

## Fournier's Gangrene: A Rare Post-Surgical Complication of Voluntary Medical Male Circumcision in Kwazulu-Natal Province, South Africa

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### Authors' Contribution:

Quazi MA, Ndirangu J, Visser C, Nyasulu P, Jacobs D and these authors are contributed equally to this work.

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### 1. Abstract

Fournier's gangrene is a rare diffuse fulminating gangrene of the penis and scrotum in young men. We present here two cases of Fournier's gangrene following uneventful Voluntary Medical Male Circumcision (VMMC) surgical procedures, in two men aged 24 and 48 years respectively.

The VMMC procedures were conducted at two rural hospitals in KwaZulu-Natal (KZN) Province, South Africa, as part of scale up of VMMC for partial HIV prevention. Both men were HIV-negative with no known previous history of underlying risk factors.

In case one, there was diffuse localised pain and tenderness, swelling and extensive desquamation and necrosis of penis and scrotum tissue, with no sign of systemic infection. In case two, the necrotising fasciitis of penis and perineal area was associated with transient hepatorenal functional impairment. Both patients were managed at Northdale hospital, KZN, where pus swabs showed heavy polymicrobial growth. The management of case one was conservative with analgesics, triple antibiotics, daily wound dressing and clinical reviews. Case two underwent surgical debridement, in addition

to conventional treatment. Both patients responded well to treatment and were discharged to continue with regular outpatient care.

These two cases illustrate a rare occurrence of a severe life-threatening complication post-VMMC procedure. This highlights the importance of adherence to protocols guiding surgical sterility and pre-anaesthetic procedures as well as reinforcing post-operative wound care, in order to reduce the impact of spontaneous wound infection.

### 2. Introduction

Fournier's Gangrene [FG] is a rare diffuse and fulminating form of infective necrotising fasciitis affecting the perineal, genital or perianal region of an individual. The disease predominantly affects young men but has also been seen in elderly men, women and children [1-3]. This disease was first described by Baurienne in 1764. However, a detailed description of the disease as an aggressive form of infection that leaves massive necrosis of skin and subcutaneous tissue of the perineal region, mostly affecting young men was reported by Jean-Alfred Fournier in 1883. Dr Fournier was a French physician specialised in venereology [4-6], who described

a diffuse form of the infection which can spread proximally to affect the anterior abdominal wall causing gross sepsis and necrosis of the soft tissues [7].

Fournier's Gangrene is associated with a very high mortality of 80% [8] documented in earlier case series with later cases reporting mortality of less than 40% [9, 10] among those affected; however, the prevalence of the disease still remains considerably low. The disease was originally regarded as idiopathic in origin, occurring in young men. However, in 20% of cases, FG has occurred following minor injuries to the perineal area or following surgical procedures done to the perineum [11, 12]. Previous studies have reported that the infection causing the disease is polymicrobial, consisting of both aerobic and anaerobic organisms i.e. Bacteroides, Corynebacterium, Streptococci, Staphylococcus aureus, E. coli etc. Candida albicans has also been implicated as a potential causative agent of FG [7, 13, 14].

In this article we report two cases of Fournier's gangrene post voluntary medical male circumcision (VMMC) in KwaZulu-Natal Province, South Africa. We look at circumstances contributing to the onset of the illness and investigate any potential predisposing factors to effectively mitigate avoidance of future occurrences of FG. Such severe adverse events carry negative implications such as: posing a threat to patient safety; reducing trust in medical

services and VMMC in particular; and undermining the VMMC demand creation efforts and HIV prevention efforts in South Africa.

### 3. Case Presentation 1

#### 3.1. Case 1

A 24-year-old male presented to a rural hospital in Zululand health district, KZN province, in July 2016 for VMMC. The VMMC services for all eligible men forms part of the National Department of Health's strategy to reduce the transmission of HIV infection as per WHO/UNAIDS recommendations [15-17]. The young man had no previous history of co-morbidities and had not visited any health facility prior to the VMMC procedure. He was not on chronic medication and reported no history of ill health prior to the procedure. History related to marital status, alcohol consumption, smoking and other sexual partners was unremarkable.

