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Case Report

Vacuum-assisted closure of necrotic and infected cranial wound with loss of dura mater: A technical note

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Abstract

Background: Complex cranial wounds can be a problematic occurrence for surgeons. Vacuum-assisted closure devices have a wide variety of applications and have recently been used in neurosurgical cases involving complex cranial wounds. There is only one report regarding the use of a vacuum-assisted closure device with loss of dura mater. We report a complicated case of a necrotic cranial wound with loss of dura mater.

Case Description: A 68-year-old female underwent an evacuation of a subdural hematoma. Postoperatively, the patient developed a wound infection that required removal of the bone flap. The wound developed a wedge-shaped necrosis of the scalp with exposure of brain tissue due to loss of dura mater from previous surgeries. She underwent debridement and excision of the necrotic tissue with placement of a synthetic dural graft (Durepair®, Medtronic, Inc.) and placement of a wound vac. The patient underwent a latissimus dorsi muscle flap reconstruction that subsequently failed. After the wound vac was replaced, the synthetic dural graft was replaced with a fascia lata graft and an anterolateral thigh free flap reconstruction. We describe the technical nuances of this complicated case, how the obstacles were handled, and the literature that discusses the utility.

Conclusion: We describe a case of a complex cranial wound and technical nuances on how to utilize a wound-vac with loss of dura mater.

Key Words: Infection, necrosis, subdural hematoma, vacuum-assisted closure

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INTRODUCTION

Complex cranial wounds can be a problematic occurrence for surgeons. These can result from trauma, infection, malignancy, wound break down, and radiation.[18] Possibilities of reconstruction have increased over the years, with options including rotational flaps, tissue expanders, and over 20 different free flaps.[13] Despite the advancements in reconstruction of cranial defects, patients can have problems with healing due to other medical co-morbidities. Due to the complexity of this clinical scenario, a well-formulated plan and a multidisciplinary approach are often required. Decisions regarding the timing of reconstruction, type of

reconstruction, and what to reconstruct are all taken into consideration.

In 1997, Morykwas *et al*. introduced negative pressure therapy via vacuum-assisted closure (VAC) for complex wounds.[15] Over the years, this concept has gained popularity and has been used for thoracic wounds, abdominal wounds, burn wounds, skin-grafting, and limb trauma.[5,11,15,19,21] Over recent years, the utility of VACs has grown to involve complex cranial wounds. There are reports in the literature that describe the use of VACs in scalp defects, defects with exposed periosteum, and fewer reports describing defects in periosteum with exposed dura. To our knowledge, there is only one report on the use of VAC with the loss of dura. This study is a technical note of our experience with VAC device in a complex cranial wound complicated by infection, loss of dura, and a failed rotational flap.

CASE REPORT

Patient is a 68-year-old female who presented to the emergency room after a fall while walking her dog with complaints of headaches, nausea, and vomiting. Patient denied any loss of consciousness. Her past medical history consisted of hypertension and peripheral vascular disease. Patient smoked one pack of cigarette per day. On physical examination, she had no focal neurological deficits but was confused. Computed tomography (CT) scan showed a large left 1 cm convexity acute subdural hematoma (SDH) with 6 mm midline shift. Due to her disorientation and midline shift, the patient was taken back to the operating room (OR) for evacuation of the SDH. A reverse question mark incision was made with a standard trauma craniotomy. During the operation, the superficial temporal artery (STA) was mistakenly sacrificed. Patient tolerated the surgery well and continued to improve with her mental status postoperatively. She was discharged to rehab on postoperative day 7. The patient continued to smoke despite our recommendations.

She returned to the emergency room 19 days later complaining of fever, erythema, swelling underneath the wound, and purulent drainage on her pillow. The radiographic findings suggested that the infection was superficial. After being evaluated in the emergency department, she was taken to the OR for surgical lavage and debridement. During the operating, her bone flap was felt to be viable and free of infection, so it was not removed. Intraoperative cultures were found to grow methicillin-sensitive *Staphylococcus aureus*, and the patient was started on IV Nafcillin. Approximately 2 weeks later, purulent drainage returned from the incision site. Radiographic findings suggested that there was an intracranial component. She was taken to the OR for a wound washout. Given the degree of infection identified during the operation, as well as the intracranial infection noted in the subdural space, the decision was made to remove the bone flap.

