Complex Flap Reconstruction for Pressure Ulcer of the Knee in the SCI Patient Secondary to Medical Device Related Injury

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Abstract: Pressure related injuries occur secondary to pressure necrosis. Medical device related pressure injury deserves notice. The injuries often occur in atypical areas although the pathophysiology is the same. In this case report we present a spinal cord injury patient with a large medial knee wound precipitated by use of a knee brace. The condition was exacerbated by a lack of awareness on the part of the medical professional and the patient on the possible injurious sequela. When wounds progress to advanced stages despite appropriate conservative treatments, reconstructive surgery is indicated. Well documented in the trauma and orthopedic surgical literature for complex knee injuries, the use of the medial gastrocnemius flap is applied by the plastic surgeon to pressure ulcer pathology.

Keywords: Spinal Injury, Flap, Knee ulcer.

1. INTRODUCTION

The spinal cord injury (SCI) patient is particularly sensitive to the development of pressure injury because of a lack of sensation coupled with the inability to relieve pressure at dependent areas of the body secondary to paralysis. Pressure ulcers are common to dependent areas of the body when in the supine or sitting position, especially the sacral area, buttocks, heels, and elbows. Atypical pressure ulcers – are pressure ulcers in unusual locations and/or have an unusual etiology. Unusual locations include, the tips of the ears, the nostrils, the neck, the urethra, and the medial surfaces of joints [1].

Medical devices are often the culprit for the development of ulcers in these unusual areas. As this is a concern in health care settings, the National Pressure Ulcer Advisory Panel has sought to raise awareness of this etiology in their clinical practice guidelines in 2014. They define medical device related (MDR) pressure injury (PI) as arising “from the use of devices designed and applied for diagnostic or therapeutic purposes. The resultant pressure injury generally conforms to the pattern or shape of the device.” [2] In 2016, the International Pressure Ulcer Prevalence survey, which includes nearly 100,000 patients in approximately 1000 facilities the United States and Canada, conducted an in depth analysis of MDR PIs. Their data showed a prevalence of 0.65% across all inpatient health care facilities including acute care, long term care, rehabilitation, long term acute care and hospice. The MDR pressure injuries were most commonly associated with nasal oxygen devices (58%), casts and splints (12%), CPAP or BIPAP masks (9.0%), sequential compression devices (7.7%), endotracheal tubes (7.5%), tracheostomy neck plates (5.5%), nasogastric tubes (5.0%) and finally cervical collars (2.4%). [3]

In this case report, we present MDR pressure injury in the outpatient health care setting. The injury developed on the medial knee of a SCI patient subsequent to prolonged leg brace wearing after orthopedic surgery. The patient failed more conservative treatments to heal the wound necessitating flap reconstruction for closure. The pedicled medial gastrocnemius flap is known in the trauma surgical literature for the closure of knee wounds after high-energy fracture to the tibial plateau. It is also known in the orthopedic surgical literature for wound closure and limb salvage in failed total knee arthroplasty secondary to infection. In our case, the plastic surgeon uses this flap to great effect in the complex wound closure of a Stage IV pressure injury to the medial knee. A local fasciocutaneous flap and a transposition flap were raised in addition to cover the defect. Split thickness skin grafting was also performed in the same stage to cover the muscle surface.

2. CASE PRESENTATION

The patient is a 51 year-old thin, healthy African-American male with a past medical history of T12 complete paraplegia secondary to a gunshot wound in 1999. The patient lacks motor and sensory below his waist. Despite his injury the patient is able to
independently perform all activities of daily living including driving. In December 2017, the patient injured his right leg while exiting a mobile home. On x-ray he was found to have a distal femur fracture for which he received an ORIF.

