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Management of a complex abdominal wound post necrotising fasciitis: A multidisciplinary approach

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Abstract:	A 59 year old patient presented with abdominal necrotising fasciitis secondary to a bowel perforation, through a previous drain site that he had waited at home with for two weeks. Enteric contents were found within the abdominal wall. Surgery required extensive abdominal wall debridement and the formation of a double-barrelled ileostomy within the debrided area. The resulting abdominal wound was large, initially covering an area of approximately 424cm ² , and had continuous contamination from enteric leakage which could not be isolated. Achieving wound healing was challenging due to the enteric output and resultant continuous contamination of the wound bed.
Suggested Reviewers:	
Response to Reviewers:	<p>I once again thank the reviewers for their kind and constructive feedback.</p> <p>I have made the following revisions as recommended by reviewer 1:</p> <p>-I have written out MASD in full when it is first used in the text and provided a short description of what this is and a reference.</p> <p>-I have included a reference to a recent review on the management of high stoma output which supports our assertion regarding the evidence base behind low fibre diet as an intervention for this.</p> <p>-I have re-worded the 2nd paragraph in the tissue viability section in order to make it less clunky to read.</p> <p>-With regards to the final comment I agree that all post-debridement patients will either be left to heal by secondary intention or undergo further reconstructive surgery. However, there is little literature which actually describes the outcomes from a conservative nurse-led approach like the one we took. I have included references to two case studies which describe surgical interventions or diagnostics for necrotising fasciitis (there are many more) but I could find only one case describing a purely</p>

	<p>conservative non-surgical approach. Notably, the later case did not result in an outcome of healing for the patient. I thereby stand by this comment.</p> <p>I have highlighted all changes for this revision (2) in yellow.</p> <p>Once again, thank you for taking the time to review this manuscript. We hope this case study may help other clinicians with similarly complex cases.</p>
Additional Information:	
Question	Response
Please enter the word count of your manuscript excluding references and tables	2000

Title: Management of a complex abdominal wound post necrotising fasciitis: A multidisciplinary approach

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Abstract:

A 59 year old patient presented with abdominal necrotising fasciitis secondary to a bowel perforation, through a previous drain site that he had waited at home with for two weeks. Enteric contents were found within the abdominal wall. Surgery required extensive abdominal wall debridement and the formation of a double-barrelled ileostomy within the debrided area.

The resulting abdominal wound was large, initially covering an area of approximately 424cm², and had continuous contamination from enteric leakage which could not be isolated. Achieving wound healing was challenging due to the enteric output and resultant continuous contamination of the wound bed.

