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Prognostic Factors for Fournier's Gangrene; A 10-year Experience in Southeastern Iran

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ABSTRACT

Objectives: To describe the characteristics and prognostic factors of 28 patients with Fournier's Gangrene (FG) referred to our medical center at Southeastern Iran.
Methods: This was a cross-sectional study including 28 cases of FG that were operated in Surgery department of Zahedan University of Medical Sciences during a 10-year period from April 2002 to March 2012. The study analyzed 9 parameters including the body temperature, heart rate, respiratory rate, hematocrit, white blood count (WBC), and serum levels of sodium, potassium, creatininee (twice for 2 for acute renal failure), and bicarbonate for Fournier Gangrene Severity Index (FGSI) score. The aspects taken into account were age, gender, predisposing factors, duration of symptoms, hospitalization period, and number of debridements, disease outcome and the FGSI.
Results: All patients were males, aged from 26 to 68 years, with mean age 44.6 ±8.49 years. Statistically significant differences in age (p<0.001), duration of symptoms (p=0.001), number of debridements (p=0.006), hospitalization duration (p<0.001) and FGSI (p<0.001) were found between surviving and dead patients. The mortality rate was 35.7%, and the most common presentation was perianal/scrotal pain (78.6%). Perianal and primary scrotal abscesses were most common causes of FG and were found in 57.14% and 21.42% of patients respectively. The most prevalent predisposing factor was diabetes mellitus in 12 (42.85%) patients. With respect to laboratory findings, statistically significant differences in WBC (p=0.002), creatinine (p<0.001), albumin (p<0.001), calcium (p<0.001) and serum sodium (p=0.035) were found between the surviving and dead patients.
Conclusion: Serious outcome of FG was associated with old age, delayed diagnosis and treatment, inadequate surgical debridement, shorter hospitalization and higher FGSI scores. In addition higher WBC, higher creatininee and serum sodium and lower albumin and calcium levels implicated worse prognosis.

Keywords: Fournier's gangrene; Prognosis; Prognostic factors; Iran.

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Introduction

Fournier's gangrene (FG) is an uncommon severe infection involving the subcutaneous soft tissue, particularly the superficial and often the deep fascia. Despite its low prevalence (3 to7/1000000), the mortality is more than 30%, and even more than 70% when associated with toxic shock syndrome [1,2].

It spreads from the external genitalia through the inguinal region towards the thighs and finally to the peritoneum along the fascia [3]. The disease is not limited to young individuals, nor is it limited to men [4]. Anorectal and urogenital infections and trauma play an important role in the etiology. Diabetes mellitus (DM), steroid use, old age, chronic ethanol abuse, malignancies, liver and kidney diseases, local traumata and obesity have been found as risk factors for FG [5-8].

Its clinical presentation is variable, but is often

associated with edema, erythema, pain and fever; the crepitus is present in 50-62% of cases [9]. The average time interval from onset of specific symptoms to the request for medical care ranges from 2 to 7 days. This time determines the extent of the necrotic area and a critical influence on the prognosis [10]. Imaging studies by X-rays are useful in demonstrating accumulation of gas in soft tissues. Additionally, the ultrasound is more useful in revealing diffuse edema, thickness of the scrotal wall and possibly the penis and the presence of escrotal gas [9]. Early surgical debridement of necrotic tissues and administration of antibiotics are crucial in the treatment of FG. Despite advanced management, mortality is still high and averages 20% to 30% [11].

The present study was conducted to determine clinical, laboratory and therapeutic aspects of FG and to analyze the outcome, identify the associated risk factors and prognostic indicators of FG using Fournier Gangrene Severity Index (FGSI) in a group of Iranian patients from Southeastern Iran.

Materials and Methods

Study population

The present retrospective cross-sectional study reviewed the medical records of 28 consecutive patients with FG admitted to the hospitals affiliated with Zahedan University of Medical Sciences during a period of 10-year from April 2002 to March 2012. The diagnosis of FG was established clinically on the basis of the patient's history, physical examination and by radiological imaging in selected cases. The inclusion criteria were patients undergoing wide surgical excision of scrotal and/or perineal necrosis along with other involved areas with a postoperative diagnosis of FG. Patients with solitary perianal, scrotal and periurethral abscesses were excluded, if there was no extension of cellulites and necrosis to surrounding tissues. The study protocol was approved by institutional review board (IRB) and ethics committee of Zahedan University of Medical Sciences. As this was a retrospective study, no informed written consents were required for the inclusion of the patients.

