Acoustic Pressure Wound Therapy to Facilitate Granulation Tissue in Sacral Pressure Ulcers in Patients with Compromised Mobility: A Case Series

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Electrical stimulation and other modalities are recommended for treatment of pressure ulcers in spinal cord injury patients but their use may be limited by clinical contraindications such as necrosis and infection. Acoustic pressure wound therapy can be used to address infection and has no known contraindications related to wound status. A retrospective nonconsecutive study was conducted involving five inpatients with sacral pressure ulcers and compromised mobility (spinal cord injury, ventilator/mobility dependency, or persistent vegetative state) treated with acoustic pressure wound therapy three times per week, 4 to 6 minutes per session, for 5 weeks to 5.5 months. Acoustic pressure wound therapy was administered until necrotic tissue was removed, granulation was complete, drainage resolved to moderate levels, and wound size was compatible with indications for high-voltage electrical stimulation. Within 1 to 4 weeks of starting acoustic pressure wound therapy, four out of five wounds with substantial yellow slough or eschar demonstrated 100% granulation tissue and wound area and volume decreased 71% to 97% and 75% to 99%, respectively. Subsequent treatments included electrical stimulation alone (three patients) or in conjunction with negative pressure wound therapy (one patient) and silver foam (one patient). Acoustic pressure wound therapy was found to be an effective option in preparing wounds for subsequent therapy.

Key words: acoustic pressure wound therapy, pressure ulcers, debridement, wound care

Ostomy Wound Management 2008;54(8):50–53

Pressure ulcers are an ever-present concern for patients with compromised mobility resulting from spinal cord injuries or other conditions that severely restrict mobility. These chronic wounds, which occur in an estimated 1.3 to 3.0 million Americans, are associated with fatal septic infections and are reported as a cause of thousands of deaths each year in the US. Incapacitating conditions, such as paralysis and neurodegenerative diseases, increase risk not only of developing a pressure ulcer, but also of pressure ulcer-associated death.

Current clinical practice guidelines from the Wound Healing Society and the Consortium for Spinal Cord Medicine indicate that high-voltage...
Electrical stimulation (ES) can be effective for treatment of pressure ulcers refractory to conventional therapy and specifically in patients with spinal cord injury. However, ES use may be limited by clinical contraindications, such as osteomyelitis or infection. Acoustic pressure wound therapy (APWT), a low-frequency, noncontact, nonthermal ultrasound therapy indicated to promote healing through cleansing and maintenance debridement of yellow slough, fibrin, tissue exudates, and bacteria, has no known contraindications related to wound status. Randomized and nonrandomized studies primarily involving lower-extremity ulcers have reported increases in the proportion of wounds healed and decreases in healing time when APWT is added to conventional therapy. Case reports describe the use of APWT to remove necrosis and promote development of granulation tissue in nonhealing wounds.

This paper reports the course and outcomes of using APWT in mobility-compromised patients to increase granulation tissue and render sacral pressure ulcers suitable for ES and other additional therapy. This particular rehabilitation nursing facility specializes in patients with spinal cord injuries, ventilator dependency, and neuromuscular degenerative diseases. The wound care team (rehabilitation director, certified registered nurse practitioner specializing in wound care, certified wound treatment nurse, and physical therapist specializing in wound care) determines when APWT would be of benefit and identifies when wound characteristics are compatible with indications for less-costly therapies such as ES. A physical therapist administers advanced wound care modalities including ES and APWT. Wounds considered appropriate for physical therapy intervention include Stage III and Stage IV ulcers and ulcers post surgical debridement.

Case Series

Patient data were collected retrospectively from the medical records of five nonconsecutive inpatients who had received APWT for chronic sacral pressure ulcers containing substantial necrotic tissue (ie, ≥50% slough or any eschar). These patients were provided consistent 2-hour turning schedules, similar pressure-relieving mattress surfaces, and consistent nutritional support. Acoustic pressure wound therapy (MIST Therapy® System, Celleration, Inc., Eden Prairie, Minn) was administered per the manufacturer’s recommended use three times per week for 4 to 6 minutes per session in conjunction with appropriate moist dressings. Treatment continued until necrotic tissue was removed, granulation was complete, drainage resolved to moderate levels, and wound parameters compatible with indications for ES (EGS 4000 high-voltage pulsed galvanic stimulator, ElectroMed Health Industries, Miami, Fla) or dressings such as NPWT and silver foam. Weekly wound assessments included length, width, depth, odor, percentage of granulation and necrosis, tissue color, and drainage. Treatment characteristics and outcomes for all five patients are shown in Table 1.

Patient 1. A 23-year-old man with quadriplegia and a history of chronic sacral wounds resulting in thin, weak scar tissue over the sacrum was readmitted following hospitalization with a Stage IV sacral ulcer with 50% yellow, adherent slough. Acoustic pressure wound therapy was administered to cleanse the wound of slough. After 5 weeks of simultaneous treatment with APWT, nonadhesive silver foam dressing (Contreet, Coloplast US, Minneapolis, Minn), and mandatory bedrest initially (side-lying only) followed by seating in a wheelchair up to 4 hours per day with gapped area around the sacrum, the wound contracted and the wound bed showed 100% red granulation tissue. Acoustic pressure wound therapy was discontinued due to very small wound size (see Table 1); foam with silver dressing was continued until closure 2 weeks later.

