Prevention of pressure-induced deep tissue injury using intermittent electrical stimulation

MED 07-29 200717272408 NDN- 234-1883-0922-8

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JOURNAL NAME- Journal of Applied Physiology
VOLUME 102
NUMBER 5
PUBLICATION DATE- 2007 May
PP 1992-2001
DOCUMENT TYPE- Journal Article; Research Support, Non-U.S. Gov't
JOURNAL CODE- 8502536
JOURNAL SUBSET- MEDJSIM
ISSN- 8750-7587
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PUBLICATION COUNTRY- United States
LANGUAGE- English

Pressure ulcers develop due to morphological and biochemical changes triggered by the combined effects of mechanical deformation, ischemia, and reperfusion that occur during extended periods of immobility. The goal of this study was to test the effectiveness of a novel electrical stimulation technique in the prevention of deep tissue injury (DTI). We propose that contractions elicited by intermittent electrical stimulation (IES) in muscles subjected to constant pressure would induce periodic relief in internal pressure; additionally, each contraction would also restore blood flow to the tissue. The application of constant pressure to the quadriceps muscles of rats generated a DTI that affected 60 +/- 15% of the compressed muscle as assessed by magnetic resonance imaging. In contrast, in the groups of rats that received IES at 10- and 5-min intervals, DTI of the muscle was limited to 16 +/- 16 and 25 +/- 13%, respectively. Injury to the muscle was corroborated by histology. In an experiment with a human volunteer, compression of the buttocks reduced the oxygenation level of the muscles by approximately 4%; after IES, oxygenation levels increased by approximately 6% beyond baseline. Concurrently, the surface pressure profiles of the loaded muscles were redistributed and the high-pressure points were reduced during each IES-induced contraction. The results of this study indicate that IES significantly reduces the amount of DTI by increasing the oxygen available to the tissue and by modifying the pressure profiles of the loaded muscles. This presents a promising technique for the prevention of pressure ulcers in immobilized and/or insensate individuals.