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ORIGINAL PAPER

Treatment outcome of Fournier's gangrene and its associated factors: A retrospective study

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Summary ***Introduction:*** *Fournier's gangrene (FG) is a rapidly progressive necrotizing infection that affects the perineal and abdominal regions and is known for its high mortality rate. This study aims to present the practical experience of managing FG patients and identify factors that may affect their clinical outcomes.*

Materials and methods: *A retrospective study was conducted from April 2009 to December 2020 at General Military Hospital in Sana'a, Yemen including 26 patients who were diagnosed with FG and treated on. Data on demographic characteristics, time to admission, surgical intervention, and treatment outcomes were collected. Univariate analysis was performed to determine factors that affect patient outcomes.*

Result: *The mean age of the patients was 65.77 ± 5.04 years, and 65.4% of them were over the age of 65. Most patients (57.7%) presented after five days of experiencing symptoms, and 65.4% were in septic conditions. Of the patients, 17 (65.4%) survived, and the total mortality rate was 34.6%. Univariate analysis showed that delayed presentation ($p = 0.001$), a history of diabetes mellitus ($p < 0.001$), end-stage renal disease ($p < 0.001$), heart failure ($p < 0.001$), cerebrovascular accident ($p = 0.032$), liver cirrhosis ($p < 001$), presence of multiple comorbidities ($p < 001$), involvement of lager area ($p < 001$), septic conditions ($p = 0.009$), advanced age ($p = 0.018$), and intensive care unit admission ($p = 0.002$) were found to be risk factors for mortality in patients with FG.*

Conclusions: *FG is a potentially life-threatening medical condition, even with aggressive and specialized treatment. Our study revealed a mortality rate of 34.6%. Factors such as older age, the presence of multiple comorbidities, septic conditions, the abdominal spread of the disease, intensive care unit admission, and delayed presentation contribute to higher mortality rates.*

KEY WORDS: *Fournier's gangrene; Necrotizing fasciitis; Risk factor; Mortality; Outcome.*

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INTRODUCTION

Fournier's gangrene (FG) is a devastating, progressive, and polymicrobial inflammation of the external genitalia and perineum (1). Also known as *necrotizing fasciitis of the genitalia* (NFG), it is a life-threatening urologic emergency that requires urgent admission and surgical intervention (1). Typically, FG is characterized by severe necrosis of the soft tissues of the genitalia and perineum. However, it can extend to the lower abdomen, flank, and even the axilla, cervical region, and upper limbs (2). Although the necrosis usually remains limited to the fascial layers of the pelvis, perineum, thighs, and tunica albuginea of the penis and testes, it can sometimes spread beyond these barriers to involve deeper structures such as the anal sphincter, rectum, thighs, penis, and testicles, necessitating more aggressive procedures such as fecal diversion, orchiectomy, and even limb amputation (2).

While FG is typically diagnosed easily by clinical examination without additional laboratory or radiological investigations, the treatment course represents a significant challenge (3). This is especially true in developing countries, where healthcare systems are under-resourced and less organized. Typically, these patients are elderly and immune-compromised, with associated comorbidities, and require admission to *intensive care units* (ICU) or isolation in separate rooms (4). It is common in such communities for hospitals to reject FG patients due to a shortage of beds and facilities or a lack of staff expertise in dealing with such patients (5). Several comorbidity indexes, such as the Charlson Comorbidity Index and Fournier's Gangrene Severity Index, have been utilized to predict the prognosis and mortality in FG (6, 7).

However, the mortality rate remains high, and their reliabilities are not yet clear. This report aims to share the experience of handling FG patients admitted to our hospital and identify the factors that affect the outcome of these patients.

MATERIAL AND METHODS

Study design and setting

This retrospective study included 26 patients diagnosed with Fournier's gangrene at *General Military Hospital*, between April 2009 and December 2020. The *Ethics Research Committees of General Military Hospital*, Sana'a, Yemen provided their approval for the study (ID: 23-008, on 1,3,2023), which adhered to the ethical principles outlined in the Declaration of Helsinki.