#### 3.2. Pre-Operative Screening

Pre-operative screening revealed a healthy adult with no significant past medical history, allergies or immunosuppression. Additionally, there was no history of sexually transmitted infections, no family history nor predisposition for diabetes mellitus, no bleeding disorders and no past history of chronic medications. His vital signs

were assessed and showed that his blood pressure was 139/91mmHg, pulse 105 beats per minute (bpm), HGT 3.9mmol/L, and weight 57kg.

#### 3.3. Operative Procedure

A standard VMMC operative procedure which was done as part of a VMMC camp was carried out under local anaesthesia in July 2016, according to the normal, approved VMMC protocol for surgical incision to ensure that the site and surrounding areas were sterile. This was achieved after thorough cleaning with iodine. The local anaesthesia consisting of 5ml of 2% lignocaine and 5ml of 0.5% marcaine was administered using the ring block method around the penile shaft. After ensuring a sufficient level of local anaesthesia, the procedure was carried out using forceps guided method and subsequent bleeding was controlled using a diathermy. The surgical wound was sutured and dressed with Jelonet paraffin gauze dressing. The patient was then sent to recovery area for observation. There was otherwise nothing remarkable about the minor surgical procedure.

#### 3.4. Post-Operative Care

During the first 30 minutes post-operatively, the patient was given a post-operative information leaflet with information related to wound care and infection prevention. The patient was given a further 30 minutes resting time after which he was reviewed to ascertain that his condition was stable. There were no signs of discomfort observed at this time and his vital signs were normal (BP 136/83mmHg, Pulse 97bpm) and there was no active bleeding on the surgical wound site. The patient was advised about the six-week abstinence period post-circumcision and was given thorough health education information regarding wound care, physical activity and emergency measures where necessary. He was discharged home and given 1-gram paracetamol orally four times daily for 7 days. He was given an appointment for a follow-up review 48 hours' post-surgery.

#### 3.5. Post-Operative Complications

The patient defaulted his 48-hour follow-up appointment. Three days' post VMMC, the patient reported to the casualty department of the nearest hospital presenting with pain and a grossly swollen penis. There was no history of coital interaction over this period and no consumption of medication other than paracetamol. On examination, his vital signs were BP 131/86 mmHg, Pulse 101 bpm, Temperature 37.60C, Respiratory rate 22bpm, Oxygen saturation (SpO2) 96%. The penis was grossly swollen, hot and very tender. The stitches were still intact. Examination of the genital area revealed a diffusely swollen penile shaft and scrotum with an open 1 cm wound oozing pus. There was hypopigmentation of the ventral surface of the glans penis and wound dehiscence around the frenulum. The clinical impression was diffuse cellulitis of the genitalia. Clinically, the patient was in acute severe pain with gross tenderness around the genital area, consistent with an acute inflammatory response [18].

#### 3.6. Investigations and Treatment Plan

The patient was admitted to hospital in the male medical ward and

given diclofenac 75mg intramuscular injection stat and as necessary, plus paracetamol 1gram 6 hourly. The patient was prescribed broad-spectrum antibiotics (including intravenous Augmentin 1.2g 8 hourly; Gentamycin 240 mg once daily; oral Doxycycline 100mg 12 hourly) and analgesics (Tramadol 50 mg 12 hourly). Samples for full blood count and urea and electrolytes were drawn and sent to the laboratory for testing. The HIV rapid test was negative. A Foley's catheter was inserted to allow for effortless flow of urine from the bladder.

### 3.7. In Hospital Follow-Up

The patient was reviewed the following day (the 4th day post VMMC procedure). The vital signs were normal (BP 121/74 mmHg, Pulse 80bpm, Temperature 36.40c). Genital assessment showed a swollen oedematous penis which was very tender, with pus oozing from the ventral aspect of the penis over the suture line, and desquamation of the penile skin. The attending clinician's assessment was a post-surgical wound sepsis with gaping suture line. The wound was cleaned with saline and dressed with Jelonet paraffin gauze. The triple antibiotic therapy was continued. The patient was advised on daily wound dressing and continuation of analgesics for pain management.

