The use of compression bandaging in fasciotomy wounds

This case report details the individual treatment for one particular case of lower limb fasciotomy wounds, which developed following traumatic acute compartment syndrome (ACS).

Fasciotomy wounds are complex in nature and are a result of ACS, often due to an acute injury or trauma to the limb. From a nursing and wound care perspective, referral is often sought from specialist tissue viability services when complications arise in wounds following surgery or when surgical teams request input in terms of ordering and application of topical negative pressure (TNP).

In this case, early collaborative working involving both the vascular and tissue viability team allowed for effective wound healing and early patient discharge with community follow up and review at the vascular leg ulcer outpatient clinic.

This case study not only highlights the use of compression bandaging for lower limb fasciotomy wounds following ACS, but more importantly it highlights effective collaborative working between both nursing and surgical teams. The tissue viability team decided to treat the wounds using compression bandaging over a 12-week period, thus avoiding the need for skin grafts.

CASE REPORT

Background

A 45-year-old male was admitted by ambulance to the accident and emergency department in the early hours of 25 April, 2010 with an ethanol (ETOH) level of +++, indicating extreme intoxication, which had resulted in him sleeping on the ground all night with his right leg bent for approximately nine hours. The patient had a history of hypertension, alcohol dependency and intravenous drug use with no previous history of injecting in the groin.

Traumatic rhabdomyolysis

On presentation, the right limb was hard and swollen and, after review by the vascular and renal teams, a diagnosis of right calf ACS and acute renal failure caused by rhabdomyolysis was confirmed. Traumatic rhabdomyolysis results in the compression of the muscles in, for example, the lower limb as a consequence of prolonged positioning of the limb, or from possible coma. The term rhabdomyolysis refers to the breakdown of striated muscle, which is mostly contained within rigid compartments formed by fasciae, bones and other structures.

Traumatised tissue can result in the muscle cells swelling with a rise in intracompartmental pressure, which, if prolonged, may provoke irreversible paralytic damage to the peripheral nerves. There is general agreement that compartment pressures of greater than 30mmHg produce clinically significant muscle ischaemia (Vanholder et al, 2000). Frink et al (2010) add that, although it is unclear at which exact pressure tissue damage necrosis occurs, studies suggest a difference between diastolic and intracompartmental pressure of less than 30mmHg as an indication for surgical fasciotomy.

Acute compartment syndrome

ACS is a limb-threatening emergency with high risk of morbidity that requires immediate treatment. Open fasciotomy is recommended for adequate decompression and effective wound healing (Tiwari et al, 2002). Heemskerk and Kitslaar (2003) add that ACS is characterised by increased intracompartmental pressure and decreased tissue perfusion often caused by trauma.

‘Traumatised tissue can result in the muscle cells swelling with a rise in intra-comparmental pressure’

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Figure 1: Lateral aspect of the calf, measuring approximately 15cm (L) x 10cm (W).

Figure 2: Medial aspect of the calf, measuring approximately 15cm (L) x 12cm (W).

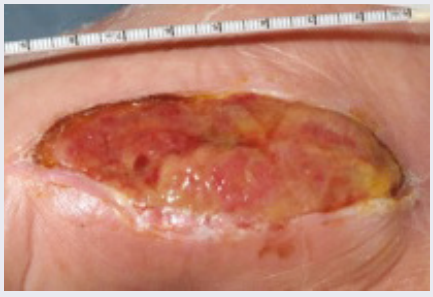

Figure 3: Medial aspect of the foot, measuring 9cm (L) x 4cm (W).

Figure 4: Medial aspect of the groin, measuring 11cm (L) X 7cm (W).

Figure 5: Lateral aspect of the groin, measuring approximately 12cm (L). Two areas tracking approximately 6–8cm into tissues and approximately 4–5cm (deep).

Patients who have altered consciousness due to drug or alcohol abuse, as was the case with this patient, can have prolonged limb compression leading to soft tissue injury and compartment syndrome (Köstler et al, 2005). Pearse et al (2002) highlight that, regardless of the cause, the increased intracompartmental pressure must be urgently treated and decompressed by surgical fasciotomy as misdiagnosis and delays in decompression are associated with significant morbidity for this population.

'Treatment of ACS requires surgical decompression as early as possible, by way of a four-compartment fasciotomy'

Elliott and Johnstone (2003) highlight that there are difficulties in accurately diagnosing ACS and, so far, no reliable clear cut diagnostic guidelines have been established. Mar et al (2009) add that diagnosis is challenging and requires a high level of suspicion as without early treatment the detrimental effects include neurological deficit, muscle necrosis, amputation and death.

Emergency fasciotomy

It was quickly decided that an emergency fasciotomy was required with follow up in the intensive care unit (ICU).

