The effects of cardiac resynchronization therapy on left ventricular function, myocardial energetics, and metabolic reserve in patients with dilated cardiomyopathy and heart failure.

OBJECTIVES: The effects of long-term cardiac resynchronization therapy (CRT) on left ventricular (LV) energetics and metabolic reserve were evaluated. BACKGROUND: Cardiac resynchronization therapy is a new therapy for patients with drug-refractory severe heart failure (HF). METHODS: Ten patients with idiopathic dilated cardiomyopathy who had undergone implantation of biventricular pacemaker 8 +/- 5 months earlier were studied during two conditions: CRT switched on, and after CRT was switched off for 24 h. Left ventricular function was measured using echocardiography and oxidative metabolism using [(11)C]acetate positron emission tomography. Both measurements were performed at rest and during dobutamine-induced stress (5 microg/kg/min). Basal- and adenosine-stimulated (140 microg/kg/min) myocardial blood flow were quantitated using [(15)O]water. RESULTS: During CRT off, LV stroke volume was significantly reduced at rest (72 +/- 18 ml vs. 63 +/- 15 ml, p< 0.05), but LV oxidative metabolism (K_mono) remained unchanged (0.046 +/- 0.008 vs. 0.054 +/- 0.016 min(-1)) leading to a significant deterioration of myocardial efficiency of forward work (from 48.2 +/- 16.7 to 36.6 +/- 11.7 mm Hg.l/g, p< 0.05). During dobutamine-induced stress,
stroke volume and $K_{\text{mono}}$ values were not different whether CRT was on or off. However, myocardial efficiency (56.1 +/- 16.1 vs. 49.8 +/- 18.0 mm Hg.ml.g(-1).min(-1), $p = 0.099$) and metabolic reserve, the response of $K_{\text{mono}}$ to dobutamine (0.023 +/- 0.014 vs. 0.013 +/- 0.014 min(-1), $p = 0.09$), tended to reduce when CRT was switched off. Cardiac resynchronization therapy had no effects on myocardial perfusion. Natriuretic peptides increased significantly during CRT-off period. CONCLUSIONS: Long-term CRT has beneficial effects on LV function and myocardial efficiency at rest in patients with HF. These effects are not associated with changes in myocardial perfusion or oxygen consumption. During dobutamine-induced stress, CRT does not affect functional parameters, but myocardial efficiency and metabolic reserve may be increased.