Use of adjunctive treatments in improving patient outcome in Fournier's gangrene

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ABSTRACT

Fournier's gangrene is a polymicrobial necrotising soft tissue infection (NSTI) affecting the perineum and scrotum. It is rapidly progressive and destructive, and is associated with high morbidity and mortality. Management protocol includes prompt diagnosis, early institution of antibiotic therapy and adequate wound debridement, usually requiring multiple operations. The resultant defect can be left to heal by secondary intention, or surgical coverage can be undertaken. We report Fournier's gangrene in a 60-year-old diabetic man and his successful treatment with skin grafting, which utilised a multidisciplinary approach and adjuncts, including negative-pressure wound therapy and hyperbaric oxygen therapy. We also review the literature related to these adjuncts and discuss their usefulness in the management of NSTIs.

Keywords: Fournier's gangrene, hyperbaric oxygen therapy, negative-pressure wound therapy

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INTRODUCTION

Treatment of necrotising soft tissue infections (NSTIs) is a surgical challenge, and if managed inadequately, can be associated with significant morbidity and mortality. As important as initially treating the infection is the subsequent healing of the defect to restore function in the patient. We present a case of Fournier's gangrene in a diabetic man and review the adjunctive treatment options in the treatment of such patients aiding in the eventual coverage, using a combination of split-thickness skin graft (SSG) and delayed primary closure.

CASE REPORT

A 60-year-old Malay man presented to our hospital with a three-day history of weakness and fever. His family noticed that he was becoming increasingly confused and his speech had slurred. His past medical history revealed insulin-dependent diabetes mellitus, hypertension and a previous right-sided stroke in March 2009, from which he had made a satisfactory recovery. On examination, the patient was noted to be dehydrated and febrile, with a pulse rate of 100/min and blood pressure of 100/60 mmHg. Shallow breathing was also observed, but his lungs were clear on auscultation. He had a tender 4 cm × 7 cm swelling in the left perianal region with surrounding cellulitis. A complete neurological examination revealed no new neurological deficits. Blood tests revealed markedly raised potassium, low sodium and normal leucocyte count, with a C-reactive protein level of 65 mg/L (normal < 5 mg/L) and an HbA1C of 12.6% (normal 4%–8%). Chest radiograph showed no focal consolidation, and computed tomography of the brain showed no acute intracranial bleed. A diagnosis of diabetic ketoacidosis precipitated by perianal abscess was made.

Fig. 1 Photograph shows post debridement of Fournier's gangrene with the Flexi-Seal™ Fecal Management System *in situ*.

The patient was admitted and monitored in the high-dependency ward under the colorectal surgery team and placed on an intravenous insulin sliding scale. Once stable, on second day post admission, he underwent a rigid sigmoidoscopy, an examination under anaesthesia and saucerisation of a large subcutaneous perianal abscess. Intraoperatively, unhealthy fascia with a significant amount of pus tracking along the fascial planes was found, with no involvement of the scrotum and genitalia. Negative-pressure wound therapy (NPWT) via VAC (Kinetic Concepts Inc, San Antonio, TX, USA) dressing was applied. Wound cultures showed a mixed growth of organisms, including group B *Streptococcus* and *Candida albicans*. A diagnosis of Fournier's gangrene was made.

The patient underwent wound inspection three days later, and some slough was found at the base of the wound,

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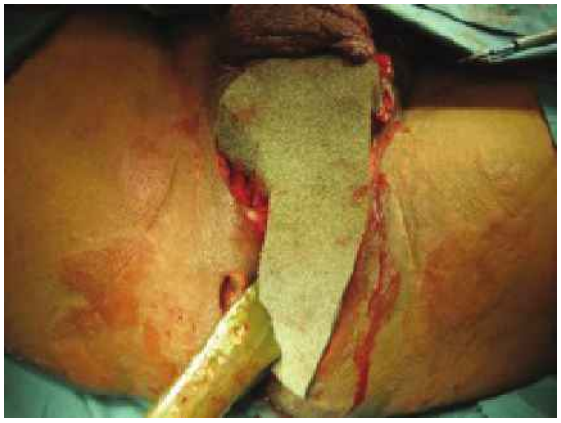

Fig. 2 Photograph shows the application of sponge for negative-pressure wound therapy dressing.