Study protocol

FGSI scores were determined using 9 parameters including the body temperature, heart rate, respiratory rate, hematocrit, white blood cell count, and serum levels of sodium, potassium, creatininee (performed twice in acute renal failure), and bicarbonate (Table 1) [12]. These parameters were measured and the degree of deviation, whether positive or negative, from the normal values was graded from 0 to 4. The total value was considered as the FGSI [12]. In addition, serum levels of calcium, and albumin, as well as fasting blood glucose and blood urea nitrogen (BUN) were measured.

Before the operation, all patients underwent aggressive fluid resuscitation and were treated with parenteral broad-spectrum triple antimicrobial agents, using a third-generation cephalosporin with an aminoglycoside and/or metronidazole, with dose adjustment according to renal status, and received haemodynamic support if needed.

Prolonged mechanical ventilation, invasive monitoring and ionotropic support were necessary in patients with cardiopulmonary failure due to sepsis. Coagulopathy was treated aggressively by using blood component therapy. Following the optimum radical and aggressive debridement, all necrotic skin, subcutaneous tissue, fascia and apparent non-viable muscle were removed and sent for microbiological and histological examination. The areas of debridement were packed with dressings soaked in hydrogen peroxide and povidone iodine. After the initial surgery, the wound was closely monitored, adequate nutrition was ensured to support wound healing along with administering early enteral or parenteral supplements. Regarding the high risk for progressive infection and significant necrosis of the wound margins, patients

Table 1. Fournier's gangrene severity index (FGSI) (12).

	High abnormal values					Low abnormal values			
	+4	+3	+2	+1	0	+1	+2	+3	+4
Temperature (°C)	>41	39-40.9	—	38.5–35.9	36–38.4	34–35.9	32–33.9	30–31.9	<29.9
Heart beat	>180	140–179	110–139	—	70–109	—	56–69	40–54	<39
Respiration rate	>50	35–49	—	25–34	12–24	10–11	6–9	—	<5
Serum sodium	>180	160–179	155–159	150–154	130–149	—	120–129	111–119	<110
Serum potassium	>7	6–6.9	—	5.5–5.9	3.5–5.4	3–3.4	2.5–2.9	—	<2.5
Serum creatinine	>3.5	2–3.4	1.5–1.9	—	0.6–1.4	—	<0.6	—	—
Hct (%)	>60	—	50–59	46–49.4	30–45.9	—	20–29.9	—	<20
WBC	>40	—	20–39	15–19.9	3–14.9	—	1–2.9	—	<1
Serum bicarbonate	>52	41–51.9	—	32–40.9	22–31.9	—	18–21.9	15–17.9	<15

—: not applicable; Hct: Hematocrit; WBC: white blood cell.

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underwent repeated wound cleansing for further removal of necrotic tissues 1 or 2 days after the first debridement. The number of debridements was defined as cleansing carried out at operating room under general anaesthesia, and not those performed at bedside with local anaesthesia. Closure of wounds was commenced as soon as healthy, viable tissue allowed re-approximation. Also split-thickness skin graft or rotational cutaneous flaps were used to repair large defects if necessary. If debridement resulted in exposure of the testes, the testes were temporarily implanted into a medial thigh pouch until healing or until reconstruction was complete. Colostomy was carried out for faecal diversion when infection originated from anorectum, with infected sphincter. Furthermore, evidence of a rectal perforation and a large rectal wound or persistence of systemic sepsis was indicative of colostomy, despite optimal radical debridement. Suprapubic cystostomy was required when there was gross urinary extravasation or periurethral inflammation. Orchidectomy was not necessary unless testicular gangrene was present. If penile skin was affected, split-thickness skin graft was carried out using skin from the inguinal area. Mortality was defined as disease-related death during the hospital stay.