The patient was discharged to home in a leg brace. He was instructed to keep the brace in place for 2 months duration, with which the patient was compliant. Upon removal of the brace at a follow up doctor’s visit, the patient was noted to have a 2.5 x 2.5 cm full thickness pressure ulcer with subcutaneous tissue visible on the medial aspect of his right knee – a stage III pressure ulcer. The ulcer corresponded to a circular metal piece of the knee brace that abutted the skin on his knee.

The patient’s wound was initially managed by another institution with dressing changes followed by negative pressure vacuum therapy. However, the wound continued to grow. At the time of presentation to the plastic surgery pressure ulcer management clinic in July 2018, the wound had grown to 5x4x3 cm and there was concern for communication with the knee joint cavity as the joint capsule was palpable – a stage IV pressure ulcer.

Due to the chronic, worsening nature of the wound and failure of conservative treatments, the patient was scheduled for elective surgery for debridement and complex wound closure using muscle flap, fasciocutaneous flaps and skin grafting.

3. OPERATIVE PROCEDURE

Preoperative Care

Preoperatively, a thorough assessment of the patient’s nutritional needs and medical comorbidities was performed to maximize wound healing and minimize complications. Wound cultures of the knee ulcer grew (methicillin sensitive) Staphylococcus aureus and the appropriate peri-operative antibiosis was administered. As occult UTI is often harbored in SCI patients with neurogenic bladder, we obtained a urinalysis and urine culture as this should be treated prior to surgery. We obtained plain x-ray films of the knee to assess for any bony or joint pathology – there was no evidence of acute osteomyelitis.

Operative Procedure and Technique

The patient was brought to the operating room to undergo excision and debridement of the knee ulcer, coverage with gastrocnemius muscle flap and fasciocutaneous flaps, and split thickness skin grafting. The knee joint was challenged with methylene blue and extravasation into the open ulcer confirmed communication with the joint. Figure 1 demonstrates this communication and the markings of our planned ulcer excision, incisions for anticipated local

Figure 1: To confirm communication between the ulcer and the knee joint, methylene blue was injected into the joint; extravasation into the ulcer demonstrates there was communication. Flap design is presented: 1 – Planned ulcer excision. 2 – Local fasciocutaneous advancement flaps. 3 – Transposition flap. 4 – Medial head of the gastrocnemius muscle flap donor site.
fasciocutaneous flaps and medial gastrocnemius donor site incision.

We first performed excision of the ulcer and then removed any pathologic bursae. Upon removal of all pathologic tissue, the joint was clearly exposed. With an electric saw and the osteotome, the prominent medial femoral condyle was shaved. The wound and the joint were irrigated with normal saline and bacitracin. After excision, the final dimensions of the ulcer was 7 x 6 x 3 cm.

The medial head was accessed via incision on the medial aspect of the lower leg. The distal Achilles tendon insertion was located and transected. The gastrocnemius was dissected proximally to the medial sural artery pedicle at the medial femoral condyle. Figures 2A through 2C demonstrate the gastrocnemius muscle raised reflected and inset into the cavity. The muscle flap was sutured to the deep tissues of the wound. Drains were placed above and below the muscle.

After insetting the muscle, a defect remained at the superior and lateral portions of the wound cavity. Figures 2A through 2C also demonstrate the use of local fasciocutaneous flaps to cover these areas. On the lateral side of the wound, a fasciocutaneous advancement flap was raised and brought medially. On the medial side of the wound a transposition flap was raised to cover the superior portion of the wound defect. These fasciocutaneous flaps were sewn to the muscle flap with absorbable monofilament (Covidien Biosyn 2-O suture). It is the senior surgeon’s experience that doing so offers several advantages. Muscle flap covered by a fasciocutaneous flap has a more durable protective covering than skin graft alone. Also, this reduces the surface area of exposed muscle flap requiring skin graft coverage. Finally, it eliminates dead space between the muscle flap and the fasciocutaneous flap, creating a flat surface for the planned skin graft to adhere to the remaining exposed muscle. A split thickness skin graft was then applied to the exposed muscle and secured with staples.

