Spatiotemporal analysis of changes in myocardial motion patterns: Application to patients with hypertrophic obstructive cardiomyopathy treated with biventricular pacing

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Purpose: To analyze subtle changes in myocardial motion in hypertrophic obstructive cardiomyopathy (HOCM) patients induced by biventricular pacing (BiV), aimed at reducing the left ventricular outflow tract (LVOT) gradient. Current motion analysis is either qualitative and subjective, or quantitative but with limited accuracy due to the lack of spatiotemporal alignment of image sequences.

Methods:

1) Studied population + echocardiographic acquisition
11 severely symptomatic HOCM patients (50±20y, 4 male) were studied at baseline and 12 months after BiV. Myocardial radial/longitudinal displacement was obtained from 4-chamber views, using speckle-tracking.

2) Data post-processing and representation
Curves were spatiotemporally realigned to allow intra/inter-subject pattern comparison in a common system of coordinates. Time to peak measurements of displacement traces were also determined before and after BiV.

Results:
Time-to-peak measurements globally failed to detect and quantify pacing-induced dyssynchrony.

However, when the patterns were looked at in their whole (after they had been spatiotemporally realigned), earlier displacement of the lateral wall became clear when using a negative VV delay (N=9). An early-systole outward motion of the septum (see average patterns on figure) was also present.

This was accompanied by significant gradient reduction (83±27 vs 36±26 mmHg, p=0.012), contrary to patients with positive VV delay (N=2, 93±10 vs 87±18 mmHg, p=NS).

Conclusions: BiV reduces LVOT obstruction in HOCM patients by inducing dyssynchrony of the LV motion with earlier displacement of the lateral wall as compared to the septum. This change was subtle and could not be easily detected by time-to-peak measurements. Spatiotemporal motion patterns, in particular when proper alignment is set, are useful to accurately characterize these subtle changes.

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