Inclusion criteria

Patients diagnosed with FG and treated at *General Military Hospital* were included in the study. The diagnosis of FG was based on clinical criteria, including the presence of fever (> 38°C), erythema and swelling in the perianal or scrotal region, purulent-malodorous discharge, and the detection of fluctuation or crepitation at the wound site. Prior to inclusion, all patients were assessed to confirm their eligibility for the study (1).

Exclusion criteria

Patients treated at other hospitals and those with abscesses confined to the scrotal, periurethral, and perianal regions with no fascial or soft tissue extension were excluded.

Surgical procedure and postoperative care

All participants in the study received immediate aggressive debridement under general or spinal anesthesia to remove necrotic tissue until healthy tissue was observed. In addition, cystostomy catheters were placed, limiting the contact of the urethra with urine. Empiric intravenous antibiotic therapy, including Ceftriaxone (1 g every 12 hours) and metronidazole (500 mg every 12 hours), was administered until culture results were obtained. Dressings were changed three times daily with sterile gauze soaked in a solution of povidone-iodine, 0.2% nitrofurazone ointment, and 250 mg rifampicin ampoule. A colostomy was performed in cases where the perirectal and anal regions were affected, while an orchiectomy was performed in testicular involvement cases. Patients were transferred to the *Plastic and Reconstructive Surgery Clinic* once their general health status and wound cleanliness had improved.

Data collection and study outcome

Patient demographic characteristics, including age, time to admission, location of the initial lesion, the extent of the disease, comorbidities, number of surgical debridements, intensive care unit (ICU) admission, colostomy diversion, length of hospital stay, and mortality rate, were extracted from patient's medical records for analysis. Patients were stratified into two groups based on their survival status: survivors and non-survivors. Mortality refers to all-cause mortality and any cause of FG-related death during the initial admission (1). To assess the extension of FG, we used a modified body surface area nomogram commonly used for estimating the extension of burn injuries (7). This involved assigning a value of 1% for penile, scrotal, and perineal involvement, and 2.5% for ischiorectal fossa involvement.

Statistical analysis

The study utilized descriptive statistics to present quantitative variables in terms of means and standard deviations, while qualitative variables were presented as frequencies and percentages. The normality of the data was assessed using the Kolmogorov-Smirnov test. To compare patients in the survivor and non-survivor groups, univariate analysis was performed using either independent samples T-Test or Mann-Whitney test to compare means for quantitative variables and Chi-square or Fisher's exact test for qualitative variables. Statistical significance was set at $p < 0.05$. The statistical analysis was carried out using IBM SPSS version 18 software (*IBM Corp., Armonk, New York*).

Table 1.
Demographic characteristics of patients.

Variable	N (%)
Age (year), mean ± SD	65.77 ± 5.04
Age groups	
< 65 years	9 (34.6)
≥ 65 years	17 (65.4)
Time to admission (days), mean ± SD	6.15 ± 2.71
Time to admission	
≤ 5 days	11 (42.3)
> 5 days	15 (57.7)
Source of infection	
Urinary tract infection	12 (46.2)
Perianal or perirectal infection	4 (15.4)
Unknown	10 (38.5)
Septic condition	17 (65.4)
History of Diabetes mellitus	13 (50)
History of heart failure	6 (23.1)
History of ESRD	6 (23.1)
History of CVA	3 (11.5)
History of anorectal surgery	3 (11.5)
History of liver cirrhosis	6 (23.1)
Total affected body surface area	
≤ 3%	18 (69.2)
> 3%	8 (30.8)
Number of debridements	
One time	11 (42.3)
2 times or more	15 (57.7)
Needs ICU admission	8 (30.8)
Hospital stays (day), mean ± SD	5.42 ± 1.88
Needs for colostomy	3 (11.5)
Needs for orchiectomy	2 (7.7)
Outcome	
Survivors	17 (65.4)
Non-survivors	9 (34.6)

ICU: intensive care unit; CVA: cerebrovascular accident; ESRD: End-Stage Renal Disease.

Figure 1.
Showing. A: Fournier's gangrene involving the scrotum; B: Fournier's gangrene involving both the penis and scrotum; C: Fournier's gangrene involving the penis, scrotum, and ischiorectal fossa; D: Partially debrided Fournier's gangrene.

