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CASE REPORT

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Clinical experience exchange of 3 cases with Fournier's gangrene

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Abstract

Fournier's gangrene (FG), also known as necrotizing fasciitis, is a condition that affects the genitalia and perineum, resulting in the rapid development of necrosis and gangrene in infected tissues and potentially spreading to adjacent tissues, including the abdominal wall. It mainly affects males and requires prompt treatment to prevent potentially life-threatening complications. In Case 1, a 64-year-old man with type 2 diabetes was diagnosed with FG due to a scrotal skin injury after scratching his scrotal skin. The patient underwent radical debridement, treatment with broad-spectrum antibiotics, negative pressure wound treatment, and skin transplantation. In Case 2, a 79-year-old man suffered from a sebaceous cyst of the scrotum that had been scratched for seven days, resulting in black and necrotic skin of the scrotum. He was diagnosed with FG and underwent radical debridement and drainage of pus, followed by anti-infection treatment, negative pressure wound treatment, and skin transplantation. In Case 3, a 48-year-old male injured at the scrotum's base developed swelling, pain, foul odor and pus discharge and was diagnosed with FG. The patient underwent emergency treatment, including incision and drainage of the scrotum and right lower abdominal wall abscess, as well as wound debridement. Ultimately, all three patients' scrotal wounds returned to normal, but Case 2 was complicated by blood vessel thrombosis in both lower limbs. Early surgical debridement is a necessary intervention for FG, along with active postoperative anti-infection treatment and measures to prevent the occurrence of complications.

Keywords

Fournier's gangrene; Case report; Experience exchange

1. Introduction

Fournier's gangrene (FG) is a rare but one of the most serious clinical infections, which can cause severe acute progressive infection and could be life-threatening. It primarily affects the perineum and external genitalia, including the perianal area. FG can lead to the formation of subcutaneous small blood vessel thrombosis, also known as endarteritis obliterans, which can cause gangrene in the skin, and has a mortality rate ranging between 20% and 30% [1]. FG can be caused by Clostridium infection, leading to crepitus upon touching the affected skin. In some cases, gram-positive bacilli can be detected on bacteriological examination, and a routine blood examination may reveal a decrease in red blood cell count and Hb, as well as an increase in white blood cell count. FG diagnosis may be confirmed through anaerobic culture and pathological biopsy. Additionally, it is worth noting that diabetes mellitus (DM) is a comorbidity found in 32–66% of scrotal gangrene patients [2], possibly related to elevated tissue glucose concentration, poor tissue perfusion, weak immune response in diabetics, thereby contributing to faster infections and more rapid systemic sepsis. Therefore, FG patients with DM have a higher rate of scrotal gangrene-related mortality. The primary treatment approach for FG is a combination of wide-spectrum antibiotic therapy and debridement surgery, intending to reduce systemic toxicity, halt the progression of infection, and eliminate pathogenic microorganisms. Proper clinical management is crucial in ensuring positive outcomes and improving patient survival. Through the retrospective study on three cases of FG treated in our department in recent years, all patients have responded well to active clinical treatment, resulting in good prognoses.

2. Case presentation

2.1 Case 1

A 64-year-old male patient developed scrotal skin damage one month ago after scratching his scrotal skin, followed by scrotal swelling and pain. He was admitted to the emergency hospital after experiencing syncope. On physical examination (Fig. 1), the patient's scrotum appeared swollen and spherical, with high skin temperature. Most of the scrotal skin and the skin on the ventral side of the penis exhibited black necrosis and foul

odor, and a small amount of secretion was visible. Ultrasound revealed subcutaneous emphysema of the scrotum, and the patient was diagnosed with FG and had a history of type II diabetes. Laboratory examination revealed a white blood cell count of 14.5 $\times$ 10^9/L, with 92% neutrophils. His random blood glucose level was 24.5 mmol/L, glycated hemoglobin level was 14.2%, blood potassium level was 3.06 mmol/L, hemoglobin level was 128 g/L, and albumin level was 30.2 g/L. In addition, wound culture showed the presence of Escherichia coli, but blood cultures showed no bacterial growth.