Successful treatment of ACS requires surgical decompression as early as possible, by way of a four-compartment fasciotomy, There is a direct relationship between the time that elapses before the fasciotomy and the final functional status of the limb.

The lower leg has four compartments which are bordered by the tibia, fibula, interosseous membrane and the surrounding fasciae (Oprel et al, 2010). The four compartments of the lower leg consist of the anterior and the lateral, the superficial and the deep posterior. Full-length incisions must be performed during the fasciotomy procedure. A common error is to make the incision too short and, although the decompression appears adequate at the time of surgery, post-operative muscle swelling can lead to reoccurrence of ACS (Clasper et al, 2009). Oprel et al (2010) add that the incision should be at least 16cm in length so that all compartments are sufficiently decompressed with the incisions left open. This means that the oedema can resolve and the wounds can be closed by secondary intention.

Options for wound closure

According to the literature, the normal treatment of fasciotomy wounds varies from secondary closure, vacuum assisted closure (VAC), skin grafting or a combination of treatments — or with other techniques promoting slow wound closure (Jensen and Sandermann, 1997; Fitzgerald et al, 2000; Scherer et al, 2002).

Giannoudis et al (2002) examined the long-term impact on patients' quality

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of life following lower leg compartment syndrome and surgical treatment and found that patients reported problems with the appearance of their limb in regards to scarring and delayed wound healing. Reportedly, this increased the likelihood of problems with mobility, self-care, anxiety and pain. The study highlights that, to prevent long-term complications, unexpected delays in hospitals should be avoided and, whenever possible, wounds should be closed without the use of skin grafting.

After an initial referral to the tissue viability team on 7 May, 2010 and after transfer from ICU to the ward area, the patient was seen by the team on the following day. It is unclear what topical treatments were used on the wounds before the period of tissue viability referral and intervention, however the plan of the medical/surgical teams prior to tissue viability nurse input was for eventual referral to the plastic team for possible skin grafting.

The aim of the tissue viability team was to treat the wounds conservatively where possible, aiming to discharge the patient early to avoid complications, any impact on quality of life and, if possible, further surgical intervention.

Tissue viability team initial review

An initial examination carried out on 8 May, 2010 established that in total there were five wounds to the right leg. (*Figures 1–5*).

Both groin wounds appeared heavily colonised and sloughy and were producing copious amounts of yellow exudate although there was no malodour present. The patient was apyrexial and systemically well at this time. The surrounding tissue appeared erythematous and fragile in areas.

All other wounds to the calf and foot were moderately sloughy (thick, adherent and moist) in places with heavy colonisation. The malodour did not concern the team. However, it was possible that the dressings had not been changed for some time and this, along with the copious amounts of exudate, could have contributed to the heavy colonisation with risk of critical colonisation.

The patient did not complain of pain or discomfort during assessment and dressing change and was more uncomfortable from the wound's heavy exudate levels, which were leaking over his clothes and bedclothes. The limb itself also had moderate amounts of pitting oedema.

Treatment

The initial treatment plan involved daily dressing changes, as well as irrigating and cleansing the wounds with warm sterile saline. Although, there has been much debate as to whether it is best to use sterile saline or tap water (Whaley, 2004; Dulecki and Pieper, 2005; Hall, 2007; Fernandez and Griffiths, 2008), it is standard procedure within the author's acute trust to cleanse/irrigate all acute/traumatic wounds with warm sterile saline. A skin care barrier was used to protect the wound edge and surrounding skin from the wound exudate and the intact skin was washed and moisturised with emollient therapy to keep the healthy skin supple in accordance with a basic skin care regime and a maintenance (Brown, 2011).

Silver antimicrobial Hydrofiber®

Initially a silver antimicrobial Hydrofiber (ConvaTec) was used to treat the wounds topically, both by placement directly on to the wounds and/or by packing the tracking areas and securing with a simple secondary absorbent pad. Topical silver-based dressings have long been used for managing acute wounds by treating the bacterial burden, reducing slough and controlling infection (Leaper, 2006). Lansdown (2004) adds that dressings containing silver are designed for ease of application, maximum patient comfort and safety in use.

As agreed with White and Kingsley (2010), the VULCAN study confirms that silver should not be used solely to aid faster healing and clinicians should be diligent in their assessment to avoid the inappropriate use of antimicrobials.

The local protocol is to always cover the limb after skin care and dressing application. The limb was covered conservatively with a cotton Tubifast® (Mölnlycke) liner from toe to thigh to protect the limb from the soft padding bandage prior to applying a simple crepe

Figure 6: Right lateral gaiter measuring 15cm (L) x 10cm (W).

Figure 7: Right medial gaiter measuring 15cm (L) x 8cm (W).

Figure 8: Right medial aspect of foot measuring 6cm (L) x 3cm (W).

