Negative Pressure Wound Therapy in the Adjunctive Management of Necrotizing Fascitis: Examining Clinical Outcomes

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Prompt diagnosis and treatment of necrotizing fascitis reduces the morbidity and mortality rates of this devastating disease. To examine the clinical outcomes of using negative pressure wound therapy in the adjunctive management of wounds secondary to necrotizing fascitis, a retrospective review of medical records was conducted. Participants included 11 consecutive patients (16 wounds) with a diagnosis of necrotizing fascitis admitted to a teaching hospital between 2000 and 2005 and treated on an inpatient basis with negative pressure wound therapy. The patients included seven men, four women (average age 54 years; range 18 to 82 years). Variables abstracted from the medical records and consultation notes included: demographic information, tissue and blood bacteriological data, wound history, wound healing outcomes, duration of negative pressure wound therapy, length of hospital stay, and mortality and morbidity information. Variables were entered into an electronic database and analyzed. Operative tissue biopsies were obtained and all participants received serial surgical debridements as well as infection, nutrition, and hemodynamic support. Negative pressure wound therapy was applied to the wound(s) at 125 mm Hg continuous negative pressure until reconstructive closure could be performed. Most wounds (10) were on lower extremities, seven patients presented with sepsis, and beta-hemolytic Streptococcus was identified in nine wounds. Mean number of negative pressure wound therapy treatment days was 25 (range: 7 to 74), mean length of stay was 67 days (range: 21 to 186). All wounds were successfully closed — 73% received split-thickness skin grafts, 27% required flaps, 100% limb salvage was achieved, and all patients survived. No negative pressure wound therapy or dressing-associated complications were observed. Negative pressure wound therapy was found to be a viable adjunctive treatment in the management of wounds associated with necrotizing fascitis.

KEYWORDS: necrotizing fascitis, case study, negative pressure wound therapy, treatment duration, length of hospital stay

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Necrotizing fascitis (NF) is a rare, potentially lethal soft tissue infection that causes rapid necrosis of the skin, subcutaneous fat, and fascia. It is excruciatingly painful and causes profound illness. The incidence of NF in adults and children is estimated to be 0.40 cases and 0.08 cases per 100,000 people, respectively.1-3 Mortality rates reported in the literature vary between 10% and 75%.4-7 Early diagnosis and treatment are key in reducing NF mortality rates.1,8-10 The sine qua non of managing this devastating necrotizing process is immediate extensive surgical debridement and aggressive wound care, hemodynamic support, broad-spectrum antibiotics, and nutritional support.1,10,11 Aggressive debridement performed rapidly and closure of these defects can enhance long-term limb function, limb salvage, aesthetic outcome, and mortality rates.1,10

Negative pressure wound therapy (NPWT) has been shown to induce micro-deformations of the tissue, which results in increased cell proliferation and migration.12,13 The removal of exudate into a collection canister reduces the number of inhibitory mediators and matrix metalloproteinases that are known to impede wound healing.14 Preclinical studies have shown that NPWT can enhance local blood perfusion15,16 and promote granulation tissue, particularly in the depth of the wound.17,18 While a modulation in bacterial species with a decrease in nonfermentative negative rods to an increase in Staphylococcus aureus in NPWT-treated wounds has been reported, this has not negatively impacted granulation tissue formation or wound healing rates.19,20

To evaluate outcomes of using NPWT as an adjunctive treatment for wounds resulting from necrotizing fascitis, total length of hospital stay (LOS), total NPWT treatment time, and wound closure status at discharge were examined in a case series of 11 consecutive patients.

**Literature Review**

While NF remains a rare condition, the incidence of NF has increased five-fold over the last decade.14 This is likely due to a combination of factors such as the resurgence of severe group A streptococcal infection and an increase in the number of patients with immunosuppression, a condition that has been shown to predispose patients to develop NF.21 These immunosuppressive conditions include diabetes mellitus, C4 deficiency, AIDS, and malignancy.1

References to aggressive, gangrenous deep tissue wound infections are not new. Hippocrates made the first known mention of this type of wound infection in the 5th century BC.22 The condition later was described in detail by Jones23 in 1871 and was coined “necrotizing fascitis” in 1952.22 It is well understood that not all strep infections produce NF. Of the approximately 80 strains of beta streptococci, only a few produce NF.11 The condition occurs most often in postoperative patients or following minor trauma.24 The most common parts of the body to become infected are the abdomen, perineum, and extremities.24

In acute cases of NF, infection progresses for 2 to 3 days until the skin turns purple to purple-black. The necrosis is thought to be directly caused by an interruption in the deep blood supply.19 The necrotic tissue harbors and encourages the unabated growth and migration of bacteria. Although the port of entry for bacteria varies among patients, generally bacteria have been shown to enter the body anywhere integument is compromised.

