Novel Physiotherapies

Therapeutic Ultrasound: Finding the Sweet Spot for Bioburden Control and Wound Healing

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Clinically, therapeutic ultrasound has been used by rehabilitation experts in physical therapy and other fields for more than 60 years [1]. Therapeutic indications have included a wide range of conditions (acute and chronic inflammation, tissue healing and repair, scar management, pain modulation and bone healing). Over the past six decades, high frequency ultrasound in the 1-3.3 MHz (1,000,000 to greater than 3,000,000 cycles per second) range has been primarily used in treating these conditions. However, in the past decade, we have seen the introduction of low frequency ultrasound for the management of nonhealing, recalcitrant wounds. Low frequency ultrasound (LFU) generators (<100,000 and > 20,000 hertz) are used for debridement [2], bioburden control [3] and to stimulate wound healing [4] through both non-contact and jet-spray modes of delivery.

A review of the research examining the effects of LFU, demonstrates an evolving body of evidence to suggest a sweet spot in the frequency range for killing wound pathogens, enhancing antibiotic effectiveness and stimulating human cells. Work by a number of investigators has demonstrated the effectiveness of 25-35 kHz LFU in killing common wound pathogens [3,5,6] as well as antibiotic resistant species [3,6]. Thirty five kHz LFU also appeared to re-sensitize Methicillin-resistant Staphylococcus aureus to methicillin in vitro [3]. Similarly, other work has demonstrated that LFU in higher frequency ranges (67 kHz) enhances the effectiveness of antibiotics when bacteria are treated with the two modalities (antibiotic and LFU in combination) [7]. However, at this higher frequency, LFU does not directly kill bacteria. Interesting in the intermediate range of 40 kHz, an average reduction of 33% of bacteria was seen after 5 minutes of direct bacterial killing. However, research demonstrates consistently positive results in facilitating wound healing. Reversal of antibiotic resistance has not been demonstrated at any frequency other than 35 kHz. Antibiotic effectiveness has been enhanced at 67 kHz without the concomitant effect of direct bacterial killing.

The above research has shifted the treatment paradigm for physical therapist and others who employee ultrasound to enhance healing. Practice has moved away from high frequency ultrasound to units that are based on low frequencies. The degree of debridement appears to be governed by the acoustic energy delivery method with the lower frequencies (35 kHz and below) used primarily in debridement. As the technology evolves, as well as our understanding of the mechanisms that underlies treatment effects, we will likely find that the clinical utility of LFU will expand.

References

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