Statistical analysis

All data were collected and analyzed using SPSS version 15.0. For nonparametric data, statistical evaluations were performed by Mann-Whitney test, and for parametric data, statistical evaluations were carried out by independent t-test, with $p<0.05$ considered as statistically significant.

Results

All of the patients were males with mean age 44.6 ± 8.49 years (range, 26 to 68 years). The mean age was 39.38±8.89 years for the surviving and 54.1±7.79 years for the dead patients (Table 2). The mean duration of symptoms at presentation was 13.6±4.57 days (range, 2 to 30 days) which was 10.38±3.75 days in surviving, but 19.6±6.07 days in those who died (Table 2). Of the 28 patients studied, 18 (64.3%) survived and 10 (35.7%) died with overall mortality rate of 35.7%. Single debridement was carried out in 7 (25%) patients and repeat debridements were performed in 21 (75%). The mortality rate was 28.57% in the single debridement group and 38.09% in repeat debridements. However, the differences between these rates were not statistically significant ($p>0.05$). Median number of surgical debridements was 2.61±1.03 in surviving and 1.5±0.7 in dead patients. The number of debridements were significantly different between surviving and dead patients ($p=0.006$).The mean duration of hospitalization was 17.22±5.73 (range, 6 to 40), which was 24.83±8.29 in surviving and 13.0±4.32 in dead patients. The mean FSI was 8.29±2.10 (range, 2 to 16) which was 4.77±1.89 for survivors and 12.6±2.22 for non-survivors (Table 2). As demonstrated in Table 3, the most common etiologies of FG were perianal abscess (57.14%) and primary scrotal abscess (21.42%). Other causes of FG were periurethral abscess (10.7%), trauma (7.14%) and postoperative wound infection (3.57%).

As shown in Table 4, the most common presentation was perianal/scrotal pain (75%) and swelling (71.4%), followed by redness (60.71%),tachycardia(57.14%), purulent discharge from the perineum (50%), fever (42.85%). crepitus (32.1%) ,tenderness(21.4%) and hotness(10.7%). Colorectal, urologic, and cutaneous lesions were found in 14 (50.0%), 10 (35.7%), and 4 (14.28%) patients respectively.

The most common predisposing factor was diabetes mellitus (42.85%). Four patients (14.28%) had a history of local trauma to perineum due to car accident. Other predisposing factors included paraplegia (10.7%), end-stage liver disease and cirrhosis from hepatitis B (7.4%), alcohol abuse (3.57%), and malignancy (3.57%). Of these 1 patient (3.57%) was homosexual and 1subject (3.57%) was drug abuser and none were immunocompromised. However, in the remaining 2 patients, predisposing factors could not be identified (Table 3).

Colostomy was carried out in 12 (42.85%) patients of whom 4 were in the initial radical debridement and

Table 2. Comparing the patients' characteristics between survivals and non-survivals.

Patient characteristics	Survivors (n=18)	Non-survivors (n=10)	*P*-value
Age (years, mean ± SD)	39.38 ± 8.89	54.1 ± 7.79	<0.001
Duration of symptoms (days)	10.38 ± 3.75	19.6 ± 6.07	0.001
Number of debridements	2.61 ± 1.03	1.5 ± 0.7	0.006
Hospitalization duration (days)	24.83 ± 8.29	13.0 ± 4.32	<0.001
FSI[a]	4.77 ± 1.89	12.6 ± 2.22	<0.001

[a]FSI: Fournier's Severity Index

Table 3. Mortality rates according to etiological and predisposing factors of 28 patients with Fournier's gangrene.

