Fluorescent Angiography Demonstrates Changes in Wound Microvasculature as a Result of Hyperbaric Oxygen Therapy

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BACKGROUND: The efficacy of hyperbaric oxygen therapy (HBOT) to facilitate wound healing in diabetic lower extremity ulcers is well established[1]. The exact mechanism of HBOT-mediated wound healing is unclear, but is thought to relate to increased reactive oxygen species and reactive nitrogen species (ROS &RNS)[2]. ROS and RNS lead to many downstream effects that impact wound healing including increased growth factors, diminished inflammatory responses and improved neovascularization. The impact on tissue perfusion, however, is not known. The purpose of this pilot study was to ascertain the effects of HBOT on the microvasculature of chronic wounds as assessed by fluorescent angiography as compared with healthy controls.

METHODS: Patients underwent fluorescent angiography at 4 different time points: immediately prior and immediately after the first and second HBOT treatments. Photo imaging with infrared camera began concurrently with the initiation of the IC-Green™ injection and lasted for 5 minutes. All videos were analyzed via MATLAB. The wound bed and the peri-wound area were then outlined as masks for the image analysis. 2 time points were determined: the onset of inflow and the time of maximal outflow (defined as the surrogate for onset of venous outflow).

RESULTS: Immediately after HBOT, there was evidence of increased flow. The onset of arterial inflow as well as venous outflow occurred earlier after the initial HBO treatment when compared with pretreatment in the chronic wound patients, indicating an immediate HBO associated vasodilitory effect. Interestingly, in healthy controls, the opposite phenomenon was observed in that both arterial and venous flow occurred in a delayed manner as a result of HBOT, perhaps suggesting a vasoconstrictive effect, consistent with prior reports[3].

CONCLUSION: This pilot study demonstrates that hyperbaric oxygen therapy appears to immediately impact the microcirculation both on an inflow (arterial) and outflow (venous) level. Interestingly, results of this study suggest inherent differences in micro-vascular physiologic responsiveness between healthy and chronic wound patients. This work offers an insight into the potential mechanism of HBOT and may direct future applications and eventually customize care.

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