Patient 2. An 81-year-old woman in a persistent vegetative state developed a Stage II sacral pressure ulcer that rapidly declined to an unstageable ulcer, despite a 2-hour turning schedule, side-to-side only. Acoustic pressure wound therapy was administered to debride the wound of large amounts of black necrosis and copious, purulent drainage. Wound size increased as the necrosis was debrided (see Table 1). After 10 weeks of APWT and use of a sodium hypochlorite solution dressing, collagenase, and hydrofiber with alginate, the wound bed was 100% red granulation tissue. At this time, it was determined that equal benefit could be achieved with ES, which was administered...
for 3 months along with silver alginate dressing (Seasorb AG, Coloplast US, Minneapolis, Minn). Wound volume decreased to 4.8 cm³, at which time the patient was rehospitalized and physical therapy wound care discontinued. She continues to be medically fragile and the wound remains open.

Patient 3. A 26-year-old quadriplegic man was admitted with a small, unstageable sacral wound that declined rapidly secondary to uncontrolled pressure. Following surgical debridement and 1 week of APWT, 50% slough was replaced with 100% granulation tissue. After 4 weeks, drainage diminished from copious purulent to moderate serous. After 4.5 months, wound volume had decreased from 378 cm³ to 24 cm³, at which time negative pressure wound therapy (NPWT—V.A.C.®, KCI, San Antonio, Tex) was administered to hasten closure and limit bedrest in this young patient. After 3 weeks of NPWT, ES was initiated and is ongoing combined with silver alginate dressing. Wound volume is currently 9.6 cm³.

Patient 4. A 57-year-old paraplegic man was admitted with a Stage III sacral pressure ulcer. Multiple hospitalizations for urosepsis resulted in continued decline to Stage IV with 80% yellow slough. Full granulation was achieved with 4 weeks of APWT and hydrofiber with alginate dressing, despite repeated interruption of therapy from Day 2 to Week 3 due to hospitalizations. After 5.5 months of APWT, wound volume decreased from 8 cm³ to 2 cm³. Therapy was changed to ES and silver alginate dressing for 4 weeks. The wound closed after 1 additional week of 3-D polymer foam dressing (Biatain, Coloplast US, Minneapolis, Minn).

Patient 5. A 65-year-old woman with a traumatic brain injury developed a large, unstageable, sacral pressure ulcer following multiple hospitalizations. She is ventilator-dependent, mobility-dependent, and unable to communicate her needs to the healthcare team. After 4 months of APWT, wound volume decreased from 216.9 cm³ to 14 cm³ but remained unchanged after an additional month of APWT. Treatment was changed to ES with silver alginate dressing. After 4 weeks, wound size remained relatively unchanged and the patient was discontinued from physical therapy wound care. The wound remains open.

Discussion
Acoustic pressure wound therapy was used to nonsurgically remove necrosis and bacteria and promote the development of granulation tissue sufficient for initiating ES or NPWT. In these patients with severely compromised mobility and advanced-stage pressure ulcers, substantial necrotic tissue was replaced with 100% granulation tissue in four out of five patients after 1 to 4 weeks of APWT and appropriate moist
dresings, proper positioning, pressure-reducing surfaces, and 2-hour turning schedules. For Patient 2, in which debridement with APWT exposed a larger wound bed, full granulation was reached in 10 weeks. Case reports at scientific congresses have described full granulation with adjuvant use of APWT ranging from 1.5 weeks to 3 months in lower-extremity wounds6-10 and 2.5 to 4 weeks in pressure ulcers.7,10 Small randomized studies have demonstrated greater proportions of wounds healed at 12 weeks when APWT is added to conventional wound care compared with conventional care alone in diabetic foot ulcers (proportion healed: 40.7% with APWT versus 14.3% without, \(P = 0.04\)12 and ischemic lower-extremity wounds (>50% volume reduction: 63% with APWT versus 29% without, \(P < 0.001\)).12 In this series of sacral pressure ulcers, APWT treatment ranging from 5 weeks to 5.5 months resulted in wound area decreasing by 71% to 97% and wound volume decreasing by 75% to 99%, with the exception of Patient 2, in whom removal of necrotic tissue exposed the true (larger) wound size. Ultimately, two ulcers closed completely in 7 weeks and 6.5 months, respectively. It has been estimated that Stage IV pressure ulcers often take one full year to heal completely.13

Outcomes in these five patients provide preliminary evidence that, in advanced-stage pressure ulcers, APWT may offer a less-invasive alternative to sharp or surgical debridement for removing necrosis and promoting granulation in preparation for subsequent treatment with ES or other appropriate wound healing modalities. Prospective randomized studies are needed to evaluate the utility of APWT as a therapy to hasten granulation of pressure ulcers.

Acknowledgement

The authors thank Laurie LaRusso, MS, ELS, for her primary contribution to the writing of this manuscript.

References