DOI: 10.4081/aiua.2023.11450

ORIGINAL PAPER

Prognostic determinants and treatment outcomes of Fournier's Gangrene treatment in a resource-limited setting: A retrospective study

Saif Ghabisha [1], Faisal Ahmed [2*], Saleh Al-wageeh [1], Mohamed Badheeb [3], Qasem Alyhari [1], Abdulfattah Altam [4], Afaf Alsharif [5]

[1] Department of General Surgery, School of Medicine, Ibb University of Medical Sciences, Ibb, Yemen;
[2] Department of Urology, School of Medicine, Ibb University of Medical Sciences, Ibb, Yemen;
[3] Department of Internal Medicine, Yale New Haven Health, Bridgeport Hospital, Bridgeport, USA;
[4] Department of General Surgery, School of Medicine, 21 September University, Sana'a, Yemen;
[5] Department of Gynaecology, School of Medicine, Jeblah University for Medical and Health Sciences, Ibb, Yemen.

Summary ***Background: Fournier's gangrene (FG) is a destructive necrotizing infection with a generally poor prognosis. This study aims to share our experience in handling FG patients in a resource-limited setting and identify prognostic factors for FG mortality.***
Methods: A retrospective study of thirty-six patients diagnosed with FG and treated at our teaching hospital between Jun 2010 to Oct 2022 was conducted. Laboratory and nonlaboratory data and patients' outcomes were gathered. A univariate analysis was computed for identifying prognostic factors for FG mortality.
Result: The main age was 68.30 ± 5.61years and most (69.4%) were older than 65 years. The overall survival was 63.9% and the mortality rate was 36.1%. Univariate analysis showed that advanced age (p = 0.02), delayed in hospital presentation (p = 0.024), involvement of larger area (p = 0.001), a history of diabetes mellitus (p < 0.006), end-stage renal disease (p = 0.018), heart failure (p = 0.005), cerebrovascular accident (p = 0.003), liver cirrhosis (p = 0.001), presence of multiple comorbidities (p = 0.001), septic conditions at admission (p = 0.048), need for mechanical ventilation (p = 0.001), hypoalbuminemia (p < 0.001), and elevated blood urea nitrogen (p = 0.002) were found to be risk factors for mortality in patients with FG.
Conclusions: Fournier's gangrene is a fulminant condition with a high mortality rate, especially in resource-limited settings. In this study, the mortality rate was 36.1%. Advanced age, delayed in hospital presentation, involvement of larger area, a history of diabetes mellitus, end-stage renal disease, heart failure, cerebrovascular accident, liver cirrhosis, presence of multiple comorbidities, septic conditions at admission, need for mechanical ventilation, hypoalbuminemia, and elevated blood urea nitrogen were associated with FG mortality.

KEY WORDS: Fournier's gangrene; Mortality; Prognostic factors; Outcome.

Submitted 5 May 2023; Accepted 8 June 2023

INTRODUCTION

Fournier's gangrene (FG) is a poly-microbial necrotizing infection that spread drastically to involve the genital, perianal area, or perineal deep tissue causing rapid tissue and is usually caused by an aerobic bacterial invasion (1). The bacterial species' combined invasive and toxic activities produce endarteritis obliterans, cutaneous and subcutaneous artery thrombosis, local tissue necrosis and gangrene, and subsequently life-threatening adverse events such as multiple organ system failures, septic shock, and death if left untreated (1, 2).

Despite the advancement of medical knowledge towards FG's pathobiology, diagnosis, and management, the mortality rate remains high, with some reported rates of approximately 50% (3). FG is a predominantly male illness and is commonly observed in men aged 40 to 50, with a reported annual incidence of 1.6 cases per 100.000 men. *Diabetes mellitus* (DM), older age, liver cirrhosis, vascular disease, cancer, chronic alcoholism, overweight, paraplegia, and renal impairment are all thought to be associated with higher mortality rates; however, up to 30% to 50% of FG cases present with no identifiable risk fact (4). There are numerous scoring methods for predicting FG mortality, such as the *Acute Physiology and Chronic Health Evaluation* (APACHE) II scoring system, which is an extensively used tool for predicting mortality outcomes, *Charlson Comorbidity Index* (CCI), and *Fournier's Gangrene Severity Index* (FGSI) which are well-defined disease-specific metric (5, 6). However, those scorings still had limitations and some factors are not included such as length of hospital stay, which is related to hospitalization costs and treatment approaches (4).