	Number (%)	Mortality (%)
Etiological factors		
Perianal abscess	16 (57.14)	5 (31.25)
Scrotal abscess	6 (21.42)	2 (33.3)
Periurethral abscess	3 (10.7)	0 (0.0)
Trauma	2 (7.4)	0 (0.0)
Postoperative wound infection	1 (3.57)	0 (0.0)
Predisposing factors		
Diabetes mellitus	12 (42.85)	5 (41.66)
local trauma to perineum	4(14.28)	1(25)
Paraplegia	3 (10.7)	1(33.3)
Chronic alcoholism	1 (3.57)	1(100)
End-stage liver disease	2 (.14)	1(50)
Malignancy	1 (3.57)	0 (0.0)
homosexual	1 (3.57)	0 (0.0)
IV drug abuser	1 (3.57)	1(100)
Alcohol abuse	1 (3.57)	0 (0.0)

8 were in repeat debridement groups. In 7 surviving patients who had undergone colostomy one had permanent colostomy because of anal incontinence. Foley catheter was applied to all patients; however, suprapubic catheter was required in only four patients (14.28%). Orchidectomy was carried out unilaterally for gangrenous testes in one patient.

Penile skin graft was required in four patients.The testes were temporarily implanted into a medial thigh pouch in two patients for testicular protection until subsequent definitive reconstruction .In two cases, a rotational cutaneous flap was also used to repair large defects.

Bacteria isolated, in decreasing frequency, from wounds are demonstrated in Table 4 and included Escherichia coli (35.7%), Bacteroides spp. (35.7%), Streptococcus spp. (28.57%), Enterococcus spp. (21.42%), Staphylococcus spp. (17.85%), Pseudomonas spp. (14.28%), Klebsiella pneumonia (14.28%) and Proteus spp. (10.7%), but mixed cultures prevailed in most cases. However, with respect to outcome, no significant differences were found between bacterial organisms cultured from the wounds.

The analyses of laboratory findings compared between survivors and non-survivors are shown in Table 5. White blood cell count, Serum Sodium, creatinine, albumin and calcium were statistically different between two groups. The mean of white blood cell count in survivors was within normal range which in 4 patients it was in upper normal range, while in non-surviving patients only one case was in upper normal range. Serum sodium and creatinine was upper in non-survivors than survivors. Albumin and calcium is within normal range in survivors and lower than normal range in non-survivors.

Table 4. Mortality rates according to symptoms, physical and laboratory findings and the most frequent bacterial organisms cultured from wounds of 28 patients with Fournier's gangrene.

	Number (%)	Mortality (%)
Symptoms and physical findings		
Perianal/scrotal pain	21(75)	6(28.57)
Perianal/scrotal swelling	20 (71.4)	5 (25)
redness	17(60.71)	4(23.52)
Tachycardia	16 (57.14)	5 (31.25)
Purulent discharge	14 (50)	4 (28.57)
Fever	12 (42.85)	3 (33.3)
Crepitus	9 (32.1)	3 (25)
Tenderness	6(21.4)	2(33.3)
hotness	3(10.7)	1(33.3)
Organism		
Escherichia coli	10 (35.7)	4 (40)
Bacteroides spp.	10 (35.7)	4 (40)
Streptococcus spp.	8 (28.57)	3 (37.5)
Enterococcus spp.	6 (21.42)	2 (33.3)
Staphylococcus spp	5 (17.85)	2 (40)
Pseudomonas spp.	4 (14.28)	1 (25)
Klebsiella pneumoniae	4 (14.28)	2 (50)
Proteus spp.	3 (10.7)	2 (66.66)

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Table 5. Comparison of laboratory findings in survivors and non-survivors.

	Survivors (n=18)	Non-survivors (n=10)	*P* value
WBC[a] count (×10³/µlit)	7000 ± 4614	13350 ± 3873	0.002
Serum Sodium (mmol/l)	131.44 ± 29.8	133.9 ± 4.17	0.035
Serum Potassium (mmol/d)	4.17 ± 0.30	4.41 ± 0.46	0.245
Creatinine(mg/dl)	1.43 ± 0.43	2.69 ± 0.88	<0.001
Albumin(g/dl)	4.25 ± 0.44	1.81 ± 0.34	<0.001
BUN[b] (mmol/l)	56.1 ± 19.8	100.6 ± 62.2	0.057
Calcium(mg/dl)	9.5 ± 1.42	5.95 ± 0.67	<0.001
Hematocrit(%)	36.5 ± 5.33	39.5 ± 3.02	0.16

[a]WBC: White Blood Cells
[b]BUN: Blood Urea Nitrogen

Discussion

FG was first described by Fournier in 1883 as an idiopathic condition, but in most cases a perianal infection, urinary tract infection and local trauma or a cutaneous source can be identified. Despite extensive modern antibiotic regimens, aggressive debridements, improved wound care, supportive care, intensive care monitoring and anaesthetic techniques, the reported overall mortality rates in FG ranges from 3 to 67%.This is due to disseminated intravascular coagulopathy or severe sepsis leading to multiorgan failure. The high mortality reflects both the aggressive nature of the infection and the destructive effect of accompanying predisposing factors [12-18].