The 5th day postoperatively was a designated public holiday, therefore the patient continued with the prescribed treatment plan. On the 6th post-operative day, the patient was reviewed by the doctor, with no significant new developments. The vital signs were normal (BP 94/57 mmHg, Pulse 88bpm, Temperature 36.40c); clinically the patient was stable, and the wound was then exposed. The plan was to continue daily wound dressing, analgesia and intravenous antibiotic therapy.

The attending doctor reviewed the patient on day 7 post-VMMC. Physical examination revealed a generally healthy-looking but acutely ill patient with infected post VMMC surgical site infection, in extreme pain. The penile shaft and scrotum were still grossly swollen with necrotic tissue on the open wound which was still oozing pus. There was desquamation on the ventral aspect of the penile shaft. The clinical impression at this stage gave evidence of a possible case of Fournier's gangrene as evidenced by diffuse necrotising fasciitis of the genitalia. The attending doctor recommended continuation of the treatment plan and referral for consultation by the Chief Specialist surgeon at the Centre of Excellence in Northdale Hospital for expert opinion and management. No debridement was done at the referring hospital before the patient was referred for specialist opinion.

### 3.8. Referral for Expert Opinion

The patient was referred on the 7th post-operative day and was reviewed by Chief Specialist surgeon at Northdale hospital. Examination revealed a patient in extreme pain with diffuse scrotal necrotising fasciitis. Pus swabs were taken for culture and sensitivity which showed heavy growth of *Acinetobacter baumannii* sen-

sitive to Gentamycin and *Staphylococcus pyogenes* which showed sensitivity to Actinomycin. Urine analysis revealed unremarkable findings and full blood count showed a high white cell count justifying the presence of localised infection. It should however be noted that the FG Severity Index (FGSI) and the Uludag Fournier's Gangrene Severity Index (UFGSI) were not used in the assessment process to predict outcome of the disease [19-21].

### 3.9. Possible Diagnosis of Fournier's Gangrene

The most likely clinical diagnosis remained Fournier's gangrene with a differential diagnosis of pyoderma gangrenosum. The presenting clinical picture and disease progression was consistent with the clinical description of the disease by Alfred Fournier (4). The patient was reviewed daily for the next four days. During this time there was noticeable progress in terms of granulation tissue formation and wound closure. After ten days, the patient showed remarkable improvement and was discharged home.

## 4. Case Presentation 2

### 4.1. Case 2

The second case was 48-year-old HIV-negative man who presented to Northdale Hospital 14 days' post VMMC. The VMMC procedure was done using conventional surgical methods at an outreach VMMC camp in rural KZN province. The patient presented with severe sepsis and gangrenous penile, scrotal and whole perineal area with gross micturition problems. The Chief Specialist Surgeon at Northdale Hospital reviewed the patient and made a clinical diagnosis of Fournier's Gangrene presenting as diffuse necrotising fasciitis of the external genital organs. Severe sepsis predisposed the patient to developing hepato-renal impairment requiring appropriate clinical management.

### 4.2. Treatment Plan

The patient was admitted to the surgical ward in November 2016 to effectively manage post- VMMC surgical complications. A urine and superficial swab were taken for Gram stain and culture and sensitivity (mcs). In addition, blood samples for blood chemistry, liver function tests and full blood count were drawn and sent to the laboratory for testing. Anti-biotic treatment was prescribed, including intravenous Augmentin 1.2g 8 hourly, Ciprofloxacin 500 mg 12 hourly, Pethidine 100 mg prn and Brufen 400 mg 8 hourly. The patient consented to surgical intervention and was taken to theatre on same day of admission where extensive debridement of necrotic tissue around the external genital area was performed. The patient was stable post-surgery with normal vital signs and satisfactory urinary output.

### 4.3. In-hospital follow-up

The patient had excellent regular clinical reviews in the ward. On day one post-operatively, the patient was stable with minimal pain; the treatment regime comprised intravenous antibiotics and oral analgesics. The results from the laboratory investigations indicated

the presence of sepsis with significant liver injury and impending renal damage. Intravenous antibiotics were continued; a Foley's catheter was kept in-situ to monitor urinary output.

