

Effect of artificial carbon dioxide foot bathing on critical limb ischemia (Fontaine IV) in peripheral arterial disease patients

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- PMID: 12518118

Abstract

Background: It has been reported that artificial carbon dioxide (CO₂) foot bathing improves subcutaneous microcirculation in peripheral arterial disease (PAD) patients. However, the effect for critical limb ischemia (CLI) with ulceration or gangrene (Fontaine stage IV) is not identified. The physiological effects of CO₂ bathing and the outcome of limb salvage in such patients were studied.

Methods: In 18 healthy volunteers (Study I), the dorsal pedis peripheral blood flow was measured by a laser Doppler flow-meter during CO₂ foot bathing (1000 ppm, 37 degrees C) for 10 min. A Holter electrocardiogram was also recording in the same period. Blood flow and cell volume significantly increased during bathing. Eighty-three CLI limbs (Fontaine IV) in 68 PAD patients (Study II) underwent artificial CO₂ foot bathing (for 10 minutes twice daily >2 months) were followed up >6 months.

Results: In Study I, analysis of heart rate variability showed that high frequency amplitude (HFA) considerably increased and the ratio of low frequency amplitude to HFA (LF/HF) noticeably decreased during bathing. In Study II, 69 limbs (83.1%) could be salvaged. Twenty-seven of 28 limbs (96.4%) which have ulcer and gangrene in only one toe, 13/16 limbs (81.2%) in multiple toes and 29/39 limbs (74.4%) in all toes and/or heel respectively were saved.

Conclusions: The effect of CO₂ enriched water on the subcutaneous microcirculation might be brought about by peripheral vasodilation reflected by increased parasympathetic and decreased sympathetic activity, and the artificial CO₂ foot bathing is clinically effective on salvage of CLI (Fontaine stage IV) limbs.