Treatment of Postoperative Infection After Posterior Spinal Fusion and Instrumentation in a Patient With Neuromuscular Scoliosis

Paul J. Ghattas, DO, Charles T. Mehlman, DO, MPH, and David Eichten, DO

Abstract

According to the literature, patients with neuromuscular scoliosis have a higher rate of infection after spinal fusion. No randomized controlled trials have been completed to assess the optimal treatment and related outcomes for patients with infections after posterior spinal fusion.

In this article, we examine the data and report a case in which a vacuum-assisted closure (VAC) device was used as definitive treatment for a deep wound infection after posterior spinal fusion and instrumentation in a patient with neuromuscular scoliosis. Our patient, a 17-year-old adolescent girl with progressive neuromuscular scoliosis, underwent posterior spinal fusion with instrumentation and bone graft from T2 to sacrum without complication. One month after surgery, she presented with a draining wound. She underwent repeat surgical irrigation and debridement with subsequent use of a wound VAC. The wound VAC was used for more than 2 months, until skin closure was complete. The deep polymicrobial wound infection was treated successfully and definitively with a wound VAC.

This case report suggests that good long-term outcomes can be achieved with use of a wound VAC for definitive closure, with possible avoidance of other secondary surgeries requiring skin grafts or flaps for wound closure.

Multisegmental spinal fusion is a common surgical procedure performed to treat conditions secondary to scoliosis, trauma, congenital anomalies, tumors, and infection. The neuromuscular patient is at increased risk for scoliosis and curve progression often requiring surgical intervention. Rates of complications after surgery are also substantially increased in neuromuscular patients and may be as high as 33.1%.[1] More specifically, deep wound infections and other complications of posterior spinal fusion can be devastating, resulting in significant morbidity. Rates of infection in patients with idiopathic scoliosis range from 1% to 5%, and rates in patients with neuromuscular scoliosis range from 4% to 18%.[2-5] Wound infections can significantly increase length of hospitalization, costs of postoperative care, pseudarthrosis rates, and pain and disability after hospitalization. Many preventive measures are taken, such as aseptic techniques and prophylactic antibiotics, but given the duration of surgery and the use of multisegmental fixation, complication rates are still relatively high.

Certain risk factors can predispose patients to infectious sequelae, including malnutrition, steroid use, immunocompromised state, poorly controlled diabetes, and infection at other sites.[2-4] In a study that included 185 patients with neuromuscular scoliosis,[3] the overall infection rate was 11%. Patients with muscular dystrophy and cerebral palsy had the highest rates over all, 23% and 18%, respectively.[3] Gersoff and Renshaw[2] studied the perioperative complications in 33 patients who had cerebral palsy and underwent posterior spinal fusion. The most common complication was wound infection. These patients were treated with irrigation and debridement (I&D), systemic antibiotics, wound packing, frequent dressing changes until granulation was adequate, and, later, staged delayed primary closure.[2] Other factors increasing the risk for wound infection include prolonged operative time, extended hospitalization, and high blood loss.[5,6] Most of these wounds are managed with irrigation, drainage, debridement, antibiotics, and early versus delayed closure with use of skin, muscle flaps, or grafting.[7]

In this case report, we describe a novel treatment approach involving use of a vacuum-assisted closure (VAC) device for definitive closure of a deep wound infection in a patient with neuromuscular scoliosis. The patient provided written informed consent for print and electronic publication of this case report.

Case Report

The patient, a 17-year-old adolescent girl with a history of traumatic brain injury after a motor vehicle accident at age 10, presented with progressive neuromuscular scoliosis. She

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was entirely care-dependent with left-sided hemiparesis and a baclofen pump for spasticity (**Figures 1A, 1B**). She underwent posterior spinal fusion from T2 to sacrum with instrumentation (Luque rods), autologous tibial bone graft, and porous hydroxyapatite grafting (Interpore; Biomet, Warsaw, Indiana) (**Figures 2A, 2B**).