Over the next week, the wound started to break down. Subsequently, there was a wedge-shaped necrosis that developed on the flap [Figure 1]. Dura was visible in the area of wound breakdown. After consulting with plastic and oral maxillofacial surgery, the patient was taken back to the OR two weeks later for resection of necrotic scalp, dura repair and wound VAC placement. The dura was noted to be frail, shredded, and portions were missing [Figures 2-4]. Because of the risk of neurological sequelae and cerebrospinal fluid (CSF) diversion with a VAC device placed on exposed brain tissue, water-tight closure of the dura was a necessity prior to placement of the VAC device. After achieving securable edges, Durepair® (Medtronic, Inc.) [Figure 5]. was sutured in to native dura with 4-0 Nurolon (Ethicon). Water-tight closure was confirmed with a Valsalva maneuver, and fibrin glue was not used. On gross inspection, the wound vac canister did not have any CSF contents. Negative pressure therapy was set to -50 mmHg [Figure 6]. The wound vac was changed approximately every 3 days until adequate granulation tissue was noted and the infection had subsided [Figure 7]. Intraoperative cultures during the wound vac changes grew Candida. Patient was started on diflucan.

Two weeks later, the patient was taken to the OR with plastic and oral maxillofacial surgery for a latissimus dorsi muscle flap reconstruction. The patient was monitored in the intensive care unit (ICU) with daily Dopplers to ensure the viability of the flap. The flap went on to necros as a result of an infection caused by Pseudomonas. The patient went to the OR for removal of her flap. The dura with the synthetic graft still had a water-tight closure. The wound VAC was replaced and changed approximately every 3 days. To ensure the next flap would not fail, the granulation tissue on the Durepair® (Medtronic, Inc.) was cultured. The intraoperative culture also grew Pseudomonas, but only on the synthetic dura. After a multidisciplinary discussion, we felt that a native substitute for the dura may decrease the risk of infection.

Three weeks later, the patient was taken to the OR removal of dural substitute, harvest of fascia lata graft, and anterolateral thigh free flap. The fascia lata graft was harvested from the contralateral leg of the anterolateral thigh free flap. The fascial lata graft was secured in a water-tight fashion. The anterolateral thigh free flap was performed without any complications [Figure 8].

Patient returned to the ICU on the ventilator with continued sedation due to flap anastomosis fragility. The ventilator was weaned off on postoperative day 1. Patient was at her neurological baseline after extubation and transferred to the floor on postoperative day 5. Patient continued her antibiotic regimen of Nafcillin and Diflucan postoperatively. Patient followed up with

Figure 1: This picture shows the patient after the subdural hematoma and bone flap were removed. There is a large wedge-shaped necrosis to the skin flap. Anterior to the necrosis, there is an opening in the scalp with exposed brain parenchyma.

Figure 2: After the scalp was elevated, the dural defect was to the anterior margin of the craniectomy. After meticulously separating the dura, more frontal bone was removed to expose native, intact dura mater

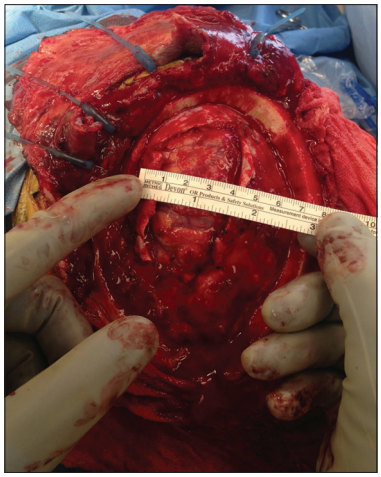

Figure 3: This shows the measurements of the dural defect, measuring approximately 7 × 4 cm

Figure 4: This shows the measurements of the dural defect, measuring approximately 7 × 4 cm

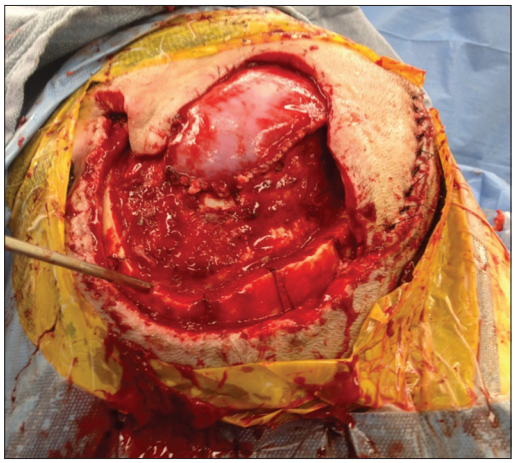

Figure 5: This picture shows the amount of scalp tissue resection, incorporation the necrotic portion and the scalp breakdown with exposed brain tissue. In the middle, the synthetic dural graft has been secure with a water-tight closure

Figure 6: This picture shows the wound vac in place with a good seal to maintain negative pressure

neurosurgery, plastic surgery, and oral maxillofacial surgery. At the 6-month follow-up, the flap had healed without any signs or symptoms of infection. The patient has been followed for 14 months after surgery with the reconstruction intact [Figure 9].

