REVIEWS

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A Complex Approach to the Treatment of Fournier's Gangrene

Kompleksowe podejście do leczenia zgorzeli Fourniera

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Abstract

Fournier's gangrene is a necrotizing, life-threatening fasciitis of the perineal, genital and perianal region which can spread to the abdominal wall, causing soft-tissue necrosis and sepsis. It is usually a polymicrobial infection. The prevalence of the disease is low, but the mortality rate remains high. Several urogenital and anorectal diseases, as well as diabetes mellitus and conditions associated with the immunosuppressive reaction, may predispose an individual to the development of Fournier's gangrene. A diagnosis of Fournier's gangrene is clinical, but radiological examinations may be helpful in establishing the extent of the necrotic process. The treatment consists mainly of aggressive surgical debridement, broad-spectrum antibiotic combinations and hyperbaric oxygen therapy. The Fournier's gangrene severity index (FGSI) score can be used to evaluate patients. Because of its heterogeneity and aggressiveness, Fournier's gangrene is a very serious and complex medical condition that should be under the care of an interdisciplinary team with access not only to the best surgical and critical care but also to a hyperbaric chamber (**Adv Clin Exp Med 2013, 22, 1, 131–135**).

Key words: gangrene, debridement, infection, hyperbaric oxygenation.

Streszczenie

Zgorzel Fourniera jest martwiczym, zagrażającym życiu zapaleniem powięzi okolicy krocza, narządów płciowych zewnętrznych oraz odbytu, które może rozciągać się w kierunku jamy brzusznej i skutkować martwicą tkanek miękkich oraz rozwojem sepsy. Zakażenie jest zwykle wywoływane mieszaną florą bakteryjną. Częstotliwość występowania choroby jest mała, śmiertelność jednak pozostaje wciąż duża. Niektóre schorzenia okolicy moczowo-płciowej oraz anorektalnej, a także cukrzyca oraz schorzenia związane ze stanem immunosupresji w organizmie mogą predysponować do rozwoju zgorzeli Fourniera. Rozpoznania zgorzeli Fourniera dokonuje się na podstawie objawów klinicznych, przy czym badania obrazowe mogą być pomocne w ocenie zaawansowania procesu martwiczego. Postępowanie terapeutyczne składa się głównie z agresywnego chirurgicznego wycięcia tkanek martwiczych, kombinacji antybiotyków o szerokim zakresie działania oraz zastosowania terapii tlenem hiperbarycznym. Do oceny pacjentów może posłużyć Skala Oceny Ciężkości Zgorzeli Fourniera. Zgorzel Fourniera ze względu na swoje zróżnicowanie i agresywny przebieg jest bardzo poważnym i złożonym problemem medycznym, które wymaga leczenia interdyscyplinarnego z dostępem nie tylko do najlepszych specjalistów z zakresu chirurgii oraz intensywnej terapii, lecz także do komory hiperbarycznej (**Adv Clin Exp Med 2013, 22, 1, 131–135**).

Słowa kluczowe: zgorzel, usunięcie tkanek martwiczych, zakażenie, terapia tlenem hiperbarycznym.

Fournier's gangrene (FG) was first mentioned by Baurienne in 1764, but a detailed description of this disease as a fulminant gangrene in the region of the penis and scrotum in a young male was made by the French venorologist Jean Alfred Fournier in 1883 [1].

Epidemiology

Fournier's gangrene is a rare condition with an incidence of 1.6 cases per 100,000 males per year, representing less than 0.02% of admissions to hospitals. The mean age of patients with FG is 50.9 years [2]. The male:female ratio is about 10 : 1 [3]. The mortality rate varies from 0% to 88%. In the largest study of FG, comprising 1726 patients, Eke reported an overall mortality rate of 16%; and in a study of 1680 patients, Sorensen et al. reported mortality rates of 7.5% in men and 12.8% in women, but this difference was not statistically significant [2, 4].