A bulky dressing of bactroban ointment, xeroform, and wet cotton wool was applied. The leg was wrapped with kerlix and ACE wrap and placed in a knee immobilizer.

Post-Operative Course

The patient was restricted to bed rest on an air fluidized mattress for 4 weeks. The first dressing change occurred 1 week postoperatively (Figure 3). Dressings involved application of bactroban ointment, xeroform, 4x4s, abdominal pads, kerlix and ACE wrap. Dressings were performed daily. The patient received double portion, high calorie, high protein meals. At week four, the patient initiated sitting and range of motion exercises with physical therapy and the graft was evaluated for any compromise. Figure 4 shows the patient’s graft and surgical wounds fully healed at week five. The patient was discharged home with instruction to apply Aquaphor ointment to the graft and all surgical sites.

Figure 2: A – Long arrow points to the medial head of the gastrocnemius flap raised. Short arrows point to the advancement and transposition fasciocutaneous flaps raised. B – The medial head of the gastrocnemius is reflected to cover the femoral condyle and fill the wound cavity. C – The fasciocutaneous flaps will partially cover the wound and the muscle flap.
4. DISCUSSION

Large wounds of the knee such as this present a unique closure challenge to the surgeon as the knee in general lacks soft tissue coverage [4]. When deep structures such as bone, joint and vessels are exposed, muscle flap coverage is necessary. A local option providing adequate volume is the medial gastrocnemius flap. The gastrocnemius muscle has two heads and is a Type I muscle. Each head has its own vascular supply with a small perforator between the heads which can be sacrificed. Therefore the lateral head or the medial head can be used independently, or in tandem, depending on the location and size of the knee defect. Use of the medial head was first described by Ger [5]. With its robust blood supply, use of the gastrocnemius muscle is acceptable in the closure of a contaminated knee wound that has been thoroughly debrided. However, gastrocnemius flap procedures also come with complications. Neale et al. [6] reported on major and minor complications in 32% of 95 muscle flaps [7].

A technical issue with the gastrocnemius pedicled flap is inadequate coverage of large knee defects that have a suprapatellar component. Anterior lateral thigh (ALT) flaps, both free and distally based, have been used to address this issue. ALT flaps were first described by Song and Lou in 1984 [8]. However, free flaps require microsurgical expertise and specialized equipment. Another limitation is that patients with multiple medical comorbidities often cannot tolerate the longer surgical times seen with free flap transfer.

Wong first described the distally based ALT flap as an alternative to the ALT free flap [9]. In 2018, Bekarev et al. [10] published a retrospective review to identify peri-patellar wounds utilizing a distally based, reverse flow anterior lateral thigh (ALT) island flap where suprapatellar coverage was an issue. The main drawback noted with this flap was venous congestion requiring flap delay or secondary outflow anastomosis [10].

In our case, insetting of the medial head of the gastrocnemius covered a majority of the wound cavity, but did not reach the suprapatellar and lateral portions of the cavity. Fasciocutaneous advancement flaps and a transposition flap were raised and sutured to the gastrocnemius muscle flap to cover these remaining defects. Thus, random pattern fasciocutaneous flaps can also be an option for assisting in the closure of large, complex knee wounds.

CONCLUSION

Medical device related pressure injury is a concern to health professionals. In the spinal cord injury patient, awareness and vigilance by health care professionals and patients alike is necessary for prevention. When MDR pressure injury does occur, progression to advanced pathologic stages develops quickly. Reconstructive surgery with muscle flap is then indicated. In our case, we demonstrate the successful use of a medial gastrocnemius flap combined with a local fasciocutaneous advancement flap and a transposition flap to close the defect of large, atypical pressure ulcer of the knee.

REFERENCES


Figure 3: Final insetting of the muscle flap into the knee defect prior to split thickness skin grafting.

Figure 4: The muscle flap, fasciocutaneous flaps and skin graft healed at week 5.


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