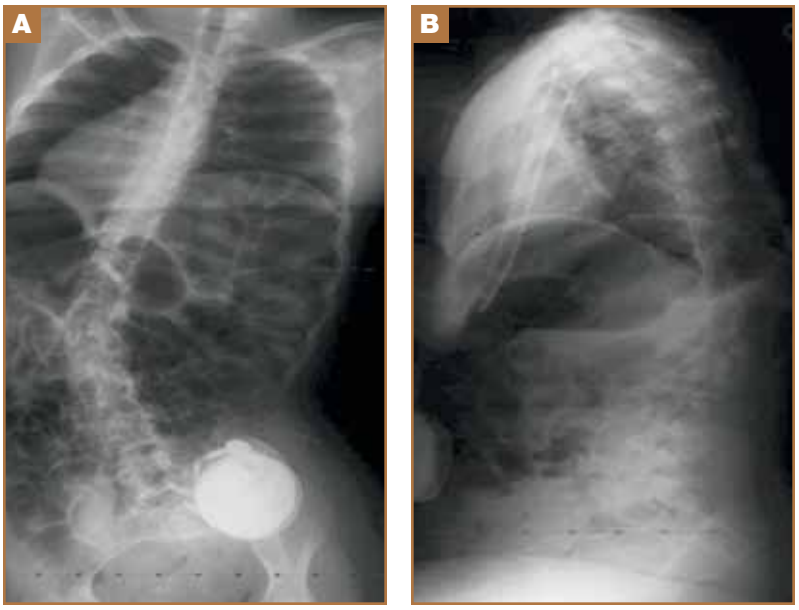

Figure 1. Seventeen-year-old adolescent girl with traumatic brain injury and progressive neuromuscular scoliosis. Preoperative posteroanterior (A) and lateral (B) radiographs show apex left thoracolumbar curve. Intrathecal baclofen pump is also visualized.

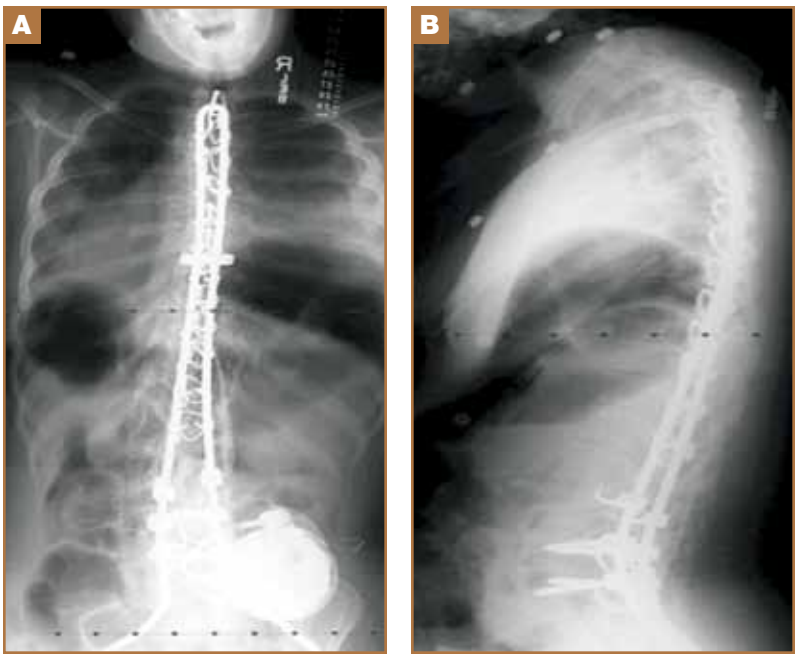

Figure 2. Patient's postoperative posteroanterior (A) and lateral (B) radiographs show posterior spinal fusion with use of Luque rod segmental instrumentation.

One month after the operation, the patient presented to the clinic with purulent drainage from the incision site (**Figure 3A**). This prompted an operating room I&D of the entire spine down to the deep tissue, bone, and instrumentation, including the pelvic portion (**Figure 3B**). All necrotic areas were thoroughly debrided, and the wound was irrigated using a Pulsavac (Zimmer, Warsaw, Indiana) with 12 L of fluid, 6 L of which contained antibiotics. The tibial bone graft, which was grossly infected on one side, was removed; the other tibial bone graft and the instrumentation were retained. The wound was packed with a 0.25% hypochlorite solution (Dakin's Solution) with gauze and left open. The patient was started on vancomycin and gentamicin empirically per infectious disease recommendations through a peripherally inserted central catheter. Gram stain revealed a polymicrobial infection with gram-positive and -negative rods, and gram-positive cocci in pairs with cultures eventually growing both *Prevotella bivia* and *Enterococcus* species.

