Velocity Vector Imaging as a New Tool to Quantify Left Ventricular Dyssynchrony Before Resynchronization Therapy

Maxime Cannesson, Matthew Suffoletto, David Schwartzman, John Gorcsan III, University of Pittsburgh, Pittsburgh, PA.

Background: Velocity Vector Imaging (VVI) is a novel image analysis approach that calculates and displays regional movements from routine black and white echo images in terms of velocity and direction.
Methods: To test the hypothesis that VVI can quantify ventricular dyssynchrony in heart failure (HF) patients referred for resynchronization therapy (CRT), 39 subjects were studied. Twenty-nine HF patients (ejection fraction 26 ± 10 %, QRS duration 161 ± 24 ms) and 10 control subjects (ejection fraction 58 ± 5 %, QRS duration 84 ± 6 ms) were studied. VVI uses an algorithm that automatically tracks motion of the tissue/cavity border, motion of references points (mitral annulus), and the periodicity of heart motion (Siemens Corp.). Applied to the apical 4-chamber, 2-chamber and long axis views, multiple regional velocity vectors are displayed on the image frame-by-frame, from which time velocity curves may be extracted. Dyssynchrony was defined as maximal differences in time-to-peak regional velocity in opposing walls. Thirteen HF patients had chronic follow-up up to 24 months after CRT.
Results: VVI quantified significantly dyssynchrony in HF patients referred to CRT: 111 ± 91 vs. 32 ± 24 ms in control subjects where there was no difference between timing of opposing wall ($p<0.05$). Patients with favourable response to CRT, defined as $\geq$ 15 % increase in EF had significantly greater baseline dyssynchrony by VVI compared to non-responders: 172 ± 75 ms vs. 55 ± 64 ms, respectively ($p<0.05$).
Conclusion: VVI applied to routine black and white images quantified LV longitudinal dyssynchrony in HF patients which was associated with response to CRT and has potential for clinical application.