

Management of Fournier's gangrene: a practical guide for clinicians

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Abstract

Fournier's gangrene is a localised form of necrotising fasciitis affecting the external genitalia, perineal and perianal regions. Although rare, it is associated with high rates of morbidity and mortality, so clinician awareness is essential for prompt treatment. Risk factors include diabetes mellitus, hypertension, chronic alcoholism and immunosuppression. Perineal pain in patients with sepsis should be treated with a high level of suspicion and early surgical referral is required as prompt debridement can improve outcomes. Repeated surgical intervention and antimicrobial therapy are often needed and recovery can take a long time, with a long-term impact on quality of life. This article discusses the natural history of Fournier's gangrene, aetiology, risk factors, investigations and treatments with an algorithm to support clinical practice.

Key words: Antibiotics; Fournier's gangrene; Necrotising fasciitis; Surgical debridement

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Introduction

Fournier's gangrene is a localised necrotising fasciitis involving the external genitalia, perineum and perianal areas that may rapidly extend towards the abdomen. It is a medical and surgical emergency (Quatan and Kirby, 2004). Fournier's gangrene is a rare condition with an estimated incidence of 1.6 cases per 100 000 males (Sorensen and Krieger, 2016). A large observational study reported that two thirds of American hospitals saw no cases of Fournier's gangrene per year on average and just 6% of hospitals treated three or more cases annually (Sorensen and Krieger, 2016). Despite its rarity, it is a very serious condition with a high rate of mortality, reported as between 4.7 and 40.4% (Bowen et al, 2022). Two of the largest case series reported mortality rates of 16% in 1726 patients (Eke, 2000) and 7.5% in 1651 male patients (Sorensen and Krieger, 2016).

Fournier's gangrene is most common in men and individuals with predisposing risk factors including diabetes mellitus, cardiovascular disease, longstanding alcohol misuse and immunocompromise (Huayllani et al, 2022). Prompt recognition is essential as this rapidly progressive disease can result in death. Urgent intervention with surgical debridement and broad-spectrum antibiotics are the mainstay of initial management (Quatan and Kirby, 2004). Those who survive typically have a protracted recovery, and may need multiple surgeries for further debridement, later surgical reconstruction and faecal diversion with stoma (Bowen et al, 2022; Huayllani et al, 2022). Fournier's gangrene can present insidiously, and understanding the condition and its management is beneficial for doctors in medical and surgical specialties. This article reviews the literature and presents a practical guide to the initial assessment and management of patients presenting with Fournier's gangrene.

Aetiology

While originally considered an idiopathic condition, an initial nidus of infection is identifiable in most cases (Grzybowski, 2009). A large case series by Eke (2000) found that the source of sepsis was dermatological (24%), colorectal (21%), urological (19%), diabetes mellitus (20%), alcohol abuse (9%) and idiopathic (7%).

Anorectal causes include perianal abscesses, haemorrhoidal pathologies, anal fissure, anal fistulae, colorectal malignancy and trauma (Bensardi et al, 2021). Urogenital causes include urethral strictures and recent instrumentation or surgery (Eke, 2000). While less

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common, Bartholin's cyst and vulval abscesses may be responsible for Fournier's gangrene in females (Morris et al, 2014).

Predisposing factors

Some common predisposing factors are summarised in [Table 1](#).

Pathogenesis and microbiology

The natural history of Fournier's gangrene begins with a break in the skin allowing commensal perineal and genital micro-organisms to enter. These micro-organisms can become virulent, resulting in the production of enzymes and toxins (Rotstein et al, 1985) including collagenase, heparinase and streptokinase that promote complement reaction and platelet aggregation, resulting in the characteristic obliterative endarteritis (Smith et al, 1998). This vascular endarteritis impairs oxygen delivery to tissue, resulting in localised tissue hypoxia and subsequently necrosis and gangrene. Gangrenous tissue releases toxins into the circulation and this, combined with massive cytokine release as part of the inflammatory response, can precipitate multi-organ failure (Mishra et al, 2013). Fournier's gangrene occurs when the initial infection overcomes host immunity mechanisms, hence the increased risk in immunocompromised patients.

Microbiology

Fournier's gangrene is typically a mixed polymicrobial infection, reported by Altarac et al (2012) in 83.8% of cases. The majority of identified organisms are commensals found in the perineal and genital regions, with both aerobic and anaerobic bacteria identified. Tang et al (2015) found that, of 2656 cases across 22 studies, the most common organism isolated was *Escherichia coli*, followed by *Streptococcus* spp., *Bacteroides*, *Enterobacter*, *Staphylococcus*, *Enterococcus* and *Pseudomonas*. Fungal infection is rare in cases of Fournier's gangrene, although *Candida* spp. have occasionally been identified in tissue cultures (Perkins et al, 2014).

