Title

Improving Glucose Tolerance with Neuromuscular Electrical Stimulation

Authors

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Abstract

Voluntary muscle contraction is known to increase glucose uptake into cells. Neuromuscular electrical stimulation (NMES) involuntarily contracts skeletal muscle; however, it is unknown what impact it will have on glucose tolerance. The purpose of this study was to determine the effect of acute and 8 weeks of NMES on glycemic control in people with hyperglycemia. We hypothesized that NMES will improve glycemic control by reduction of blood glucose (acute effect) and improvement in glucose tolerance (chronic effect). METHODS: 56 participants (Age:33.3 ± 11.8 years; BMI: 34.8 ± 5.6 kg/m^2) with hyperglycemia (fasting glucose ≥ 100 ug/dL or 2-hour post-glucose load ≥ 140ug/dL) were recruited for the study. Glucose levels were measured using continuous glucose monitoring (CGM). A subset of participants was randomized into control or NMES groups for an 8-week intervention to receive supervised bilateral quadriceps stimulation (30 minutes/session; 3 times/week at 50 Hz and 300 μs pulse width) at a low intensity sensory level or at a high intensity neuromuscular level respectively. Glycemic control was measured using oral glucose tolerance test (OGTT) before and after the intervention. Data were analyzed using paired t-test and two-way ANOVA. RESULTS: Thirty minutes of NMES (acute effect) resulted in significant reduction of fasting blood glucose (116.7 ± 2.7 mg/dL to 113.2 ± 2.5 mg/dL; $p<0.0001$). Additionally, the 24-hour glucose fluctuations were significantly decreased on NMES stimulation day compared to control day (18.0 ± 1.0 vs 20.0.0 ± 1.2; $p<0.05$). Eight weeks of NMES intervention (chronic effect) resulted in reduction of blood glucose levels at the 120, and 150 minutes of the OGTT test ($p<0.05$ at each time points). CONCLUSION: Involuntary muscle contraction through NMES is a potential strategy for blood glucose management in people with hyperglycemia. Future studies should evaluate the feasibility and adherence of NMES administration among people with hyperglycemia.