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Figure 9: Right lateral gaiter measuring 14cm (L) x 9cm (W).

Figure 10: Right lateral gaiter measuring 14cm (L) x 7cm (W).

Figure 11: Right medial aspect of foot measuring 5cm (L) x 3cm (W).

Figure 12: Right medial/inner thigh measuring 5cm (L) x 2.5cm (W).

Figure 13: Right lateral/outer thigh measuring 2cm (L) x 1.5cm tracking 2cm with minimal depth.

bandage from toe to groin. This was very comfortable for the patient and it controlled the exudate levels that were bothering him.

Cutting (2011) adds that, in the past, before the full impact of antimicrobials on the bacterial burden of the wound bed was known, topical antimicrobials were not encouraged for use in isolation as the only treatment with the 'at risk patient.' Normally, antibiotics were given in conjunction, especially with surgical wounds. However, it was agreed that, as with the above patient, active intervention with the use of an antimicrobial Hydrofiber had the potential to contain patient care costs in maintaining normal wound colonisation, thus reducing the risk of infection and the use of systemic antibiotics and hospital stay. This, in turn, reduced clinician time and improved quality of life by reducing patient morbidity.

The left leg was intact and of normal size and shape and no concerns were raised from the patient or the medical/surgical teams.

Debate on the possibility of skin graft

The preferred option was for the plastic surgery team to review for possible grafting. However, it was emphasised by the tissue viability team that at this point the wound was not appropriate for grafting due to the heavy colonisation and slough present. Beldon (2007) highlights that, in order for a skin graft to successfully adhere to the wound bed, it should be clean and free from necrotic or sloughy tissue, which would be heavily colonised with bacteria.

Young and Fowler (1998) add that any wound bed being considered for skin graft should have perfect haemostasis and signs of healthy granulating tissue. Although granulation was present in the patient's wounds, the clinical signs of slough and heavy colonisation were sufficient to delay further surgical intervention with a skin graft.

The tissue viability team then discussed with the vascular consultant the possibility of first treating the wounds with a topical antimicrobial to reduce the bacterial burden, which in turn would control the malodour and debride the slough.

At this time the team discussed the opportunity of treating the wounds with compression bandaging. It was agreed that the arterial/venous scans indicated that this could safely be applied. It should be noted that the vascular team must be consulted when proposing treatment with compression bandaging in lower limb fasciotomy wounds following ACS.

Doppler assessment

After agreeing a trial with compression bandaging the tissue viability team undertook a Doppler assessment, which is paramount as the first step in vascular limb assessment and should be performed before contemplating the application of compression therapy. The principles of lower limb vascular assessment using a Doppler to determine the ankle brachial pressure index (ABPI) were applied. A reading equal or greater than 0.8 indicates that compression is appropriate. This ensured the safety of the limb and a structure for consistent

care as the team felt that this wound may develop chronicity, due to the expected healing time (Anderson, 2006).

Mekkes et al (2003) and Anderson (2006) add that it is important to have a detailed knowledge of the clinical picture of the wound including pathogenesis and diagnostic possibilities, as an incorrect diagnosis may cause serious injury.

An ABPI can be performed as an isolated investigation or as part of an arterial duplex scan (Dean, 2006). In the above patient's case, a Doppler assessment was included as part of an arterial and venous duplex scan to ensure it was safe to proceed with the proposed compression bandaging.

Measurements were also taken of both limbs. The results showed an ABPI of 1.11 in the right leg and 1.06 in the left leg. The measurements were as follows:

- Right ankle: 26cm
- Right calf: 64.5cm
- Right thigh: 61cm
- Left ankle: 23cm
- Left calf: 36cm.

Compression bandaging

After the successful Doppler the team commenced compression bandaging. To begin with a long stretch elastic system was used, starting off with reduced compression of layers Profore #1, #2 and #3 (Smith & Nephew), equalling 17mmHg to begin with to monitor tolerance and to observe the limb. This choice of compression was selected as the patient's ankle and calf movement was limited as was his mobility at the time. Thus, the team wanted to use a compression system that worked at rest. As this was the first instance the team had used compression to treat a fasciotomy wound of the lower limb, they were cautious to begin with, however, after a successful initial application the team were able to increase the compression system to the full four-layers of Profore equalling 40mmHg in accordance with ankle circumference.

The wound itself was treated with silver Hydrofiber for one week but as the wounds began to show signs of hyper/overgranulation, were no longer malodorous and were covered with minimal slough, this was discontinued and a plain Hydrofiber was used to treat the wounds as they were still producing copious amounts of fluid.