The patient underwent another I&D using the same protocol, with application of a wound VAC instead of open packing. For the third I&D, the baclofen pump and preexisting lumbar subarachnoid catheter were removed to prevent meningitis. A small cerebrospinal fluid leak was found, which prevented application of the wound VAC per the neurosurgical team. Once the leak was sealed, by the next I&D, the VAC device was reapplied. After 5 subsequent operations, the wound was adequately clean, and granulation tissue was diffused enough to attempt delayed primary closure. This was unsuccessful, as the patient returned 2 weeks later with sepsis secondary to recurrent infection of the spinal wound. I&D was repeated 3 more times using 9 L of sterile saline, and deep wound packing was completed with Dakin's impregnated Kerlix (Covidien, Mansfield, Massachusetts). Then the wound was covered with the wound VAC.

After the third I&D, it was decided to leave the wound VAC in place indefinitely to allow for granulation, without a delayed closure procedure. The wound VAC was left in place when the patient was discharged from the hospital to a rehabilitation facility. During rehabilitation, the VAC sponge and dressings were changed every Monday, Wednesday, and Friday for more than 2 months (**Figures 4A, 4B**). Six months after the original operation, the wound was well healed, and there was no need for skin grafting or flaps. With a follow-up physical examination, and laboratory test results showing erythrocyte sedimentation rate of 11 mm/h, C-reactive pro-

tein level of 1.1 mg/L, and white blood cell count of 6400/μL, the infection was resolved, and vancomycin, gentamicin, and ceftriaxone were discontinued. Patient was seen again at 2-year follow-up with no additional wound complications or signs of infection (**Figure 4C**).

Discussion

Deep wound infection after surgical treatment of neuromuscular scoliosis is among the most likely of complications associated with spine surgery. Kretzler and Banta[4] reviewed 649 consecutive spinal fusions over a 10-year period and identified 27 postoperative wound infections. They found rates for idiopathic scoliosis (1%) and congenital scoliosis (2%) to be significantly lower than those of the neuromuscular population for cerebral palsy (11%) and myelodysplasia (11%).[4] Treatment for these wound infections included repeat I&D with wound packing and healing through secondary intention.

In patients with neuromuscular scoliosis, there is an increased incidence of polymicrobial infections, which may be attributed to associated risk factors, such as malnutrition, increased duration of surgeries, and extensive blood loss.[6] Szöke and colleagues[5] found an infection rate of 8.7% in a study of 172 patients with cerebral palsy undergoing posterior spinal fusion. Treatment included opening the wound in the area of drainage (<50% of original incision), I&D, and subsequent packing of the wound, with eventual closure through secondary intention.[5] In light of the high rate of superficial extension of infection to deep layers, most authors recommend opening the incision the entire length of the original wound.

General guidelines based on retrospective studies have been reported for the treatment of early wound infections after reconstructive spinal surgery.[5,6,8-11] Suspected infections should be opened through the length and depth of the wound, and all necrotic tissue should be sharply debrided and irrigated. Bone graft should be removed, cleaned, and replaced if still viable, and the instrumentation should be left in place.[5,6,8-11]

The need for serial debridement and the best method for wound closure are debated in the literature.[10] With more marked infections devoid of necrotic tissue after debridement, the wound may be closed over irrigation suction using saline irrigation until the infection is controlled, followed by 24 hours of suction.[6,8,10] It is important to note that Theiss and colleagues[10] found that wounds treated with suction irrigation after surgery had a higher rate of pseudarthrosis than those treated with repeat debridement. Wounds with polymicrobial infection and residual necrosis after debridement should be packed open for repeat I&D until the wound is clean and granulating, at which time it can be secondarily closed.[10] Wounds with persistent, severe infection should be allowed to granulate without closure.[10] Often, these patients require plastic surgery for procedures ranging from skin grafts to large flaps, all of which impose some element of morbidity as well as higher costs.[7] The literature did not include any articles indicating use of a wound VAC as the definitive treatment for closure, as is presented in the present case report.

Szöke and colleagues[5] used a protocol of treating all children with deep infections with wound closure by secondary intention. They used surgical I&D in treating 6 patients with early (within 2 months after surgery) deep wound infections. The instrumentation and bone grafts were left in place, and the wounds were left open. All 6 patients had complete healing and resolution of infection without development of pseudarthrosis.[5] Alternatively, Lonstein and Akbarnia[12] successfully treated 4 of 5 patients with deep wound infections using closure over irrigation and suction tubes, and skin grafting as needed.