Conflicts of interest: None

Figure 1. Wound area over time

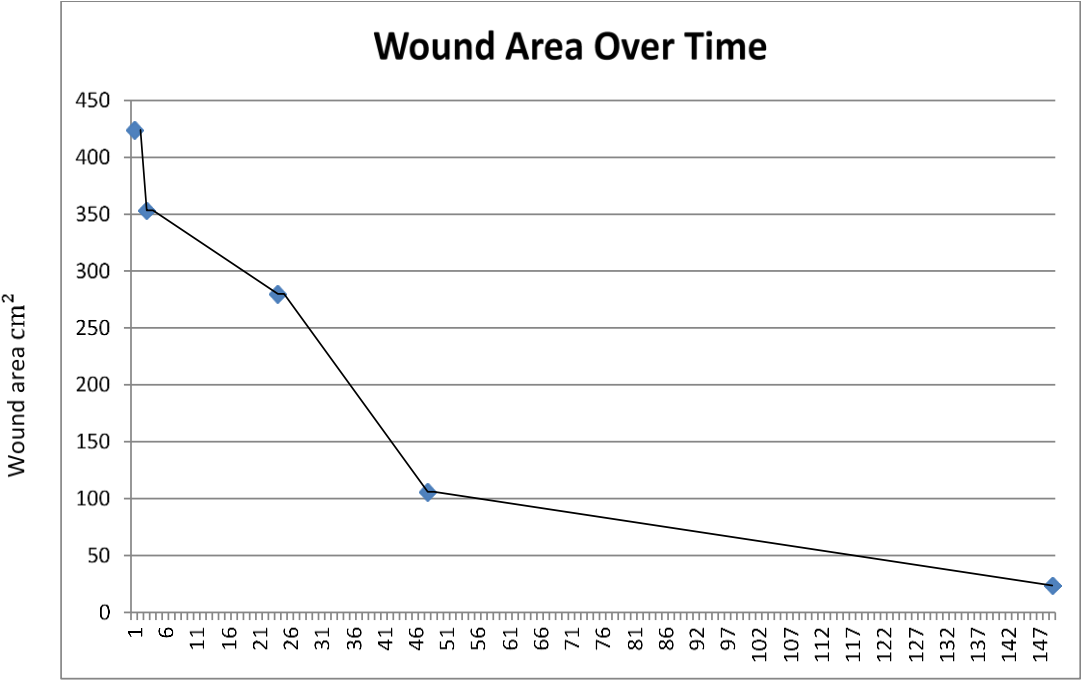


Figure 1. Days since initial visit by multidisciplinary nurse specialist team

Table 1. Successful / unsuccessful wound management approaches

Successful approaches	Unsuccessful approaches
Hollister adapt barrier rings cut in half and placed around the wound edge, pelican cohesive paste was used in gaps and the wound was covered with an Oakmed wound manager bag . Dansac flange extenders were used to secure the bag.	Regular suctioning of the bag contents was advised to prevent a buildup of fluid: This was poorly adhered to leading to regular bag leaks.
A cyanoacrylate barrier film was used over the MASD damaged areas proximal to the wound bag to prevent interference with the bag adhesives. A notable improvement was seen within 48 hours (see images 5/6).	Free drainage bag: Despite efforts to alter the consistency of the ileostomy output it remained too thick to drain effectively through the available drainage products.
Hollister Karaya powder was used with good effect to manage bleeding and the wound edges allowing epithelialisation (see image 3)	Dressings could not be used over the central wound bed due to them being immediately contaminated and/or washed away by the ileostomy output.
Aquacel Ag+ extra was used for a 21-day period to manage over-granulation, likely caused by colonisation of the wound. These were placed beneath the hydrocolloid of the wound management bag to maximize wound contact area at the wound edges.	Ilex skin protectant was trialed across the wound to reduce contact between the enteric contents and healing tissues over two weeks. The ileostomy output appeared to wash away the Ilex.
The wound manager bag aperture was reduced incrementally at each review to allow healing at the edges.	
Digitalisation of ileostomy by patient to maintain patency following rapid healing and granulation over the ileostomy (see image 4)	













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Title: Management of a complex abdominal wound post necrotising fasciitis: A multidisciplinary approach

Key words: Abdominal, contamination, complex wound, necrotising fasciitis

Abstract: *A 59-year-old patient presented with abdominal necrotising fasciitis secondary to a bowel perforation, through a previous drain site that he had waited at home with for two weeks. Enteric contents were found within the abdominal wall. Surgery required extensive abdominal wall debridement and the formation of a double-barrelled ileostomy within the debrided area.*

The resulting abdominal wound was large, initially covering an area of approximately 424cm², and had continuous contamination from enteric leakage which could not be isolated. Achieving wound healing was challenging due to the enteric output and resultant continuous contamination of the wound bed.

Background: This case highlights three key issues; the importance of timely and aggressive surgical intervention for necrotising fasciitis, the value of multidisciplinary approaches to complex wound care and the healing outcomes possible in wounds exposed to heavy faecal contamination. There is currently little literature describing wound healing outcomes in heavily contaminated wounds. This case demonstrates that rapid and effective healing is attainable despite heavy faecal contamination. Finally, the importance of effective risk communication during public health crises is clear from this case, the late presentation caused by anxiety related to the Covid-19 pandemic may have potentially negatively impacted both clinical outcomes and patient experience.

Case presentation: A 59 year old male presented with a two week history of right sided abdominal pain with deteriorating overlying skin changes. He had not presented earlier due to concerns about the safety of hospitals due to the COVID-19 pandemic. His past medical history included:

- Hartmann's procedure with small bowel resection for perforated diverticular disease four years earlier.
- During the hospital admission for his Hartmann's he developed a perforation of his right colon which was managed conservatively.

On examination he had skin changes involving most of the right lower quadrant of his abdomen and radiating into his flank. There was also a palpable mass under the skin changes. A working diagnosis of necrotising fasciitis was made with concern that there may be underlying bowel involvement. A CT scan was performed which revealed an abdominal wall hernia and free gas. The patient was taken to theatre immediately. All infected skin was debrided back to bleeding tissue. During the debridement enteric content was noted within the abscess cavity. This was identified as perforation of the small bowel that had perforated from a prolonged period of incarceration within the hernia. During the operation the patient was haemodynamically unstable and on inotropes to support his blood pressure. The two ends of bowel were brought out as a stoma in the right iliac fossa within the area of debrided tissue. In the post-operative period the patient went to critical care to correct his acute kidney injury and sepsis. He stepped down to the ward after ten days.

Outcome and follow up: Over a period of 150 days the wound area reduced from 424cm² to 23.56 cm² (see figure 1), there were no episodes of infection associated with the wound during this period and the patient did not report any significant pain associated with the wound. In total 14 visits were made by the specialist tissue viability and stoma nurses including one review as an outpatient.