As the infection worsens, frank cutaneous gangrene becomes visible and extends into the deep tissues.24 Patients suffer from systemic complications such as high fever, chills, constitutional symptoms, multi-organ system failure, neuralgia, and shock.14 The condition has historically made headline news as...
a “flesh-eating bacteria” because of its visibly aggressive necrotizing effects and the massive defects that result. Initial treatment requires direct radical surgical necrotomy without wound closure and daily wound culture swabs. The condition necessitates debridement beyond the visible margins of infection until the subcutaneous tissue can no longer be separated from the deep fascia.

Repeated direct radical surgical debridements are critical for patient survival; they typically result in massive soft tissue defects. Advanced wound care is recommended to treat these wounds, but they commonly are managed with conventional moist gauze dressings applied two to three times daily. Recently, in a small, controlled study by Huang et al of NPWT versus traditional wet-to-dry gauze in 24 patients with open limb wounds following NF, NPWT was found to reduce nursing time spent on wound care 3.7-fold.

Methods
This study consisted of a non-randomized, retrospective review of data from 11 consecutive patients admitted with a diagnosis of NF who were treated with NPWT between 2000 and 2005 in a teaching hospital. Demographic, tissue and blood bacteriological data, wound history, wound healing outcomes, duration of NPWT, LOS, and mortality and morbidity information were entered into an electronic database and analyzed. All data were abstracted by the author from patients’ medical records and the author’s consultation and follow-up notes. All patient data were de-identified and HIPAA compliant. Primary endpoints measured were: 1) total LOS stay, 2) total time on NPWT, and 3) wound closure status upon discharge.

Operative tissue biopsies were obtained and all patients received aggressive, serial surgical debridements. Blood cultures followed by broad-spectrum systemic antibiotics were administered on day 1 of hospital admission, along with nutritional and hemodynamic support.

Negative pressure wound therapy (V.A.C. System™, KCI, San Antonio, Tex) was applied to the wound(s) via GranuFoam™ dressing at 125 mm Hg continuous negative pressure until 100% granulation was established after aggressive operative debridement was performed and tissue cultures were taken. The open-cell reticulated foam dressing was placed within the entire wound cavity and covered with a semi-occlusive transparent adhesive drape. The T.R.A.C.® Pad (KCI, San Antonio, Tex) was applied over a 2-cm hole cut into the drape. The distal end of the tubing was connected to the fluid collection canister within the NPWTT device and pressure was initiated.

Daily wound assessments and dressing changes were performed until viable tissue, granulation budding, and acceptable tissue plane resistance were observed. Patients then were converted to three-times-weekly NPWT dressing changes. Reconstructive closure was performed once tissue bacteriology was <10⁶ and negative for beta-hemolytic Streptococcus, patients were medically stable, and wounds were filled with granulation. All patients were hospitalized during the entire course of therapy.

Data were analyzed using the SAS statistical analysis system V9.3 (SAS Institute Inc., Cary, NC). Outcomes were analyzed for the entire patient set. Categorical variables were expressed as frequency while continuous variables were expressed as the median and range unless otherwise stated. Institutional Review Board approval was obtained to perform this study, meeting criteria outlined in the Code of Federal Regulations 45 CFR 46.101 and 21 CFR 56.101.

Results
Eleven patients (seven men, four women) with a total of 16 wounds received NPWT. Average patient age was 54 years (range: 18 to 82 years), median 57 years. Of the 11 patients, six (56%) were admitted to the hospital within 48 hours of initial NF symptoms (eg, pain, erythema, edema, cellulitis). Operative debridements were performed within 24 hours in seven (64%) cases, at 48 hours in three patients (27%), and on hospital day 8 for one patient. In 36% of the cases, NF developed without an identifiable antecedent (see Table 1).

Of the 16 wounds, 10 (63%) were located on lower extremities (see Table 2 and Figures 1 to 3). Comorbidities included diabetes mellitus (seven,
64%), malnourished (one), peripheral vascular disease (three), and obesity (three). Initial operative tissue cultures identified beta-hemolytic Streptococcus in nine (82%) wounds. Blood cultures were positive for Escherichia coli (9%), Staphylococcus aureus (18%), and Corynebacterium (9%).

