Dead space management of an infected wound with the use of silver impregnated tulle

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Infection may proceed ulceration in patients with loss of the protective sensation mechanism or with peripheral arterial disease. Ulcerations create a portal of entry for bacteria and the utilisation of wound care products placed in these dead spaces can help control the local wound environment and bio-burden.

One of the body's main defences is the sensation of pain: an important warning mechanism against bodily harm. Unfortunately for some patients with diabetes this warning mechanism is lost due to the underlying processes that lead to diabetic peripheral neuropathy. The loss of this protective mechanism in the insensate foot, when combined with a foot deformity, can greatly increase the risk of diabetic foot ulceration.[1,2] When a breach in the skin occurs the natural barrier to surrounding microorganisms is lost and the invasion of potential pathogens may spread from the superficial structures to underlying bone. Advances in wound care include the use of ionic or nanocrystalline silver products which are shown to reduce the bacterial burden in wounds that are colonised or infected with invading pathogens. Such products are an effective material to use for packing the dead spaces of wounds in patients that may be vulnerable to infection.

Case study

Patient A is a 60-year-old male who presented to the High Risk Foot Service at Liverpool Hospital in 2012 with distal gangrene affecting the right 3rd toe. His medical history includes type 2 diabetes (1991), retinopathy (2005), peripheral arterial disease (2007), hypertension (1999), and peripheral neuropathy (2000). His presenting HbA1c was 8.7%, however, his medical records revealed a long history of sub-optimal glycemic control. His medication at presentation included atenolol 25mg daily, quinine sulphate 300mg, simvastatin 40mg and metformin. The patient is a non-smoker but had smoked 10 years earlier.

Clinical presentation

On examination of the right foot, the third toe had a clearly demarcating gangrenous tip (Figure 1). The base was sloughy and the intermediate phalanx was visible through the base of the wound. The sausage toe appearance (dactylitis) indicated probable soft tissue infection and the exposed bone strongly indicated osteomyelitis. The presence of malodour pointed to an anaerobic infection.

Figure 1. Gangrene of the distal phalanx on the right third toe.

Assessment

A Modified Neuropathy Disability Score was undertaken which indicated diabetic peripheral neuropathy with a patient score of 8/10. The tibialis posterior and dorsalis pedis pulses were not palpable, however, bi-phasic waveforms were noted on the Doppler assessment. Patient A was known to the vascular team who subsequently diagnosed the gangrenous tip due to an embolic event.

Investigations

A plain x-ray showed absorption of the distal interphalnageal joint with extensive erosion of the intermediate phalanx in keeping with gangrene (Figure 2). CBC, ESR, and CRP were obtained which showed only mildly elevated signs: WBC was 8.0 X 10(9)/L, ESR 35 mmol/L, CRP 7.2 mg/l. A deep wound swab was obtained from the base of the wound along with an osseous sample from the exposed intermediate phalanx; both were sent for microbiology, culture and sensitivity for aerobic and anaerobic bacteria. The results of the cultures indicated 3+ *Pseudomonas aeruginosa* as a pathogen of infection.

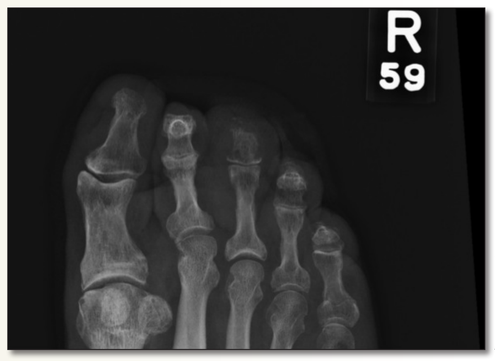

Figure 2. Total destruction of distal phalanx with osseous infection of intermediate phalanx.

Management

The patient was placed on oral antibiotic therapy of ciprofloxacin 500 mg, PO, Q12 hours to cover the soft tissue infection. With the permission of the vascular team the podiatrist removed the gangrenous distal phalanx, and the exposed osteomyelitic intermediate phalanx was removed using sterile bone rangeur forceps down to the proximal phalanx. The right third toe now had a large cavity, open to the environment, effectively a dead space was left between the surface and the underlying osseous structures. In order reduce and manage infection in the dead space, a silver impregnated tulle (Atrauman Ag) was used. Dressing changes were advised every 3 days and the patient was given a two week follow up.

At week 2, the wound had improved dramatically (Figure 3). A significant reduction in erythema, malodour and minimal exudate was noted. The wound site looked clear of infection and the resulting deep wound cultures were negative for *Pseudomonas aeruginosa*. As the majority of the intermediate phalanx with osteomyelitis was removed (Figure 4), antibiotic coverage was only continued for a further 4 weeks. Serial x-rays reported no further osteomyelitis in the remaining phalanx.

The dressing regime of silver impregnated gauze was continued for a further two weeks (total 4 weeks) and then discontinued due to the rapid improvement of the wound. Wound closure was obtained at week 10 (Figure 5).

Figure 3. Large dead space following removal of intermediate phalanx.

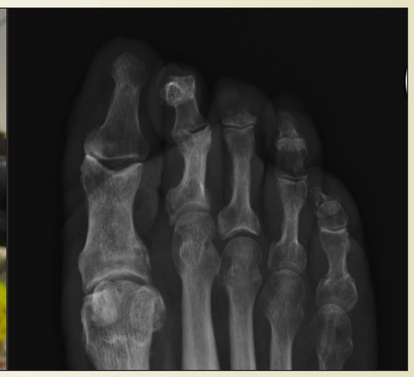

Figure 4. Removal of distal and majority of intermediate phalanx.

Figure 5. 10 weeks post removal of necrotic digit.

Conclusion

Voids or dead spaces present a problem for a healing wound. These voids can present a portal of entry for invading pathogens which can lead to subsequent infection. Some voids or dead spaces are made from surgical procedures to remove unwanted tissue or bone that may already be infected. With the removal of unwanted tissue or bone it is imperative to keep the site free from infection or attempt to reduce existing infection. In this case study all infected bone and necrotic tissue was removed and antibiotic therapy was instigated to further reduce pathogens already established within the soft tissue.

From a local wound perspective it is important to keep the dead space of the wound clean and free from any further opportunistic microorganisms. One way to achieve this is to use to a cavity filler to reduce the dead space that also provides an antimicrobial barrier. This was an important factor when deciding to choose a dressing for Patient A as the main concern was to protect the underlying osseous structures which were free from infection. A tulle dressing was used as the cavity filler due to its flexibility, being easily placed and conformed inside the dead space. The tulle (Atrauman Ag) used contained metallic silver that also provided an effective antimicrobial barrier to potential pathogenic invaders. The antimicrobial properties of silver based dressing products are extensively evidenced [2,3,4] and can prove a useful treatment adjunct to the local wound environment in those patients with infection.

Referencese
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