In low-income countries, such as Yemen, there is limited information available about the extent of FG mortality rate, and its predisposing factors (7). Here, we studied the characteristics and clinical course of patients diagnosed with FG at our institution over a period of 12 years. Our primary objective was to discern the prognostic factors intricately linked to this debilitating disease. By furnishing essential data, we aspire to enhance the foundation for future investigations and therapeutic interventions. Such endeavors hold immense potential to empower healthcare practitioners in promptly identifying FG and initiating timely and efficacious care for afflicted individuals.

Materials and methods

Study design

Between Jun 2010 to Oct 2022, this retrospective study was conducted at Ibb University-affiliated Hospitals and included 36 consecutive patients diagnosed with FG and treated by the same surgeon (*Professor S. Ghabisha*). The *Ethics Research Committees of Ibb University* provided their approval for the study (ID: IBBUNI.AC.YEM.2023.55, on 03.03.2023), which adhered to the ethical principles outlined in the Declaration of Helsinki.

Inclusion criteria

Patients diagnosed with FG and treated at Ibb University-affiliated hospitals (*Al-Nasar Hospital*) were included in the study. 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 were used to make the diagnosis of FG (8).

Exclusion criteria

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

Surgical procedure and postoperative care

All participants 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 crystalline penicillin (4miu IV every 6 hours), ceftriaxone (1 g every 12 hours), and metronidazole (500 mg every 12 hours), was administered until culture results were obtained and in cases of sepsis, imipenem and vancomycin were used. 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 and hyperbaric oxygen was done in cases needing multiple debridements (9). A fecal diversion (colostomy) was performed in cases where the perirectal and anal regions were affected, while an orchiectomy was performed in testicular involvement cases (5). Patients were transferred to the *Plastic and Reconstructive Surgery Clinic* once their general health status and wound cleanliness had improved.

Data collection

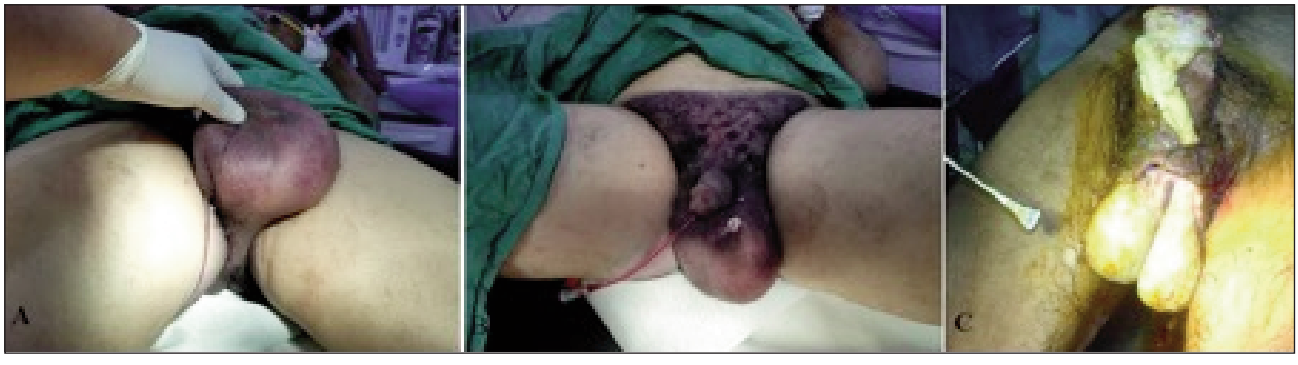
Patient demographic characteristics, including age, time to hospital admission, comorbidities, albumin level, number of surgical debridements, need for mechanical ventilation, need for colostomy diversion or orchiectomy, length of hospital stay, and mortality were extracted from the patient's medical records. Mortality refers to all-cause mortality and any cause of FG-related death during the initial admission or follow-up. To assess the FG extension, we used a modified body surface area nomogram commonly used for estimating the extension of burn injuries. This involved assigning a value of 1% for penile, scrotal, and perineal involvement, and 2.5% for ischiorectal fossa involvement (5, 8).

The comorbidities were heart failure, *end-stage renal disease* (ESRD), liver cirrhosis, history of anorectal surgery, and old *cerebrovascular accident* (CVA), which were also evaluated as several comorbidities (presence of one versus more than one of comorbidities) (10). The number of surgical debridements was defined as the number of times a patient entered the operating room (10). The albumin level was dived into two categories (equal or more than 3 g/dL and less than 3 g/dL).