Clinical presentation

The presenting symptoms of Fournier's gangrene are typically a painful swelling in the perineal or scrotal regions and, as with other necrotising skin infections, pain disproportionate to the physical findings (Saeed et al, 2018). A retrospective cohort study found that perineal pain was present in 94% of cases (Bensardi et al, 2021). This may be associated with features of sepsis with tachycardia, hypotension and pyrexia. On examination, there is typically evidence of extensive inflammation with erythematous changes, oedema and necrotic regions (Huayllani et al, 2022). As with necrotising fasciitis, skin crepitus may be palpable in cases arising from gas-producing organisms, although the absence of this sign does not exclude Fournier's gangrene (Thwaini et al, 2006).

Table 1. Predisposing factors for Fournier's gangrene

Diabetes mellitus
Hypertension and obesity
Medications, eg sodium–glucose cotransporter-2 inhibitors
Chronic alcoholism
Others, eg anaemia, cardiovascular disease, chronic obstructive pulmonary disorder, peripheral vascular disease, increasing age, male sex
Immunosuppression, such as concurrent malignancy, chemotherapy, steroid use and human immunodeficiency virus infection

From Huayllani et al (2022)

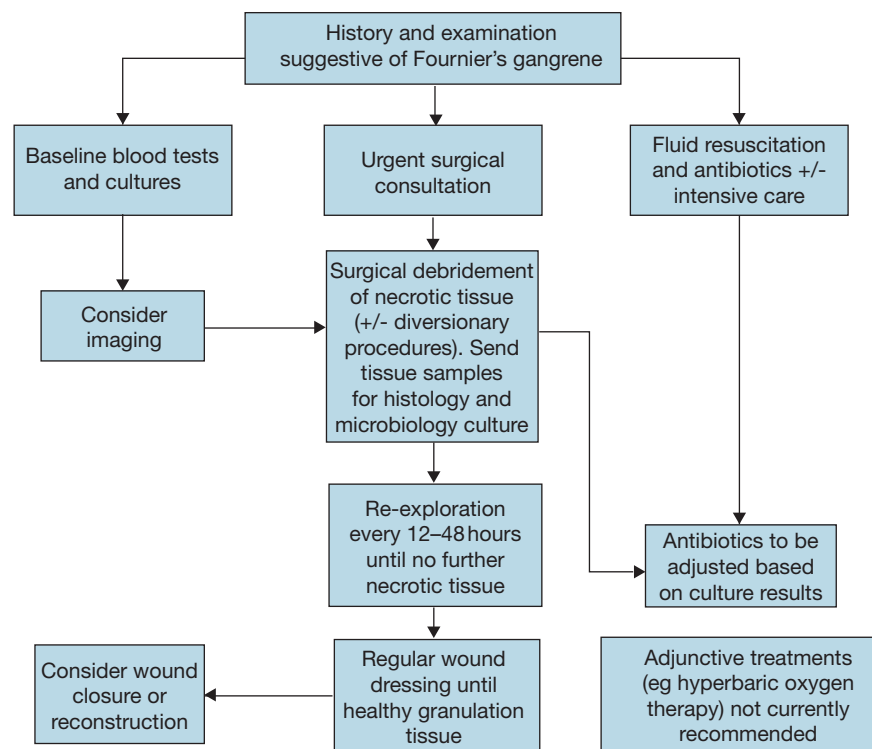


Figure 1. Proposed management algorithm for patients presenting with suspected Fournier's gangrene. Initial investigations, fluid resuscitation and antibiotics and early surgical debridement should be started simultaneously.

Investigations

While Fournier's gangrene is predominantly a clinical diagnosis, blood tests taken on admission can support the diagnosis and are also useful for prognostic purposes. Recommended investigations include full blood count with differentials, renal profile, blood gas sampling (to assess acid–base balance and lactataemia) and clotting studies to assess for evidence of disseminated intravascular coagulation (Mallikarjuna et al, 2012).

Electrolyte disturbances are commonly present. Bensardi et al (2021) found hyponatraemia to be the most common abnormality in 44%, followed by hyperkalaemia (17%) and hypokalaemia (10%). Corcoran et al (2008) found an association between increased mortality rates and elevated serum creatinine, lactate or calcium levels, or low serum bicarbonate levels. Other commonly identified abnormalities on haematological and biochemical work up include hyperglycaemia, hypoalbuminaemia, anaemia, thrombocytopenia and leucocytosis (Laor et al, 1995). Samples of blood and urine should be obtained for microbiological culture, as should culture from any open wounds or abscesses (Mallikarjuna et al, 2012). **Figure 1** proposes a pathway for investigations and management of patients with suspected Fournier's gangrene.