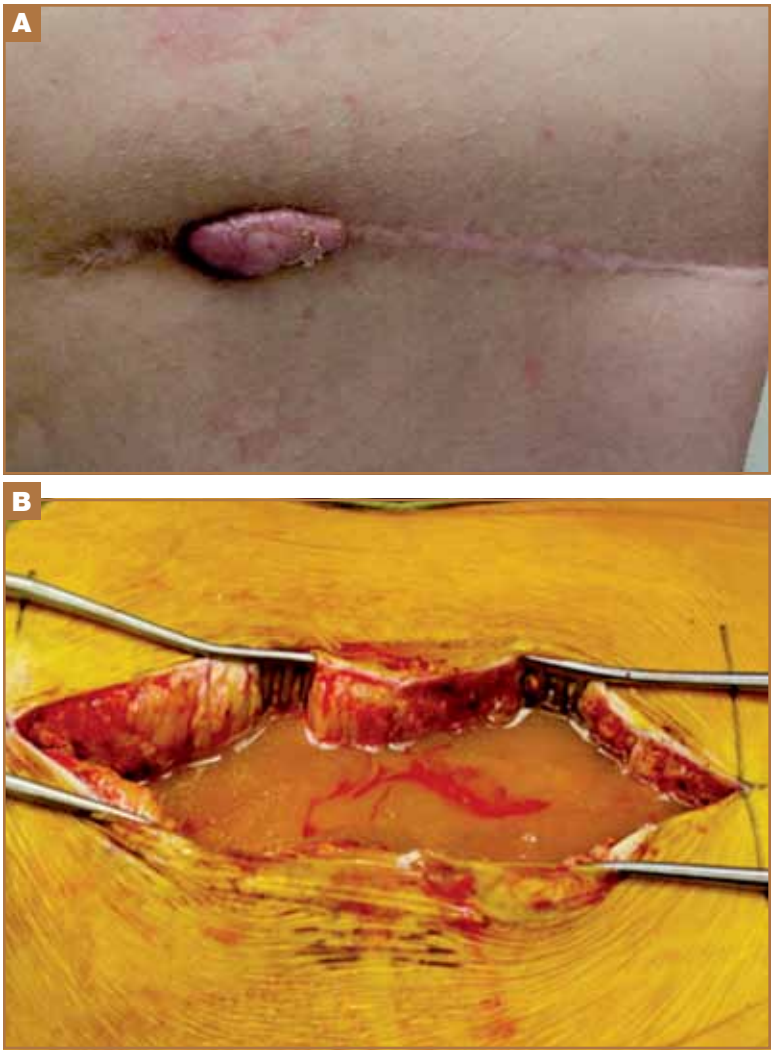

Figure 3. (A) One month after posterior spinal fusion and instrumentation, patient presented with wound drainage. (B) Purulent drainage was found during initial irrigation and debridement. Wound cultures obtained during surgery grew *Prevotella bivia* and *Enterococcus* species.

In a retrospective case–control study of 210 patients with myelomeningocele and cerebral palsy, 25 developed postoperative infections.[13] Polymicrobial infections were present in 52% of the cases. I&D with closure over suction drains was successful in 11 of the 25 patients. The other 14 patients' wounds had to be left open; some required hardware removal, others were closed but needed rotational flaps (using latissimus dorsi and trapezius muscles), and 3 developed pseudarthroses. VAC was recommended to hasten delayed primary closure.

VAC of postoperative spinal wounds has received attention recently. The wound VAC was developed in the 1990s initially for the treatment of large, chronically infected wounds.[7] After thorough mechanical debridement, an open-pored sponge is placed in the wound with an occlusive dressing to create an airtight seal.[7,9] Tubing then connects the sponge to a negative-pressure device with subatmospheric pressure either intermittent or continuous 125 mm Hg. The VAC removes excess interstitial fluid, evacuating purulence, decreasing bacterial cell counts, and increasing blood flow and mechanical stimulation of cells, resulting in proliferation of granulation tissue.[14,15] Studies have found that VAC increases granulation tissue by 63%.[7] VAC was recently used in adults with scoliosis and postoperative infections.[15] Twenty patients (age 31 to 81 years) underwent I&D. On average, wounds closed by 7 days after initial VAC placement.

