color coding of areas reaching the normal value. Image quality of the 2D image with simultaneous acquisition of TDI data was compared with image quality of mere 2D image acquisition on a three grade score (1: worst to 3: best).

Results: Image quality of 2D images with simultaneous acquisition of TDI data was non-significantly impaired compared to mere 2D image acquisition (2.68±0.37 vs 2.74±0.36, respectively). There was agreement between DSE test result based on visual evaluation of 2D images and DSE test result based on color coded automatic analysis of quantitative TDI data in 87% of patients (kappa=0.58). Accuracy of DSE for detection of coronary artery disease defined by coronary angiography with analysis of TDI in addition to 2D images was 82% vs. 79% for analysis of 2D images alone (p=n.s.).

Conclusion: Simultaneous acquisition of TDI and 2D data is highly feasible as it allows rapid acquisition of TDI data without a substantial loss of 2D image quality. Automatic analysis of TDI data allows rapid quantitative analysis of regional myocardial function at peak stress. It increases the security on the accurate interpretation of DSE test results.

Multi-scale Motion Mapping (Triple M Imaging) for Color Coded Analysis of Stress Echocardiograms

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Background: Echocardiographic evaluation of coronary heart disease mainly depends on subjective analysis of multiple ultrasound loops at rest and stress. Although suited for quantitative measurement, the use of tissue Doppler and border detection algorithms remains limited for various reasons.

Methods: Multiscale motion mapping (“triple-m imaging”) is a novel imaging modality for measurement of motion in echocardiograms. In opposite to tissue Doppler or endocardial border detection algorithms the use of all available greyscale information yields quantitative motion maps which are neither angle dependent nor limited to endocardial visibility.

To test the feasibility of detecting abnormal motion in stress echo, echo data from various stress states in experimental myocardial infarction in an animal model (6 mongrel dogs) were analysed in noninfarcted and infarcted segments.

Results: There was 100% agreement of infarcted versus noninfarcted segments and a dyskinesis versus normal contractility in multiscale motion mapping (chi-square test: p=0.001).

Conclusion: In an in vivo model of myocardial infarction, Multiscale Motion Mapping, a novel image analysis technology, allowed reliable, user-independent classification of normal and abnormal segments in stress echocardiograms. The availability of this automatic analysis method for stress echo, which is independent from Doppler and border detection, thus promises to render stress echo more objective and quantitative.