

Outcome of Fournier's gangrene in relation to Fournier Gangrene Severity Index (FGSI) score

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ABSTRACT

Introduction: Fournier's gangrene is a rapidly progressive necrotizing fasciitis, involving perineum mainly. The purpose of the study is to evaluate etiology, treatment, and outcome of Fournier's gangrene so that such type patient's management can be done by primary care physicians with best outcomes. **Method:** This was a retrospective study including 156 patients, treated for Fournier's gangrene, between Jan 2012 and Dec 2018. The outcome and prognosis of Fournier's gangrene were reviewed. **Result:** The mean age and mode among survival patients were 47.94 ± 14.9 and 60 years, and the mean age and mode in nonsurvival patients was 47.64 ± 15.9 and 65 years. The most common predisposing factor was diabetes mellitus ($n = 49$, 31.4%) having mortality rate was 9% ($n = 14$). Most common causative bacteria were *E. coli*. In the study, the survival rate was 100% in patients having Fournier Gangrene Severity Index (FGSI) ≤ 3 . As FGSI increased from 3, the mortality rate increased. **Conclusion:** Fournier gangrene is a surgical emergency. Early diagnosis, serial surgical debridement, and broad-spectrum antibiotics decrease the mortality and morbidity of patients. The sensitivity and specificity of FGSI determine the prognosis of Fournier's gangrene. FGSI is a simple method to know the severity and prognosis.

Keywords: Debridement, Fournier's gangrene, perineum, predisposing factor

Introduction

Fournier's gangrene is a life-threatening necrotizing soft tissue infection of the perineal area including the perianal and genital area. It was first described by Jean Alfred Fournier in 1883, who was a French dermatologist.^[1] The purpose of study is to evaluate etiology, treatment, and outcome of Fournier's gangrene so that such type patient's management can be done by primary care physicians with best outcomes.

Fournier's gangrene affects males more than females. The mean age of patients having Fournier gangrene is 50.9 year.^[2] The

male:female ratio is about 10:1.^[3] There are many predisposing factors which include advanced age, diabetes mellitus (DM), chronic renal failure, alcoholism, smoker, immunosuppressive disease, peripheral artery disease, chemotherapy, malignancy, urological surgery, urinary tract infection (UTI), paraphimosis, urethral stricture, traumatic catheterization, anorectal pathology like ischiorectal, perianal, and intersphincteric abscess.^[4,5] Early diagnosis with adequate treatment which includes hemodynamic stabilization, broad-spectrum antibiotic therapy, and aggressive surgical debridement are the keys of the successful management of Fournier's gangrene.^[6,7] Here we studied the co-morbid condition, etiological agents, management, and prognosis of patients, who were admitted to our institution in the emergency surgical unit presenting with Fournier's gangrene.

Method

This was a retrospective observational study, which included

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156 patients of Fournier's gangrene, presented in the emergency department of a tertiary care hospital between Jan 2012 and Dec 2018. Ethical clearance was obtained from Institutional Ethical Committee. The diagnosis was made on the basis of history, presenting complaints and clinical examination [Figure 1]. The review of the medical records of these patients included age, aetiology, predisposing factors, culture findings, and clinical outcome. Patients of Fournier's gangrene were given parental broad-spectrum antibiotic [intravenous amoxicillin and clavulanic acid combination of 1.2 gm 8 hourly and injection clindamycin 600 mg 12 hourly] initially and later they received antibiotic according to culture and sensitivity. Patients also received hemodynamic support when required. All patients underwent extensive surgical debridement under local/spinal/general anaesthesia after optimization of patients followed by serial surgical debridement. During debridement, necrotic tissue was removed till fresh bleeding was observed. Before debridement in the ward, the wound was dipped in a tub containing water mixed with hydrogen peroxide and Eusol, after that the wound was washed with normal saline and then debridement was done under local anaesthesia. Tissue culture was obtained routinely at the time of debridement to know the causative microorganism and sensitivity. Sigmoid colostomy was performed in cases with severe perianal area involvement for diversion of faecal [Figure 2], and suprapubic catheterization was performed in case of penile involvement for diversion of urine. Fournier Gangrene Severity Index (FGSI) score was used to determine the prognosis of Fournier's gangrene patients, and all patients were classified according to the FGSI score.

Statistical analysis

Categorical variables were presented in numbers and percentage (%), and continuous variables were presented as mean \pm SD and median. The normality of data was tested by the Kolmogorov–Smirnov test. If the normality was rejected, then nonparametric test was used.

