Machine Learning to Understand Anthropomorphic Modulators of Spatiotemporal Myocardial Mechanics

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Background, Motivation and Objective

Speckle tracking echocardiography (STE) is a very promising technique for the assessment of left ventricular (LV) function. Nevertheless, to date, it did not become part of clinical routine due to: i) inter-vendor variability; ii) difficulties in data interpretation. Anthropomorphic patient characteristics (APC) are known to affect the LV strain values as studies have shown the effect of gender, age, body-mass-index (BMI), blood pressure and heart rate on peak global strain. However, to date, it remains unknown how the spatiotemporal strain (STS) patterns across the LV are modulated by these APC. The aim of this study was therefore to statistically determine the effect of APC on the STS measurements.

Statement of Contribution/Methods

144 subjects from a general population were scanned using a Vivid E9 scanner (GE Healthcare, Norway). For each subject, the three apical views were acquired and processed using 2D STE software (GE Healthcare, Norway) to extract segmental strain curves. In addition, APC were collected, including: gender, age, BMI, systolic blood pressure (SBP), diastolic blood pressure (DBP) and heart rate (HR). The proposed method includes 3 parts: (1) temporal interpolation of the strain curves, performed on the systolic and diastolic phases separately; (2) definition of the STS by spatial concatenation of interpolated strain curves following the LV 18-segment model; (3) analysis of the effect of the APC on the STS patterns using partial least square regression (PLSR). PLSR analysis provided spatiotemporal regression coefficient of each APC; coefficient of determination, fitting model and statistical significance.

Results/Discussion

The measured APC were uniformly distributed. PLSR analysis showed that there is a significant effect of some of the APC on the STS patterns: i) aging was associated with changes during diastole for all LV segments but was associated with systolic changes in the Infero-Septal wall only (Figure 1); ii) women were demonstrated to have higher systolic strains; iii) BMI was associated with higher strain values during the filling phase mainly in the Inferior wall. On the other hand, SBP and DBP had negligible effects on the STS patterns while HR had no effect at all. In conclusion, our study showed that LV STS pattern is modulated by APC. These findings are important in order to facilitate interpretation of strain in the clinical setting.