Exercise Programmes

Presence and clinical significance of myocardial ischemia during aerobic exercise training in patients with ischemic burden

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Background: Cardiovascular rehabilitation is efficient and safe for patients with coronary artery disease (CAD). Exercises are usually prescribed below the clinic and electrocardiographic ischemic threshold. Training above this threshold remains controversial, given the potential risks compared to the additional benefits. However, clinic and electrocardiographic detection of ischemia has lower accuracy than myocardial perfusion scintigraphy (MPS). Therefore, MPS during physical training can better assess ischemia. Moreover, serial maximum MPS can document the benefits of exercise that can be correlated with ischemia during training.

Purpose: To investigate the presence and clinical significance of scintigraphic myocardial ischemia during aerobic exercise in patients with CAD and ischemic burden.

Methods: Thirty-three patients with stable CAD were evaluated at maximum effort (M1) and at rest (R1) using MPS. Twelve patients were excluded; 3 did not complete the intervention, and 9 did not exhibit ischemia. The remaining 21 patients with ischemic burden were included. The intervention consisted of a 12-week training program of moderate-intensity aerobic exercises, below the clinical and electrocardiographic ischemic threshold. During weeks 1 (T1) and 12 (T2), patients underwent MPS during the exercises. After 12 weeks, patients underwent another MPS at maximum effort (M2). All images were quantitatively analyzed, and the presence, extent, and intensity of ischemia were determined. The Wilcoxon test was used to compare 2 variables, and the Friedman test to compare 3 variables, followed by the post hoc Dunn's test. Correlations were analyzed using Spearman's test. The level of significance was set at 5% ($p < 0.05$).

Results: The prevalence of scintigraphic ischemia during exercise training was 81% at T1 and 71% at T2. The median number (and interquartile range) of ischemic segments at T1 was 3 (2–5), which was significantly different ($p = 0.003$) from that observed at M1 [5 (3–8)]. The median values of the myocardial uptake in the ischemic segments at R1, T1, and M1 were 59.1% (53.1–68.5), 51.5% (45.3–60.3), and 40.8% (37.3–53.3), respectively, with significant differences between T1 and R1 ($p < 0.05$) and between T1 and M1 ($p < 0.01$). After 12 weeks, the extent and intensity of ischemia at maximum effort decreased. The median number of ischemic segments significantly decreased from 5 (3–8) at M1 to 4 (2–6) at M2 ($p = 0.005$). This reduction in the extent of ischemia after training was significantly correlated with the number of ischemic segments at M1 ($r = 0.60$; $p = 0.004$) and at T1 ($r = 0.64$; $p = 0.002$), such that patients with more extensive ischemia experienced greater benefits from training.

Conclusions: Scintigraphic ischemia was highly prevalent during moderate-intensity aerobic training in patients with CAD and ischemic burden. There was a correlation between the ischemic stimulus during training and the documented benefits at maximum effort.

Abstract Figure. Polar maps at rest, training and maximum