Variables and measures

The outcome variable was FG mortality expressed as a binary variable: alive and dead. Independent variables included age (≤ 65 years and more than 65 years), CVA (yes and no), heart disease (yes and no), liver cirrhosis (yes and no), ESRD (yes and no), the number of debridement (≤ 2 times and ≥ times), comorbidity number (one and more than one), need for a colostomy (yes and no), need for orchiectomy (yes and no), mean hospital stays, etiological subtypes (genitourinary infection versus non-genitourinary infections), septic condition (yes and no), comorbidity number (< two comorbidities and ≥ two comorbidities), mean total affected body surface area (≤ than 3% and more than 3%), blood urea nitrogen

Figure 1.
A. Fournier's gangrene involved the scrotum.
B. Fournier's gangrene involved the penis, scrotum, and ischiorectal fossa.
C. Fournier's gangrene involved both the penis and scrotum with a purulent discharger.



(BUN) (more than 50 mg/dl and less), Albumin level (≤ 3 g/dL and more than 3 g/dL), need for mechanical ventilation (yes and no), time to hospital presentation (≤ 7 days and more than 7 days), and DM (yes and no).

Study outcome

The mortality rate and the independent predictors of FG mortality.

Statistical analysis

The study utilized both quantitative and qualitative, for which means and standard deviations were used to present quantitative data, while frequencies and percentages were reported for qualitative variables. The normality of the data was confirmed using the Smirnov-Kolmogorov test. To determine the independent risk variables related to FG mortality, univariate analysis was done. Effect sizes in the model were expressed using odds ratios and confidence intervals at 59%.

The statistical significance level was set at $p < 0.05$. The IBM SPSS version 22 software (*IBM Corp., Armonk, New York*) was used for statistical analysis.

Result

Baseline clinical characteristics

The mean age was 68.30 ± 5.61 years and most of patients (69.4%) were aged more than 65 years. The main time to hospital presentations was 7.47 ± 4.10 days and 15 (41.7%) patients presented after 7 days from starting symptoms. Most of them (25, 69.4%) were in septic conditions.

History of DM, heart failure, ESRD, CVA, anorectal surgery, and liver cirrhosis was present in 20 (55.6%), 11(30.6%), 8 (22.2%), 5(13.9%), 6 (16.7%), 6 (16.7%), respectively. Additionally, 14 (38.9%) had more than one comorbid number. The source of infection was a genitourinary infection in 15 (41.7%) patients, perianal infection in 6 (16.7%) patients, and an unknown source in 15 (41.7%) patients. The mean calculated total affected body surface area was 3.59 ± 1.47 (%) and was more than 3% in (19, 52.8%) patients. The serum albumin level was less than 3 g/dL in 14 (38.9%) patients. Most of the patients (72.2%) more than one surgical debridement. Colostomy and orchiectomy were done on 6 (16.7%) and 3 (8.3%) patients respectively. The mean hospital stay was 57.00 ± 4.01 days and 15 (41.7%) patients need mechanical ventilation. Within a median follow-up time of 14.0 months (range 2-30 months), 23(63.9%) of patients survived and the total mortality rate was 36.1%.

Table 1 summarizes the baseline clinical characteristics of the research cohort.

Mortality predictors in patients with Fournier's gangrene

The association of independent variables with the dependent variable was investigated using univariate, analysis. Univariate analysis showed that advanced age (p = 0.02), delayed in hospital presentation (p = 0.024), involvement of larger area (p = 0.001) (Table 2), a history of DM (p < 0.006), ESRD (p = 0.018), heart failure (p = 0.005), CVA (p = 0.003), liver cirrhosis (p = 0.001), presence of multiple comorbidities (p = 0.001), septic conditions at admission (p = 0.048), (p = 0.018), need for mechanical ventilation (p = 0.001), hypoalbuminemia (p < 0.001), and elevated blood urea nitrogen (p = 0.002) were found to be risk factors for mor-

Table 1.
Demographic characteristics of patients.

