Early and Late Effects of Passive Epicardial Constraint on Left Ventricular Geometry: Ellipsoidal Re-shaping Confirmed by Electron-beam Computed Tomography


Background
Previous studies have shown that passive epicardial constraint using a cardiac support device (CSD) reduces left ventricular (LV) size. However, specific data describing LV shape and the time course of changes in LV geometry are still incomplete. Thus, the aim of this study was—using 3-dimensional data sets obtained by computed tomography (CT)—to test the hypothesis that the CSD not only alters LV size but also LV shape, and that short-term post-operative changes in LV geometry are maintained during long-term follow-up.

Methods
Ten Patients with non-ischemic dilated cardiomyopathy underwent electron-beam CT examination before and again at 2.6 ± 0.5 and 32.4 ± 8.7 months after CSD implantation. At end-diastole and end-systole LV volumes, the length-to-width diameter ratio and a sphericity index were determined and ejection fraction and end-systolic meridional and circumferential wall stress were calculated.

Results
Implantation of the CSD led to a significant reduction in LV size, a more ellipsoidal LV shape and a subsequent decrease of LV wall stress post-operatively (p < 0.05 for each), but no substantial changes were found between short- and long-term follow-up (p > 0.05 each). Mean preoperative and early and late post-operative end-diastolic values were 310.4 ± 87.8, 235.5 ± 102.0 and 229.4 ± 103.1 ml for volume; 1.27 ± 0.20, 1.37 ± 0.20 and 1.38 ± 0.20 for diameter ratio; and 0.78 ± 0.22, 0.067 ± 0.26 and 0.65 ± 0.23 for sphericity index. A similar pattern was observed for end-systolic values. Ejection fraction was 23.4 ± 6.2%, 32.9 ± 11.6% and 34.4 ± 14.9%. End-systolic meridional and circumferential wall stress was 182.2 ± 45.6, 128.2 ± 52.6, 130.6 ± 56.7 kdyn/cm² and 411.5 ± 94.0, 297.4 ± 108.4 and 302.8 ± 117.5 kdyn/cm², respectively.

Conclusions
Three-dimensional data obtained by CT demonstrate that passive cardiac constraint leads not only to a size reduction but also to an ellipsoidal re-shaping. Our data indicate that these effects are primarily a short-term consequence of the CSD implantation but are maintained during long-term follow-up.

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