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Opinion

Does Neuromuscular Electrical Stimulation Lower Limbs can be used to Treat of Patients with Type-2-Diabetes?

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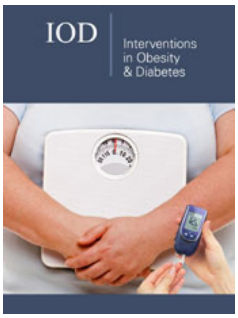

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Opinion

Regular physical activity is reported to be effective in treating the early forms of T2DM and reducing the risk for cardiovascular complications [1,2]. Clinical trials [3,4] have shown that physical activity has many benefits for patients with T2DM, such as changes in metabolism, including increased insulin sensitivity, more efficient supply of insulin to the tissues and improved glucose metabolism. There is also evidence that it keeps glucose levels in the normal range when applied as part of a comprehensive diabetes treatment program [2]. Muscle glycogen usage during exercise increases glycogen synthase activity and carbohydrate production, which improves aerobic capacity and skeletal muscle exercise tolerance [4]. However, some patients with T2DM and hemiplegia caused by a stroke, or motor system disorders, cannot exercise. The results of clinical studies indicate that physical exercise could be replaced in such cases by Neuromuscular Electrical Stimulation (NMES) [5]. In our pilot study [5] was to determine whether a combination of Neuromuscular Electro Stimulation (NMES) and insulin therapy could improve the management of T2DM patients with hemiplegia caused by an ischemic stroke. Fifteen patients with T2DM on insulin therapy and post-stroke hemiplegia were enrolled in the study. The NMES sessions were performed by the participants at their homes for 60min, 5 days per week for a period of 12 weeks. NMES was applied to both quadricep muscles for 30min and then the triceps muscles for another 30min. After 12-week lower limb NMES, standard insulin and pharmacotherapy significantly reduced the blood levels of HbA1C, total cholesterol, LDL in T2DM patients with post-stroke hemiplegia, but their body weight and TG and HDL concentrations did not change. Furthermore, systolic and diastolic blood pressure levels were significantly lower. The values of LVEF, LVESD and LVEDD did not change significantly between baseline and week 12, echoing the results of our previous study with patients with Chronic Heart Failure (CHF) [6]. The changes suggest that NMES can be effective in improving HbA1C, lipid levels and reduce systolic and diastolic blood pressure in T2DM patients who cannot exercise because of hemiplegia following an ischemic stroke.

Joubert et al. [7] used NMES settings in their study of 18 patients with T2DM. Insulin sensitivity of the participants (treated with oral hypoglycemic agents and/or glucagon-like peptide 1 inhibitors) was compared between a single NMES session and a series of seven consecutive session). In both cases, NMES was applied to both quadriceps muscles for 25min. Insulin sensitivity was evaluated by euglycemic hyperinsulinemia clamp before and after a single NMES session and after a week of daily NMES training. Energy expenditure was evaluated by indirect calorimetry. Insulin sensitivity after the NMES was significantly higher than at baseline only in group 2. The energy expenditure caused by the NMES was not significantly increased from the baseline. The authors reported that a 1-week training program of daily 25min NMES sessions significantly improved insulin sensitivity in patients with T2DM treated with oral hypoglycemic agents and/or glucagon-like peptide 1 inhibitors. Crowe et al. [8] conducted a case series with eight men with T2DM, who had been diagnosed with the disease within the past 5 years. NMES was applied to both quadriceps muscles,

hamstrings, gluteal and calf muscles. NMES sessions of 45-60min were performed by the participants at their homes once a day, 6 days per week, over a period of 8 weeks. Measurements of HbA1C levels at week 8 showed that they were statistically significantly higher than at baseline, by 0.8±0.7% on average. The authors of the study concluded that aerobic NMES might be acceptable and have a beneficial effect on the HbA1c of some men with T2DM, especially those of them who will not or cannot do adequate amounts of voluntary exercise. Miyamoto et al. [9] designed their clinical study as a randomized controlled cross-over trial to examine the effect of NMES training on metabolic parameters and the levels of the plasma Brain-Derived Neurotrophic Factor (BDNF) and the Insulin-Like-Growth Factor (IGF-1) in patients with T2DM. NMES was delivered to the gluteus maximus, quadriceps, hamstrings, hip abductor and adductor muscle groups, and dorsi- and plantar flexor muscle groups on each leg using monophasic exponential pulses (0.2ms and 4Hz). NMES sessions lasted 40min and were performed by the participants at their homes, once a day, 5 days per week, over 8 weeks. The fasting glucose concentration measured at week 8 was statistically significantly lower. Percent body fat also decreased statistically significantly. Its changes in the control period were not statistically significant. Changes in the levels of HbA1c and blood lipids were not significant in either the NMES period or the control period. The BDNF levels increased significantly more in the NMES period than in the control period. The application of NMES did not influence the blood concentration of IGF-1. The authors of the study concluded that an 8-week NMES training program could have a positive effect on the blood glucose concentration, percent body fat, and plasma BDNF levels in patients with T2DM, and that NMES training might prove to be an alternative exercise method for patients who might have difficulties in performing adequate voluntary exercise. These results are preliminary, and more randomized clinical trials are needed to confirm whether NMES can replace physical exercise and improve glucose and cholesterol metabolism in immobile patients with T2DM.

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