Variable	Subgroup	N (%)
Age (year)	Mean ± SD	68.30 ± 5.61
	< 65 years	11 (30.6)
	≥ 65 years	25 (69.4)
Time to hospital admission (days)	Mean ± SD	7.47 ± 4.10 (2-20)
	≤ 7 days	21 (58.3)
	> 7 days	15 (41.7)
Source of infection	Urinary tract infection	15 (41.7)
	Perianal or perirectal infection	6 (16.7)
	Unknown	15 (41.7)
Septic condition	-	25 (69.4)
Predisposing factors	Diabetes mellitus	20 (55.6)
	Heart failure	11 (30.6)
	Renal failure	8 (22.2)
	Cerebrovascular accident	5 (13.9)
	Liver cirrhosis	6 (16.7)
	Anorectal surgery	6 (16.7)
Comorbid number	One	22 (61.1)
	≥ Two	14 (38.9)
Total affected body surface area (%)	Mean ± SD	3.59 ± 1.47
	≤ 3%	17 (47.2)
	> 3%	19 (52.8)
Number of debridement	Mean ± SD	2.27 ± 1.13 (1-5)
	One	10 (27.8)
	≥ Two	26 (72.2)
Needs for colostomy	-	6 (16.7)
Needs for orchiectomy	-	3 (8.3)
Need for mechanical ventilation	-	15 (41.7)
Blood urea nitrogen (mg/dl)	≥ 50	18 (50)
Albumin level (mg/dl)	< 3	14 (38.9)
Hospital stay (day)	Mean ± SD	7.00 ± 4.01
Outcome	Survivors	23 (63.9)
	Non-survivors	13 (36.1)

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

Variable	Outcome		Mean difference (95 % CI)	t & z	P-value *
	Survivors N = 23 Mean (SD)	Died N = 13 Mean (SD)			
Age (year)	66.69 (5.19)	71.15 (5.35)	-4.45(-8.15 to -0.75)	-2.44	0.020
Number of debridements	2.21(1.12)	2.38(1.19)	-0.16(-0.97 to 0.64)	-0.42	0.678
Time to hospital presentation (days)	6.91 (4.83)	8.46(2.14)	-1.54(-4.43 to 1.33)	-1.09	0.024
Total BSA (%)	3.00(1.47)	4.65(0.65)	-1.65(-2.53 to -0.77)	-3.81	0.001
Hospital stay (days)	7.08 (3.42)	6.84(5.04)	0.24(-2.63 to 3.11)	0.170	0.361

BSA: Body surface area.
** P-values of < 0.05 were considered significant.*

Table 3.
Comparison between survivors and non-survivors for categorical variables.

Variable	Sub variable	Total (n = 36) N (%)	Outcome		Univariate analysis	
			Survivors N (%)	Died N (%)	OR (95 % CI)	P-value *
Age (year)	< 65	11 (30.6)	9 (81.8)	2 (18.2)	0.28 (0.05 to 1.58)	0.151
	≥ 65	25 (69.4)	14 (56.0)	11 (44.0)	Reference group	
Diabetes mellitus	Yes	20 (55.6)	8 (40.0)	12 (60.0)	22.50 (2.46 to 205.7)	0.006
	No	16 (44.4)	15 (93.8)	1 (6.3)	Reference group	
Number of debridements	≤ 1	10 (27.8)	6 (60.0)	4 (40.0)	1.25 (0.28 to 5.65)	0.763
	> 2	26 (72.2)	17 (65.4)	9 (34.6)	Reference group	
Time to the presentation (day)	≤ 7	21 (58.3)	16 (76.2)	5 (23.8)	0.27 (0.06 to 1.14)	0.075
	> 7	15 (41.7)	7 (46.7)	8 (53.3)	Reference group	
Comorbidity number	≤ 1	22 (61.1)	19 (86.4)	3 (13.6)	0.06 (0.01 to 0.33)	0.001
	> 1	14 (38.9)	4 (28.6)	10 (71.4)	Reference group	
Need colostomy	Yes	6 (16.7)	4 (66.7)	2 (33.3)	0.86 (0.13 to 5.50)	0.877
	No	30 (83.3)	19 (63.3)	11 (36.7)	Reference group	
Need orchiectomy	Yes	8 (8.3)	2 (66.7)	1 (33.3)	0.87 (0.07 to 10.69)	0.917
	No	33 (91.7)	21 (63.6)	12 (36.4)	Reference group	
Septic condition	Yes	25 (69.4)	13 (52.0)	10 (90.9)	9.23 (1.02 to 83.33)	0.048
	No	11 (30.6)		1 (9.1)	Reference group	
CVA	Yes	0 (0.0)	0 (0.0)	5 (100.0)	-	0.003
	No	0 (0.0)	23 (74.2)	8 (25.8)	Reference group	
Liver cirrhosis	Yes		0 (0.0)	6 (100.0)	-	0.001
	No		23 (76.7)	7 (23.3)	Reference group	
History of heart failure	Yes	11 (30.6)	3 (27.3)	8 (72.7)	10.66 (2.04 to 55.51)	0.005
	No	25 (69.4)	20 (80.0)	5 (20.0)	Reference group	
ESRD	Yes	8 (22.2)	2 (25.0)	6 (75.0)	9.00 (1.46 to 55.24)	0.018
	No	28 (77.8)	21 (75.0)	7 (25.0)	Reference group	
History of anal surgery	Yes	6 (16.7)	4 (66.7)	2 (33.3)	0.86 (0.13 to 5.50)	0.877
	No	30 (83.3)	19 (63.3)	11 (36.7)	Reference group	
Mechanical ventilation	Yes	15 (41.7)	4 (26.7)	11 (73.3)	26.12 (4.09 to 166.0)	0.001
	No	21 (58.3)	19 (90.5)	2 (9.5)	Reference group	
Etiology	Non-GU	21 (58.3)	16 (76.2)	5 (23.8)	0.27 (0.06 to 1.14)	0.075
	GU	15 (41.7)	7 (46.7)	8 (53.3)	Reference group	
BUN (mg/dl)	< 50	18 (50.0)	17 (94.4)	1 (5.6)	0.03 (0.003 to 0.27)	0.002
	≥ 50	18 (50.0)	6 (33.3)	12 (66.7)	Reference group	
Albumin (g/dL)	< 3	22 (61.1)	2 (14.3)	12 (85.7)	126.0 (10.31 to 1539)	< 0.001
	≥ 3	14 (38.9)	21 (95.5)	1 (4.5)	Reference group	

