Fournier's Gangrene: A 4-Year Retrospective Study in a Tertiary Academic Hospital

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Abstract

Background: Fournier's gangrene (FG) is a necrotizing fasciitis disease that affects the genital, perianal, and perineal regions. This study investigated the demography and treatment methods of patients with FG in a 4-year period in our hospital. **Methods:** Medical records of 14 patients with Fournier's gangrene who underwent treatment were analyzed retrospectively. Data on the patients were collected such as gender, age, length of stay (LOS), comorbidities, wound treatment, bacteriological cultures, and reconstructive procedures. **Results:** There was no significant correlation between age (p = 0.776), comorbid disease (p = 0.954), LOS or age (p = 0.221), comorbid disease (p = 0.928), and patient outcome. Wound treatment using negative pressure wound therapy (NPWT) was performed in 14% of the patients. Wound treatment had a statistically significant effect toward LOS (p = 0.044). Flaps were the most common reconstructive procedure (71.4%) followed by skin grafts (14%). Age and comorbid disease did not have an effect toward hospital LOS or patient outcome. The use of NPWT is likely related to the increased complexity of the lesion. Flaps provided a reliable method of reconstruction for patients. **Conclusion:** Patients who were treated with NPWT had a longer LOS compared to other methods.

Keywords: Fournier's gangrene, Wound treatment, Negative pressure wound therapy, Debridement, Reconstruction

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Introduction

Fournier's gangrene (FG) is a necrotizing fasciitis illness that affects the genital, perianal, and perineal areas and produces considerable soft tissue necrosis by rapidly progressing across fascial planes when its diagnosis and treatment are delayed (1). FG affects the genital region, the perianal region, and the perineal region. It is thought to be caused by a polymicrobial infection that progresses to obliterative endarteritis with microthromboses of cutaneous and subcutaneous arterioles and perifascial bacteria spread, ultimately leading to gangrene of the underlying tissues (2). The exact etiology of this condition is unknown. The majority of cases of FG are brought on by traumatic injuries in addition to urogenital and anorectal infections. It is often caused by a wide range of microbes, both aerobic and anaerobic. Despite the fact that males and the elderly are more likely to be affected

by FG, the condition can strike persons of any age or gender (3).

Treatment for FG, which consists of substantial fluid resuscitation, surgical debridement, and broad-spectrum antibiotics, is most successful when it is initiated and completed as soon as possible after diagnosis. It is imperative to have an early surgical intervention, which must include rigorous debridement of necrotic tissue, and subsequent operations may be required (4). After the first therapy, patients are frequently left with major tissue anomalies, which in some instances need the performance of reconstructive procedures.

In this study, we aim to analyze and evaluate the demographic data of FG and treatment modalities toward patient outcome and hospital length of stay (LOS) within a time period of 4 years who had undergone reconstructive therapy in our hospital's Department of Plastic and Reconstructive Surgery. The time span for this study was from 2010 to 2014.

Materials and Methods

We conducted a retrospective study to analyze the medical records obtained from the clinical files of 14 patients with FG who underwent treatment in our hospital from the year 2017 to 2021. Inclusion criteria for this study included patients diagnosed with FG. Exclusion criteria included patients with a diagnosis of infections located in other sites of the body and patients who refused treatment. Our department diagnosed the patients with FG by performing a thorough medical history and physical examination. Inclusion criteria for this study included patients with data collected such as gender, age, LOS, comorbidities, the type of wound treatment that was prescribed, bacteriological cultures, and reconstructive procedures. Wound treatment discussed in this study was conducted after initial debridement and was done for wound bed preparation before reconstruction. The data analyzed for each patient included age, result of bacteriologic cultures, predisposing factors, type of wound treatment, and reconstructive procedures. We calculated the means, medians, and frequencies of the age and LOS of 14 patients. In this study, our team analyzed the effect of the patient's age, comorbid diseases, and method of wound treatment toward the hospital LOS and patient outcomes. All data were analyzed using SPSS for Mac 20.0 (SPSS Inc., Chicago, IL, USA) using the Kolmogorov–Smirnov test to assess the effects of patient age toward hospital LOS; analysis of variance test to determine the correlation between comorbid diseases, type of wound treatment, and hospital LOS; and chi-squared test to analyze comorbid disease, type of wound treatment, and hospital LOS. Values of $p < 0.05$ were considered statistically significant. The study was approved by the Ethical Committee at our hospital (No. 2159/108/4/V/2023).

Results

We identified 14 patients with FG. All of the patients included in this study were male with a mean age of 51.21 years with a range of 32–65 years. The mean LOS in our patients was 13.43 days with a range of 3–34 days (Table 1).

