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## OstomyWoundManagement

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#### Mind-Body Techniques in Wound Healing

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*Right medial lower wound after 1 month of weekly UVC treatments. See related story on page 52.*

# ULTRAVIOLET LIGHT C IN THE TREATMENT OF CHRONIC WOUNDS WITH MRSA: A CASE STUDY

– Thao P. Thai, BScPT, MSc; Pamela E. Houghton, BScPT, PhD; David H. Keast, MD, CCFP; Karen E. Campbell, RN, MScN, NP; and M. Gail Woodbury, BScPT, MSc, PhD

*The prevalence of antibiotic-resistant bacteria such as methicillin-resistant Staphylococcus aureus is rapidly increasing in healthcare facilities and spreading to the community. Methicillin-resistant S. aureus colonize the skin and open wounds and can interfere with wound healing. Recent studies have shown that ultraviolet light C can kill antibiotic-resistant strains of bacteria such as methicillin-resistant S. aureus in both laboratory cultures and animal tissue. This clinical report describes the effects of ultraviolet light C on wound bioburden and closure in three people with chronic ulcers infected with methicillin-resistant S. aureus. In all three patients, ultraviolet light C treatment reduced wound bioburden and facilitated wound healing. Two patients had complete wound closure following 1 week of ultraviolet light C treatment. This case study suggests that ultraviolet light C is a promising adjunctive therapy for chronic wounds containing antibiotic-resistant bacteria such as methicillin-resistant S. aureus.*

*Ostomy/Wound Management 2002;48(11):52–60*

A worldwide development of virulent bacteria that are resistant to multiple antimicrobial treatments is occurring.<sup>1</sup> One strain of antibiotic-resistant bacteria currently receiving attention is methicillin-resistant *Staphylococcus aureus* (MRSA). In many hospitals in the United States and Europe, the prevalence of MRSA has increased from less than 3% in the early 1980s to rates as high as 40% in the 1990s.<sup>2–5</sup> Since the first report of MRSA in Canada in 1981, the number of MRSA cases has increased dramatically, and cases of community-acquired MRSA also have been documented.<sup>6–15</sup> Methicillin-resistant *S. aureus* bacteria colonize the skin and open wounds and may interfere with wound healing.<sup>16</sup>

Artificially produced ultraviolet light (UVL) was introduced as a therapeutic treatment for skin disorders at the beginning of the 20<sup>th</sup> century.<sup>17</sup> Cell culture and animal studies that have examined mechanisms by which UVL augments wound repair propose that UVL can stimulate cell proliferation,<sup>18</sup> epidermal thickness,<sup>19</sup> blood flow in the cutaneous capillaries,<sup>20</sup> and wound debridement.<sup>21</sup> A particular wavelength of UVL of between 200 nm and 290 nm called ultraviolet light C (UVC) has been shown to have bactericidal effects.<sup>22–26</sup>

Recent studies indicate that UVC can kill antibiotic-resistant strains of bacteria such as MRSA in laboratory cells and in animal tissue.<sup>24,26</sup> However, whether UVC can kill these bacteria when applied to human chronic wounds, using suggested clinical protocols, is not

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known. The purpose of this case study was to evaluate the potential role of UVC in reducing wound bioburden and improving wound status in chronic ulcers infected with MRSA.

## Method

**UVC treatment protocol.** Using an application technique that has been previously described by Nussbaum et al,<sup>21</sup> UVC was applied at a distance of 1 inch and perpendicular to the wound using premeasured disposable spacers. Before treatment, a 254-nm, cold quartz UVC generator, approved for clinical use in Canada (supplied by Medfarrx Inc., Raleigh, NC) was warmed for 5 minutes before being placed over the wound. The ulcer was cleansed with sterile saline, a thick layer of petroleum jelly was applied to the surrounding periwound skin and any healthy granulation tissue, and the wound edges were covered with a drape.

The UVC generator was applied to the wound for 180 seconds per wound site. This length of time is recommended for the treatment of infected ulcers<sup>21</sup> and was selected based on the MRSA killing rates reported in a previous *in vitro* study.<sup>24</sup> To shield the eyes from UVC, the therapist and patient wore protective goggles. All products applied to the patient were sterilized or discarded after a single use. Equipment that had to be reused was decontaminated using appropriate protocols.

**Subject recruitment.** Approval for research involving human subjects was obtained from appropriate institutional review boards. The purpose, method, risks, and benefits of UVC treatment were explained to the patients and/or their substitute-decision makers and informed consent was obtained. Patients included in this case series had a chronic ulcer present for at least 3 months that was infected with MRSA. By definition, an infected wound has a positive swab culture and clinical signs of infection, including: marked redness extending beyond the wound margins; increased pain; and increased amounts of foul smelling, purulent wound exudates. Oral antibiotic or topical antimicrobial therapy may or may not be required.<sup>27</sup>

**Outcome measures.** To determine the magnitude of bacterial burden in wounds for this case study, clinicians used a standardized protocol for administering a semiquantitative swab.<sup>28-31</sup> The lab results from the semiquantitative swab are report-

ed as type and relative amount of bacteria present — eg, no growth (0), occasional growth (scant), light growth (1+), moderate growth (2+), or heavy growth (3+). Other outcome measures included taking photographs and assessing changes in wound appearance using the Pressure Sore Status Tool (PSST).<sup>32</sup> The PSST is a pen-and-paper tool consisting of 13 domains that assess the composition of wound bed; wound size, depth, and exudate; and the condition of the periwound skin and wound edge. Scores assigned on a scale of 1 to 5 to each of the individual domains of the PSST are totaled to derive a total score ranging between 13 and 65, with 13 representing a completely healed wound. The PSST has previously been shown to produce valid and reliable assessments of wound appearance.<sup>32</sup>

## Case 1

A 77-year-old man had multiple leg ulcers due to a combination of venous and arterial insufficiency related to his previous occupation that involved prolonged standing. His long history of venous insufficiency included numerous corrective surgical procedures, including vein stripping. He presented with hypertension, bilateral leg edema, and significantly impaired bilateral lower extremity blood flow with ankle brachial indices (ABI) of 0.53 and 0.61 of the left and right leg, respectively. He ambulated with a cane and had limited mobility and impaired muscle pump function in both lower extremities. The extreme pain reported by this patient not only limited his mobility, but also caused significant sleep disturbances, leading to mild depression. Current medications included: pentoxifylline (400 mg tid), enalapril maleate (2.5 mg bid), and acetaminophen (500 mg qid).

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### KEY POINTS

- Chronic wounds are an important risk factor for acquiring antibiotic-resistant bacteria that may, in turn, delay healing.
- The case studies presented here build on and confirm earlier pre-clinical study observations: Ultraviolet light C can kill methicillin-resistant *Staphylococcus aureus*, as well as other non-antibiotic resistant bacteria.
- Given existing treatment limitations, current trends in the emergence of antibiotic-resistant bacteria, and the encouraging results reported here, research to ascertain the effectiveness of treatments that may help break the cycle of antibiotic resistance is long overdue.

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