Lloyd (2006) adds that, in an overgranulated wound, the use of dressings that promote granulation should be discontinued and changed to those that provide a warm moist environment. Williams (1999) examined the benefits of a Hydrofiber in absorbing and managing large amounts of exudate locking it away from the surrounding skin thus preventing maceration and damage. They concluded that it was successful in managing and controlling exudate and protecting the surrounding skin from maceration and damage. Foster et al (2000) compared the performance of a Hydrofiber dressing with an alginate dressing on acute surgical wounds left to heal by secondary intention. Although the study concluded that both dressings performed well, the Hydrofiber consistently performed better than the alginate, although this did not reach statistical significance and highlighted the need for further studies.

Discharged with community service

With this plan in place it was decided to withhold grafting and to discharge the patient from the hospital and monitor him weekly in the tissue viability/vascular clinic. This meant that the patient could be discharged home with community services less than one week after his wounds were initially reviewed.

8 JUNE: FOUR-WEEK REVIEW

On examination of the wounds *(Figures 6–8)* they all showed significant signs of healing with wounds beds exhibiting a mixture of granulation (approximately 70%) with a superficial covering of sloughy tissue (approximately 30%). The measurements taken of the right limb are shown below, with the decrease in measurements from initial commencement of compression given in brackets:

- Right ankle: 24.5cm (reduced by 1.5cm)
- Right calf: 40cm (reduced by 24.5cm)
- Right thigh 52cm (reduced by 9cm).

The wound had a healthy amount of colonisation and there were no signs of infection. There was no evidence of

Figure 14: Healed scar tissue on Lateral aspect of right calf.

Figure 15: Healed scar tissue on medial aspect of right calf.

Figure 16: Healed scar tissue on Medial aspect of right foot.

Figure 17: Healed scar tissue on medial aspect of right groin.

Figure 18: Healed scar tissue on lateral aspect of right groin.

necrosis or tissue breakdown. Exudate levels remained yellow in colour with no malodour and had reduced considerably resulting in dressing changes being required three times a week. There was encouraging evidence of epithelial edges and scar formation and the surrounding skin was considerably healthy.

The patient did not complain of any pain or discomfort during dressing removal or change and reported that the bandage was 'quite comfortable'. The patient's mobility had improved, although he was still resting a lot during the day and needed a walking stick to help him get around.

Emollient therapy

After four weeks of treatment with compression bandaging — in which the tissue viability team were working closely with the community teams in managing the bandaging regime, with weekly reviews — the limb was being washed using emollient therapy with normal tap water for 5–10 minutes during dressing changes about two to three times a week. Wingfield (2009) has listed emollient therapy as having the following properties:

- Occlusive — trapping water in the stratum corneum
- Active — moving water from the dermis to the epidermis
- Exfoliative
- Anti-inflammatory
- Antimitotic
- Antipruritic
- Accelerates regeneration of skin barrier.

The team also moisturised the wound edge and gently debrided the scabbed/adherent areas to reveal healthy epithelial tissue and promote scar formation. The wound dressing was a simple composition of a non adherent silicone primary layer to stop secondary, alginate/Hydrofiber from adhering to the main wound bed. Again, this was secured with an absorbent padding and the leg was bandaged in the same way. Firstly, the limb was covered with a cotton liner to protect the area from toe to two fingers below knee level. Then it was bandaged as before using the full four-layer compression system. The groin wound was dressed in the same way and secured with absorbent padding and secured with a semi-permeable film.

24 JUNE: SIX-WEEK REVIEW

On examination two weeks later all of the patient's wounds were progressing well with dimensions steadily reducing *(Figures 9-13)*.

The wound beds remained superficial in nature with a minimal covering of superficial slough — approximately 20% with 80% healthy granulation. There was normal colonisation of the wound and no clinical signs of infection or wound breakdown. The exudate levels continued to reduce steadily and remained yellow in colour with no malodour. This allowed for the dressing changes to be reduced to twice a week. The surrounding skin remained generally healthy and the patient did not complain of pain at dressing change or in general.

The treatment continued as above with the only change being a reduction in dressing changes to twice a week according to exudate levels.

10 AUGUST: 12-WEEK REVIEW

On examination all wounds were completely healed with intact vulnerable scar tissue in place *(Figures 14–18)*. The measurements of the right limb had also decreased.

The right ankle wound measured 22cm and the right calf wound 40cm. At this point it was agreed with the vascular team that it would be appropriate for the patient to wear a Class II thigh-length made-to-measure flat knit compression hosiery to the right limb, which would be continually reviewed every six to eight weeks to monitor tolerance.

CONCLUSION

Over a period of 12 weeks the team treated the original acute wounds with compression therapy which, in turn, reduced hospital stay and aided early discharge and rehabilitation in the community. It also meant that the patient did not have to undergo further surgery with placement of a skin graft.

This case report concludes that more individual cases of lower limb fasciotomy wounds will be explored using the above treatment in conjunction with specialist vascular assessment management and patient concordance. WUK

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