Fig. 3 Photograph shows the wound bed cleaned with granulation tissue prior to the placement of split-thickness skin graft.

with necrotic fascial tissue at the base of the scrotum (Fig. 1). With the help of the urology team, further debridement of the wound was done, with extension to the left scrotum. VAC dressing was re-applied (Fig. 2). The patient was referred to our plastic surgery team for wound management and the Hyperbaric and Diving Medicine Centre for hyperbaric oxygen therapy (HBOT), in addition to surgical debridement and antibiotics, until the wound was ready for coverage. These sessions were conducted at a standardised 2.4 atmosphere absolute pressure for 90 minutes twice daily for a total of six sessions. A Flexi-Seal™ Fecal Management System (ConvaTec, Princeton, NJ, USA) rectal tube was inserted in the patient in order to divert faecal contaminants from the wound.

The patient underwent a combined procedure with the colorectal and plastic surgical teams on Day 14 of his admission. Clean granulation tissue was noted at the base of the wound, and SSG was taken from his right thigh to cover part of the defect so as to reduce the portal of entry of bacteria (Figs. 3 & 4). VAC dressing was applied to the grafted area to assist in graft acceptance by removing exudates and applying consistent pressure. This was followed by delayed primary closure ten days later. The patient successfully avoided the morbidity of a diversion colostomy to reduce faecal soilage to the area, and probably, the subsequent need for re-anastomosis.

Fig. 4 Photograph shows the split-thickness skin graft placed on the wound with bolsters superiorly.

DISCUSSION

Fournier's gangrene is a form of NSTI involving the superficial and deep fascia of the perineal and scrotal areas. It is polymicrobial in nature, and can be rapidly progressive and destructive if not treated early. It is more common in immunocompromised individuals such as our diabetic patient, and can result from skin trauma or insect bites to the perineal area. Initial treatment involves prompt institution of antimicrobial therapy and early debridement of the infected tissue to limit spread. However, this usually results in a defect around the perineal area, which is commonly treated with regular wound dressing and healing by secondary intention. Complications may arise from large defects, as they take time to heal and can get secondarily infected due to their proximity to the anus and genitalia. Coverage of the defect can be undertaken using a flap or a graft. This itself poses challenges, including poor tissue perfusion and awkward positioning.

Faecal diversion was essential to prevent deleterious ongoing wound infection in our patient. Due to their close proximity to the anus, perineal wounds are frequently exposed to continual faecal contamination and sepsis, leading to delayed healing. While temporary diverting colostomies have been shown to be successful in minimising contamination and facilitating wound healing, they are also associated with significant morbidity such as skin irritation and stenosis.[1-3] They also mandate

the need for another more invasive surgical procedure, which would have been associated with significant risk in our patient with multiple comorbidities.[4] Ger described the use of a simple collared latex tube in five patients, which was secured by sutures in successful non-surgical diversion of faeces, allowing for control of perineal infections.[5] More sophisticated systems have since been developed, such as the Flexi-Seal™ Fecal Management System, which our institute utilised. Prospective studies on patients with perineal burns and immobilised patients with faecal incontinence have proven these systems to be effective in diverting faeces away from the perineal region to facilitate wound healing and avoid the need for stoma formation.[6,7]