FIGURE 1. Typical scrotal gangrene, scrotal swelling, necrosis and blackening of scrotal skin, accompanied by a foul odor. Images taken before the first debridement surgery (25 February 2021).

The patients underwent an emergency operation comprising scrotal exploration, debridement, removal of necrotic tissue, and abscess drainage (Fig. 2), followed by thorough irrigation of the wound with hydrogen peroxide solution (H_2O_2) and normal saline (NS). A sinus tract was discovered at the left root of the penis, which was connected to the subcutaneous area of the pubis, and was drained accordingly. After surgery, the wound was rinsed daily with H_2O_2 and NS, and multiple conservative sharp instrument debridements were performed (Fig. 3).

After the operation, the patient was started on Cefoperazone Sodium and Sulbactam Sodium 1.5 g Every 12 hours (Q12H), and Ornidazole 0.25 g IV three times a day (TID) for anti-infection treatment. However, due to sustained high fever post-surgery, the infection was not effectively controlled, and the antibiotic regimen was changed to Tienam 1 g Q8H and vancomycin 1 g Q12H. Other treatments included pain relief, hemostasis, electrolyte supplementation, and albumin administration. An insulin pump was utilized to continuously adjust and control blood sugar levels dynamically, while a pneumatic pump was used to prevent thrombosis in both lower limbs. Wound exudation was managed to prevent incontinence dermatitis and stress injury. Despite ongoing exudation and

FIGURE 2. After the first debridement, the necrotic skin of the scrotum was removed, and both testicles were exposed. The wound surface was filled with a large amount of purulent secretions (26 February 2021).

FIGURE 3. After surgery, there is still necrotic tissue on the wound surface, and conservative sharp instrument debridement is performed on the wound surface (12 March 2021).

the presence of purulent sinus secretion 18 days post-surgery, negative pressure wound therapy (NPWT) was applied to the wound (Fig. 4). Effective infection control was achieved 28 days post-surgery, after which the wound bed underwent re-debridement, a left thigh skin transplantation, and NPWT. The transplanted skin fully recovered and survived within 13 days after transplantation, the patient was discharged 41 days post-surgery (Fig. 5).

FIGURE 4. Negative pressure wound therapy (NPWT) was applied to the wound to remove necrotic tissue and exudate, reducing the bacterial load (15 March 2021).

FIGURE 5. Image recovered after scrotal skin transplantation (08 April 2021).

2.2 Case 2

A 79-year-old male patient was admitted to the emergency department due to a scrotal rupture that had persisted for 7 days and a fever that had lasted for one day. Physical examination (Fig. 6) revealed significant redness and swelling of the skin in the bilateral inguinal area, perineal area under the scrotum, and perianal area. The patient's scrotum was also swollen with high skin temperature, and necrotic tissue was visible. Some of the skin had become black, ulcerated, and purulent secretions were flowing out, accompanied by foul odor. Ultrasound showed subcutaneous emphysema in the bilateral scrotum, and Computed Tomography (CT) revealed gas accumulation and exudation in the left groin and bilateral scrotum, which led to the diagnosis of Fournier's gangrene.

FIGURE 6. Image of preoperative scrotal Fournier's gangrene (25 April 2021).

Laboratory examination showed a white blood cell count of 19.3×10^9/L and 82.9% neutrophils. The patient's albumin level was 24.4 g/L, blood potassium level was 3.48 mmol/L, serum calcium level was 1.86 mmol/L, glycated hemoglobin level was 6.3%, serum creatinine level was 57.3 umol/L, hemoglobin level was 105 g/L, D-dimer level was 2.03 mg/L, lactate dehydrogenase level was 521 U/L, and C-reactive protein level was 60.3 mg/L. The wound culture revealed the presence of Acinetobacter baumannii and Escherichia coli.

This patient also underwent emergency treatment, which included scrotal exploration, removal of necrotic tissue, incision of abscess, and drainage of the groin, scrotum and perianal area (Fig. 7). The wound was rinsed daily with H_2O_2 and NS, and multiple conservative sharp instrument debridements were performed (Fig. 8).

