Augmentation of Wound Healing Using Monochromatic Infrared Energy
Exploration of a New Technology for Wound Management

Lon R. Horwitz, DPM, CWS; Thomas J. Burke, PhD; and Dale Carnegie, DPM

Abstract
The results presented in this paper document healing of different types of extremity wounds with 890 nanometer (nm) monochromatic infrared energy. Recalcitrant dermal lesions, including venous ulcers, diabetic ulcers, and a wound related to scleroderma, were treated with a Food and Drug Administration-cleared infrared device. The infrared protocol was instituted after conventional management protocols were shown to be ineffective. The rate and quality of healing of these previously refractory wounds, following use of monochromatic infrared energy, may be related to local increases in nitric oxide concentration. Increases in nitric and anabolic responses. Further research is needed to confirm the results found in these patients.

ADV WOUND CARE 1999; 12:35-40

Venous ulcers, diabetic ulcers, and post-amputation wounds are difficult to manage and often do not heal, even with aggressive medical management and conscientious patient compliance. The lack of consistent and favorable outcomes is a costly problem for the health care industry, patients, and physicians. With an aging American population, the opportunity to explore novel and cost-effective treatment strategies will likely increase during the next several decades.

It has recently been demonstrated that a commercially available Food and Drug Administration-cleared infrared energy (MIRE) modality increases nitric oxide (NO) in the blood and plasmas of normal adult subjects (author's unpublished research). An elevation in NO has been suggested to be the basis of improved rates and quality of healing during L-arginine or nitroglycerin therapy in patients with wounds. Dietary L-arginine, a source of NO via the constitutive isoform of the enzyme nitric oxide synthase (cNOS), increases the rate of wound healing following traumatic, thermal, and fracture injuries.

It has been proposed that through this NO-mediated process MIRE might prove beneficial in patients with venous and diabetic ulcers and in patients who exhibit slow rates of post-amputation wound closure. The authors have evaluated the efficacy of wound healing during use of a commercially available MIRE device. The 5 patients discussed in this paper had wounds that were deteriorating or stagnant.

Purpose
The authors propose that the net result of increasing local amounts of circulating NO may be neovascularization, enhanced tissue perfusion, and successful wound healing.

Discussion
Monochromatic infrared energy was effective in healing a variety of wounds that either had become stagnant or had deteriorated with conventional management. Because virtually all other interventions were discontinued, these results suggest that MIRE,

perhaps the specific wavelength of 890 nm, could have been responsible. In addition, the design of the pads that maintained the focused energy density perpendicular to the wound site and the large surface area of the diode array may have contributed to the results achieved. In 3 cases, the healed wounds have not recurred during 1 to 2 years of follow-up evaluation, despite the cessation of MIRE exposure. The ease of pad placement, which does not involve the stress of continuous had positioning, is subject-friendly and contributed to the subject compliance required in this study.

It recently has been demonstrated that application of this particular MIRE device to the skin for 30 minutes increases plasma NO in nondiabetic subject volunteers, as measured with a Sievers Instrument, Model 280, Nitric Oxide Detector (authors' unpublished data). NO is a potent endogenous vasodilator that can be liberated from tightly bound hemoglobin on exposure to various wavelengths of energy. In the patients described here, the use of MIRE on refractory wounds may have involved elevations in local and systemic NO. Recently Schindl et al reported increased circulation in the feet of diabetic patients with micro-angiopathy after using a visible red monochromatic energy device with an energy density of 30 J/cm2. The circulatory effects were sustained even after the use of the device was discontinued. Bioavailable NO has been shown to enhance arterial perfusion, by vasodilation, at a site of previous vascular compromise.

No is a powerful anabolic agent, and it is thought to be the molecule that accounts for the wound healing efficacy of oral supplementation with L-arginine or topical nitroglycerine, both of which are sources of NO. In addition, the healing process may be accelerated by increasing circulatory NO-a potent vasodilator. Shorter wavelengths in the ultraviolet range also have been shown to promote vasodilation through release of NO.