Result

Baseline clinical characteristics

The mean age of patients was 65.77 ± 5.04 years, and most (65.4%) were over 65 years. The mean time to hospital admission was 6.15 ± 2.71 days, and the majority (57.7%) presented after five days of symptom onset. 65.4% of patients were in septic conditions. A history of diabetes mellitus, heart failure, renal failure with hemodialysis, *cerebrovascular accident* (CVA), anorectal surgery, and liver cirrhosis was present in 13 (50%), 6 (23.1%), 6 (23.1%), 3 (11.5%), 3 (11.5%), and 6 (23.1%) patients, respectively. The mean total affected body surface area was 3.02 ± 1.41%, and in 18 (69.2%) patients, the total affected area was 3% or less. The infection involved only the scrotum in 6 (23.1%) patients (Figure 1A), while penile, scrotal, and perineal involvement was seen in 11 (42.3%) patients (Figures 1B and 1C). Most patients (57.7%) required more than one surgical debridement (Figure 1D).

Orchiectomy and colostomy procedures were performed in 3 (11.5%) and 2 (7.7%) patients, respectively. The mean hospital stay was 5.42 ± 1.88 days and 8 (30.8%) patients required ICU admission. Of the patients, 17 (65.4%) survived and the total mortality rate was 34.6%. The baseline clinical characteristics of the study population are summarized in Table 1.

Factors associated with mortality in patients with Fournier's gangrene:

Univariate analysis showed that a long time to hospital admission ($p < 0.001$), history of diabetes mellitus ($p < 0.001$), history of *end-stage renal disease* (ESRD) ($p < 0.001$), history of heart failure ($p < 0.001$), history of CVA ($p = 0.032$), history of liver cirrhosis ($p < 0.001$), presence of multiple comorbidities ($p < 0.001$), involvement of larger area ($p < 0.001$), presentation in septic conditions ($p = 0.009$), advanced age ($p = 0.018$), and need for ICU admission ($p = 0.002$) were found to be risk factors for mortality in patients with FG (Table 2 and 3).

Table 2.
Comparison between survivors and non-survivors for quantitative variables.

Variable	Sub variable	Total (n = 26) N (%) 17 (65.4)	Outcome Survivor N (%) 9 (34.6)	Died N (%)	Univariate analysis OR (95 % CI)	P-value*
Age (year)	< 65	9 (34.6)	7 (77.8)	2 (22.2)	0.40 (0.06-2.58)	0.341
	≥ 65	17 (65.4)	10 (58.8)	7 (41.2)	Reference group	
History of Diabetes mellitus	Yes	13 (50)	4 (30.8)	9 (69.2)	-	0.000
	No	13 (50)	13 (100)	0 (0.0)	Reference group	
Number of debridements	≤ 1	11 (42.3)	6 (54.5)	5 (45.5)	2.29 (0.44-11.91)	0.324
	> 2	15 (57.7)	11 (73.3)	4 (26.7)	Reference group	
Time to presentation (day)	≤ 5	11 (42.3)	11 (100)	0 (0.0)	-	0.002
	> 5	15 (57.7)	6 (40.0)	9 (60.0)	Reference group	
Total affected BSA (%)	≤ 3	18 (69.2)	17 (94.4)	1 (5.6)	-	0.000
	> 3	8 (30.8)	0 (0.0)	8 (100)	Reference group	
Comorbidity number	≤ 1	19 (73.1)	17 (89.5)	2 (10.5)	-	0.000
	> 1	7 (26.9)	0 (0.0)	7 (100)	Reference group	
Need colostomy	Yes	3 (11.5)	2 (66.7)	1 (33.3)	0.93 (0.07-11.99)	0.960
	No	23 (88.5)	15 (65.2)	8 (34.8)	Reference group	
Need orchiectomy	Yes	2 (7.7)	1 (50.0)	1 (50.0)	2.00 (0.11-36.30)	0.639
	No	24 (92.3)	16 (66.7)	8 (33.3)	Reference group	
Septic condition	Yes	17 (65.4)	8 (47.1)	9 (52.9)	-	0.009
	No	9 (34.6)	9 (100)	0 (0.0)	Reference group	
History of heart failure	Yes	6 (23.1)	0 (0.0)	6 (100)	-	0.000
	No	20 (76.9)	17 (85.0)	3 (15.0)	Reference group	
History of ESRD	Yes	6 (23.1)	0 (0.0)	6 (100)	-	0.000
	No	20 (76.9)	17 (85.0)	3 (15.0)	Reference group	
History of CVA	Yes	3 (11.5)	0 (0.0)	3 (100)	-	0.032
	No	23 (88.5)	17 (73.9)	6 (26.1)	Reference group	
History of anal surgery	Yes	3 (11.5)	2 (66.7)	1 (33.3)	0.93 (0.07-11.99)	0.960
	No	23 (88.5)	15 (65.2)	8 (34.8)	Reference group	
History of liver cirrhosis	Yes	6 (23.1)	0 (0.0)	6 (100)	-	0.000
	No	20 (76.9)	17 (85.0)	3 (15.0)	Reference group	
Need ICU admission	Yes	8 (30.8)	1 (12.5)	7 (87.5)	56.00 (4.33-724)	0.002
	No	18 (69.2)	16 (88.9)	2 (11.1)	Reference group	