Imaging

While imaging should not delay the initiation of treatment with early surgical debridement and broad-spectrum antibiotics, it may be necessary in cases where the presentation is more ambiguous and there is uncertainty regarding the diagnosis (Quatan and Kirby, 2004). Plain X-ray, ultrasonography, computed tomography and magnetic resonance imaging have all been used in the diagnosis of Fournier's gangrene, with the presence of surgical emphysema being a hallmark. Imaging has a role in identifying the extent of disease and as interval imaging following initial debridement to determine the need for further surgery or help with reconstruction.

Plain X-ray

Plain X-ray of the abdomen and pelvis can demonstrate subcutaneous air in the perineal, scrotal or inguinal regions, even before it becomes evident on clinical examination (Levenson

et al, 2008). However, the absence of subcutaneous air does not exclude a diagnosis of Fournier's gangrene and a major limitation is that gas within the deep fascial layer is rarely identified on plain X-ray.

Computed tomography

Soft tissue thickening, inflammatory changes and the presence of subcutaneous emphysema can be well demonstrated on computed tomography (Levenson et al, 2008). Other characteristic changes include asymmetrical fascial thickening involving both superficial and deep fascial layers with fat stranding allowing the extent of disease to be established. The extent of tissue involvement identified on surgical debridement correlates well with that found on computed tomography and this could allow more targeted surgical debridement (Gupta et al, 2014). Co-existing or aetiological pathology such as perianal abscess, fistulae and intra-abdominal, pelvic or retroperitoneal sources of infection can be readily identified on computed tomography (Gupta et al, 2014). Computed tomography of the pelvis demonstrates the presence of gas within the soft tissues, even in the absence of crepitus on clinical examination (Lang et al, 2010).

Magnetic resonance imaging

Magnetic resonance imaging can identify soft tissue inflammation and the extent of the disease process in Fournier's gangrene, but is only occasionally used in clinical practice because of the increased time required for image acquisition, limited benefit over computed tomography, and often reduced accessibility (Ballard et al, 2020).

Ultrasonography

The presence of air within a thickened, oedematous scrotal wall on ultrasound suggests a diagnosis of Fournier's gangrene and can distinguish between alternative causes of scrotal pain including scrotal cellulitis, epididymo-orchitis or an incarcerated inguino-scrotal hernia (Levenson et al, 2008; Gupta et al, 2014). Although ultrasonography has the advantage of portability, computed tomography is superior for diagnosing Fournier's gangrene and assessing the extent of tissue involvement and the aetiological manifestation (Levenson et al, 2008).

Scoring systems

The laboratory risk indicator for necrotising fasciitis (LRINEC) and Fournier's gangrene severity (FGSI) are two frequently used scoring systems to stratify disease severity and determine prognosis in patients with Fournier's gangrene (Bowen et al, 2022). While LRINEC is used in necrotising fasciitis more broadly, FGSI is more specific to Fournier's gangrene with both scoring systems investigating the deviation from homeostatic equilibrium.

Laor et al (1995) established the FGSI on a series of 30 patients using physiological variables that are rapidly obtainable on initial assessment. The FGSI includes nine variables (temperature, heart rate, respiratory rate, serum sodium, serum potassium, serum creatinine, serum bicarbonate, haematocrit and total white cell count). Each variable is given a score of 0 to 4 (a higher score indicates greater deviation from normal) and an overall FGSI is calculated by adding the scores. Laor et al (1995) found a positive correlation between FGSI score and mortality rate – those with a score >9 had a 75% probability of death, while a score of 9 or less was associated with a 78% probability of survival. Subsequent studies have validated the FGSI and concurred that a threshold score of 9 is both sensitive and specific for the prediction of mortality in Fournier's gangrene (Corcoran et al, 2008). However, the validation was not universal – Tuncel et al (2006) found that the FSGI did not adequately predict disease severity and survival, suggesting that the extent of disease is an important variable. Subsequently, Yilmazlar et al (2010) proposed a modified 'Uludag FGSI' with additional points given for the extent of disease and age. They reported a 94% probability of death and 81% probability of survival for a score of greater than 9 or less than 9 respectively. However, the role of LRINEC and other scoring systems is debatable and certainly should not be used to exclude Fournier's gangrene or other necrotising skin infections (Saeed et al, 2018).

Management

The key principles of treatment of Fournier's gangrene include early surgical debridement, prompt administration of broad-spectrum parenteral antibiotics, fluid resuscitation and correction of blood glucose levels (Bensardi et al, 2021).