Twice each day, the patient was reviewed by the Chief Specialist Surgeon and his team and there was visible positive progress regarding wound healing with formation of granulation tissue clearly visible. The day 4 urine mcs results showed scanty leucocytosis (1+) and moderate erythrocytosis (2+) and no growth after 24 hours. Gram stain showed Gram positive cocci with culture yielding heavy growth of *Staphylococcus haemolyticus* sensitive to Clindamycin, Vancomycin and Trimethoprim-sulfamethoxazole. The vital signs were normal and remained normal throughout the duration of admission in hospital. On day 7 post-operatively, results for Gram stain and culture and sensitivity showed moderate neutrophilia and scanty Gram-positive cocci (1+), and Gram-negative bacilli (1+), culture grew *Streptococcal pyogenes* sensitive to Penicillin, Erythromycin/azithromycin and Clindamycin. At this stage intravenous antibiotics were replaced by oral Amoxyl and Clindamycin. On day 8 post-operatively, the patient was prescribed a high protein diet to expedite granulation tissue formation and aid wound healing. In addition, other specialists including a psychologist, dietician and medical specialists in the management of hepatorenal dysfunction which the patient developed as a result of the severe sepsis. On day 10 post-operatively, repeat blood chemistry, liver function test and full blood count were done. Blood chemistry showed elevated potassium 8.9 mmol/L and creatinine 177  $\mu\text{mol/L}$  while liver function tests were normalising. The liver and renal functions showed remarkable impairment and continued to be closely monitored by the medical specialist team through regular monitoring of blood chemistry, liver function tests and urinary output. The patient continued on a high protein diet to enhance wound healing.

Over the next two weeks, the patient's condition progressed positively. On day 14 post-operatively, all blood chemistry and liver function tests were normal. However, persisting abnormal tests included a platelet count of  $488 \times 10^9/\text{L}$ , ESR 29 mm/hr and haemoglobin (Hb 11.4 g/dL). Despite this, the general condition of the patient showed an overall positive progression, therefore the high protein diet was discontinued, and the patient was put on a normal diet, with continued monitoring of input and output flow. On day 22 post-operatively, there was good hepato-renal recovery. Investigations done showed negative hepatitis surface antigens, non-elevated blood chemistry, and satisfactory urine output which is a marker of positive renal function recovery; an ultrasound scan of the abdomen was normal.

On day 25 post-operatively, the patient was discharged to continue with regular surgical wound care. He was advised to continue regular dressings on outpatient care basis. On discharge, the wound was clean with a healthy red granulation tissue. The patient was reviewed after three weeks. The wound was clean but moist and

dressings were done with antiseptic and jelonet respectively. The wound continued to be regularly dressed, with steady healing observed over a period of three months.

## 5. Discussion

Fournier's Gangrene is a serious surgical complication associated with high mortality and morbidity. It has been reported that FG occurs following trauma to the genital area. Circumcision is shown to be one of the catalysts of FG including other precipitating factors of immunosuppression such as alcohol, diabetes, HIV infection and others. The two cases reported here, of healthy HIV negative men, with no history of co-morbidities suffered diffuse cellulitis of the genitalia following VMMC. Both cases received specialist review and care. An initial differential diagnosis considered in the case of these two patients was Necrotizing Fasciitis, a rapidly progressive inflammatory infection of the fascia, with secondary necrosis of the subcutaneous tissues [22].

Above the potential risk of necrotising fasciitis occurring as result of circumcision, several other potential explanatory predisposing factors include i) the possible use of a high dosage of Marcaine supplemented by dextrose and or use of contaminated Marcaine which might have induced a possible inflammatory reaction leading to swelling and pain; ii) application of extremely tight dressing post circumcision might have caused vascular occlusion causing tissue hypoxia and necrosis; iii) lastly, excessive diathermy burns might have caused swelling of penile tissue in a tightly occluded surrounding causing hypoxia and necrosis. However, the natural course of FG suggests that it is more likely that the

surgical incision increased the patients' propensity to develop this complication, giving rise to postoperative wound infection causing swelling, pain and suppurative inflammation.