Table 1. Patient characteristics

Characteristics	**n (%/range)**
Gender, n (%)	
Male	14 (100%)
Female	0 (100%)
Age (range), years	51.21 (32–65)
LOS (range), days	13.43 (3–34)

LOS, length of stay.

The type of wound treatment that was the most common among the patients was autolytic debridement which was seen in 42.8% (n=6). Details on the patient's data can be seen in Table 2.

When analyzing whether or not there was a correlation between the patient's age and their hospital LOS, we found that there was no significant correlation ($p = 0.776$) (Table 3). Among the 14 patients in this study, 14.3% (n=2) died. To analyze whether or not age played a significant role in patient outcome, patient age was divided into three groups and was shown to have no effect toward patient outcome ($p = 0.221$) (Table 4). The most common comorbid disease seen in this study was diabetes which was observed in 64.28% (n=9) of the subjects. Obesity, hypertension, benign prostate hyperplasia, and urinary tract infection were other

comorbid diseases that were seen in this study. When analyzing whether or not the patient's comorbid diseases had an effect on the duration of hospital LOS, the result was insignificant (p = 0.954) (Table 5).

Table 2. Patient data

No.	Age (years)	LOS (days)	Comorbid diseases	Type of wound treatment	Isolated bacteria (pus)	Reconstructive operation	Patient outcome
1	62	16	DM, HT, BPH	Autolytic	-	Scrotal flap	Alive
2	32	13	DM	-	*Streptococcus anginosus*	Scrotal flap	Alive
3	33	19	DM, Ob	NPWT	*Corynebacterium amycolatum*	STG	Alive
4	51	10	DM	Autolytic	*C. amycolatum, Streptococcus agalactiae*	Bilateral medial thigh flap	Alive
5	65	10	-	-	-	Bilateral medial thigh flap	Alive
6	41	8	DM	Autolytic	*Klebsiella pneumoniae*	Advancement flap	Alive
7	54	34	DM	NPWT	*Pseudomonas aeruginosa*	STG	Alive
8	57	16	DM	Other methods	*Staphylococcus haemolyticus*	-	Death
9	60	14	-	Mechanical debridement	*Acinetobacter baumannii*	Bilateral medial thigh flap	Alive
10	57	14	-	Autolytic	ESBL *Escherichia coli*	-	Death
11	52	3	DM	Autolytic	*Streptococcus gallolyticus*	Local flap	Alive
12	52	12	-	Autolytic	*Streptococcus pyogenes*	Bilateral medial thigh flap	Alive
13	37	7	DM	Mechanical debridement	ESBL *E. coli*	Local flap	Alive
14	64	12	HT, UTI	Mechanical debridement	*Staphylococcus aureus*	Bilateral medial thigh flap	Alive

BPH, benign prostatic hyperplasia; DM, diabetes mellitus; ESBL, extended-spectrum β-lactamase; HT, hypertension, LOS, length of stay; NPWT, negative pressure wound therapy; STG, semitendinosus and gracilis tendons; UTI, urinary tract infection.

Comorbid diseases of patients with FG also had no statistically significant correlation with the outcome of the patients (p = 0.928) (Table 5).

In this study, we analyzed the effects of wound treatment toward patient's LOS at the hospital and also its effects on patient outcome. From the data, we can observe that wound treatment had a statistically significant effect toward hospital LOS (p = 0.044) (Table 6). Wound treatment using negative pressure wound therapy (NPWT) was performed in 14% (n=2) of the patients and 71% (n=10) without NPWT. More than half of the patients were treated using autolytic wound treatment.

Patients treated with autolytic wound treatment also had the lowest mean of hospital LOS at 10.50 days. From

this table, we can see that patients treated with NPWT had the longest LOS at 26.50 days. When analyzing whether wound treatment had an effect toward patient outcome, the results were not statistically significant (*p* = 0.126) (Table 6). Flaps were the most common reconstructive procedure at 71.4% of all patients in our study (n=10), followed by skin grafts in 14% (n=2).

Table 3. Statistical analysis of patient age and hospital LOS

	Minimum	**Maximum**	**Mean**	**Standard deviation**	***p* value**
Age	32	65	51.21	11.199	0.776
LOS (days)	3	34	13.43	7.208	

LOS, length of stay.