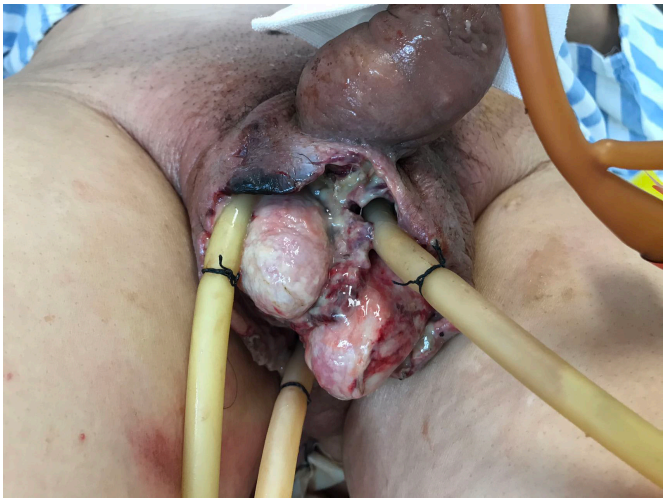

FIGURE 7. Surgical debridement, necrotic resection. Drainage of pus (26 April 2021).

FIGURE 8. Image after multiple conservative sharp instrument debridement (29 April 2021).

After the operation, the patient was given anti-infection treatment with Sulbactam Sodium + ornidazole, analgesia, hemostasis, electrolyte and albumin supplementation, and air pump treatment for both lower limbs to prevent pressure ulcers and incontinence dermatitis. Due to poor infection control, the treatment was changed to Tienam + vancomycin. Effective infection control was achieved 18 days post-surgery, following which the patients underwent wound debridement, free skin transplantation, and wound vac negative pressure suction. They were discharged 25 days post-surgery (Fig. 9). Although the scrotal wound had healed, the patients developed bilateral lower limb vascular thrombosis and continued treatment at a local hospital.

FIGURE 9. Image of the skin graft restored blood circulation after scrotal transplantation (21 May 2021).

2.3 Case 3

A 48-year-old male patient developed swelling and pain in the left scrotum after trauma two weeks ago without seeking medical attention. Over time, the scrotum gradually increased in size and became swollen, eventually leading to an abscess that ruptured on its own, making it difficult for the patient to urinate. The patient was admitted to the emergency department, where a physical examination (Fig. 10) revealed redness and swelling at the root of the scrotum, with significant enlargement, high skin temperature, and tenderness. A small amount of purulent secretions was seen flowing out, accompanied by a foul odor. The patient also had redness and swelling in the right lower abdominal wall. CT scans showed infectious lesions in the testicles, perineum, right middle and lower abdominal wall, pelvic cavity, and gas accumulation, leading to a diagnosis of FG.

FIGURE 10. Image of Fournier's gangrene with scrotum redness and swelling, purulent secretions was seen flowing out, accompanied by a foul odor (25 November 2020).

The laboratory examination revealed a white blood cell count of 24.3×10^9/L, with 92.8% neutrophils. The patient's blood potassium level was 3.2 mmol/L, serum calcium level was 1.87 mmol/L, hemoglobin level was 128 g/L, serum creatinine level was 53.4 umol/L, D-dimer level was 2.33 mg/L, albumin level was 20.8 g/L, alanine transaminase level was 117 U/L, and C-reactive protein level was 264.1 mg/L. The wound culture did not detect any pathogens.

Emergency treatment for the patient included urethral catheterization to resolve dysuria, incision and drainage of the scrotal abscess, incision and debridement of the right lower abdomen, and incision and drainage of the scrotum root (Fig. 11). Following the surgery, the wound was rinsed daily with H_2O_2 and NS. The patient was given anti-infection treatment with Tienam and vancomycin, analgesia, hemostasis, and electrolyte and albumin supplementation (Fig. 12). The patient was discharged 26 days after surgery (Fig. 13).

FIGURE 11. Surgical debridement, exposing the wound surface and drainage of pus through drainage tubes (26 November 2020).

FIGURE 12. Image of wound surface 16 days after surgery (11 December 2020).