The mean number of NPWT treatment days was 25 (range: seven to 74, median = 21). The mean hospital LOS was 67 days (range: 21 to 186, median = 45, mode = 37). While all wounds were appropriate for closure within 3 weeks or less, the medical instability of four patients delayed surgical closure and as a result increased LOS numbers. All wounds were closed successfully by surgery — 73% received split-thickness skin grafts and 27% required flaps. Six patients (55%) were discharged home, 45% were transferred to rehabilitation, 100% limb salvage was achieved, and no patients expired. No complications were associated directly with the therapy.

Although surface area of all wounds decreased and 100% had well vascularized granulation beds within 3 weeks or less, the medical instability of the previously mentioned four patients resulted in delayed surgical reconstruction, delayed rehabilitation placement, and as a result, increased outlier LOS.

**Table 1**

<table>
<thead>
<tr>
<th>Antecedent Event</th>
<th>Frequency</th>
<th>Percent</th>
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<tbody>
<tr>
<td>Trauma</td>
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<td>9.09</td>
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<tr>
<td>Abscess</td>
<td>2</td>
<td>18.18</td>
</tr>
<tr>
<td>Surgical wound</td>
<td>3</td>
<td>27.27</td>
</tr>
<tr>
<td>Human bite</td>
<td>1</td>
<td>9.09</td>
</tr>
<tr>
<td>Unknown</td>
<td>4</td>
<td>36.36</td>
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**Table 2**

<table>
<thead>
<tr>
<th>Location</th>
<th>Frequency</th>
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<tbody>
<tr>
<td>Upper extremity</td>
<td>2</td>
<td>12.5</td>
</tr>
<tr>
<td>Posterior thorax/sacrum</td>
<td>3</td>
<td>18.75</td>
</tr>
<tr>
<td>Lower extremity</td>
<td>10</td>
<td>62.5</td>
</tr>
<tr>
<td>Abdomen</td>
<td>1</td>
<td>6.25</td>
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Discussion

Extreme pain, increased bacterial burden, a prolonged hospital stay, and high intensity staff and supply utilization are associated with the care of wounds secondary to NF. In a US case series involving 216 hospitalized patients with NF, the median cost of care per patient was reported to be $54,533.

This retrospective analysis was conducted to evaluate outcomes of the adjunctive application of NPWT in treating these complex wounds secondary to NF. Study results demonstrate a 0% mortality rate, limb salvage in all cases, and no complications, which seem to suggest the overall safety and efficacy of the therapy.

The successful use of NPWT to treat NF soft tissue defects has been previously documented in the literature. A case series of two patients diagnosed with NF and a pathologic diagnosis of calciphylaxis concluded that NPWT was of value in healing these types of wounds. However, in the patient with 48% total body surface area skin necrosis, the therapy was only partly effective due to a lack of intact skin surface. In one case study of cervicofacial NF where copious exudate prevented skin graft take following a bilateral neck dissection, NPWT was effective in avoiding extensive skin excision and complicated reconstructive surgery.

In a case series of three patients describing the use of the therapy in abdominal NF, Oetting et al determined that NPWT demonstrates clinical feasibility advantages and lower complication rates compared to other methods of temporary abdominal closure. One case report describes the use of NPWT in tandem with maggot debridement to treat a complex leg wound following a simple pelvic fracture. After 6 days of NPWT alone, the distal portions of the wound still harbored large quantities of pus and necrosis. Maggot-filled biobags (Vitapad, Polymedics, Peer, Belgium) were added to the base of the wound. Negative pressure wound therapy with instillation, a system that delivers regular instillation of a topical solution in addition to negative pressure, was applied. The therapy was set to rinse the polyvinyl alcohol NPWT dressing three times per hour with an antiseptic agent (Lavasept

Figure 2. Upper extremity wound extending from the forearm to the scapular region secondary to necrotizing fascitis; top to bottom — post-debridement, pre-NPWT; NPWT in use; NPWT day 13; day 13, NPWT close-up; NPWT day 28 (split-thickness skin graft then performed); split-thickness skin graft with 98% take.
After 6 days, the wound had improved considerably and could be surgically closed.34

Limitations

The limitations of this study are its retrospective nature, small sample size, and lack of controls. However, all care was standard care for the management of NF debridements, nutritional support, systemic antibiotics, and medical optimization.

Conclusion

In 100% of wounds treated with NPWT in this case series, rapid wound bed preparation for surgical closure was achieved. Negative pressure wound therapy was found to be an efficacious adjunct to the management of complex wounds associated with necrotizing fascitis. Larger controlled studies are needed to establish the effectiveness and cost-effectiveness of this therapy. - OWM

References

15. Wackenfors A, Sjogren J, Gustafsson R, Algotsson L, Ingemansson R, Malmsjo M. Effects of vacu-