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Dermal fenestration 'pie crust' technique for difficult fasciotomy closures

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A patient in his 40s presented to the emergency department with a 1-day history of severe right lower extremity pain, numbness and dark urine. Prior to presentation, he admitted to using alcohol and cocaine and became unconscious and immobilized for a prolonged time. Vitals and labs including complete blood count and Basic Metabolic Panel (BMP) were normal. Creatine kinase level was elevated (296 000).

On physical examination, tense, exquisitely tender compartments were present along the right lower extremity from the proximal hip to the lower calf. Motor function was decreased. Pulses were intact. He was taken emergently for right gluteal, thigh and leg fasciotomy and treated for rhabdomyolysis with hydration and eventual hemodialysis. Continued evaluation of multiple open wounds ensued with difficulties encountered with delayed primary closure given significant muscle edema (figure 1).

WHAT WOULD YOU DO?

A. Continue with serial evaluations in the operating room with attempts at primary suture closure.
B. Apply wound Vacuum assisted closure (VAC) therapy with plan for eventual split thickness skin grafting.
C. Attempt to mobilize skin flaps to facilitate faster closure.
D. A combination of any of the above.

WHAT DID WE DO AND WHY?

Serial returns to the operating room ultimately enabled primary closure of the gluteal, lateral thigh and lateral calf incisions. The posterior thigh and medial calf wounds required wound VAC placement and continued re-evaluations. A dermal fenestration technique was discussed with the patient to allow for more expeditious tension-free skin closure of the remaining open wound in delayed fashion.

On postoperative day 9, the patient was taken back to the operating room and multiple transdermal relaxing 1 cm skin incisions were created with a scalpel and carried down through the subcutaneous tissues with hemostats. These incisions were created parallel to the wounds and multiple rows were required on the skin flaps in a staggered orientation. Rows were 1 cm apart and the distance between each incision was 1 cm. This enabled primary closure of both the posterior thigh and medial calf incisions (figure 2). A modified Smead-Jones suture technique was used with #2 nylon sutures for skin closure which was achieved without tension. The fenestrating incisions were dressed topically with xeroform and a dry sterile dressing without packing after hemostasis was achieved and ultimately left to heal by secondary intention.

Figure 1 Decompressive fasciotomy wound of lateral leg.

The patient had significant improvement in his renal function to discontinue dialysis and was discharged 3 weeks following initial presentation and had clinic follow-up at 1 month and 3 months for wound checks (figure 3).

DISCUSSION

Compartment syndrome is a limb-threatening disease process, which occurs when pressure builds in a non-compliant osseofascial compartment.[1] The incidence of acute extremity compartment syndrome is estimated to be 7.3 per 100 000 in men and 0.7 per 100 000 in women.[2] This sudden increased pressure can be precipitated by a multitude of reasons, including burns, crush injuries, drug overdoses resulting in prolonged periods of immobility, reperfusion injuries, vascular injury, thrombosis, bleeding disorders or infections can all cause acute compartment syndrome.[2] As compartment pressure exceeds arterial perfusion pressure, oxygenated blood delivered to the compartment structures decreases precipitously, resulting in further inflammatory response. This cycle continues

Figure 2 Completion of closure after 'pie crusting'.

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Figure 3 (A) One month follow-up. (B) Three-month follow-up after suture removal.

often resulting in increased edema, leading to acute limb ischemia if intervention does not occur.

Fasciotomy is essential for decompression and separation of specific restricted fascial planes to restore perfusion and prevent tissue necrosis and death. The surgical literature often preaches the importance of low threshold to decompressive fasciotomy given the proven benefit of limb salvage, however guidelines for postfasciotomy management are less clear.

Traditionally, in the absence of a tension-free primary closure, split thickness skin grafts (STSG) are often employed for wound coverage. In the presence of comorbid disease, risks of STSG are amplified. Reddy *et al* found an estimated 33% lower extremity skin graft failure rate in patients with increased body mass index, peripheral vascular disease or immunosuppressant use. These authors suggest alternative methods be employed for dermal coverage in high-risk patients.[3]

One of the earliest documented studies mentioning dermal fenestration as means of propagated delayed primary closure was published by Capo *et al*. This study employed the pie crust technique on 16 porcine limbs and 7 human patients for means of closure of extremity wounds.[4] Biomechanical analysis was performed, which showed that linear transdermal incisions with both a single and double row of incisions significantly decreased the dermal tension on approximation of wound edges. They reported a single row decreased wound tension by an average of 34%. The authors further mentioned at using an average of 3.5 parallel layers of 'pie crusting' at the time of definitive closure provided all wounds with adequate tension-free closure. They reported no complications at 18-month follow-up. Dermal fenestration 'pie crusting' for delayed primary closure of upper and lower extremity fasciotomy incisions is a reliable alternative to skin grafting. Typically utilized by day 7–10 following initial decompression, this technique is easily reproducible and has been performed successfully by our group thus avoiding the need for STSG. Early wound closure, avoiding prolonged wound VAC therapy with its associated cost and logistical challenges as well and reduced hospital length of stay may be possible with adoption of this technique in the closure of difficult fasciotomy wounds.

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