BSA: body surface area; BUN: Blood urea nitrogen; CI: confidence interval; CVA: cerebrovascular accident; ESRD. End-Stage Renal Disease; GU: Genitourinary; OR: odds ratio.
** P-values of < 0.05 were considered significant.*

tality in patients with FG (Table 3). The relative risk of SSI occurrence was also higher among patients with genitourinary infection; however, it was not statistically significant in univariate analysis (p = 0.075).

Discussion

In this study, we evaluated the predictive factor for mortality in FG patients who were treated in resource-limited settings. The survival rate was 63.9% and the mortality rate was 36.1%. Univariate analysis showed that advanced age, delayed in hospital presentation, involvement of larger area, a history of DM, ESRD, heart failure, CVA, liver cirrhosis, presence of multiple comorbidities, septic conditions at admission, need for mechanical ventilation, hypoalbuminemia, and elevated blood urea nitrogen were found to be risk factors for mortality in patients with FG.

FG is a polymicrobial illness that resulted typically from facultative aerobic and anaerobic bacterial growth. The rapid proliferation is linked to decreased cellular immunity of FG's patients and the synergistic release of toxins (11). The mortality associated with the disease is high and has been reported from 6% to as high as 76% (12). In this study, the total mortality rate was 36.1%. This is in agreement with other studies in most developing countries. For example, *Sabzi et al.* study in Iran reported a mortality rate of 37.5% (12).

In our study, genitourinary infection was the most common cause of FG and one-third of cases had an unknown etiology. Our result was similar to *Tahmaz et al.*'s study, which reported that 33% of FG cases were due to genitourinary infections (13). Nevertheless, no identifiable cause was observed in one-quarter of the patients in the *El-Qushayri et al.* study (14).

The factors that predict FG mortality are, for the most part, debatable. Because many studies are retrospective and included a small number of patients. For that, solid criteria are still missing and statistical analysis is still limited. 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 was associated with improved survival (8, 15, 16). While other studies have not found a significant difference in disease onset between various age groups (17, 18). In our study group, advanced age was noticed among non-surviving patients and was a risk factor for FG mortality in univariate analysis.

In line with earlier research, the majority of our patient population had DM as the most common comorbidity. This pathology in our study was a predictive factor for mortality in univariate analysis (19, 20). According to previous researchers, the incidence of DM was found in between 50% and 70% of FG patients (19, 21). DM has been identified as a risk factor for FG and has been linked to a more progressive and poorer outcome due to reduced phagocytic and intracellular bactericidal activity and neutrophil dysfunction (19).

