Attenuation of the Threshold for Myocardial Ischemia in Ramp vs Standard Bruce Protocol in Patients with Positive Exercise Stress Test and Angiographically Demonstrated Coronary Artery Narrowing?

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Background: Gradual instead of abrupt increases in workload favour a more physiological response in terms of hemodynamic and gas exchange parameters. Therefore, we sought to determine whether myocardial ischemia is attenuated with a ramp compared to a standard Bruce exercise protocol in patients with coronary artery disease (CAD).

Methods: We compared ischemic parameters on the Bruce protocol with an individualized ergocycle ramp protocol in 18 men with documented CAD ($\geq 70\%$ stenosis) and a reproducible ischemic ECG exercise test. These 2 symptom-limited tests were performed in random order 2 weeks apart. Oxygen consumption (VO_2), ischemic threshold [systolic blood pressure $\times$ heart rate (RPP) at 1 mm ST-segment depression], and maximum ST-segment depression corresponding to the highest RPP common to the 2 tests (AdjSTmax) were determined.

Results: While all subjects showed ischemia on the treadmill, 6/18 did not on the ergocycle. However, ischemic threshold was higher on the ramp than the Bruce protocol ($23\,420 \pm 5\,732$ vs $20\,018 \pm 3\,542$ $\text{bpm} \cdot \text{min}^{-1} \cdot \text{mmHg}$; $P=0.007$). Peak RPP was higher during the ramp than with the Bruce protocol ($28\,492 \pm 6\,450$ vs $25\,519 \pm 6\,067$ $\text{bpm} \cdot \text{min}^{-1} \cdot \text{mmHg}$, respectively; $P=0.02$), despite similar peak VO_2 (25.59 ± 5.05 vs 26.39 ± 4.65 $\text{mlO}_2 \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$, respectively; $P=0.6$). AdjSTmax was less on the ramp than the Bruce protocol (-1.2 ± 0.9 vs -1.9 ± 0.7 mm; $P=0.003$).

Conclusion: Exercise-induced myocardial ischemia is markedly attenuated on the more gradually increasing workload of the individualized ramp ergocycle compared with the standard Bruce treadmill protocol. This

effect is unexplained by energy expenditure (VO_2) or myocardial work (RPP) and is consistent with a “warm-up” ischemic mechanism. The more gradually increasing workload of the ramp ergocycle protocol may have favoured a “warm-up” ischemic effect despite achieving higher RPP than the Bruce protocol treadmill suggesting it may be physiologically preferable for exercise prescription in patients with CAD.

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Role of Functional Indicators in the Multifactorial Pathologies in Cardiopulmonary Rehabilitation

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Background: Patients in cardiopulmonary rehabilitation often complain of exercise intolerance. While ventilatory limitation is often present, other factors are also important: cardiovascular deconditioning, respiratory muscle dysfunction, gas exchange abnormalities and ventricular dysfunction.

Methods: Forty patients, hospitalized for a consecutive 6 month-period, with persistent exercise intolerance due to cardiopulmonary pathologies were included. 90% were COPD II to IV GOLD stage; 5% had chronic cardiac decompensation; 5% had undergone surgery for coronary bypass and/or cardiac valve prosthesis. Patients were excluded who were clinically unstable, unable to cooperate correctly, had arrhythmia due to atrial fibrillation and/or receiving beta-blocking therapy. We have, furthermore, measured parameters of ventilatory dysfunction (ventilatory reserve, dynamic inspiratory capacity), the parameters of cardiovascular limitation (peak heart rate and recovery heart rate at the first minute), parameters of respiratory muscles dysfunction (maximal inspiratory pressure and at the end of the 6 min walking test). Afterwards we classified patients into three groups: ventilatory-limited, cardiovascular-limited, respiratory muscles-limited.

Results: Exercise performance limitation resulted from ventilatory limitation in 60% of the patients, second by cardiovascular limitation in 30% of the