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Heart Failure and Cardiomyopathies

THREE-DIMENSIONAL ECHOCARDIOGRAPHIC EVALUATION OF VENTRICULAR SEPTAL CIRCUMFERENTIAL STRAIN IN THE PRESENCE OF INTERVENTRICULAR DYSSYNCHRONY

Poster Contributions
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Background: We tested the feasibility of 4D and 2D speckle tracking echocardiography for determining effects of varying levels of interventricular dyssynchrony by analyzing left ventricular (LV) strain.

Methods: The atria were removed from eight porcine hearts. A balloon was sutured into the annulus of each mitral and tricuspid valve. Each balloon was connected to a separate pulsatile pump. Hearts were imaged at constant stroke volumes (SV) (40 mL for LV, 30 mL for RV) and pump rate (60 beats per minute) while submerged in a water bath. Interventricular dyssynchrony was simulated by delaying end-diastolic timing in both pumps. Short axis 2D and long axis 4D images were acquired by the GE Vivid 7 ultrasound system at differences in timing (0 ms, 20 ms, 40 ms, 60 ms, 80 ms) of LV and RV. GE EchoPac PC 2DQ-analysis and TomTec Image Arena were used to quantify 2D strain and 4D strain, respectively.

Results: Statistically significant differences were observed in global 2D circumferential strain (GCS), as well as 2D septal radial strain (RS) and 4D septal circumferential strain (CS) values, at each level of dyssynchrony ($p < 0.002$). A shift from negative to positive 2D CS values between 20 ms delay and 40 ms delay illustrates a severe change in heart function at 40 ms, as does a shift from positive to negative RS values.

Conclusion: 4D echo is capable of determining strain of dyssynchrony. Significant differences in 4D septal CS between levels of dyssynchrony demonstrate decreased heart function as dyssynchrony increases.