Table 4. Statistical analysis of patient age and patient outcome

			Patient outcome		**Total**	***p* value**
			Death	**Alive**		
Age, years	32 - 43	n	0	4	4	0.211
		%	0.0%	28.6%	28.6%	
	44 - 55	n	0	4	4	
		%	0.0%	28.6%	28.6%	
	56 - 65	n	2	4	6	
		%	14.3%	28.6%	42.9%	
Total		n	2	12	14	
		%	14.3%	85.7%	100.0%	

Table 5. Statistical analysis of patient comorbid disease, hospital LOS, and patient outcome

	n	**Mean**	**Standard deviation**	**Minimum hospital LOS**	**Maximum hospital LOS**	***p* value**	**Patient outcome**		***p* value**
							Death	**Alive**	
No comorbid	4	12.50	1.915	10	14	0.954	1	3	0.928
DM	7	13.00	10.165	3	34		1	6	
DM + obese	1	19.00	-	19	19		0	1	
DM + HT + BPH	1	16.00	-	16	16		0	1	
HT + UTI	1	12.00	-	12	12		0	1	
Total	14	13.43	7.208	3	34		2	12	

BPH, benign prostatic hyperplasia; DM, diabetes mellitus; HT, hypertension; LOS, length of stay; UTI, urinary tract infection.

Discussion

FG presents unique challenges in developing countries, as highlighted in studies conducted in developing countries across Asia and Africa (5). Managing FG remains a challenging problem with the persistent difficulties in addressing this complex condition in resource-constrained environments. Targeted strategies

and resource allocation to improve the outcomes of FG in developing countries are highly necessary (6, 7).

Studies have revealed a correlation between FG mortality and diabetes, cardiac disease, renal failure, and kidney disease. Numerous systemic diseases, such as diabetes (8) and cardiovascular disease, are well known to impact the microvasculature of numerous tissues and organs.

Table 6. Statistical analysis of wound treatment, hospital LOS, and patient outcome

Wound treatment	n	Mean	Standard deviation	Minimum hospital LOS	Maximum hospital LOS	*p* value	Patient outcome		*p* value
							Death	Alive	
None	2	11.50	2.121	10	13	0.044	0	2	0.126
NPWT	2	26.50	10.607	19	34		0	2	
Autolytic	6	10.50	4.637	3	16		1	6	
Mechanical debridement	3	11.00	3.606	7	14		1	3	
Other methods	1	16.00	-	16	16		0	1	
Total	14	13.43	7.208	3	34		2	14	

LOS, length of stay; NPWT, negative pressure wound therapy.

These include the genitourinary region with subsequent ischemia development and a rise in diabetic susceptibility to FG (9). Due to their immunosuppression, poor wound healing, defective phagocytosis, and pre-existing small vessel disease, diabetic patients have a higher incidence of FG. Because of this, diabetic patients with FG were also found to have significantly higher rates of morbidity and mortality. In our study, 71% (n=9) of the patients with FG had diabetes mellitus as a comorbid disease. Of the two patients who died in this study, one of the patients also had diabetes mellitus as a comorbid disease. In our study, there was no significant correlation between comorbid disease and hospital LOS (p = 0.954) or comorbid disease and patient outcome (p = 0.928). Various articles have studied the role of comorbid diseases on patient outcome in patients with FG (10-12). A meta-analysis conducted reported higher mortality rates detected in patients with diabetes, heart disease, renal failure, and kidney diseases (13).

The incidence of FG is 10 times more likely to occur in males than it is in females, with a ratio of 1–10 in favor of males. Scrotal involvement was an essential part of the original FG definition; however, the term has subsequently been broadened to include women, albeit at a lower incidence than in males. In the past, scrotal involvement was an essential component of the original FG definition (13). In the course of our study, all of the participants were male and the average age was 51.21 years. The age range of males who are most likely to be affected by FG is between 30 and 60 years, and the average age of patients is somewhere in the fifth or sixth decade of their lives (14). According to the findings of our study, there was no association between patient age and LOS in the hospital (p = 0.776). According to the findings of other research, there is no substantial association between a patient's age and the outcome of their condition (15, 16).

The majority of FG infections arise from anorectal, genitourinary, and cutaneous sites, which suggests that a polymicrobial infection with numerous cofactors in the background is likely to be the root cause of the condition (17). The majority of the time, the periurethral glands are where the infecting organisms in FG first manifest themselves. Other illnesses such as scrotal abscesses, urethral strictures, perirectal abscesses, burst

appendices, colonic cancer, diverticulitis, and dermatological problems have all been identified as possible entrance routes for bacteria (18). This condition is brought on by an infection of the subcutaneous and fascial soft tissues that is induced by a polymicrobial anaerobic and aerobic synergistic infection. The organisms that are most typically developed in wound cultures of FG patients include Gram-positive bacteria such as *Group A Streptococci* and *Staphylococcus aureus* and Gram-negative bacteria such as *Escherichia coli* and *Pseudomonas aeruginosa* (19).