Statistical tests were applied as follows:

1. Age was compared using an Independent *t*-test (as the data



Figure 1: Clinical picture of Fournier gangrene

sets were normally distributed) between survivors and nonsurvivors.

2. Qualitative variables were correlated using Chi-square test.
3. The receiver operating characteristic (ROC) curve was used to find out the cut-off point of FGSI^[8] for predicting mortality.
4. Inter-kappa agreement was used to find out the strength of agreement between mortality and FGSI.

[k value < 0.20 = poor, 0.21–0.40 = fair, 0.41–0.60 = moderate, 0.61–0.80 = good, 0.81–1.00 = very good strength of agreement].

A *P* value of <0.05 was considered statistically significant. The data were entered in MS Excel spreadsheet and analysis was done using Statistical Package for Social Sciences version 21.0.

Result

It was observed in this study that most of the patients with Fournier's gangrene were in between 41 and 60 years of age [Table 1]. The mean age among 156 patients was 47.91 ± 14.94 , and mode was 50 years. Among survival and nonsurvival patients, medians were 47.94 ± 14.9 and 47.64 ± 15.9 , but statistically *P* value was insignificant [Table 2].

It was also observed that out of 156 cases, 140 cases (89.74%) had aetiological factors and in 10.26% ($n = 16$) cases, there were no aetiology and classified as idiopathic Fournier's gangrene. The most common aetiological factor was perineal soft tissue infection ($n = 49$, 31.4%) followed by a scrotal abscess ($n = 37$,

Table 1: Age range of patients with Fournier's gangrene

Age range (yr)	No of patients	Survival	Nonsurvival
10–20	7	6	1
21–30	17	15	2
31–40	29	27	2
41–50	34	30	4
51–60	39	38	1
61–70	23	19	4
71–80	4	4	-
81–90	3	3	-
S	156	142	14



Figure 2: Diversion stoma due to Fournier gangrene

23.7%); others were perianal trauma ($n = 16, 10.3\%$), perianal abscess ($n = 11, 7.1\%$), fistula in ano ($n = 7, 4.5\%$), perianal sinus ($n = 6, 3.8\%$), ischioanal abscess ($n = 5, 3.2\%$), penile abscess ($n = 5, 3.2\%$), and postorcheodectomy ($n = 4, 2.6\%$).

In the present study, it was observed that predisposing factors in most cases ($n = 85, 54.49\%$) were no comorbidity and were classified as undefined. Others were DM $n = 49, 31.4\%$, smoker $n = 2, 1.28\%$, lung disease $n = 6, 3.85\%$, Hypertension (HTN) with alcoholic $n = 1, 0.64\%$, and UTI $n = 1, 0.64\%$. It was observed in this study that mortality is 8.57% ($n = 14$); mostly were diabetic ($78.56\%, n = 11$).

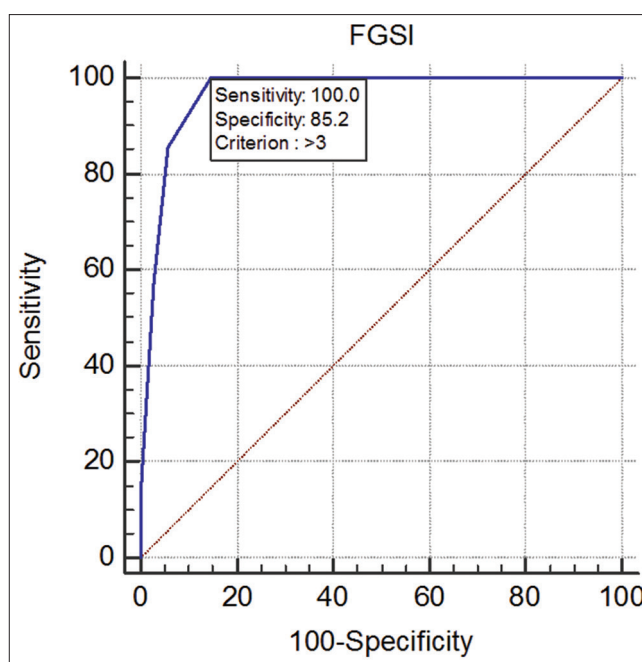
In this study, out of 156 patients, FGSI 0, 1, 2, and 3 were $n = 42, 39, 28,$ and $12,$ respectively, and all survived. As FGSI increased, survival rate decreased (FGSI = 4, two patients died out of 15; FGSI = 5, four patients died out of 8; FGSI = 6, three patients died out of 5; FGSI = 7, three patients died out of 5; FGSI >7, i.e. 8 ($n = 1$) and 11 ($n = 1$) were 100% nonsurvival. It was also observed statistically that there was moderate significant agreement [Table 3] exist, between FGSI and mortality with a kappa value of 0.508 and P value <0.05, which is significant. By taking cut-off as FGSI >3, 86.53% of the observations were in agreement; 77.56% of patients with FGSI ≤ 3 were alive; and 8.97% of patients with FGSI >3 had died.