Etiology

At the time of the first description of the disease its cause was unknown. Nowadays, scientists know more about the etiopthogenesis of FG. It usually represents a polymicrobial infection. The responsible bacterial species include both aerobic and anaerobic strains: *E. coli*, Streptococcus species, *Staphylococcus*, *Enterococcus* and *Bacteroides* [1]. In patients who were hospitalized for a longer time, MRSA and Candida species were isolated [5–7]. The bacterial infection leads to thrombosis of small subcutaneous vessels and tissue necrosis, which leads to low concentrations of oxygen and the growth of anaerobes. Diabetic microangiopathy further limits tissue oxygenation. Aerobes and anaerobes act synergistically and produce enzymes like collagenase, heparinase, hyaluronidase, streptokinase and streptodornase, which destroy the tissues. The vascular thrombosis and dermal necrosis are due to the activity of the heparinase and collagenase produced by aerobes. The impaired activity of phagocytic leucocytes in necrotic tissue is responsible for the spread of the infection, because they require oxygen for the production of antibacterial high energy radicals [1, 8].

General conditions that may predispose an individual to the development of FG are diabetes mellitus, steroid therapy, chronic alcohol abuse, older age, HIV infection, cardiac disorders, systemic lupus erythematosus, renal failure, diseases of the peripheral arteries, chemotherapy and malignancies [1, 3].

Local factors include urological pathologies (e.g., urological surgery, urinary tract infection, paraphimosis, urethral stricture, traumatic catheterisation), anorectal pathologies (e.g, ischiorectal, perianal and intersphincteric abscess, proctological surgery, rectal trauma) and dermatologic conditions (purulent skin infections, allergic reactions) [9].

Diagnosis

A diagnosis of FG is based on clinical symptoms which include genital discomfort and pruritus in the prodromal period, followed by scrotal edema, genital erythema, scrotal pain, partial necrosis, induration, crepitations, feculent odor and fever. Not all the symptoms must be present, making an early differential diagnosis from other soft tissue infections very difficult [1, 10].

Radiological examinations may be helpful in establishing the extent of the necrotic process rather than in the diagnosis. A plain radiograph may detect air in soft tissues, whereas ultrasonography, computed tomography and magnetic resonance imaging may detect deeply positioned foci like an ischiorectal abscess or other sources of infection in patients without clinical improvement after surgical debridements [9, 11, 12].

Treatment

Early and aggressive surgical debridement of necrotic tissue is the key to successful treatment of FG [12]. Empirical broad-spectrum antibiotic therapy (penicillin, metronidazole and third-generation cephalosporin with gentamicin) should be introduced before surgical treatment and changed according to the culture findings [11]. Surgical debridements should entail wide excision of the necrotic tissue and should be repeated as the necrosis progresses. The patient's usually poor general condition, inadequate fluid resuscitation, the need for strict monitoring, proper and frequent wound dressing and repeated wide debridements are factors that usually qualify the patient to be treated in the intensive care unit [3]. In individual cases with extensive urethral or penile involvement, urinary diversion in the form of a suprapubic cystostomy may be indicated, but usually urinary catheterization provides a satisfactory diversion [3, 11]. Because it increases morbidity, colostomy is reserved only for selected cases involving the anorectal area and sphincter with a high risk of fecal contamination [11]. Very rarely, orchidectomy and penis amputation are necessary in patients with FG [12]. The surgical wounds are usually left for secondary healing or delayed primary wound closure, but patients with large tissue defects are candidates for reconstructive surgery with local skin flaps or skin grafts [11].

Hyperbaric oxygen therapy (HBOT) is a recognized additional form of treatment in FG, which is officially accepted by the Undersea and Hyperbaric Medical Society. HBOT is performed in 100% oxygen at 2.5 absolute atmospheres (2.5 ATA) of

pressure for 90 to 120 minutes. HBOT reduces the hypoxic dysfunction of leukocytes and has a direct antibacterial effect against anaerobes. It has been found that the activity of endotoxins produced in some clostridial species is diminished when the level of tissue oxygen is elevated. HBOT can also enhance the penetration of some antibiotics into bacterial cells and increase the post-antibiotic effect for aminoglycosides and Pseudomonas. HBOT plays an important role in wound healing, angiogenesis, the stimulation of fibroblasts and the production of granulation tissue [8, 11, 13].