These assumptions are in keeping with the observed clinical signs and symptoms, sudden onset of severe pain, swelling, and necrotising fasciitis of the penis and scrotum. The clinical presentation in both cases is consistent with Fournier's gangrene, as a rare occurrence of polymicrobial infection following an injury to the genital areas in otherwise healthy young men or associated closely with diabetes and other co morbidities [4, 5]. Other previous reports have documented Fournier's syndrome post circumcision, which is in line with the description given by Jean-Alfred Fournier suggesting that infection of the surgical wound post circumcision might have been a more likely predisposing factor in the case of these two patients [23, 24].

A third possibility is pyoderma gangrenosum (PG) an extremely rare disease that has been reported as a form of severe adverse event of VMMC [23]. While this is a potential differential diagnosis, it does not exclude the other underlying causes of similar diseases which have not been well described. Although the aetiology of PG is not well understood, the disease is thought to be due to immune dysfunction, particularly improper functioning of

the neutrophils. In support of an immune aetiology, a variety of immune mediators such as IL-8, IL-1 $\beta$ , IL-6, interferon gamma (IFN $\gamma$ ), granulocyte-colony stimulating factor (G-CSF), tumour necrosis factor (TNF), matrix metalloproteinase (MMP-9, MMP-10 and Elafin) have all been reported to be elevated in patients with pyoderma gangrenosum [23]. In these two cases, due to the low probability of occurrence, and the presence of multiple bacteria, these laboratory investigations were not conducted.

## 6. Conclusion

Fournier's gangrene is a rare post-VMMC complication. It is a severe life-threatening polymicrobial infection with low chances of survival and gross surgical sequelae that requires hospitalization, broad-spectrum antibiotics, and surgical debridement [2]. Facilities to manage such complex cases in resource poor settings are generally unavailable. In view of the observed health system challenges encountered, the following recommendations are made:

- There is need for improved communication within the public health care facilities in order to eliminate delays in patient management;
- Follow up rates should be enhanced for the VMMC program through aggressive patient management and prompt follow up visits;
- There is need for strict pre-operative cleaning of surgical facilities / sites;
- Postoperative care protocols should be developed to strengthen post-operative care of patients after the surgical procedure through re-enforced health promotion focussing on wound care, personal hygiene, avoidance of coital interaction, exercises etc to ensure complete and speedy recovery.

To the authors best knowledge, these two cases are the first cases of FG to be reported within the South African VMMC program. As such, there is need to conduct comprehensive VMMC training for all staff to achieve the following outcomes as expansion and scale-up of the VMMC program progresses:

- To reduce delay in attending to clients pre- and post-VMMC procedure;
- Reduce reluctance of reporting and managing post operation complications amongst clinicians;
- Improve referral rates and time to diagnosis and treatment. In Case 1, the patient was transported over 600kms to the referral hospital by-passing several other tertiary centres along the way - this delay might have compounded VMMC complications;
- Reduce inefficient and ineffective use of resources;
- Enhance active follow-up of all clients post operatively and improve the 48 hours follow up rate, to reduce the number of defaulting patients within this critical time period;
- Enhance open discussions regarding severe adverse events (SAEs) at all forums within the medical fraternity to raise

awareness and reduce occurrence of post VMMC SAEs.

- Improve accuracy of medical documentation to facilitate opportunities for learning and development.

These two cases provide an opportunity to contribute to the body of knowledge on FG, specifically as a complication following VMMC within South Africa. These cases also illustrate the need for greater advocacy around the issue of post-operative adverse events and the need for a high index of suspicion in all cases.

