Sound Evidence

Negative Pressure Wound Therapy Combined with Acoustic Pressure Wound Therapy for Infected Post Surgery Wounds: A Case Series

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Acute infection of surgical incision sites often requires specialized wound care in preparation for surgical closure. Optimal therapy for preparing such wounds for a secondary closure procedure remains uncertain. The authors report wound outcomes after administering acoustic pressure wound therapy in conjunction with negative pressure wound therapy with reticulated open-cell foam dressing changes to assist with bacteria removal from open, infected surgical-incision sites in preparation for secondary surgical closure in three patients. Before incorporating acoustic pressure wound therapy at the authors’ facility, the average negative pressure wound therapy with reticulated open-cell foam dressing course prior to secondary surgical closure was 30 days; with its addition, two of three patients underwent successful surgical closure with no postoperative complications after 21 and 14 days, respectively; one patient succumbed to nonwound-related complications before wound closure. Larger, prospective studies are needed to evaluate combining negative pressure wound therapy with reticulated open-cell foam dressing and acoustic pressure wound therapy for infected, acute post surgery wounds.

KEYWORDS: acoustic pressure wound therapy, wound care, infection, surgery, negative pressure wound therapy

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In the presence of surgical site infection, primary surgical closure of the incision is deferred in favor of specialized wound care to resolve infection and prepare the wound for surgical closure as quickly as possible.1 Based on systematic reviews2-3 of the published literature, randomized, controlled trials comparing various debridement and dressing options in the healing of infected post-surgery wounds are lacking. Small studies of weak methodologic quality have evaluated various dressings and topical agents (including gauze, bead, foam, alginate, and hydrocolloid) but provide no conclusive evidence as to their relative efficacy in terms of adequate wound healing.3
Recently, a combination of negative pressure wound therapy (NPWT) and acoustic pressure wound therapy (APWT) administered over 4 to 12 weeks was reported to result in wound volume reduction of 99% to 100% and wound surface area reduction of 82% to 100% in a series of five patients with large, infected wounds healing by secondary intention post surgery or surgical debridement. In a recent systematic review of randomized controlled trials of NPWT, the time to secondary surgical closure of chronic and diabetic wounds was reduced by 1 to 10 days for NPWT compared with control therapies. This review cites 17% earlier healing of acute wounds resulting from diabetic foot amputation, although this benefit was offset by an 11% increase in rate of wound infection. Evidence from multiple consecutive case series and one randomized trial suggest that NPWT is useful in treating open wounds to closure via secondary intention, as an adjunct to surgical debridement in open infected wounds, and for drainage reduction in intact surgical wounds. Saxena et al have characterized the mechanisms by which NPWT with reticulated open-cell foam (ROCF) dressing stretches cells, resulting in microdeformation capable of promoting cellular proliferation in the wound microenvironment.

Based on its FDA-approved indication for cleansing and maintenance debridement of yellow slough, fibrin, tissue exudates, and bacteria, APWT has been administered in the treatment of infected wounds without any published reports of adverse effects. Acoustic pressure wound therapy is a noncontact, low-frequency ultrasound therapy that delivers ultrasound energy to wound tissues by means of a fine, sterile saline mist. In a review of the literature, Unger describes animal and in vitro research and suggests that low-frequency ultrasound produces a range of biophysical effects essential to the tissue repair process. A single in vitro experiment by Kavros and Schenck demonstrated cell wall destruction of bacterial organisms exposed to APWT compared with intact cell walls of the same organisms exposed to a saline-drip control. Unlike surgical and mechanical debridement therapies, APWT is generally considered to be painless, with one small, retrospective investigation (N = 15) hinting at a potential palliative benefit.

This report details the authors’ experience administering APWT to wounds during NPWT/ROCF dressing changes to assist in the preparation of infected, open surgical-incision sites for secondary surgical closure.

Case Series

The authors prospectively evaluated the clinical impact of supplementing NPWT/ROCF with APWT for resolution of infection in large, open surgical-incision wounds in three nonconsecutive patients at a long-term, acute-care hospital. Antibiotic prophylaxis was administered to all patients based on pre-existing infection at the surgical sites. All patients received NPWT/ROCF (V.A.C.®, KCI, San Antonio, Tex) and APWT (MIST Therapy® System, Celleration, Inc., Eden Prairie, Minn). Based on prior experience at this facility, it was expected that approximately 30 days of NPWT/ROCF would be required. The goal of supplemental APWT was to prepare the wounds for surgical closure in the shortest possible timeframe and to minimize patient discomfort.

