An electrocardiogram-based algorithm to detect loss of left ventricular capture during cardiac resynchronization therapy

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BACKGROUND: Loss of left ventricular capture in patients with cardiac resynchronization devices may account for worsening heart failure and can be difficult to diagnose without a programmer. OBJECTIVE: To determine whether distinct morphologic changes on the surface electrocardiogram indicate loss of left ventricular capture. DESIGN: After analysis of the R-S spike ratio in the 12-lead electrocardiogram during right ventricular and biventricular pacing in 10 patients, an algorithm to detect loss of left ventricular capture was developed. SETTING: University hospital. PATIENTS: 54 patients with a cardiac resynchronization device and underlying left bundle-branch block. MEASUREMENTS: Leads V1 and I of a 12-lead electrocardiogram were assessed after biventricular pacing was confirmed and after the device was programmed to right ventricular pacing only (simulating loss of left ventricular capture). RESULTS: The sensitivity of the algorithm to correctly identify loss of left ventricular capture was 94% (95% CI, 88.2% to 97.7%), and the specificity was 93% (CI, 86.3% to 95.8%). The likelihood ratio of a positive test result was 12.8 (CI, 6.443 to 23.310), and the likelihood ratio of a negative test result was 0.06 (CI, 0.024 to 0.137). LIMITATIONS: The algorithm was tested in patients in whom the right ventricular electrode was placed in the apex of the right ventricle only. CONCLUSION: Presence of biventricular capture--the prerequisite for successful cardiac resynchronization therapy--and loss of left ventricular capture can be accurately detected by an algorithm based on analysis of the R-S ratio on leads V1 and I of the surface electrocardiogram.