NEUROMUSCULAR STIMULATION VIA THE COMMON PERONEAL NERVE PROMOTES LOWER LIMB BLOOD FLOW AND AUGMENTS MICROCIRCULATION: A POTENTIAL TREATMENT FOR LEG ULCERS OF VENOUS, ARTERIAL, OR MIXED AETIOLOGY

Bain DS1, Tucker AT2

1 The Ernest Cook Clinical Micromascular Unit, 4th Floor, Dominion House, St Bartholomew’s Hospital, London E1 2HA 07872619664 DSain@virgin.net
2 Duncan Bain Consulting, 22 Gypsy Lane WD4 4PF 0797619664 j.duncan.bain@virgin.net

Introduction

Clarke Moloney et al (2006) demonstrated an increase in venous velocity using electrical stimulation as a treatment adjunct for venous ulceration. However, stimulation was applied transdermally to the gastrocnemius muscle and required high levels of stimulation, which were not well tolerated.

Recently, a new Neuromuscular Electrical Stimulation (NMES) technology has been developed (OnPulse™, Firstkind ltd) primarily for prophylaxis of deep vein thrombosis (DVT) (Tucker et al, 2010); it stimulates contraction of the muscles of the lower leg indirectly via the common peroneal nerve accessed transcutaneously at the lateral side of the knee. The technology activates the muscle pumps using much smaller levels of stimulation, which are consequently better tolerated, and feasible using a small, self-contained battery-powered unit with no separate leads or electrodes.

The volunteers evaluated acceptance and tolerability of the electrical stimulation device by use of a questionnaire (Visual Analogue Scores) and a scoring index (Vascular Analogue Scores).

Discussion

Randomized blood flow to the leg is the prime objective in the treatment of leg ulcers (Briggs et al 2003); optimal treatment modalities vary depending on diagnosis (Gibby, 2005). With venous aetiology, the aim of treatment such as compression is to encourage blood from the legs, reduce venous backflow, venous hypertension and oedema (Morison and Moffatt, 2004). High levels of compression are more effective in achieving this than lower levels of compression, but also increase the risk of microcirculatory occlusion due to pressure.

With arterial aetiology, impaired arterial flow due to atherosclerotic plaque causes tissue hypoxia and risk of necrosis, which may be exacerbated by compression, often leaving surgery as the only option to restore blood supply (Herbert, 1997).

With arterial ulceration, impaired arterial flow due to atherosclerotic plaque (Siegrist, 2004) causes tissue hypoxia and risk of necrosis, which may be exacerbated by compression, often leaving surgery as the only option to restore blood supply (Herbert, 1997). Mixed aetiology ulcers result from a combination of venous disease and arterial disease, but arterial blood supply may not yet be poor enough to cause critical ischaemia. However, arterial disease is progressive and without intervention the arterial problem may eventually take precedence over the venous problem in treatment decisions (Clark, 2003). Applying full compression to a limb with an ulcer with mixed aetiology may be catastrophic (Moffat, 2004).

NMES of the common peroneal nerve appears to achieve the intended objectives of augmentation of venous flow, as well as augmenting skin microvascular flow, without the risks of compromise associated with compression. The OnPulse™ technology makes it possible to provide NMES in a convenient, wearable, battery-powered unit, with a low level of stimulation which is well tolerated.

Conclusion

NMES of the common peroneal nerve using OnPulse™ offers a potential means of promoting conditions favourable for wound healing, where compression may be contraindicated.

References


Figure 1: OnPulse™ electrode configuration

Objectives

To examine the effects of the OnPulse™ Electrical Stimulation on microcirculatory flow in the lower limb, measured by laser Doppler flowmetry, and venous flow in the lower limb, measured by Doppler ultrasound. Additionally to explore the patients’ acceptability and tolerance through the use of a scoring scales.

Method

OnPulse™ was applied to 30 healthy volunteers. Duplex ultrasound measurements were made at the femoral vein, and Laser Doppler Flowmetry measurements were made of the microvascular flow in the dorsum of the foot.

Results

NMES was effective in increasing microcirculation 20-fold in the lower leg (95%CI 1471% - 2252%). Peak venous velocity and venous blood flow also showed substantial and significant increases. Stimulation was well tolerated, with subjects generally reporting only mild discomfort while using the device.

Figure 3: Laser Doppler Flowmetry, as % of baseline

Figure 4: Doppler ultrasound measurements of peak venous velocity

Figure 5: Doppler ultrasound measurements of venous volume flow

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