BSA: body surface area; CI: confidence interval; ICU: intensive care unit; OR: odds ratio; CVA: cerebrovascular accident; ESRD: End-Stage Renal Disease.
**P-values of < 0.05 were considered significant.*

Discussion

FG is a life-threatening condition that involves necrotizing fasciitis in the genitourinary areas and the perineum. It is typically a polymicrobial infection caused by anaerobic and facultative aerobic bacteria (8). The rapid progression of FG is linked to impaired cellular immunity, which permits suppurative bacterial infection, and the synergetic polymicrobial nature, which causes a substantial release of bacterial toxins. Eventually, small subcutaneous vessels experience obliterative thrombosis, resulting in gangrene of the involved struc-

Table 3.
Comparison between survivors and survivors for quantitative variables.

Variable	Outcome Survivors Mean (SD)	Died Mean (SD)	Mean Difference (95 % CI)	t & z	P-value*
Age (year)	64.11 (3.98)	68.88 (5.55)	-4.77 (-8.65 to -0.88)	-2.53	0.018
Number of debridements	1.76 (0.66)	1.77 (1.56)	-0.01 (-0.90 to 0.88)	-0.39	0.711
Time to hospital presentation (days)	4.94 (2.13)	8.44(2.18)	-3.50 (-5.33 to -1.67)	-3.94	0.001
Total BSA (%)	2.29 (0.98)	4.16(1.39)	-1.87 (-2.83 to -0.90)	-3.99	0.001
Hospital stays (days)	5.82 (1.81)	4.66 (1.87)	1.15 (-0.40 to 2.71)	1.53	0.138

BSA: body surface area; CI: confidence interval; ICU: intensive care unit; OR: odds ratio; CVA: cerebrovascular accident; ESRD: End-Stage Renal Disease.
**P-values of < 0.05 were considered significant.*

tures (1, 9). The bacterial access usually results from a cutaneous breakdown (e.g., local trauma) or the spread of urinary or perineal infections. In our study, urinary tract infection was the most common cause of FG (46.2%). Our result was similar to *Tahmaz et al.'s* study, which reported that 33% of FG cases were due to urinary tract infections (10). Nevertheless, no identifiable cause was observed in one-quarter of the patients in *El-Qushayri et al.* study (11).

There is a discrepancy in the literature regarding several independent prognostic factors in patients with FG. For example, some studies have shown that younger age is associated with improved survival (1, 12, 13), while other studies have not found a significant difference in disease onset between various age groups (5, 14). In our study group, advanced age was noticed among non-survival and was found to be a risk factor for mortality. This suggests that the average age of those affected by Fournier's gangrene is rising as reported by *Hong et al.* (15).