Use of wound VACs is not without complications. Our patient's baclofen pump was removed with subsequent dural leak; had the VAC been placed immediately after the cerebrospinal fluid leak, there may have been complications. Other reported complications include toxic shock syndrome secondary to foreign body/sponge material retained within the wound.[7] Reports of death, though rare, are related to excessive bleeding, with patients either on anticoagulants or refusing blood transfusion after surgery.[7,16]

The benefits of VAC therapy include use on an outpatient basis, less frequent dressing changes, and fewer visits to the operating room for debridement.[8,16] Herscovici and colleagues[14] used VAC in patients with high-energy soft-tissue injuries and demonstrated a proliferation of granulation tissue in 12 wounds (57%), successfully avoiding the need for skin grafting and tissue transfers. Yuan-Innes and colleagues[7] reported success in using VAC for the treatment of deep wound infections after posterior spinal fusion for the treatment of 2 cases of progressive kyphosis secondary to Hurler syndrome and spina bifida. The ability of VAC therapy to generate granulation tissue over exposed hardware is advantageous in these cases with retained instrumentation. These reports identify VAC as a promising alternative to the traditional management of deep wound infections after posterior spinal fusion in the neuromuscular patient.

A unique case is presented here to demonstrate use of a VAC device to successfully treat a deep wound infection after posterior spinal fusion for neuromuscular scoliosis. Although the reported use of VAC therapy in this patient population is just beginning, this case provides an example of successful treatment as an adjunct to staged surgical I&D.

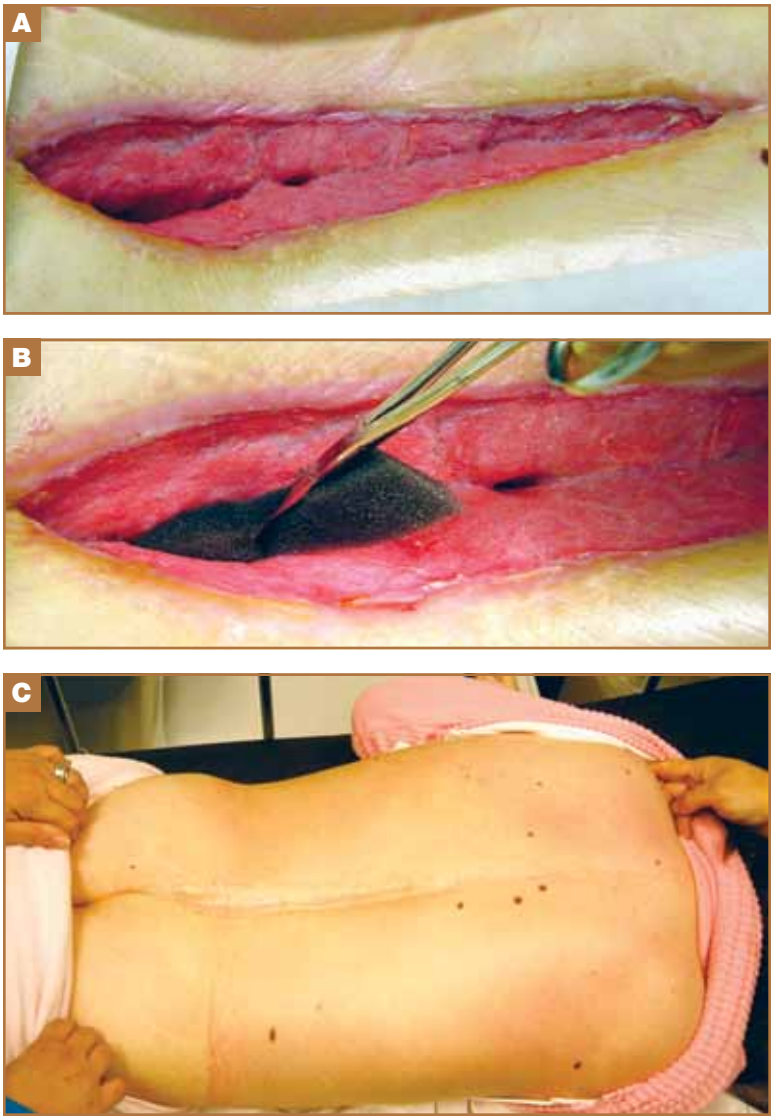

Figure 4. (A) Wound shows good granulation tissue about 6 weeks after wound VAC was started. (B) Wound VAC sponge material is applied to hasten healing with negative pressure. (C) Follow-up 2 years after initial surgery for deep wound infection revealed complete skin healing.

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This paper will be judged for the Resident Writer's Award.