Haemodynamic changes with the use of neuromuscular electrical stimulation compared to intermittent pneumatic compression

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Abstract

Introduction

Enhancement of peripheral circulation has been shown to be of benefit in many vascular disorders, and the clinical effectiveness of intermittent pneumatic compression is well established in peripheral vascular disease. This study compares the haemodynamic efficacy of a novel neuromuscular electrical stimulation device with intermittent pneumatic compression in healthy subjects.

Methods

Ten healthy volunteers (mean age 27.1±3.8 years, body mass index 24.8±3.6kg/m2)were randomised into two groups, in an interventional crossover trial. Devices used were the SCD Express™ Compression System, (Covidien, Ireland) and the geko™, (Firstkind Ltd, UK). Devices were applied bilaterally, and haemodynamic measurements taken from the left leg. Changes to haemodynamic parameters (superficial femory artery and femoral vein) and laser Doppler measurements from the hand and foot were compared.

Results

Intermittent pneumatic compression caused 51% (p ¼0.002), 5% (ns) and 3% (ns) median increases in venous peak velocity, time-averaged maximum velocity and volume flow, respectively; neuromuscular electrical stimulator stimulation caused a 103%, 101% and 101% median increases in the same parameters (all p¼0.002). The benefit was lost upon deactivation. Intermittent pneumatic compression did not improve arterial haemodynamics. Neuromuscular electrical stimulator caused 11%, 84% and 75% increase in arterial parameters ($p < 0.01$). Laser Doppler readings taken from the leg were increased by neuromuscular electrical stimulator ($p < 0.001$), dropping after deactivation. For intermittent pneumatic compression, the readings decreased during use but increased after cessation. Hand flux signal dropped during activation of both devices, rising after cessation.

Discussion

The neuromuscular electrical stimulator device used in this study enhances venous flow and peak velocity in the legs of healthy subjects and is equal or superior to intermittent pneumatic compression. This warrants further clinical and economic evaluation for deep venous thrombosis prophylaxis and exploration of the haemodynamic effect in venous pathology. It also enhances arterial time-averaged maximum velocity and flow rate, which may prove to be of clinical use in the management of peripheral arterial disease. The effect on the microcirculation as evidenced by laser Doppler fluximetry may reflect a clinically beneficial target in microvascular disease, such as in the diabetic foot.