The clinical signs and symptoms of FG in our patients were similar to those described previously [12,13,19]. After an indistinct prodromal period consisting of local discomfort and fever, patients developed typical presentations of crepitus, swelling, and erythema. In patients with severe clinical presentations, progression of the gangrenous process leading to malodorous drainage and sloughing in affected sites were present and resulted in deterioration of the patients' conditions. Considering the rapid spread of the gangrenous area that is reported to be up to 2 cm/h to 3 cm/h, prompt diagnosis and appropriate emergent management seems to be vital [19].

Although Laor and colleagues claimed that the interval between the onset of the disease and the hospital admission does not impact the prognosis and clinical outcomes, the mortality rate may increase in patients with significant delay in admission to the medical center [12,20]. Since FG usually begins and progresses suddenly, it must be diagnosed and treated immediately. The duration of symptoms before being admitted to hospital was 6.4 days and 3.5 days according to the reports of Basoglu *et al*. and Yanar *et al*. respectively [5,21]. In our study the mean duration of symptoms at presentation was 13.6±4.57 days which were significantly different between survivors and non-survivors.

Aggressive surgical debridement continues to be the cornerstone of treatment of FG [14]. Chawla *et al*. found that survivors and non-survivors had on the average 2.3 and 5.2 surgical debridements respectively. They attributed these differences to the fact that patients with more serious conditions, which did not survive, required multiple debridements in contrast to survivors with less severe disease and smaller affected areas which did not need frequent wound cleansing [14]. However, Laor *et al*. and Palmer *et al*. showed that repeated surgical debridements did not appear to influence patients' outcome [12,15]. However, the number of debridements in survivors was higher in our study which was in contrast to other reports. The difference can be explained by the fact that in non-survivors there was not enough time to perform repeat surgical debridement, but repeated cleansing salvaged the lives of survivors. However, Basoglu M *et al*. claimed that survivors were healthy enough to tolerate further debridement and this caused longer hospitalization [21]. In our study of survivors, longer hospitalization was associated with increasing number of debridements.

In an effort to classify these patients, FSI was used in combination with the Acute Physiology and Chronic Health Evaluation (APACHE II) score designed by Laor *et al*., [12] The FSI takes into account the standard data collected in most emergency rooms, including temperature, pulse and respiratory rate, serum sodium, potassium, bicarbonate and creatininee levels and haematocrit and WBC values (Table 1). The FSI gives some indication about the likelihood of survival and comparing the patients, based on variables that can be recorded on presentation. Although the repeated debridements may be considered as the accepted standard of care in these patients, this was not found to be predictive of outcome in regard to FSI [12-14,16-18]. Surprisingly only a few researchers have used FSI in their sets of patients [12,14]. Ersay *et al*. found the mean FSI being 6.26-3.78 in their patients, which was lower (4.66-2.31) in survivors compared with 11.56-2.68 in non-survivors [22]. Laor *et al*., [12] and Chawla *et al*., [14] showed that the median FSI was 6.9 and 8.6 in survivors compared with 13.5 and 12.4 in non-survivors. Consistent within different

studies that demonstrated lower FSI in survivors, our results showed mean FSI being 8.29±2.10 (range, 2 to 16) which was 4.77±1.89 for survivors and 12.6±2.22 for non-survivors, and according to other studies [12-14,16-18] several factors including age account for the discrepant results

Clayton *et al*., [23] and Laor *et al*., [12] have shown that survivors were younger than non-survivors, and the age difference was statistically significant. In this connection, Srensen *et al*., [6], showed that increasing patient age was associated with higher mortality. In contrast, Yeniyol *et al*., [24] and Corcoran *et al*., [7] have shown no statistical difference in age between survivors and non-survivors. In our study the mean age of the patients was 44. ±8.496 years, and in agreement with other studies [16-18] the survivors were younger (mean age: 39.38±8.89 years) than non-survivors (mean age: 54.1±7.79 years).