DISCUSSION

Morykwas *et al*. introduced negative pressure therapy with a VAC device improved blood flow, increased granulation tissue formation, and decreased bacterial cell counts.[15] Other studies have shown that negative pressure therapy increases microvessel density, exudate removal, edema reduction, wound volume reduction, improves wound healing, decreases wound drainage, shortens the length of hospital stay, reduces the cost of wound care, and ultimately improves patient survival.[4,6,8,9,12,15,16,22-24,26,27,30-32] The application of this technology has increased over the years to treat a wide variety of wounds, such as degloving injuries, abdominal defects, enterocutaneous defects, gynecological wounds, sternal dehiscence, spinal wound infections, pressure sores, and augmentation of skin grafts.[2,3,5,7,10,11,14,17,19,20,25,33]

Recently, this technology has been applied to complex cranial wounds. Historically at our institution, small scalp defects have been treated with primary closure, scoring the galea to improve elasticity of the scalp, skin grafts, or small rotational flaps. Larger scalp defects have been treated with large rotational flaps or free flaps. One of the earliest reports describing treatment with VAC therapy on complex cranial wounds was by Andrews *et al*., where two patients with traumatic scalp injuries were successfully treated without any complications.[1]

Subotic *et al*. expanded the utility of VAC treatment by using it on scalp defects with coinciding calvarial defects. One case was on a young boy with Apert syndrome. This case had a chronic methicillin-resistant *S. aureus* infection with a coinciding bony defect and exposed dura. VAC treatment allowed protection while the infection was eradicated. After promoting granulation tissue, a full thickness skin graft was transplanted, which ultimately failed. After eradicating the infection, the VAC device was used as a stand-alone method for wound closure. Another case involved an eccrine gland carcinoma of the cranium that led to erosion of the calvarium. It is important to note that both cases did not violate the dura.[28]

Tanna *et al*. described a patient that underwent resection of the floor of his mouth with a subsequent cervical flap. The cervical flap dehisced on postoperative day 10, exposing the underlying bone. VAC treatment allowed the formation of granulation tissue, which was later treated with a full-thickness skin graft.[29]

Figure 7: After days of negative pressure therapy, there is granulation tissue on native dura

Figure 8: This pictures shows the anterolateral thigh free flap immediately after surgery and in a postoperatively clinic visit, respectively

Figure 9: This pictures shows the anterolateral thigh free flap immediately after surgery and in a postoperatively clinic visit, respectively

The first report of a scalp and bony defect with a coinciding dural defect was described by Powers *et al*. They reported on five patients, of whom four had a loss of dura mater and one had a dural dehiscence. Different methods to reapproximately the dura were used prior to placing the VAC device. One patient had the dura closed primarily, one patient had a pericranial graft sutured into the native dura, and three patients had Alloderm (LifeCell Corp.) sutured into the native dura using 4-0 Nurolon (Ethicon).[18]

Our case was unique in many ways. The STA was iatrogenically sacrificed in the initial craniotomy for the SDH evacuation. Unfortunately, because the STA was sacrificed, blood flow to the scalp was compromised. The patient's cigarette use during the hospitalization and postoperative infection likely contributed to nerosis of the scalp. In the initial SDH evacuation and subsequent washout, dura mater was lost. Because the necrotic tissue had to be excised, and the bone flap was not secured back in an infected setting, there was a large defect exposing brain tissue. Before a flap could be performed, we felt that eradicating the infection would improve the chances of a successful flap reconstruction. Initially, we used Durepair® (Medtronic, Inc.) to create a water-tight closure with native dura. We confirmed the water-tight closure with a Valsalva maneuver. In retrospect, placing a synthetic dural substitute in the setting of a prior infection could have provided a medium of bacterial regrowth. This likely contributed to the latissimus muscle free flap to fail. For autologous dural patch, pericranium was available but would have required extending the incision; therefore, we decided to use fascia lata.

After adequate long-term follow-up showing a viable free-flap reconstruction, a cranioplasty is an option to close the boneless defect. Due to the initial difficulty in free-flap reconstruction, history of infection, smoking status, and peripheral vascular disease, the treating physician team and patient do not feel closing a boneless defect outweighs the risks of a cranioplasty.

CONCLUSION

To our knowledge, there is only one study that discussed the use of VAC in a complex cranial wound with loss of dura mater. The aim of our study was to provide a technical note on a VAC in a patient with a complex cranial wound and loss of dura. This is the first report to discuss the use of fascia lata graft with wound-vac closures. The complications and obstacles encountered with this patient were unique to the literature and provide an option on how to treat complex cranial wounds.

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