Prognosis

Despite aggressive treatment of FG, the mortality rate can reach as high as 88% [2]. The causes of death in patients with FG are severe sepsis, coagulopathy, acute kidney failure, diabetic ketoacidosis and multiple organ failure. It has been found that aggressive and early surgical debridements have a positive effect on survival, but the number of performed debridements does not influence the patient outcome [10]. On the basis of their own and other authors' observations, Ulug et al. reported that patients with renal dysfunction had a higher mortality rate [10, 14]. There is no agreement among authors as to whether age, diabetes and the extent of body surface area affected are factors that significantly influence the patient outcome [1, 8, 10, 15].

In 1995 Laor et al. developed the Fournier's gangrene severity index (FGSI) in an attempt to assess the severity of the disease. In the FGSI, nine parameters are measured and the degree of deviation from normal is graded from 0 to 4. The values are then added to obtain the FGSI score (FGSIS). The nine parameters are temperature, heart rate, respiratory rate, serum sodium and potassium, creatinine and bicarbonate levels, hematocrit and leukocyte count (Table 1). Laor et al. found that patients with FGSIS > 9 had a 75% probability of death, and that those with FGSIS ≤ 9 had a 78% probability of survival [10, 15, 16]. In studies by Yeniyol et al. and Ulug et al., there was a strong

Table 1. The Fournier's Gangrene Severity Index

Tabela 1. Skala Oceny Ciężkości Zgorzeli Fourniera

Parameters (Wskaźniki)	High abnormal values (Wartości nieprawidłowe za wysokie)				Normal values (Wartości prawidłowe)	Low abnormal values (Wartości nieprawidłowe za niskie)			
	+4	+3	+2	+1	0	+1	+2	+3	+4
Temperature (Temperatura) [°C]	> 41	39–40.9	–	38.5–39.8	36–37	34–35.9	32–33.9	30–31.9	< 29.9
Pulse (Tętno) [/min]	> 180	140–179	110–139	–	70–109	–	55–69	40–54	< 39
Respiratory rate (Częstotliwość oddechów) [/min]	> 50	35–49	–	25–34	12–24	10–11	6–9	–	< 5
Sodium (Sód) [mmol/l]	> 180	160–179	155–159	150–154	130–149	–	120–129	111–119	< 110
Potassium (Potas) [mmol/l]	> 7	6–6.9		5.5–5.9	3.5–5.4	3–3.4	2.5–2.9	–	< 2.5
Creatinine (Kreatynina) [mg/ml]	> 3.5	2–3.4	1.5–1.9	–	0.6–1.4	–	< 0.6	–	–
Hematocrit (Hematokryt) [%]	> 60	–	50–59.9	46–49.9	30–45.9	–	20–29.9	–	< 20
Leukocytosis (Leukocytoza) [$mm^3 \times 1000$]	> 40	–	20–39.9	15–19.9	3–14.9	–	1–2.9	–	< 1
Bicarbonate (Dwuwęglan) [mmol/l]	> 52	41–51.9	–	32–40.9	2–31.9	–	18–21.9	15–17.9	< 15

From Laor et al. [16].

Z Laor et al. [16].

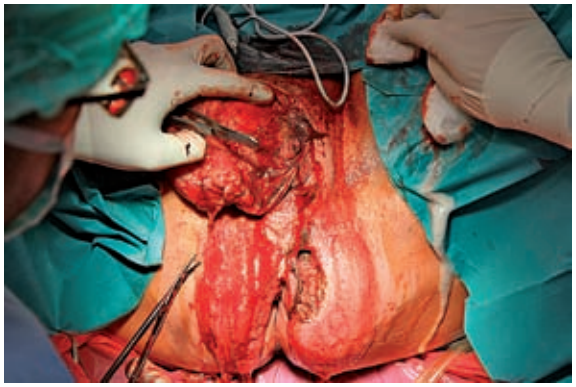

Fig. 1. The first surgical debridement after admission to the hospital

Ryc. 1. Pierwsze wycięcie chirurgiczne tkanek martwiczych po przyjęciu do szpitala