3. Discussion

FG is primarily caused by anaerobic or mixed bacterial infections that release various exotoxins, such as lecithin, nucleotidase, hyaluronidase, plasmin, and hemagglutinin under low oxygen conditions. These toxins can cause partial and systemic changes in the affected patient. Early removal of necrotic and inactivated tissue is a crucial step in preventing the progression of FG, and studies have shown that delayed debridement surgery increases the risk of death. According to the literature, the number of debridement surgeries required

FIGURE 13. Image of scrotal wound closed and sutured (16 December 2020).

for patients to recover ranges from 3.1 to 7.3 times [3–5]. Thorough debridement surgery, open wound treatment, and proper drainage are effective measures to reduce the spread of necrotic tissue in FG. Upon admission, all three patients underwent thorough debridement surgery and were placed with drainage tubes. After the surgery, the scrotal wounds were given multiple conservative sharp instrument debridements and rinsed with H_2O_2 and physiological saline, allowing the wound to be in full contact with air to prevent further diffusion of anaerobic bacteria, thereby gradually reducing the malodor and inflammation of the wound.

In most cases, therapy for FG involves the use of two or more antibiotics [6] because the disease is often caused by a mixed infection of two or more pathogenic bacteria. FG is common in patients with weakened immune systems or underlying conditions such as malignant tumors, diabetes mellitus, peripheral vascular disease, intravenous drug addiction, malnutrition, and others [7]. In most cases, FG is caused by pathogens entering through traumatic wounds. In all three cases presented in this article, the infection was caused by bacterial invasion due to skin damage around the scrotum or anus, which developed into scrotal and perineal abscesses. In many clinical settings, subcutaneous soft tissue infections with gas are diagnosed as gas gangrene, even if Clostridium is absent. Diagnosis is typically based on clinical and imaging findings [8]. No Clostridium was detected in the secretion culture of the three patients presented in this article. One patient had an Escherichia coli infection, another patient had both E. coli and Acinetobacter baumannii infections, and the third patient did not have any bacteria in the bacterial culture. Studies indicate that scrotal gangrene wound secretion cultures typically detect an average of four species of microorganisms, with the most common being Streptococcus, Staphylococcus, and Escherichia coli [8]. Antibiotics are just as crucial as debridement surgery, and early antibiotic treatment has

been shown to significantly improve survival rates [9]. The European Urological Association (EAU) recommends using vancomycin/linezolid, quinolones, and metronidazole as the initial antibiotics for scrotal gangrene [10]. When selecting antibiotics for patients, appropriate choices should be based on bacterial culture results and antibacterial susceptibility test results.

Based on the clinical symptoms and various examinations, the three patients described in this article were found to have a wide range of crepitus, scattered gas echoes visible on B-ultrasound and CT, rapid development, and a strong foul odor, all of which are typical signs of FG. We provided anti infection regimens covering Gram negative bacteria, Gram positive cocci, and anaerobic bacteria, and adjusted our medication regimen in a timely manner based on the result of wound secretion culture and consultation opinions of the infection department. During the antimicrobial therapy process, they experienced a sharp decline in hemoglobin levels and difficulty controlling the systemic infection. In such cases, Tienam and vancomycin were selected for treatment. It is crucial to administer a sufficient amount of antibiotics for the full course of treatment, typically 7 days, to prevent the recurrence of infection even when symptoms and test indicators are normal. Maintaining the correct blood concentration of antibiotics is also crucial [11], and strict control of the drip rate and administration time is essential.

Maintaining normal blood sugar levels is beneficial for the effectiveness of antibiotics and the early healing of wounds. Individuals with diabetes are more susceptible to infections due to their disordered glycometabolism, which can lead to decreased immune function and impaired host defense mechanisms. High blood and urine glucose level in the internal environment of diabetics can promote the growth of bacteria and viruses, especially gram-negative bacilli such as monilia, bacillus septicus sputigenus, and bacillus coli. Additionally, ischemia and hypoxia caused by angiopathy in DM create a favorable environment for the growth of anaerobic bacteria [12]. More than 80% of patients with FG have diabetes mellitus, making it the most common predisposing factor for scrotal gangrene [13]. In this article, one case had a history of type 2 DM for more than 7 years, with poor blood glucose control. Therefore, strict control of blood glucose is especially important in treatment. Comparatively, the other two patients had no DM history, with normal blood glucose levels at diagnosis. Effective control of blood glucose can help inhibit the spread of infection, and it requires regular monitoring of blood glucose, adjusting insulin and dosage according to blood glucose levels, and maintaining blood glucose at normal levels. In this study, patients used insulin pumps to control blood sugar. Related studies have shown that insulin pumps are convenient and economical, especially for patients with poor glycated hemoglobin control [14].