Multidisciplinary perspectives on care

Surgical perspective: Once surgery had been completed, it was necessary to prioritise avoiding post-operative surgical complications of necrotising fasciitis, namely, incomplete debridement and further spread of infection. Over the course of the patients' inpatient stay he maintained good nutrition and avoided further sepsis. This was due in part to the multidisciplinary approach to care between the surgical, tissue viability and stoma teams to ensure excellent wound healing.

Stoma nurse perspective:

Stoma care was a challenging complex due to the ileostomy situated within the wound bed. The double barrel ileostomy was recessed in a crease within the wound (See image 4). The stoma was only visible when parting the skin folds. As a result it was impossible to isolate the stoma from the wound. Due to the amount of moisture we were unable to apply a

pouch over the ileostomy to isolate it from the wound bed. A large wound manager bag was used and incorporated both the wound and stoma.

The main objectives were to ensure that there were no leaks from the pouch causing further damage to the healthy skin and to reduce the output of enteric output to prevent further complications caused by the enteric fluid such as moisture associated skin damage (MASD).

This is caused by prolonged exposure to excess moisture and is characterized by inflammation of the skin, with or without erosion and secondary cutaneous infection.¹

Application of the wound manager bag involved placing 98mm Hollister™ adapt barrier rings, cut in half and framed around the wound, Pelican™ cohesive paste in gaps around the wound edge, an extra-large Oakmed™ bag was applied over the Hollister rings and Dansac™ flange extenders used to secure the bag. On subsequent reviews bleeding was noted at the wound edges, Hollister™ Karaya powder was used with good effect to manage bleeding. The wound edges improved clinically following the use of Karaya powder, this was subsequently used on every bag change to facilitate epithelialisation at the wound edges. Due to the reduction in wound area the wound bag was eventually changed to a smaller Pelican Eakin™ pouch. As the wound continued healing the template was decreased in size to overlap onto the granulation to aid healing. This method effectively allowed advancing epithelialisation at the wound edges despite the continuous contamination of the wound tissue by the ileostomy output.

An output of over 1500ml/day is considered a high-output stoma (HOS). This can occur in 14-16% new patients² and was present in this case. Most patients with high output will resolve. However in some cases this can take months and require strict medication management. To reduce the stoma output nutrition and pharmacological management is required. If this is not treated effectively this can cause serious harm to patients which can result in electrolytes imbalance and dehydration².

The stoma output was monitored daily and anything over one litre was treated. The stoma output was successfully managed using antimotility agents and weak opiates, either alone or in combination with each other depending on the output. The patient required both anti-motility and anti-diarrheal agents and Loperamide 16mg four times daily was administered 30 minutes before meals. Weak opiates inhibit gut motility, codeine phosphate 60mg four

times daily was used with Loperamide if the desired effect was not achieved with Loperamide alone. To maintain normal electrolyte balance oral rehydration solutions was introduced (double strength Dioralyte™ sachets in 1000mls water). Unfortunately, the patient developed hyperkalaemia and St Marks was subsequently prescribed. Electrolytes were maintained with the oral hydration solution.

Although there is limited evidence that low fibre diet has a positive effect on high stoma output³ it was recommended that the patient avoid eating seeds, nuts, skins and fruit juice. Salt was encouraged to be added to the diet to replace electrolytes lost via the stoma. Following the rapid healing of the wound it was noted that over granulation had appeared over the stoma causing stenosis. As a result the patient was advised to digitalize the hole to prevent a blockage. The patient engaged with this and the stoma remained patent.

Tissue viability perspective:

The abdominal wound resulting from extensive debridement presented a challenge from a tissue viability perspective. During our initial assessment the wound was heavily contaminated with enteric contents, contained large areas of dried bowel (see Image 3) and there was significant moisture associated dermatitis (MASD) to the right flank caused by poor management of fluid from the stomas (see images 1/2).

Our initial concern was the high risk of infection created by the contamination of the wound tissues by enteral fluid. In addition to this, MASD to the patient's peri-wound tissues was causing significant pain, potentially compromising pressure relieving turns. This may have increased the risk of both infection and a breakdown in tissue integrity over vulnerable pressure areas. Foley™ catheters had been used in theatre to try and contain the enteric contents and manage both the MASD and the risk of infection, however due to the anatomical position and dimensions of the stomas this was ineffective.