NPWT was introduced in 1997 by Argenta and Morykwas, and has been described for the treatment of Fournier's gangrene.[8,9] It involves the placement of a porous sponge over the wound after the removal of contamination and coverage with adhesive dressing in order to ensure an airtight seal. A suction device is then placed over the sponge, and once activated, it deflates the sponge and creates a sub-atmospheric pressure within the wound. It exerts its beneficial effects by enhancing the microcirculation, reducing the microbial and exudative loads and improving granulation of tissue. Furthermore, the porous nature of the dressing allows oxygen into the wound, thereby facilitating the killing of harmful anaerobic bacteria. The combined effect results in improved healing of open wounds, decreased time to wound closure and enhanced survival of skin grafts.[10,11] NPWT was used on our patient prior to skin grafting in order to enhance the wound bed and after coverage was done so as to improve the chances of graft acceptance. In addition, the NPWT system helped put an occlusive dressing in a wound, thereby preventing faecal soilage, which would have affected wound bed preparation for secondary closure.

As Fournier's gangrene spreads along the fascia, involvement of the dermal blood vessels leads to ischaemic dermal necrosis and death of the surrounding tissue. This process, along with oedema of the inflamed tissue, leads to severe tissue hypoxia. Hypoxia impairs the functioning of polymorphonuclear leucocytes (PMNLs), which leads to rapid advancement of the infectious process within the skin and subcutaneous tissues.[12] HBOT introduces the patient to a supra-atmospheric pressure environment with 100% oxygen saturation, with the aim to reverse, or at least, limit this hypoxia. It is a recognised and accepted adjunct in goal-directed therapy of NSTI. The benefits of HBOT in the treatment of Fournier's gangrene are manifold. By improving PMNL function, it enhances their phagocytic ability and the production of free radicals for killing of bacteria.[13] It provides oxygenation to ischaemic areas, thus limiting the spread of infection and reducing the need for further debridement.[14] By increasing wound perfusion and reducing bacterial contamination, the wound bed is optimised for the placement of a graft. Furthermore, HBOT can aid the penetration of antibiotics into target bacteria, as was proven with aminoglycosides and *Pseudomonas*.[15]

There is strong clinical evidence that HBOT decreases mortality in patients with NSTIs and Fournier's gangrene. Gozal et al reported a reduced historic mortality rate from 38.0% to 12.5% in a group of patients with NSTIs treated with antibiotics, radical surgery and HBOT.[16] This benefit in NSTIs was also reported by Riseman et al, who showed that the overall mortality in a group treated with HBOT was 23% compared to 66% in the group without HBOT, even when perineal involvement and septic shock were more common in the hyperbaric group.[14] A five-year retrospective cohort study by Wilkinson and Doolette on NSTI treatment concluded that the strongest association with survival was the intervention with HBOT.[17] Specifically to Fournier's gangrene, a retrospective study by Hollabaugh et al reported a mortality rate of 7% in a group treated with HBOT vs. 42% in the comparison group that was treated with antibiotics and surgical debridement only. The relative risk for survival was found to be 11 times greater in the group receiving HBOT.[18]

The use of NPWT and HBOT was vital in the treatment of our patient, whose management was further complicated by his evidently poorly controlled diabetes mellitus. This could lead to impaired wound healing, increased susceptibility to infection and compromised microvasculature of the tissues. The goal in such patients would be to remove and divert the existing infection and to improve wound bed perfusion prior to definitive coverage, without the additional morbidity from potentially, two sessions of diverting colostomy and subsequent anastamosis. The synergistic effects of NPWT and HBOT, along with the non-surgical diversion of faecal flow, helped in achieving the above while improving survival chances in this patient, and optimised him for his eventual successful skin graft and delayed primary closure.

In conclusion, early diagnosis and prompt treatment of Fournier's gangrene is essential in order to ensure good patient outcome and survival. The broad management of the patient includes initial eradication of infection, followed by healing of the defect. While antibiotic therapy, adequate wound debridement and goal-directed

critical care would be the mainstays in this process, the adjunctive use of HBOT, NPWT and non-surgical faecal diversion have been shown to improve healing, aid wound bed preparation and reduce faecal soilage. While further studies are required, these interventions are potentially useful in preventing the need for faecal diversion surgery in such patients.

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