Three-dimensional Parametric Imaging for Intraoperative Quantification of Regional Left Ventricular Function in Ischemic Cardiomyopathy

The Editor,

The intraoperative assessment of regional left ventricular (LV) function using three-dimensional (3D) echocardiographic parametric imaging is evolving as the technique has a steep learning curve. The two-dimensional wall motion score index is a subjective and a semi-quantitative way of describing segmental contractile dysfunction. Parametric imaging provides a finer approach; it processes more than 800 endocardial data points to develop bull's eye diagrams of 17-segmented LV model as described by the American Society of Echocardiography in transthoracic echocardiographic orientation.[1]

The 3D echocardiographic system offers the possibility of acquiring wide-angle datasets (pyramidal volume of about 110° × 110°) at a frame rate of 20–25 Hz, which allows incorporation of the entire LV cavity with adequate temporal and spatial resolution. After data acquisition, the datasets need to be exported to the inbuilt software program designed for quantitative analysis of LV function. The good image quality is the most important prerequisite for accurate estimation. Based on the end-diastolic and end-systolic frames in a cardiac cycle, the sequential analysis of LV segmental volumes is performed by the software itself that generates a composite report of parametric imaging as shown in Figure 1. The report includes: (a) Two color-coded polar maps; one for segmental "timing" and the other for segmental "excursion" and (b) intraventricular dyssynchrony indices. For the visual interpretation of regional LV contractility, endocardial motion is depicted as shades of blue (positive excursion values representing normal inward motion of segments), red (negative excursion values for outward moving dyskinetic segments), and

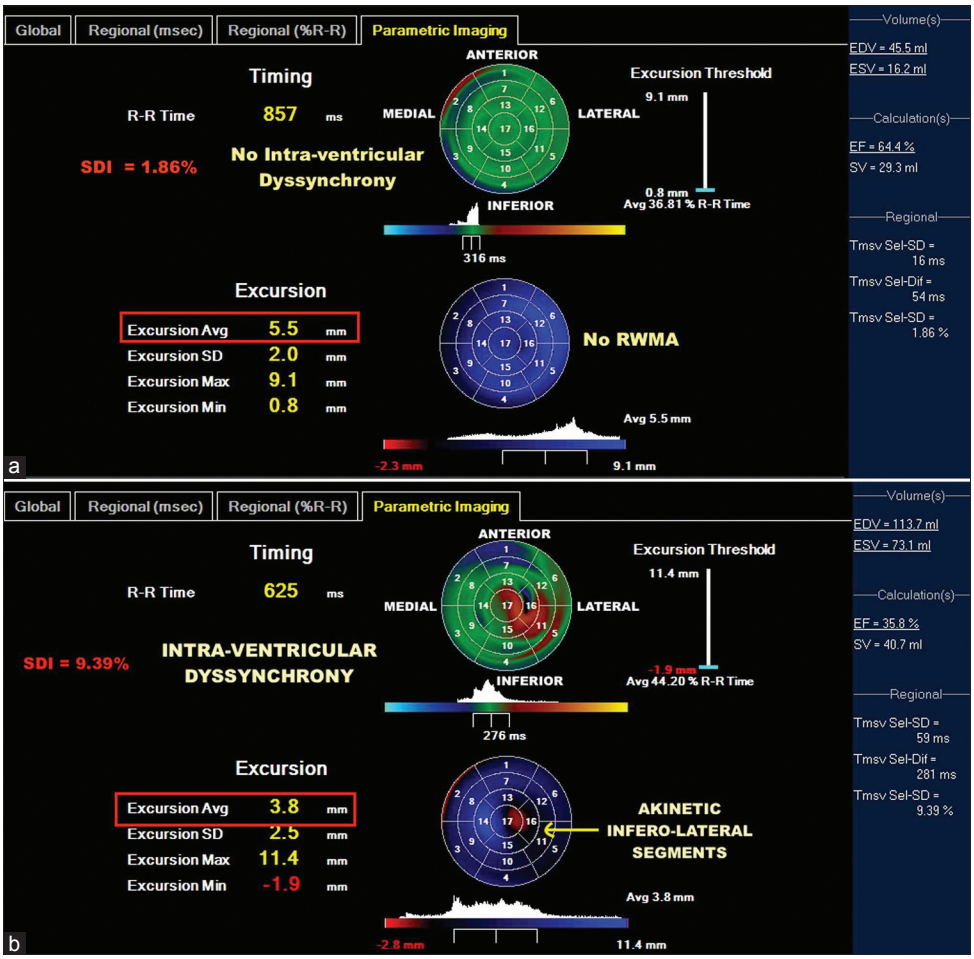

Figure 1: (a) Parametric image shows no regional wall motion abnormality with average segmental excursion of 5.5 mm. Average timing of all the segments is displayed in green color. (b) Excursion analysis shows hypokinetic inferior wall (dark blue) and akinesia (black) of inferolateral segments. Timing analysis reveals intraventricular dyssynchrony; delayed contractions of inferolateral segments (red color)

black (akinetic segments).[1] The "excursion" bull's eye diagram confirms the presence of regional wall motion abnormality and provides measurements of global LV excursion (average, minimum, maximum, and standard deviation).

The "timing" analysis of regional endocardial motion is another essential feature of parametric display. For this purpose, the time to maximal end-systolic excursion is assessed for each endocardial data point. Subsequently, a polar map is created showing the average timing of endocardial motion in green. Early contracting segments before the average motion are displayed in shades of blue while delayed contractions acquired red color. Software from different vendors may have alternative color schemes. In a normal heart, ventricular activation spreads through the atrioventricular node, His bundle, left and right bundles, and the Purkinje system. Normal activation and thus synchronization of segmental contractions get impaired if there is ischemic contractile dysfunction resulting in intraventricular dyssynchrony.[2] Intraventricular dyssynchrony is suggested by the following parameters:

- Maximal time difference to reach minimal systolic volume (MSV) for 16 LV segments >60 ms (Tmsv sel-diff)
- Standard deviation of time difference >32 ms between 16 segments (Tmsv sel-SD)
- Systolic dyssynchrony index,[1] standard deviation of the time taken to reach MSV for each segment as a percentage of the cardiac cycle (%R − R) >3.5% ± 1.8%
- Abnormal red/blue-colored segments on "timing" bull's eye analysis.

The study by Penicka *et al*. found high in-hospital mortality (55%) in patients with severe dyssynchrony after coronary artery bypass graft (CABG) surgery and advocated biventricular pacing in such patients for better long-term prognosis.[3] There is a need for the assessment of systolic dyssynchrony in patients undergoing CABG. In this context, parametric imaging is an excellent modality for comprehensive quantification of regional LV function and may help in decision-making. However, limited data on the clinical application of this approach are available. Therefore, the authors emphasize on the routine use of parametric imaging to evaluate regional myocardial function.

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Conflicts of interest

There are no conflicts of interest.

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