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Cardiac morphology changes in heart failure and provides information on the state of the heart. We hypothesized that pre-implant left ventricular (LV) morphology differs significantly between responders and nonresponders to cardiac resynchronization therapy (CRT). To this end, the LV morphology of 50 subjects selected for CRT was studied from cardiac magnetic resonance by building a statistical 3-dimensional (3D) anatomic atlas. An asymmetric wall-thickening pattern, whereas responders showed thicker walls in the lateral and basal regions (e.g., right lateral wall in the nonresponder) and an irregular thickening pattern, whereas responders showed thicker walls in the lateral and basal regions compared with nonresponders. Results do not suggest to capture the extreme wall thinning of non-viable ischemic regions (see ~3std thickness map in Figure 1).

The presence of a thicker lateral wall in the responder suggests a larger workload localized in this
region causing the localized thickening. This is supported by earlier studies using positron emission tomography, which demonstrated metabolism was highest in the lateral wall and lowest in the septum at baseline in all patients (3). The specific localization in the lateral wall is also consistent with in silico results that showed the imbalance of work distribution in the presence of a LBBB, where the lateral wall is the one that produces the largest work rate (4). We then speculate that, in the presence of LBBB, the lack of this local remodeling response (i.e., the LV wall getting thinner and not thicker) reflects the lack of the myocardial tissue to cope with the extra work burden. And this impaired adaptation is a signature that predicts the impaired capability of the heart to positively respond to the resynchronization procedure.

In conclusion, a specific morphological signature, with asymmetric thickness in the pre-implant LV shape, was found to be an independent predictor of a favorable remodeling response to CRT. LV shape may represent a potential new criterion for CRT patient selection.