Certain conditions such as alcohol consumption, immunocompromised status, malignancy, heart failure, hepatic disease, and ESRD were reported to be associated with FG mortality (8, 13, 22). Similarly, in our study, those factors were associated with FG mortality and were statistically significant in univariate analysis.

Additionally, 38.9% of our patients had at least one of the following conditions: ESRD, cardiac insufficiency, CVA, and liver cirrhosis; these conditions were highly represented among nonsurvivors patients. In *Roghmann et al.*

study, history of DM, ESRD, cardiac insufficiency, CVA, liver cirrhosis, and comorbidity were outcome predictors and Authors suggested that the presence of multiple comorbidities might predict poorer outcomes (23). In our study, the presence of multiple comorbidities was associated with FG mortality in univariate analysis.

The duration between symptom onset and treatment initiation has been reported as a significant predictor of outcomes for patients with FG (19, 24). However, these findings are not universally agreed upon. For instance, a study by *Sallami et al.* reported no significant difference in time to admission between survivors and non-survivors (20). In our study, we found that a longer time to hospital admission was significantly associated with FG mortality ($p = 0.024$). Other reports mentioned higher mortality among FG patients with delayed hospital admission (19, 24). These inconsistencies may be attributed to variations in study settings, patient demographics, hospital accessibility, income, and educational levels. In our study, the delayed patient presentation may be attributed to the limited access to healthcare facilities. Specifically, the residence of our cohort was located at a considerably far distance from the specalized health centers, from the study area, which likely contributed to the delay in seeking medical attention.

Various laboratory abnormalities have been evaluated to predict FG mortality, including *white blood cell* (WBC) count, *blood urea nitrogen* (BUN), serum creatinine, albumin, calcium, and sodium (12, 23). However, there is a discrepancy in the literature regarding several independent laboratory prognostic factors in patients with FG. *Sabzi Sarvestani et al.* reported a significant correlation between those factors and FG mortality (12). These findings were also endorsed by *Yeniyol et al.*, who showed elevated WBC, BUN, creatinine, alkaline phosphatase (ALP), and lactate dehydrogenase levels, and lower hematocrit, metabolic acidosis, hyponatremia, hypokalemia, in addition to decreased total protein, and albumin levels in non survivors compared to survivors (17). Reduced sodium levels, along with lower serum albumin and total protein levels, can signify both a catabolic state and a poor response to therapy, which were seen among these patients with a worse prognosis and higher mortality rates. These factors are directly correlated with poor outcomes (20). *Laor et al.* found a higher level of calcium, albumin, and cholesterol, and lower levels of BUN and ALP at admission of surviving patients compared to non-survivors (25). Another retrospective study, reported that BUN > 50 mg/dL was significantly associated with a higher mortality (26). It should be noted that various confounding factors or effect modifiers (e.g., severe dehydration, sepsis, and shock) that were not controlled in the study may have influenced these findings. Our univariate analysis showed that albumin levels lower than 3 g/dL and BUN > 50 mg/dL were associated with overall increased mortality. Nevertheless, the generalizability of these findings is limited by the small and heterogeneous nature of our cohort.

The reported indications for orchidectomy in FG patients were preexisting epididymorchitis, gangrenous testis damage, or scrotal abscess (21). Although testicular involvement appears to be uncommon in FG, a modest incidence rate was reported by *Sallami et al.* as seven patients, of 40 included, underwent orchidectomy for gangrenous testis damage; in addition to four patients needed subcutaneous testicular repositioning (20). In our study, three patients underwent orchidectomy as a sequala of testicular gangrenous necrosis. A colostomy is sometimes needed to decrease fecal contamination, especially in the presence of infective sphincteric destruction or rectal perforation (20, 27). In our study, six patients underwent colostomy diversion due to the extensively involved perianal area.

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 (3.0 ± 1.5 *vs.* 4.7 ± 0.7 respectively). The number of surgical debridements, on the other hand, did not have a significant impact on patient outcomes, which is in line with the findings of *Yeniyol et al.* (17). However, the result reported by *Spirnak et al.* differs from these findings, as they showed a higher mortality rate among patients who underwent more frequent debridements due to more extensive disease (28).

Generally, prompt surgical intervention (aggressive and often repeat debridement), broad-spectrum antibiotics, and appropriate resuscitation are crucial in these patients (29). 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. A similar report has been mentioned by *Sabzi Sarvestani et al.* (12).

