

## Publication

## Multivariable analysis of heart rate recovery after cycle ergometry in heart failure: exercise in heart failure

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The purpose of this study was to investigate the association between impairment in heart rate recovery (HR(rec)) after cycle ergometry and prognostic markers in patients with heart failure (HF) compared with healthy controls. Fifty patients with chronic HF (systolic HF, N = 30; diastolic HF, N = 20; mean age = 62 ± 12 years) and 50 healthy controls (N = 50; mean age = 66 ± 13 years) underwent 2-dimensional and M-mode echocardiography followed by cardiopulmonary exercise testing. Independent predictors of HR(rec) at 1 and 2 minutes after exercise were analyzed by univariable and multivariable regression analyses, and receiver operating characteristics were performed to obtain area under the curve. In HF, left ventricular end-diastolic diameter (millimeters), left ventricular ejection fraction (%), N-terminal pro-brain natriuretic peptide (picograms/milliliter), peak oxygen uptake (VO<sub>2</sub>peak [milliliters/kilogram/min]), and peak heart rate (HR(peak)) showed a significant association with HR(rec) (beats/min) in univariate regression analyses (P < .001), but only VO<sub>2</sub>peak remained independently predictive of both HR(rec)1 (P = .034) and HR(rec)2 (P = .008) in the multivariable regression analyses. In controls, VO<sub>2</sub>peak (P = .035) and HR(peak) (P = .032) were significantly associated with HR(rec)2 in univariate analyses only. Optimal cutoff values for discriminating HF versus non-HF based on HR(rec) were 17.5 beats/min (sensitivity 92%; specificity 74%) for HR(rec)1 and 31.5 beats/min (sensitivity 94%; specificity 86%) for HR(rec)2. Optimal cutoff values for discriminating systolic HF versus diastolic HF were 12.5 beats/min (sensitivity 78%; specificity 80%) for HR(rec)1 and 24.5 beats/min (sensitivity 82%; specificity 90%) for HR(rec)2. Impairment in after exercise HR(rec) is significantly and independently associated with VO<sub>2</sub>peak in HF and thus might constitute a useful tool for assessing the degree of functional status during exercise rehabilitation.

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