Clinical Effectiveness of Noncontact, Low-frequency, Nonthermal Ultrasound in Burn Care

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More than 2 million burns occur in the US annually.1 More than 500,000 burn patients are treated as outpatients and approximately 40,000 require hospitalization.2 More than 2 million burns occur in the US annually.1 More than 500,000 burn patients are treated as outpatients and approximately 40,000 require hospitalization.2

Burns are classified by depth of tissue damage. Superficial burns damage the epidermis and usually heal spontaneously within 3 to 5 days. Partial-thickness burns can extend to the dermis, exposing nerves and causing pain. Healing can occur within 10 to 14 days, depending on wound size.1 Full-thickness burns extend to the subcutaneous layer, are typically painless due to nerve destruction, and usually require surgery.1

Burn treatment varies according to type, depth, and extent of injury. Conventional treatment of minor burns (<10% total body surface area) includes daily cleansing, debridement, antimicrobial creams, and nonadherent dressings.1 Treatment

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exacerbates wound-related pain; therefore, attention to pain and anxiety is essential.\textsuperscript{5}

The MIST\textsuperscript{r} Therapy System (Celleration, Eden Prairie, Minn) is a noncontact, low-frequency, nonthermal ultrasound (LFTU) treatment that promotes wound healing through cleansing and maintenance debridement. The ultrasound waves are delivered via sterile saline mist, making treatments painless. Nonthermal ultrasound has been used to effectively treat acute and chronic wounds,\textsuperscript{6-8} including burns.\textsuperscript{9}

This case series reviews the clinical effectiveness of LFTU in six patients with thermal burns.

Methods

Consenting outpatients were nonrandomly selected for treatment with LFTU based on wound bed composition (ie, slough and necrosis requiring debridement). The effectiveness of LFTU was evaluated through changes in wound bed composition, size, exudate, and pain. Patients rated pain using a 10-point numerical rating scale, where 0 = no pain and 10 = extreme pain. Treatment continued until wound beds were predominantly granulated. Ultrasound was used as an adjunct to conventional burn care.

Case Reports

Six patients, 8 to 73 years old, received LFTU. Patients’ wounds included three partial-full-thickness burns, ranging in area from 83.6 cm\textsuperscript{2} to 375.0 cm\textsuperscript{2}; two deep-partial-thickness burns, ranging in area from 14.9 cm\textsuperscript{2} to 60.0 cm\textsuperscript{2}; and a superficial-partial-thickness burn, area 19.0 cm\textsuperscript{2}. Patients received LFTU as an adjunct to conventional burn care (eg, sulfadiazine cream 1\% and nonadherent dressings). Treatments were administered one to five times weekly for 3 to 20 minutes, depending on the burn surface area.

Results

Six patients with a total of seven thermal wounds were treated. Nonthermal ultrasound was used to cleanse and debride wounds; the wounds demonstrated rapid granulation and pain resolved (see Table 1 and Figure 1). Patients reported no pain with removal of fibrin, slough, and eschar. Exudate was reduced to minimal amounts of serous fluid in 1 to 3 weeks. Wound areas decreased an average of 76\% in 3 weeks (see Figure 2). All patients reported complete pain reduction. Complete epithelialization was achieved in 1 to 6 weeks. Surgery was not required for wound closure.

Discussion

The essentials of burn care are debridement and infection control. Managing pain and anxiety are important treatment concerns. As an adjunct to conventional burn care, LFTU was used to cleanse and debride partial- to full-thickness thermal burns. Treatment was painless because the device does not contact the wound.

Burn patients are predisposed to infection because necrotic tissue is an excellent culture medium for...
micro-organisms. Nonthermal ultrasound waves are delivered via sterile saline mist, reducing bioburden and subsequently reducing infection. None of the study patients developed an infection.

In addition to wound cleansing, daily dressing changes are necessary for infection control. Changing dressings can induce pain and lead to treatment anxiety. Patients treated for burns often report intolerable treatment anxiety. Severe anxiety was observed in the 8-year-old study patient. His anxiety resolved after his first LFTU treatment.

Other forms of nonsurgical debridement have not been widely adopted. Chemical and enzymatic debridements provide variable results and can cause pain and bleeding. In this study, debridement results with LFTU were consistent; slough easily and painlessly lifted.

**Conclusion**

This case series confirms earlier reports of accelerated healing and pain relief with LFTU. Additionally, ultrasound delivered through sterile saline mist reduces bioburden, making it well-suited as an adjunct to conventional burn care.

**Acknowledgment**

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**References**


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**TABLE 1**

**DEMOGRAPHIC, BURN CHARACTERISTICS, AND OUTCOMES OF PATIENTS TREATED WITH NONCONTACT ULTRASOUND**

<table>
<thead>
<tr>
<th>Patients/age</th>
<th>Medical history</th>
<th>Burn location</th>
<th>Burn depth (thickness)</th>
<th>Exudate, pre-treatment</th>
<th>Pain, pre-versus post-treatment*</th>
<th>Noncontact ultrasound treatments Duration/ minutes†</th>
<th>Eschar at baseline,%</th>
<th>Time to 100% granulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hispanic man/73 years</td>
<td>Hyperlipidemia, asthma, diabetes mellitus, type 1</td>
<td>Hand</td>
<td>Partial to full</td>
<td>Serous</td>
<td>5 vs. 0</td>
<td>10/8</td>
<td>90</td>
<td>4 weeks</td>
</tr>
<tr>
<td>Caucasian man/20 years</td>
<td>Smoker</td>
<td>Leg</td>
<td>Partial to full</td>
<td>Copious, purulent to minimal, serous</td>
<td>7 vs. 0</td>
<td>16/20-4</td>
<td>90</td>
<td>6 weeks</td>
</tr>
<tr>
<td>Caucasian girl/16 years</td>
<td>None reported</td>
<td>Leg</td>
<td>Partial</td>
<td>None</td>
<td>7 vs. 0</td>
<td>3/4</td>
<td>100</td>
<td>1 week</td>
</tr>
<tr>
<td>Hispanic boy/8 years</td>
<td>None reported</td>
<td>Forearm</td>
<td>Superficial Partial</td>
<td>Serous</td>
<td>0 vs. 0</td>
<td>1/4</td>
<td>0</td>
<td>1 week</td>
</tr>
<tr>
<td>African American girl/15 years</td>
<td>None reported</td>
<td>Both legs</td>
<td>Partial</td>
<td>Serous/serosanguineous</td>
<td>9/10</td>
<td>6/3</td>
<td>40</td>
<td>2 weeks</td>
</tr>
</tbody>
</table>

* Numerical rating scale, 0 (no pain) to 10 (severe pain)
† Treatment duration decreased with healing
‡ Wound was an unroofed blister that was 100% pink upon evaluation; no eschar or granular tissue. Fresh epithelium covered the wound within 1 week of treatment
§ At baseline, wounds were fluid-filled intact blisters. All blisters reabsorbed within a few days of the first treatment. Patient, a firefighter, returned to duties in 6 weeks
Figure 2. Wound area reduction with LFTU treatment.