Upon admission, NPWT/ROCF was administered to the three patients at 125 mm Hg continuous pressure for 48 hours followed by intermittent therapy (7 minutes on / 2 minutes off). Acoustic pressure wound therapy was administered according to standard practice for 10 minutes per treatment, three times per week, during NPWT/ROCF dressing changes.
Patient 1. A 75-year-old woman with type 1 diabetes, anemia, and an infected, open abdominal wound from an incarcerated abdominal hernia repair had multiple wound infections (mixed flora) with graft failures previous to her most recent surgery (April 28, 2008). At that time, acellular dermal matrix was placed in the wound bed. Despite this application, a large abdominal wound remained that was in need of surgical closure. Undermining was 6 cm in length involving approximately 50% of the wound circumference. The patient did not complain of pain before or during NPWT/ROCF dressing changes. On May 16, NPWT/ROCF with APWT was initiated. Bacitracin ointment was applied along the suture line. This approach was discontinued on the day of surgical closure, June 6 (21 days later) see (Figure 1).

Patient 2. A 77-year-old man with type 2 diabetes, peripheral artery disease, anemia, and chronic renal insufficiency had a wound that resulted from a left below-the-knee amputation (April 30, 2008) for suppurative infection of the left foot with abscess formation, as well as significant devitalized musculature. The surgical incision wound was left open due to infection with mixed flora. Upon admission, this patient reported episodes of phantom sensations at the operative site. Meropenem 1 g was given intravenously every 8 hours. On May 16, NPWT/ROCF with supplemental APWT was started and discontinued on the day of surgical closure with split-thickness skin graft, May 30 (14 days later) (see Figure 2). After the first two APWT treatments, the patient reported decreased phantom sensations. The patient returned to the authors’ facility on June 2. Acoustic pressure wound therapy was continued over the new skin graft for four treatments, ending on June 11. At that time, complete healing was documented with 100% graft take with molding evident.

Patient 3. In the case of a 63-year-old, mentally retarded woman with type 2 diabetes on a ventilator, a new-onset abdominal abscess was incised and drained (with gastric tube replacement) on February 28, 2008 and left open due to infection with *Escherichia coli*, *Klebsiella*, and *Pseudomonas*. Intravenous antibiotic therapy included meropenem 1 g and metronidazole 500 mg every 8 hours and vancomycin 1 g once daily. From March 11 (admission) to March 17, the wound was treated with hydrogel. On March 17, NPWT/ROCF with adjunctive APWT was started and continued until April 25. This patient was unable to communicate a pain rating but exhibited discomfort during initial dressing changes by grimacing and withdrawing from staff. Nociceptive pain medication (hydromorphone 2 mg) was required before dressing changes. After four APWT treatments (approximately 2 weeks), the patient’s demeanor was calmer, she was more cooperative with dressing changes, and her need for narcotics was reduced by 50%. Slough in the wound bed, which had been 50% on March 14 (before NPWT/ROCF-APWT treatment), had decreased to 10% on April 11. During 5.6 weeks of NPWT/ROCF-APWT treatment, wound area decreased from 260 cm² to 83 cm² and volume from 1,300 cm³ to 108 cm³ (see Figure 3). Based on visual assessment of the wound on April 25, it is likely this wound would have healed without surgical closure.

Discussion

Infection of surgical incision sites is undesirable and rapid closure of such wounds is essential for reducing morbidity and mortality, particularly in medically fragile patients. Before incorporating APWT at the authors’ facility, the average NPWT/ROCF course prior to secondary surgical closure was 30 days. With the addition of APWT to NPWT/ROCF in these patients, two patients...
underwent successful surgical closure with no postoperative complications after 21 and 14 days of therapy, respectively, and one patient succumbed to nonwound-related complications. Decreased time from original surgery to secondary closure reduces the time the wound is susceptible to further infection and allows patients to begin rehabilitation sooner. The labeled indication for APWT for “cleansing and maintenance debridement of yellow slough, fibrin, tissue exudates, and bacteria” suggests it may be capable of eliminating bacterial infection from the wound bed.

This is the second anecdotal report from wound care clinicians using APWT as an adjunct to NPWT in an effort to speed healing of infected postsurgery wounds. The series of six patients reported by Ligouri et al included chronic wounds post surgical debridement as well as true post surgery wounds and none were sent for secondary surgical closure. In those six patients, 4 to 12 weeks (<8.5 weeks in five of six patients) of combination APWT-NPWT resulted in 99% to 100% volume reduction and 82% to 100% area reduction.

Conclusion
It would be imprudent to draw definitive conclusions regarding the role of APWT in resolving wound infection and advancing postsurgery wounds toward closure based on two anecdotal reports. However, given the apparent lack of evidence-based standards for treatment of such wounds, this case series is presented as evidence that larger prospective studies are warranted to examine the possible contribution of APWT to the healing of infected postsurgery wounds.

References