Interpretation of the area under the ROC curve (AUC) showed that the performance of the FGSI score was excellent (AUC 0.967; 95% CI: 0.926–0.989) at the cut-off point of >3 [Table 3]. Among patients who died, 100% of the cases had FGSI scores of more than 3. In total, 85.21% of the survived patients had FGSI score ≤ 3 . Forty per cent of the patients with FGSI scores more than 3 had died and 100% of the patients with FGSI score ≤ 3 survived. Also it showed that sensitivity and specificity were 100 and 85.2%, respectively. FGSI can determine the prognosis of patients with Fournier's gangrene [Table 3, Graph 1].

The microbiological culture was found in 56 patients, and out of 56 patients, most frequent bacterial agents found were *E. coli* ($n = 14, 25\%$), *Acinetobacter* ($n = 12, 21.4\%$), *Pseudomonas Aeruginosa* ($n = 12, 21.4\%$), *Klebsiella* ($n = 6, 10.7\%$), *Staphylococcus aureus* ($n = 4, 7.1\%$), *Diphtheroid* ($n = 4, 7.1\%$), and *Staphylococcus pyogene* ($n = 2, 3.5\%$). Serial surgical debridement was carried out in all cases [Figure 2], diversion colostomy was performed in 10 cases [Figure 2], and total penectomy was done in one case.

Discussion

Fournier's gangrene is a fulminant spreading necrotizing infection of the skin and subcutaneous tissue of the perineum and external genitalia,^[9] with high mortality and morbidity. Wilson in 1951 used the term necrotizing fasciitis first time for the description of inflammation of soft tissue in superficial and deep fascia regardless of location.^[10] Initially, term Fournier's gangrene was used for gangrene of genitalia of men of unknown origin; later it



Graph 1: Graphical representation of sensitivity and specificity of FGSI

Table 2: Statistical analysis between the age of survival and nonsurvival

	Survival	Nonsurvival	Total cases
Sample size	142	14	156
Mean \pm SD	47.94 \pm 14.9	47.64 \pm 15.9	47.91 \pm 14.94
Mode	60	65	50
Median	48.5	50	50
Min-Max	12–90	19–65	12–90
Interquartile range	38–60	35–65	38–60
$P = 0.944$			

was used for all necrotic inflammation of the region.^[11] Fournier's gangrene is a rare condition and its incidence is 1:7500.^[12,13]

There were various predisposing factors which are related to Fournier's gangrene, which reduced cell-mediated immune response, which favours the development of infection. DM is the most common predisposing factor with an incidence of 46–76.9%.^[14] In the present study, out of 71 patients, 49 (69.01%) were diabetic. It was also noticed that most patients that died with Fournier gangrene were diabetic (11 out of 14). DM is a major predisposing and prognostic factor in our result. It was also noticed that in this study, maximum patients were of low socioeconomic status and from rural areas. All patients, who died, were of low socioeconomic status. Mortality and morbidity rates were higher in rural than in urban areas, which may be due to late presentation to the hospital.

Fournier's gangrene is a polymicrobial infection, i.e., caused by both aerobic and anaerobic bacteria,^[15] which include *E. coli*, *Klebsiella*, *Streptococcus*, *Staphylococcus*, *Clostridia*, *Bacteroid*, and *Cornybacteria*. Laor et al.^[8] reported that *E. coli* and *Streptococcus* species were the most commonly isolated organisms. In our