Similarly, there are inconsistent findings regarding the duration between the onset of FG symptoms and hospitalization, ranging from 1 to 30 days (15). Our study showed a statistically significant difference between survivors and non-survivors in the time it took to seek medical care, with survivors presenting earlier (4.94 ± 2.13 days) compared to non-survivors (8.44 ± 2.18 days) ($p = 0.001$). These findings are consistent with the results of other studies, such as those conducted by *Doluoğlu et al.* and *Yeniyol et al.* (1, 14), and are further supported by a systematic review that identified a positive correlation between time to treatment and patient survival (16). However, some studies have reported no significant difference in time to admission between survivors and non-survivors (15, 17). These inconsistencies may be attributed to variations in study settings, patient demographics, hospital accessibility, income, and educational levels. FG is a multifactorial disease with a mortality rate ranging from 3% to 67% (15). The variable outcomes of the disease suggest the involvement of various underlying conditions that can contribute to the FG occurrence, aggravation, and mortality rate. Certain conditions such as DM, alcohol consumption, immunocompromised status, malignancy, heart failure, hepatic disease, and renal insufficiency are reported to be positively associated with FG mortality (1, 10, 15, 16, 18). In this study, despite meticulous and specialized management and selective antibiotic therapy, the mortality rate was 34.6%, and patients with a history of DM, ESRD, heart failure, cerebrovascular accident, and liver cirrhosis were found to suffer poorer outcomes with a higher mortality rate. DM was the most common comorbidity, affecting 50% of patients, and was significantly associated with a higher mortality rate in our cohort. However, the relationship between DM and mortality remains controversial, as some studies have reported an association with both incidence and mortality (18, 19), while others have shown an association with incidence but not with FG mortality (1, 15, 20). The increased incidence and higher mortality rate of FG in diabetics may be attributed to the small-vessel disease-induced propensity to tissue ischemia and the decreased phagocytic and intracellular bactericidal activity and neutrophil dysfunction that attenuate bacterial microbes' clearance (18). Similarly, immunocompromised patients (e.g., HIV) and patients on immunosuppressive medications are at higher risk (16). *Doluoğlu et al.* reported that severe sepsis and multiple organ failure, chronic renal failure, and pulmonary embolism were the major mortality-associated etiologies in FG patients, with a reported mortality of 20.5% (1). We found that septic conditions and having multiple comorbidities at the time of admission were significant predicting factors for mortality and outcome, which goes in trend with prior reports (13, 21).

This study found a significant difference in the average extent of body surface area affected by necrotizing tissue between patients who survived and those who did not (2.29 ± 0.98 versus 4.16 ± 1.39, respectively) ($p = 0.001$). The number of surgical debridements, on the other hand, did not have a significant impact on patient outcomes ($p = 0.711$), which is in line with the findings of *Yeniyol et al.* (14). However, the results reported by *Spirnak et al.* differ from these findings, as they showed a higher mortality rate among patients who underwent more frequent operations due to more extensive disease (22). Generally, prompt surgical intervention (aggressive and often repeat debridement), broad-spectrum antibiotics, and appropriate resuscitation are crucial in these patients (23). As expected, patients with large involved body surface areas usually died during the hospital course, and the chance of undergoing multiple debridements subsequently decreased in this group.

In our study, the need for ICU admission was associated with non-survival, and our result was similar to a study by *Azmi et al.* (8). In contrast, in the study by *Yilmazlar et al.*, survivors stayed in the hospital significantly longer than non-survivors (24). We explain that high-risk patients with multiple underlying diseases had a low probability of survival and died within a few days of ICU admission.

This study has several limitations. Firstly, the retrospective design and the small sample size are potential sources of bias that might limit the generalizability of our findings. Secondly, due to the nature of the study, some relevant factors, such as laboratory data, *Charlson Comorbidity Index*, and *Fournier's Gangrene Severity Index*, were not included in our analysis. Future studies with larger sample sizes and prospective multicenter designs are recommended to strengthen the validity and generalizability of our findings.

Conclusions

Fournier's gangrene represents a critical medical condition with notable morbidity and mortality rates. Our investigation unveiled a mortality rate of 34.6%, despite the implementation of maximum multidisciplinary therapy in a specialized center. Notably, increased mortality rates were associated with advanced age, underlying diseases, delayed hospital presentation, the presence of multiple comorbidities, septic conditions, the abdominal spread of the disease, and intensive care unit admission.

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