The initial management plan aimed to debride contaminated slough and contain the enteric fluid, ensuring it was not able to leak onto healthy tissues. For this we used Aquacel™ hydrofiber as a primary dressing and covered the wound using a wound manager bag. We initially advised the bag contents be suctioned regularly to prevent a buildup of fluid. We

later changed this to a free drainage bag however, this did not drain effectively due to the width of the drainage tubing. Our final plan included a wound management bag emptied regularly by the patient to prevent over-filling of the bag and subsequent compromise of the adhesive seal and leaking of the bag contents onto periwound tissues. A cyanoacrylate barrier film (Cavilon™ advanced) was used over the MASD damaged areas proximal to the wound bag to prevent interference with the bag adhesives and protect the tissue around the bag. A silicone barrier film was then applied over the remaining area in order to protect the damaged tissue and prevent the skin adhering to bedsheets. A notable improvement in the MASD present on the initial visit was observed within 48 hours of barrier film application (see image 2).

On subsequent reviews of the wound the contaminated slough had gone and the dried areas were moist and granulating well (see image 5), the overall wound area had reduced. As such, the Aquacel was discontinued and management goals focused on managing the fluid in collaboration with the stoma nurse.

Antimicrobial dressings (Aquacel Ag+ extra™) were used for a 21-day period over the wound bed to manage over-granulation which was likely caused by colonisation of the wound tissues. These were placed beneath the hydrocolloid of the wound management bag to maximize wound contact area. This was effective and allowed epithelialization at the wound edges to advance. No further episodes of over-granulation were noted after this period of treatment with silver dressings.

Ilex™ skin protectant was used across the surface of the wound to reduce contact between the enteric contents and healing tissues over a period of two weeks. However, this did not appear to adhere to the wound tissues and was subsequently discontinued. This may have been due to the levels of moisture on the wound tissues or the interaction between the Ilex and the enteric fluid.

At the time of the last review the wound area had reduced significantly (see image 6) leaving an area of granulation tissue consistent with the aperture of stoma bags applied by stoma nurses in the community. A full list of effective and ineffective approaches to managing the wound can be seen in table 1.

Discussion: Abdominal necrotising fasciitis is a life-threatening condition requiring timely diagnosis and surgical intervention in addition to antimicrobial therapy⁴. In our case the risk of mortality was increased by a late presentation due to anxiety related to the COVID-19 pandemic. This indicates the significance of the psychological burden on patients with conditions unrelated to the pandemic. With time critical conditions such as necrotising fasciitis, clinical outcomes may be significantly worse if presentations are delayed. This highlights the need for robust communication of risk to the public and inter-organisational cooperation, to avoid unnecessarily poor outcomes in situations where access to healthcare is compromised by national crises such as pandemics.

Cases of necrotising fasciitis have been described in numerous case studies; however, these focus mainly on diagnostics or therapeutic surgical interventions^(5,6). There remains little literature describing wounds healing by secondary intention following debridement for necrotising fasciitis. In addition to this, our case is especially complex given the constant contamination of the wound tissues with enteric fluids which are typically considered a barrier to healing and an established cause of moisture associated skin damage (MASD)⁷ as was the case with our patient on his right flank (see image 1/2). A previous case of an abdominal wound of similar dimensions containing an enteric fistula was described by Benbow⁸, this was also managed using a wound manager bag. However, progress towards complete wound healing was not achieved in this case and deterioration of periwound tissue was reported. No incremental reduction in the aperture of the wound manager bag was described as per the approach taken in our case, which allowed wound-edge tissues to recover from the corrosive enteric fluid and resulted in wound healing. No pharmacological, or specific dietary approaches, were described by Benbow⁸ to control the thickness of the enteric effluent or loss of fluid and electrolytes. This highlights the importance of multi-disciplinary input in complex abdominal wounds such as this to ensure that all actionable factors affecting wound healing are considered and interventions implemented.

In this case we have demonstrated that wound healing is achievable despite heavy faecal contamination. Despite the lack of literature, it has been noted by the authors anecdotally that wounds can heal despite faecal contamination. More investigation is required to

elucidate the physiological impacts of faecal fluids on healing tissues to help explain this phenomenon.

Learning points:

- *Risk communication is crucial during pandemics to ensure that individuals continue to attend hospitals for acute medical/surgical issues.*
- *Wound healing is possible despite significant faecal contamination; this should be considered when formulating management plans for patients with wounds.*
- *Fluid management is critical to healing wounds and protecting peri-wound tissues in cases where products cannot be applied across the wound bed.*
- *Multidisciplinary approaches are vital to ensure optimal outcomes are achieved in complex cases.*
- *In cases where there is an ileostomy within a large wound, healing can be achieved by incrementally reducing the aperture of a wound bag whilst using hydrocolloid powders to protect the epithelialising tissues at the wound edge.*
- *Silver hydrofiber dressings can manage hyper granulation effectively in faecally contaminated wounds over an extended period of 21 days.*

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