In this study, we investigated the bacteria found in the pus of the patient's wounds and found that the most common bacteria were *E. coli* (n=2) and *Corynebacterium amycolatum* (n=2). Both of the samples with *E. coli* were found to be extended-spectrum β-lactamase (ESBL)-producing *E. coli*. ESBL-producing *E. coli* was found to show a significant increase in mortality in patients with FG (20). The bacteriology of FG is constantly changing with some reports of multi-drug-resistant organisms (MDROs) accounting for around 20% of cases. The most common MDRO is methicillin-resistant *S. aureus*, followed by ESBL-producing *E. coli* (21, 22). In light of the fact that these infections are linked to high morbidity and death rates, the findings of this study support the use of antibiotics with broad-spectrum anti-MDRO activity for the initial treatment.

Early diagnosis and treatment are essential for managing FG (23), involving intensive fluid resuscitation, surgical debridement, and broad-spectrum antibiotics. Traditional wound dressings with various active agents have been commonly used, but the recent introduction of the NPWT system dressing has shown promise in reducing skin defects and accelerating tissue regeneration in FG by enhancing blood supply, inflammatory cell migration, and granulation tissue formation (23). However, a study found a significant association between wound treatment type and hospital LOS, with NPWT-treated patients experiencing longer hospital stays compared to those treated with other methods (24-26). This discrepancy may be due to the complexity of FG lesions and the progression of substantial soft tissue defects affecting LOS. Nonetheless, NPWT is generally effective for managing large wounds, reducing pain, patient distress, enhancing mobility, and minimizing dressing usage. Once infection control is achieved and wound care is established, the focus shifts to surgical wound closure with the aim of achieving optimal functional and aesthetic outcomes with minimal complications. Multiple treatments may be required, emphasizing the importance of early surgical exploration and thorough tissue debridement.

In scrotal reconstruction in patients with FG, various techniques are available, including primary closure for smaller defects, skin grafts, and flap reconstruction for more extensive tissue loss. Primary closure is suitable for smaller defects, while skin grafts (Figure 1) and flap reconstruction are commonly used for larger defects, with flap reconstruction being favored for deformities exceeding half the scrotal surface or extending beyond its boundaries.

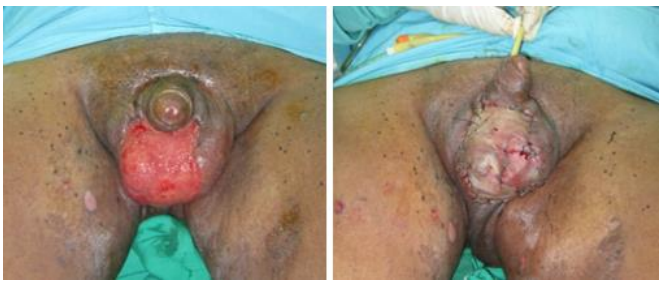

Figure 1. Reconstruction of Fournier's gangrene using split-thickness skin graft

Some experts recommend early single-stage sensate flap repair for optimal testicular protection, as flaps provide better and longer-lasting safeguarding, reduced contraction, immediate coverage, and enhanced aesthetics despite increased complexity, longer surgery duration, higher morbidity rates, and donor location limitations (27). The fasciocutaneous bilateral medial thigh flap, performed on most patients in this study (Figure 2), offers lasting and aesthetically pleasing results without impairing muscle function, with a blood supply from three arteries and preserved sensation due to nerve supply, making it a preferred choice for scrotal reconstruction (28, 29).

Figure 2. Reconstruction of Fournier's gangrene using the bilateral medial thigh flap

Conclusion

In this study, we can conclude that FG is more prevalent in males with an average age of 51 years. We found that diabetes was the most common morbidity seen in our patients. A strong association between the type of wound treatment used in this study and LOS in the hospital was found. Reconstruction of FG using a flap was the most common method used in our patients.

Limitations

This study is not free from limitations. Because this was a retrospective study, certain data were not accessible which made it impossible to calculate the FG Severity Index. The sample size of this study was also limited due to the rarity of the disease.

Data Confidentiality

Regarding the publishing of patients' data, the authors state that they have adhered to the protocols that are currently in effect at their working center.

Author contributions

IDS led in conceptualization, formal analysis, methodology and in writing of the original draft and equally contributed to validation and resources. ANP led in project administration. ANP and LH equally contributed to the reviewing & editing of the original draft. LH and AAD equally contributed to data curation. AAD equally contributed to investigation.

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