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Transcutaneous application of the gaseous CO₂ for improvement of the microvascular function in patients with diabetic foot ulcers

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Abstract

Introduction: Microvascular function is impaired in patients with diabetes mellitus (DM) and is involved in numerous DM complications. Several microvascular-supporting interventions have been proposed of which the transcutaneous application of gaseous CO₂ (hereinafter CO₂ therapy) is one of the most promising. The aim of present study was to determine the effect of repeated CO₂ therapies on the cutaneous microvascular function in DM patients with diabetic foot ulcers.

Methodology: A total of 42 subjects with at least one chronic diabetic foot ulcer were enrolled in the study. They were divided into the experimental group (21 subjects aged 64.6 ± 11.6 years) that underwent 4-week-long treatment with transcutaneous application of gaseous CO₂ (hereinafter CO₂ therapies), and the placebo group (21 subjects aged 65.0 ± 10.7 years) that underwent 4-week-long placebo treatment with transcutaneous application of air. Before the first and after the last treatment in both groups, laser Doppler (LD) flux in foot cutaneous microcirculation, heart rate, and arterial blood pressure measurements were carried out during rest and local thermal hyperaemia (LTH) provocation test.

Results: In the experimental group the following statistically significant changes were observed after the completed treatment 1) increased mean relative powers of LD flux signals during rest in the frequency bands related to NO-independent endothelial (0.07 ± 0.055 vs. 0.048 ± 0.059, p = 0.0058), NO-mediated endothelial (0.154 ± 0.101 vs. 0.113 ± 0.108, p = 0.015), and neurogenic (0.17 ± 0.107 vs. 0.136 ± 0.098, p = 0.018) activity; 2) decreased resting LD flux (35 ± 29 PU vs. 52 ± 56 PU; p = 0.038); and 3) increased peak LD flux as a function of baseline during LTH (482 ± 474%BL vs. 287 ± 262%BL, p = 0.036); there were no statistically significant changes observed in the placebo group. No systemic effects were observed in none of the two groups by means of mean values of heart rate and arterial blood pressure.

Conclusions: Repeated CO₂ therapies improves the microvascular function in DM patients without any systemic side effects.

Keywords: CO(2) therapy; Diabetic foot ulcer; Dry CO(2) bath; Microcirculation.

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