Postoperative mechanical ventilation has been demonstrated as a powerful factor in FG mortality. In *Benjelloun et al.* and *Yanar et al.* studies, the need for mechanical ventilation is a predictive factor for FG mortality (30, 31). Our findings are consistent with those previously reported in the literature and the need for mechanical ventilation was an independent predictor of mortality (30, 31).

This study has several limitations. Firstly, the retrospective design and the small sample size were 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 blood gas analysis data, APACHE II scoring system, CCI, and FGSI, were not included in our analysis. Future studies with more sample sizes and prospective designs are recommended to strengthen the validity and generalizability of our findings.

Conclusions

FG represents a critical medical condition with notable morbidity and mortality rates. In this study, Advanced age, delayed in hospital presentation, involvement of larger area, a history of DM, ESRD, heart failure, CVA, liver cirrhosis, presence of multiple comorbidities, septic conditions at admission, need for mechanical ventilation, hypoalbuminemia, and elevated blood urea nitrogen were associated with FG mortality.

Acknowledgments

The authors would like to thank the general manager of *Al-Thora General Hospital* and *Al-Nassar Hospital, Ibb, Yemen, Dr. Abdulghani Ghabisha*, for editorial assistance.

References

1. Boughanmi F, Ennaceur F, Korbi I, et al. Fournier's gangrene: its management remains a challenge. Pan Afr Med J. 2021; 38:23.

2. Thwaini A, Khan A, Malik A, et al. Fournier's gangrene and its emergency management. Postgrad Med J. 2006; 82:516-519.

3. Tuncel A, Aydin O, Tekdogan U, et al. Fournier's gangrene: Three years of experience with 20 patients and validity of the Fournier's Gangrene Severity Index Score. Eur Urol. 2006; 50:838-843.

4. Zhang KF, Shi CX, Chen SY, et al. Progress in Multidisciplinary Treatment of Fournier's Gangrene. Infect Drug Resist. 2022; 15:6869-6880.

5. Hong KS, Yi HJ, Lee RA, et al. Prognostic factors and treatment outcomes for patients with Fournier's gangrene: a retrospective study. Int Wound J. 2017; 14:1352-1358.

6. Noegroho BS, Adi K, Mustafa A, et al. The role of quick Sepsis-related Organ Failure Assessment score as simple scoring system to predict Fournier gangrene mortality and the correlation with Fournier's Gangrene Severity Index: Analysis of 69 patients. Asian J Urol. 2023; 10:201-207.

7. Al-Kohlany K, Baker K, Ahmed F, et al. Treatment outcome of Fournier's gangrene and its associated factors: A retrospective study. Arch Ital Urol Androl. 2023:11318.

8. Doluoglu Ö G, Karagöz MA, Kılınç MF, et al. Overview of different scoring systems in Fournier's Gangrene and assessment of prognostic factors. Turk J Urol. 2016; 42:190-196.

9. Feres O, Feitosa MR, Ribeiro da Rocha JJ, et al. Hyperbaric oxygen therapy decreases mortality due to Fournier's gangrene: a retrospective comparative study. Med Gas Res. 2021; 11:18-23.

10. Griebling TL. Re: Prognostic Factors of Fournier's Gangrene in the Elderly: Experiences of a Medical Center in Southern Taiwan. J Urol. 2017; 197:709.

11. Huang CS. Fournier's Gangrene. N Engl J Med. 2017; 376:1158.

12. Sabzi Sarvestani A, Zamiri M, Sabouri M. Prognostic Factors for Fournier's Gangrene; A 10-year Experience in Southeastern Iran. Bull Emerg Trauma. 2013; 1:116-122.

13. Tahmaz L, Erdemir F, Kibar Y, et al. Fournier's gangrene: report of thirty-three cases and a review of the literature. Int J Urol. 2006; 13:960-967.

14. El-Qushayri AE, Khalaf KM, Dahy A, et al. Fournier's gangrene mortality: A 17-year systematic review and meta-analysis. Int J Infect Dis. 2020; 92:218-225.

15. Tuncel A, Keten T, Aslan Y, et al. Comparison of different scoring systems for outcome prediction in patients with Fournier's gangrene: experience with 50 patients. Scand J Urol. 2014; 48:393-399.

16. Martinschek A, Evers B, Lampl L, et al. Prognostic aspects, survival rate, and predisposing risk factors in patients with Fournier's gangrene and necrotizing soft tissue infections: evaluation of clinical outcome of 55 patients. Urol Int. 2012; 89:173-179.