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## References:

1. Smith GL, Bunker CB, Dinneen MD, Fournier's gangrene. *British journal of urology*. 1998; 81: 47-355.
2. Ward L, Eisenson D, Fils JL. Fournier's gangrene of the penis in a 12-year-old patient secondary to phimosis. *Rhode Island medical journal*. 2016; 99: 45-46.
3. Sussman SJ, Schiller RP, Shashikumar VL. Fournier's syndrome. Report of three cases and review of the literature. *American journal of diseases of children*. 1978; 132: 1189-91.
4. Fournier JA. Jean-Alfred Fournier 1832-1914. Gangrene foudroyante de la verge (overwhelming gangrene). *Sem Med* 1883. *Diseases of the colon and rectum*. 1988; 31: 984-8.
5. Norton KS. Management of Fournier's gangrene: an eleven-year retrospective analysis of early recognition, diagnosis, and treatment. *The American surgeon*. 2002; 68: 709-13.
6. Rodriguez MR. Fournier's gangrene: a monographic urology center experience with twenty patients. *Urologia internationalis*. 2009; 83: 323-8.
7. Sroczynski M. A complex approach to the treatment of Fournier's gangrene. *Advances in clinical and experimental medicine: official organ Wroclaw Medical University*. 2013; 22: 131-5.
8. Stephens BJ. Fournier's gangrene: historic (1764-1978) versus contemporary (1979-1988) differences in etiology and clinical importance. *The American surgeon*. 1993; 59: 149-54.
9. Morpurgo E, Galandiuk S. Fournier's gangrene. *The Surgical clinics of North America*. 2002; 82: 1213-24.
10. Pawlowski W, Wronski M, Krasnodebski IW. [Fournier's gangrene]. *Polski merkuriusz lekarski: organ Polskiego Towarzystwa Lekarskiego*. 2004; 17: 85-7.
11. Whaley RNMMK. *Muir's textbook of Pathology*. 13th Ed. ed. 1993, Edward Arnold: Boston. 1245.
12. Eke N. Fournier's gangrene: a review of 1726 cases. *The British journal of surgery*. 2000; 87: 718-28.
13. Hota PK. Fournier's Gangrene: Report of 2 Cases. *Case reports in emergency medicine*. 2012; 2012: 984195.

14. Thwaini A. Fournier's gangrene and its emergency management. *Postgraduate medical journal*. 2006; 82: 516-9.
15. WHO/UNAIDS, New data on male circumcision and HIV prevention: policy and programme implications, WHO/UNAIDS technical consultation. Male circumcision and HIV prevention: research implications for policy and programming. Conclusions and recommendations, Montreux, Switzerland. March 2007.
16. WHO/UNAIDS, Joint Strategic Action Framework to Accelerate the Scale-Up of Voluntary Medical Male Circumcision for HIV Prevention in Eastern and Southern Africa, 2012-2016. 2011, WHO: Geneva.
17. Siegfried N. Male circumcision for prevention of heterosexual acquisition of HIV in men. *The Cochrane database of systematic reviews*. 2009; 2: 003362.
18. Chalya PL. Fournier's gangrene at a tertiary health facility in north-western Tanzania: a single centre experiences with 84 patients. *BMC research notes*. 2015; 8: 481.
19. Lin E. Is Fournier's gangrene severity index useful for predicting outcome of Fournier's gangrene? *Urologia internationalis*. 2005; 75: 119-22.
20. Verma S. Evaluation of the Utility of the Fournier's Gangrene Severity Index in the Management of Fournier's Gangrene in North India: A Multicentre Retrospective Study. *Journal of cutaneous and aesthetic surgery*. 2012; 5: 273-6.
21. Tuncel A. Comparison of different scoring systems for outcome prediction in patients with Fournier's gangrene: experience with 50 patients. *Scandinavian journal of urology*. 2014; 48: 393-9.
22. Wallace HA, Perera TB. Necrotizing Fasciitis. [Updated 2020 Nov 20]. In: *Stat Pearls* [Internet]. Treasure Island (FL): Stat Pearls Publishing. 2021.
23. Patel F. Effective strategies for the management of pyoderma gangrenosum: a comprehensive review. *Acta dermato-venereologica*. 2015; 95: 525-31.
24. Adeyokunnu AA. Fournier's syndrome in infants. A review of cases from Ibadan, Nigeria. *Clinical pediatrics*. 1983; 22: 101-3.