Surgical management

Early involvement of a surgeon is essential to debride necrotic tissue and improve outcomes (Thwaini et al, 2006), so a low threshold should be maintained for such a consult. While imaging can be a useful adjunct, especially in equivocal cases, it should not delay treatment. The extent of disease may be underestimated by external appearances of the skin and all necrotic tissue should be debrided until healthy, viable tissue is reached (Mishra et al, 2013; Zhang et al, 2020). This may require extensive debridement of necrotic skin, subcutaneous tissue, fascia and muscle, leaving a large defect (Figure 2). A tissue biopsy for histological review should be obtained during debridement in addition to samples for microbiological culture. Classical histological features are neutrophilic exudate, vessel thrombosis and necrosis (Mishra et al, 2013).

Mortality rates are higher for patients with increased duration from onset of symptoms to first surgical debridement, emphasising the urgency of early surgical intervention (Kabay et al, 2008).

Additional surgical procedures

Orchidectomy is rarely necessary as the blood supply is intra-abdominal from the deeper fascial planes (Eke, 2000). Overall rates of orchidectomy are approximately 5.6% (Bowen et al, 2022) but there is a large degree of variability. Koukouras et al (2011) reported an orchidectomy rate of 26.6% in 40 men, whereas Altarac et al (2012) reported no requirement for orchidectomy in 39 men. Osburn et al (2017) reported a higher rate of orchidectomy in low-volume compared to high-volume centres (11% vs 2.8%).

Faecal diversion with stoma can be used when there is sphincter involvement and to divert faecal matter and pathogens away from the wound; a rate of 6.8% was reported in a review of 13 903 cases (Bowen et al, 2022). However, a meta-analysis reported that patients undergoing diversionary stoma were at a higher risk of mortality (Sarofim et al,

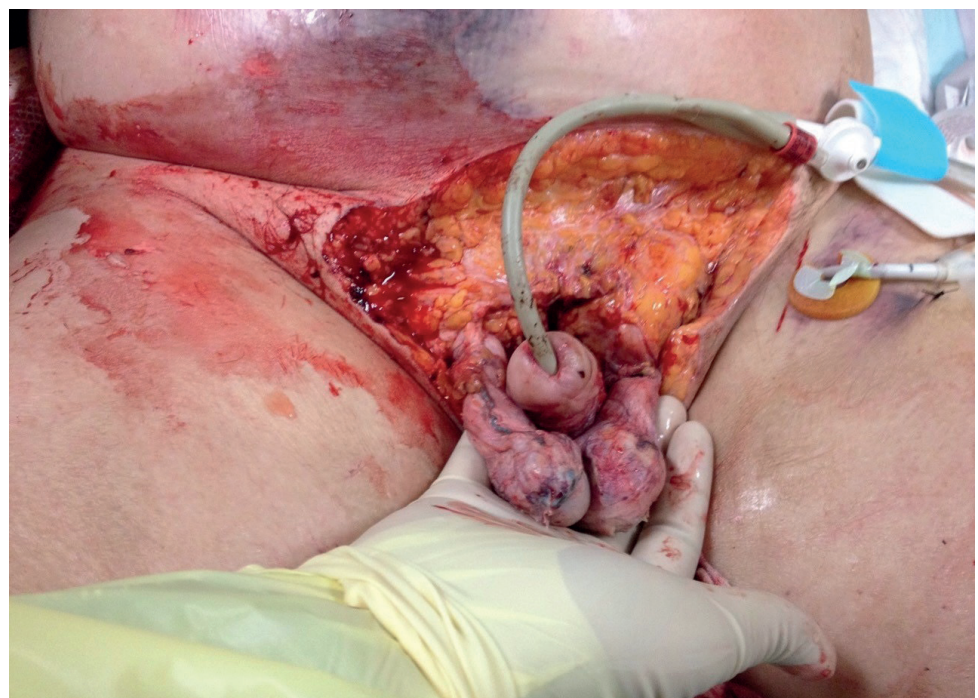


Figure 2. Patient following extensive debridement of the scrotum extending into the lower abdominal wall with testes intact. All necrotic tissue has been debrided with healthy bleeding wound edges seen. Urinary diversion is achieved with a urethral catheter.

2021). Urinary diversion procedures (eg suprapubic catheterisation) are undertaken in a similar number of patients (7%) and are not associated with an increased rate of mortality (Bowen et al, 2022). Extensive wounds or debridement in the peno-scrotal region may require long-term catheterisation to avoid urinary contamination of the wound until healed as seen in [Figure 2](#).