Table 3: Statistical analysis of FGSI among patients

		Survival												
		Alive	Died	Total	P	Kappa								
FGSI	<=3	121 (77.56%)	(0.00%)	121 (77.56%)	<.0001	0.508								
	>3	21 (13.46%)	14 (8.97%)	35 (22.44%)										
Total		142(91.03%)	14(8.97%)	156 (100.00%)										
		Area under ROC curve (AUC)	SE	95%CI	P	Cut off	Sensitive ity	95%CI	Specificity	95%CI	+PV	95%CI	-PV	95%CI
FGSI		0.967	0.0 133	0.926- 0.989	<0.0001	>3	100	76.8-100.0	85.21	78.3-90.6	40	23.9-57.9	100	97.0-100.0

study, *E. coli* had been identified as a major associated bacteria. The bacterial infection causes thrombosis of small subcutaneous vessels and tissue necrosis leading to an anaerobic environment and the growth of anaerobes. Aerobe and anaerobes act as synergistically and produce enzymes like collagenase, heparinase, hyaluronidase, streptokinase, and streptodornase that destroy the tissue. Vascular thrombosis and dermal necrosis are due to the activity of the heparinase and collagenase produced by aerobes. The impaired activity of phagocytic leucocytes in necrotic tissue is responsible for the spread of infection because they require oxygen for the production of antibacterial high-energy radicals.^[15,16]

There are three routes by which infection follows in Fournier's gangrene^[13]

- Bacteria in the lower urinary tract move to the paraurethral gland and corpus spongiosum to bucks fascia, colles, and scrapa fascia. Infection can pass through buck's fascia of the penis and spread along dartos fascia of scrotum, penis, colles fascia of perineum, and scarpa fascia of anterior abdominal wall.
- Infection begins around the rectum and spreads directly to the scrotum and testes through the colles fascia.
- Bacteria that present on the skin penetrate the subcutaneous tissue by trauma.

The clinical picture of Fournier's gangrene generally starts in the scrotal region and rapidly spread to the penis, perineum, and inner thigh.^[17] The local signs of inflammation [pain, heat, erythema, and oedema] involving the scrotum, perineum, and perianal reason are up to 93.3, 46.5, and 37.2%, respectively.^[18]

Fournier's gangrene prognosis can be determined by FGSI, which has been developed by Laor *et al.*^[8] in 1995 by modifying the APACHE-2 score. In FGSI, there are nine parameters (temperature, heart rate, respiratory rate, Na, K, creatinine, haematocrit, WBC, HCO₃) which are measured, and degree of deviation from normal is graded from 0 to 4. Laor *et al.* also found that Fournier's gangrene patients having FGSI >9 had 75% probability of death and ≤9 had a 78% of probability of survival.^[8] In our cases, positive predictive values having FGSI >4, >5, >6 were 60, 66, and 71.4, respectively. FGSI >7 had 100% predictive value.

Patients with Fournier's gangrene should be carefully monitored. Early and aggressive surgical debridement of necrotic tissue is the key to successful treatment.^[7] Broad-spectrum antibiotic [Penicillin, third-generation cephalosporin, gentamycin] should be started before surgical treatment and should be changed according to culture findings.^[6] Delay in surgical debridement can increase the extent of necrosis, leading to poor prognosis. Most of the patients of Fournier's gangrene are from rural areas and poor general conditions with inadequate fluid resuscitation, so they need strict monitoring, proper and serial wound debridement, and wound care and dressing.^[5] In some cases, Supra pubic cystostomy (SPC) should be done for urinary diversion when penile or urethral involvement.^[3,6] Colostomy was made if the perianal area involved.^[6] Penile amputation and orchidectomy are rarely done in patients with Fournier's gangrene. In our study, out of 156 cases, one case total penectomy was done due to the involvement of the penis which is rare. Patients with large tissue defects should be considered for reconstructive surgery with local skin flap/graft, otherwise wound left for secondary healing or delayed primary wound closure.^[6] The regular dressing is one of the mainstays of treatment of Fournier's gangrene after surgical debridement; negative pressure wound therapy is also effective for wound management of Fournier's gangrene with shorter wound healing time.^[19]

Conclusion

Fournier gangrene is a rapidly progressive disease with high mortality and morbidity. Sensitivity and specificity of FGSI can determine the prognosis of Fournier's gangrene. Patients with high FGSI score had poor prognosis and high mortality. On the basis of FGSI score, high-risk patients can be identified and aggressive treatment can be started. Early diagnosis, FGSI score, broad-spectrum antibiotic, serial surgical debridement, and proper wound care are beneficial in these patients to prevent mortality. This study will be helpful for primary care physicians for the proper management of patients.

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Conflicts of interest

There are no conflicts of interest.

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