Effects of continuous physical exercise in hypoxia on prevention of vascular complications in Type 1 diabetes

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Introduction
According to scientific reports cardiovascular complications are the leading cause of death in people with diabetes (Stirban and Tschoepe 2008). It has been shown that chronically elevated blood glucose concentration is mainly responsible for the development of micro- and/or macroangiopathy (American Diabetes Association 2009). Angiogenesis is mainly stimulated by hypoxia, and more specifically by hypoxia inducible factor-1 alpha (HIF-1α) the main proangiogenic factor – vascular-endothelial growth factor (VEGF). In diabetes chronic exposure to hyperglycemia modifies the function these main angiogenic factors (Simons et al. 2005). Studies suggest that combining physical activity with hypoxia improves glycaemic control (D’hooge et al. 2011; Mackenzie et al. 2012) and to have beneficial effect on vascular function (Fuchsjäger-Mayrl et al. 2002.). Therefore, the aim of the study was to assess the effect of moderate intensity continuous exercise in normobaric hypoxia on glycaemic control and concentration of proangiogenic factors in patients with Type 1 diabetes.

Methods: Twelve patients (age: 29.2±9.5 years) suffering from Type 1 diabetes (T1D) for 12.1±6.0 years, with HbA1c at approximately 56.3mmol/mol, free of diabetic complications, and twelve randomly chosen adults (GC) without diabetes performed the 40 min continuous exercise (ExC) of moderate intensity (50% of lactate threshold load). The exercise tests were performed in normoxia and normobaric hypoxia, which simulated the altitude of 2500 m a.s.l. Serum glucose, proangiogenic factors, and brain-derived neurotrophic factor (BDNF) concentrations were measured at rest, immediately and up to 24 h after exercise.

Results: A significant decrease in serum glucose concentration was observed immediately after ExC in hypoxia (p<0.001) and normoxia (p<0.05). Continuous exercise in hypoxia caused the greatest decline in blood glucose (mean Δ glucose: 83.6±13.3 mg/dl) and had the most beneficial effect on moderate-term (up to 24 h) glucose control. A significantly higher baseline serum concentrations of HIF-1α were showed in the group of individuals with T1D in comparison with healthy subjects (p<0.05). ExC in normoxia (p<0.001) and hypoxia (p<0.05) significantly increased the level of BDNF in T1D. A tendency TNF-α level reduction was observed in T1D in response to Ex. No significant modifications in concentrations of other proangiogenic factors were stated in response to exercise tests.

Conclusions
The significant glycaemia reduction induced by continuous exercise in hypoxia with a tendency to reduction of pro-inflammatory cytokine level suggest that physical exertions of different intensity combined with exposure to hypoxia may improve metabolic control and stabilize the process of angiogenesis decreasing the risk of severe vascular complications in patients with Type 1 diabetes.

References