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Hypoxia and Hyperoxia Affect Serum Angiogenic Regulators in T2DM Men during Cycling.

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Abstract

Exercise-induced transient increases in pro-angiogenic regulators can promote angiogenesis.This pilot study aims to analyze the potential of exercise to positively affect angiogenic regulators in patients with type 2 diabetes mellitus (T2DM), who often exhibit abnormal angiogenesis, under different environmental conditions. 9 overweight/obese men with uncomplicated T2DM (8 took anti-diabetic drugs) performed submaximal cycling for 40 min in normoxia (≈21 vol%O_2), hypoxia (≈14 vol%O_2) and during alternating hypoxia/hyperoxia (≈14 vol%O_2/≈30 vol%O_2, 5-min intervals) (3×3 crossover design). Serum pro-angiogenic vascular endothelial growth factor (VEGF), matrix metalloproteinase (MMP)-2, MMP-9 and anti-angiogenic endostatin were quantified using enzyme-linked immunosorbent assay (ELISA) kits. Non-parametric statistical tests (Wilcoxon, Friedman analysis of variance) were applied. VEGF increased significantly from pre- to post-exercise with hypoxia and hypoxia/hyperoxia. MMP-2 increased significantly in all experimental runs, while MMP-9 only increased significantly with hypoxia and hypoxia/hyperoxia. Endostatin increased significantly with normoxia and hypoxia. However, the magnitude of changes did not differ significantly between conditions. Capillary blood lactate was significantly lower following cycling with hypoxia/hyperoxia than with hypoxia alone. Although differences in subjective ratings of perceived exertion failed significance, 7 subjects were less exerted with hypoxia/hyperoxia than with hypoxia. Submaximal cycling with hypoxia or alternating hypoxia/hyperoxia may induce a more reliable up-regulation of pro-angiogenic regulators compared with normoxia, while hypoxia/hyperoxia may be better tolerated than hypoxia alone.

Beide Formen der Hypoxie sind gut
aber IHHT ist besser