17. Yeniyol CO, Suelozgen T, Arslan M, et al. Fournier's gangrene: experience with 25 patients and use of Fournier's gangrene severity index score. Urology. 2004; 64:218-222.

18. Wetterauer C, Ebbing J, Halla A, et al. A contemporary case series of Fournier's gangrene at a Swiss tertiary care center-can scoring systems accurately predict mortality and morbidity? World J Emerg Surg. 2018; 13:25.

19. Chalya PL, Igenge JZ, Mabula JB, et al. Fournier's gangrene at a tertiary health facility in northwestern Tanzania: a single centre experiences with 84 patients. BMC Res Notes. 2015; 8:481.

20. Sallami S, Maalla R, Gammoudi A, et al. Fournier's gangrene : what are the prognostic factors? Our experience with 40 patients. Tunis Med. 2012; 90:708-714.

21. Dahm P, Roland FH, Vaslef SN, et al. Outcome analysis in patients with primary necrotizing fasciitis of the male genitalia. Urology. 2000; 56:31-35.

22. Lewis GD, Majeed M, Olang CA, et al. Fournier's Gangrene Diagnosis and Treatment: A Systematic Review. Cureus. 2021; 13:e18948.

23. Roghmann F, von Bodman C, Löppenberg B, et al. Is there a need for the Fournier's gangrene severity index? Comparison of scoring systems for outcome prediction in patients with Fournier's gangrene. BJU Int. 2012; 110:1359-1365.

24. Villanueva-Sáenz E, Martínez Hernández-Magro P, Valdés Ovalle M, et al. Experience in management of Fournier's gangrene. Tech Coloproctol. 2002; 6:5-10.

25. Laor E, Palmer LS, Tolia BM, et al. Outcome prediction in patients with Fournier's gangrene. J Urol. 1995; 154:89-92.

26. Clayton MD, Fowler JE, Jr., Sharifi R, et al. Causes, presentation and survival of fifty-seven patients with necrotizing fasciitis of the male genitalia. Surg Gynecol Obstet. 1990; 170:49-55.

27. Sarofim M, Di Re A, Descallar J, et al. Relationship between diversional stoma and mortality rate in Fournier's gangrene: a systematic review and meta-analysis. Langenbecks Arch Surg. 2021; 406:2581-2590.

28. Spirnak JP, Resnick MI, Hampel N, et al. Fournier's gangrene: report of 20 patients. J Urol. 1984; 131:289-291.

29. Auerbach J, Bornstein K, Ramzy M, et al. Fournier Gangrene in the Emergency Department: Diagnostic Dilemmas, Treatments and Current Perspectives. Open Access Emerg Med. 2020; 12:353-364.

30. Benjelloun el B, Souiki T, Yakla N, et al. Fournier's gangrene: our experience with 50 patients and analysis of factors affecting mortality. World J Emerg Surg. 2013; 8:13.

31. Yanar H, Taviloglu K, Ertekin C, et al. Fournier's gangrene: risk factors and strategies for management. World J Surg. 2006; 30:1750-1754.

Correspondence

Saif Ghabisha, MD - saifalighabisha@yahoo.com

Saleh Al-wageeh, MD - alwajihsa78@gmail.com

Department of General Surgery, School of Medicine, Ibb University of Medical Sciences, Ibb, Yemen

Faisal Ahmed, MD (Corresponding Author)
fmaaa2006@yahoo.com
Urology Research Center, Al-Thora General Hospital, Department of Urology, School of Medicine, Ibb University of Medical Sciences, Ibb, Yemen

Mohamed Badheeb, MD - badheeb2009@gmail.com
Internal Medicine Office, Yale New Haven/Bridgeport Hospital, CT (USA)

Qasem Alyhari, MD - qalyhary@hotmail.com
Department of General Surgery, School of Medicine, Ibb University of Medical Sciences, Ibb, Yemen Urology Office, Althora General Hospital, Alodine Street, Ibb (Yemen)

Abdulfattah Altam, MD - dral_tam@yahoo.com
Urology Office, School of Medicine, 21 September University, Sana'a (Yemen)

Afaf Alsharif, MD - afafmussa2018@gmail.com
Department of Gynaecology, School of Medicine, Jeblah University for Medical and Health Sciences, Ibb, Yemen
Gynaecology Office, Jeblah Hospital, Jeblah, Ibb (Yemen)

Conflict of interest: The authors declare no potential conflict of interest.