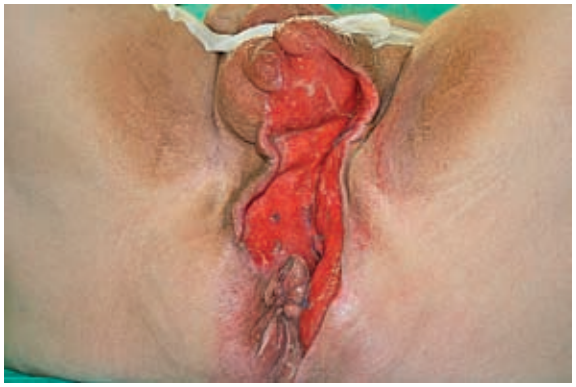

Fig. 2. After several debridements the wound was left open for secondary healing. The healing process was supported by HBOT

Ryc. 2. Po kilku wycięciach chirurgicznych tkanek martwiczych rana została pozostawiona do gojenia przez ziarninowanie. Proces gojenia był wspomagany przez terapię tlenem hiperbarycznym

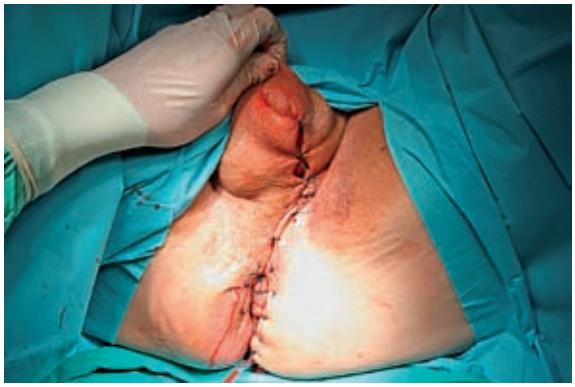

Fig. 3. Delayed primary wound closure

Ryc. 3. Pierwotnie odroczone zamknięcie rany

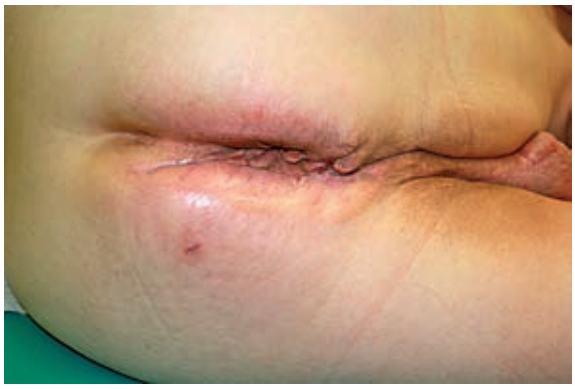

Fig. 4. The wound after successful treatment of FG

Ryc. 4. Rana po pomyślnym leczeniu zgorzeli Fourniera

correlation between an FGSIS of 9 and the mortality rate ($p \leq 0.0001$) [10, 15]. In studies by Janane et al. and Tuncel et al., the differences between survivors' FGSIS and non-survivors' FGSIS were not significant [8, 10, 17]. The proponents of the FGSI consider it an objective and simple method that can be used clinically to evaluate therapeutic options and assess results [10, 15].

The authors who used HBOT in treating their patients believe that it was connected with a lower mortality rate. Korhoen et al. found that in patients without HBOT, the mortality rate ranged between 18% and 50%, and in patients with HBOT the mortality rate was 20% or less [14, 18]. The availability of HBOT is limited and it is mentioned only by a handful of authors, but it should be used more often in the treatment of FG because of its beneficial impact on survival and the wound healing process [5, 11, 19].

Figures 1–4 present a 60-year old male with Fournier's gangrene who was treated at Wroclaw Medical University's Department of Minimally Invasive Surgery and Proctology in 2011. This patient was an example of successful treatment of FG consisting of repeated surgical debridements, antibiotic therapy and HBOT.

The key to successful treatment of FG is an early diagnosis and therapy which should include aggressive surgical debridement(s), antibiotics, HBOT, proper wound care and, in selected patients, colostomy or cystostomy. Patients with FG should be very carefully monitored, usually in an intensive care unit, and should have an unlimited access to consultations by experienced surgeons and urologists. It follows that the best chances of survival for patients with FG are in high-volume and specialized centers with proctological, surgical, urological and intensive care wards, and with constant access to hyperbaric chamber and microbiology laboratory.

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