Malnutrition and low socioeconomic status have also been shown to be associated with the development of FG [15]. Adequate systemic nutrition and maintenance of electrolyte and acid-base balance are essential for combating septic shock and improving survival. Shock is a common complication of FG, and its condition can worsen rapidly. Therefore, systemic nutritional support and maintenance of electrolyte balance are crucial in treating gangrene. Serious infection can lead to high consumption of patients, who should be given a high-calorie, high-protein, and high-vitamin diet to support their recovery. To maintain stable blood glucose control, patients should be encouraged to eat regularly, and their electrolyte levels, hemoglobin, and albumin should be monitored. Active supportive care should be given to patients, including blood and albumin transfusions and electrolyte supplementation based on electrolyte test results. Timely correction of electrolyte imbalances can reduce the incidence of poor prognosis. Due to infection and long-term wound exudation, the patient's red blood cell count and hemoglobin may continue to decline. At this time, prompt correction of anemia and blood volume supplementation should be administered. In this study, all three cases had hypoproteinemia and hypokalemia. Despite receiving intravenous supplementation of albumin and potassium, the recovery rate of these nutrients was slow or even decreased during the entire treatment process. Therefore, a more comprehensive nutrition plan should be developed that simultaneously includes enteral and parenteral nutrition to address these deficiencies more effectively.

NPWT has played an important role in the treatment of acute and chronic wounds in recent years [16]. Firstly, the sealed environment created by the dressing isolates the wound from external contaminants, including bacteria from fecal matter. Secondly, continuous negative pressure suction can remove necrotic tissue and exudate, reducing the bacterial load and avoiding the absorption of harmful substances. Additionally, the negative pressure suction device on the wound provides constant pressure, which promotes closer attachment of skin grafts to the wound bed. Moreover, NPWT may reduce the afterload on the microvasculature, increasing local blood flow velocity and blood flow, thereby ensuring smooth local blood circulation and improving the survival rate of skin grafts [17].

Active control of other complications, such as pressure ulcers, incontinence dermatitis and thrombosis, of FG can speed recovery. To prevent pressure ulcers, an air cushion bed was used, and the patient was regularly repositioned. After the surgery, a large amount of oozing fluid was observed on the scrotal wounds. Thus, we placed them in a semi-lying position, which is conducive to drainage of oozing fluid and to timely clean it and keep the skin dry. A pneumatic pump was used to treat both lower limbs and prevent thrombosis, but one patient still developed lower limb thrombosis. This may have been due to a combination of patient inactivity, prolonged bed rest, slow blood flow, and the hypercoagulable state of the blood, along with drainage that may have damaged the blood vessel wall. Therefore, in the future, in addition to the use of pneumatic pump, it is recommended to use anticoagulants [18], such as hypodermic injection of enoxaparin sodium injection, in the early stage to prevent the occurrence of deep vein thrombosis.

4. Conclusions

For the management of FG, thorough debridement surgery and proper wound care are crucial for preventing the spread of infection. The appropriate and rational use of antibiotics can effectively control the infection. Maintaining normal blood glucose levels is important for enhancing the effectiveness of

antibiotics and facilitating wound healing. Proper systemic nutritional support and electrolyte balance are critical for improving survival and preventing septic shock. Additionally, active management of various complications is necessary for a successful recovery and restoring patients' conditions and quality of life.

AVAILABILITY OF DATA AND MATERIALS

The data presented in this study are available on reasonable request from the corresponding author.

AUTHOR CONTRIBUTIONS

WC, YJW and XYC —designed the research study. WC and JW—performed the research. WW—provided help and advice on designing. YZ—analyzed the data. WC and ESZ—wrote the manuscript. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study was approved by the Ethics Committee of the Nanjing Drum-Tower Hospital, Nanjing, China (number: 2021-359-02) and conformed to the standards set by the latest revision of the Declaration of Helsinki. Written informed consent was obtained from all study participants.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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