Adjuvant antibiotic therapy

Guidelines vary regarding antibiotic regimens, with the evidence predominantly arising from expert opinion. In practice, a triple antibiotic regimen is often used with a broad-spectrum penicillin or cephalosporin, aminoglycoside and metronidazole or clindamycin (Mallikarjuna et al, 2012). However, local microbiology guidelines and patient allergy status should be used to determine antibiotic choice. Once culture results are available, antibiotic therapy can be tailored. A study of the duration of parenteral antibiotic administration found no difference in outcomes if >10 days or <10 days of parenteral antibiotics were given (Lauerman et al, 2017). They also found no difference in rates of surgical site infections, recurrent Fournier's gangrene or rates of *Clostridioides difficile* infection.

Wound care

Most patients will require at least one return to theatre for re-exploration of the wound (Mallikarjuna et al, 2012). Repeated surgical debridement should be undertaken every 12–48 hours until all necrotic tissue has been removed (Mishra et al, 2013). Conventional wet to dry dressings can be applied to the wound, which must be changed regularly (Huayllani et al, 2022). Alternatively, a vacuum-assisted closure (VAC) system can be used following adequate surgical debridement to apply negative pressure to the wound, promoting wound healing and reducing the size of the defect (Mishra et al, 2013; Huayllani et al, 2022). Compared with conventional dressings, VAC dressings have been associated with reduced pain, increased mobilisation and reduced frequency of dressing change (Yanaral et al, 2017).

Hyperbaric oxygen therapy

Hyperbaric oxygen therapy has been used as an adjunct to increase the oxygenation of tissues and therefore stimulate angiogenesis and re-epithelialisation while inhibiting the growth of anaerobic bacteria (Thom, 2011). Studies have reported that hyperbaric oxygen therapy as an adjunct to standard care was associated with a lower rate of mortality vs standard care alone (Feres et al, 2021). While these studies are encouraging, the European Association of Urology (2023) has advised against the use of adjunctive treatments outside of clinical trials because of a lack of consistent evidence for their use.

Intravenous immunoglobulin

Intravenous immunoglobulin has been proposed as an adjunctive therapy in necrotising skin infections, because of its theoretical role in promoting bacterial opsonisation, immunomodulation of the systemic inflammatory response and neutralisation of microbial antigens and toxins, particularly for group A *Streptococcus* and *Staphylococcus aureus* (Saeed et al, 2018; Hofmaenner et al, 2022). The evidence supporting the use of intravenous immunoglobulin in necrotising infection including Fournier's gangrene is limited and inconsistent, thus its routine use is not currently recommended (Sanders et al, 2017; Hofmaenner et al, 2022).

Reconstruction

Wound closure should not be attempted until the infection has resolved and healthy granulation tissue is present. Options include allowing the wound to heal by secondary intention, skin grafts and flap reconstruction with different techniques reported (Zhang et al, 2020; Huayllani et al, 2022).

Long-term outcomes

The mean length of hospital stay for patients with Fournier's gangrene is 18.5 days (range 13.0–26.6 days) and this often involves more than one surgical procedure and an intensive

Key points

- Fournier's gangrene is a rare form of necrotising fasciitis that is associated with high rates of morbidity and mortality.
- Early recognition and prompt surgical debridement are essential to improve outcomes.
- Many patients will require multiple surgical procedures for debridement and later reconstruction.
- A multidisciplinary approach is required to optimise management and will often involve urology, general surgery, plastic surgery, microbiology, tissue viability and intensive care teams.

care admission for at least single organ support in 17.5% of cases (Bowen et al, 2022). Few studies have reported the long-term consequences for patients with Fournier's gangrene. Osburn et al (2017) reported that 27% of patients were discharged to a skilled nursing facility and another 14% required home health services. Patients followed up with the SF-36 quality of life questionnaire had significantly reduced physical functioning, general health and physical health scores compared to the general population, and 65% reported a deterioration in sexual function (Czymek et al, 2013). Rosen et al (2016) found an average healing time of 4.8 months for patients with Fournier's gangrene, although the range was up to 31 months.

Conclusions

Although rare, Fournier's gangrene is a urological emergency with a high rate of morbidity and mortality. Prompt recognition and early management are essential to improving outcomes. It should always be considered in a patient presenting with features suggestive of perineal or scrotal infection, especially in those with significant risk factors such as diabetes mellitus. The mainstay of treatment is the early administration of broad-spectrum antibiotics and surgical debridement of necrotic tissue. Further research is required to elicit the benefit of adjunctive treatment and to determine the long-term impacts of Fournier's gangrene on both physical and psychological health.

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Conflicts of interest

The authors declare that there are no conflicts of interest.

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