The mortality associated with the disease is high and has been reported from 6% to as high as 76% [25]. Multivariate analysis showed that only a delay in surgery of more than twenty-four hours was correlated with increased mortality [26]. In our study the mortality rate was 37.5%, that could be due to rare delay between presenting symptoms and admission to hospital and starting treatment; mean duration of symptoms at presentation was 13.6±4.57 days.

In our study various bacteria were isolated from the patients with FG, and usually wound culture contained multiple organisms. Gram-negative enteric bacilli and Gram-positive cocci have been identified in most patients [14,27]. The most frequent microbial agent isolated from our patients was *E. coli* which was in agreement with the study of Martínez-Rodríguez R *et al*., [28].

Diabetes has always been associated with an increased incidence of FG. Pizzorno *et al*., [29] Hejase *et al*., [30] and Dahm *et al*., [13] reported the prevalence of diabetes in 73%, 66%, and 50% of patients respectively. Furthermore, Olsofka *et al*. reported a history of diabetes in 31% of the patients with FG [31]. The high incidence of FG in diabetics was explained by increasing propensity to tissue ischemia caused by small-vessel disease [32]. Similarly, diabetes mellitus was most common predisposing factor in our study which involved 12 (42.85%) patients.

FG has been reported to occur particularly in men (male: female ratio10:1) [33]. This was in agreement with our study where all patients were males.

FG is described as a fulminat infection of the perineum and abdominal wall along with the scrotum and penis in males [34-37], and vulva in women [38]. An analysis of the predisposing and accompanying conditions suggests that most cases occur as a result of one of three mechanisms: (1) trauma to the area, providing access of organisms to the subcutaneous tissues; (2) extension from urinary tract infection, most probably from a periurethral gland infection, with dissection along the fascial planes involving the penis and scrotum; and (3) extension of an infection from the perianal area or, less commonly from the retroperitoneal space along fascial planes to the penis and scrotum [36]. Controversy still exists concerning the etiology of FG process. Although Fournier originally reported a disease that was idiopathic in nature, many recent studies hold divergent opinions on this issue. Hollabaugh *et al*., [39] reported definite etiologies in 11 of 26 patients in their series. Conversely, a study by Spirnak and associates [34] revealed a clear focus of origin in 95% of patients. In our series, all patients had clear origin and involved 14 (50.0%), 10 (35.7%), and 4 (14.28%) colorectal, urologic, and cutaneous lesions respectively. The statistical analysis of laboratory findings remains limited, because many series with clinical presentation were small and heterogeneous. White blood cell count, Serum sodium, creatinine, albumin and calcium were statistically different between two groups. The mean of white blood cell count in non-survivors were higher than in survivors who related to poor condition and sepsis in non-survivors. Serum sodium and creatinine was higher in non-survivors than in survivors that was probably due to severe dehydration, sepsis and shock in non-survivors. Albumin and calcium was within normal range in survivors and in lower than normal range in non-survivors. Schaeffer indicated that hypocalcaemia seems to be secondary to the destruction of triglycerides by bacterial lipases and release of the free fatty acids that are chelators of the ionized form of the calcium [35].There was not any significantly statistical difference in serum K+, blood urea nitrogen and hematocrit between survivors and non-survivors.

In conclusion, FG is a rapidly progressive and fulminant infection. The prompt diagnosis of FG can be difficult and requires a high index of suspicion. Factors associated with poor prognosis are controversial. Currently, old age with delayed diagnosis and treatment, lesser surgical debridement, shorter hospitalization time and higher FSI scores are predictive of gloomy outcome. In addition higher white blood cell count, higher creatinine and serum sodium and lower albumin and calcium levels indicate poor prognosis. However serum potassium, blood urea nitrogen and hematocrit had no effect on prognosis. Future studies may also determine the prognostic factors in assessing patients with FG.

Conflict of Interest: None declared.

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