THE ANALYSIS OF FACTORS AFFECTING PROGNOSIS IN FOURNIER'S GANGRENE AND THE IMPORTANCE OF SEVERITY SCORES: OUR RESULTS IN FIFTY-TWO PATIENTS

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ABSTRACT

Background*: Fournier's gangrene (FG) is a rare, an acute, rapidly progressive, fatal necrotizing fasciitis of the genital, perianal and perineal areas. The incidence of mortality is still high, and mortality increases with age. In this study we purposed our experience in the treatment of FG and to determine risk factors affecting prognosis.*

Methods*: Fifty-two patients operated for FG who presented at our hospital from January 2009 to December 2014 were investigated retrospectively. Patients were divided into two groups; surviving and non-surviving. Groups were compared regarding demographic features, vital signs and laboratory analysis, FG severity scores and surgical treatment requirements.*

Results*: Mean age was 56.4 years, and female/male ratio was 20/32. The mortality rate was 9.6% (5 patients), and significantly higher in men (80%). The two most common etiological factors were soft tissue infection (63.5%) and anorectal diseases (28.8%). There was difference between groups in terms of requirements fecal diversion, respiratory rate, potassium and urea levels ($p<0.05$). There was significant difference between groups according to the FG severity index (FGSI) and Uludag FGSI (respectively $p=0.001$ and $p=0.002$). There were no significant difference between groups according to the duration of symptoms and hospitalization, use of antibiotic, etiology, wound culture and debridement number.*

Conclusions*: FG is an unpredictable fulminant disease and there is need for new proposals to reduce morbidity and mortality. In our study, male gender, hypokalemia, uremia and increased respiratory rate at first presentation, and having a neurological disease were found to be the factors affecting mortality in FG patients.*

Key words*: Fournier's gangrene, FGSI, mortality, soft tissue infections.*

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Introduction

FG, named by the French dermatologist Jean-Alfred Fournier who described gangrene of genital region in five young men in 1883, is a rare, rapidly progressive, fulminant necrotizing fasciitis of the genital, perianal, perineal region and abdominal wall. Mortality is high due to a polymicrobial infection that associated with broad necrosis, and systemic toxicity. FG generally occurs in elderly patients and men. However, it is also reported in women and children[(1)]. FG incidence is 1.6/100000 male patients/year, mean age is 50.9 years and the male/female ratio is about 10/1. Regardless of aggressive treatment modalitiy, mortality rate is still high and averages 20-30%[(2)].

In the pathogenesis of FG, polymicrobial infections that include both aerobic and anaerobic organisms originate from a genitourinary, colorectal or soft tissue infection. Histopathological evaluation of the affected region shows vascular thrombosis and dermal necrosis cell, infiltration with bacteria and inflammatory cells[(2)].

Predisposing factors such as diabetes, renal failure, cancer, immobilization and immunosuppression contribute to the formation of polymicrobial infection and increase the susceptibility to the FG[(1)].

The most important feature that identifies FG is the presence of necrotizing component. This feature refers patients requiring surgical and supportive treatment. Early diagnosis is very important on the prognosis and the first step in diagnosis is to suspect. In this process, clinical symptoms such as edema, erythema, pain, induration and fever play a major role. Radiological examination and laboratory investigations may be helpful in the diagnosis[3]. Recently, diverse scoring systems are used for early diagnosis and determination of prognosis. The best known of these are laboratory risk indicator for necrotizing fasciitis (LRINEC), FGSI and Uludag FGSI. The FGSI has become a standard for researchers[1].

The methods of treatment include medical, surgical and antibiotic treatment. Early and aggressive surgical debridement is the key of successful treatment, and it requires a multidisciplinary approach formed from surgery, reconstructive surgery, and rehabilitation specialist[3].

In this study, we aimed to investigate patients with FG, to identify the availability of the scoring systems, and to determine risk factors that affect mortality and morbidity.

Materials and methods

Study groups and design

This study was retrospective and cross sectional conducted on a single center basis after the approval of the local ethical committee was obtained. The medical records of patients with FG were evaluated from 01 Jan 2009 to 31 Dec 2013 at an urban, secondary care emergency and surgery departments, and the records were obtained from archive records of patients and automation system. Patients who detected tenderness, erythema, induration, swelling, scrotal gangrene, cyanosis, skin necrosis and subcutaneous crepitus on physical examination were considered as FG. In medical records, it was seen that the vital signs of all patients underwent closely, intravenous hydration and antibiotic therapy are given both before and after surgery, and wound cultures were examined during surgery. While all patients operated due to FG were included in this study, patients with no automation and archive record and with a local superficial inflammation of the perianal or urogenital regions were excluded.

The patients included in the study were divided into two groups; surviving and non-surviving. Comparisons in the groups were made on the four main categories;

1. Demographic features: Gender, mean age, etiology, localization of gangrene, duration of symptoms and hospitalization, presence of comorbidities, use of antibiotic.

2. Vital signs and laboratory analysis: temperature, pulse, respiratory rate, leukocyte count, hemoglobin, hematocrit, serum sodium, potassium, creatinine, bicarbonate, glucose, urea, C-reactive protein, and wound culture results.

3. FG severity scores: LRINEC, FGSI, Uludag FGSI.

4. Surgical treatment requirements: fecal and urinary diversion, debridement number, reconstructive surgery and orchiectomy.

Laboratory Analysis

Biochemical tests and complete blood count are performed by fully automatic analyzers. Results were specified separately for each parameter by converting.

FG Scoring Systems

The LRINEC score system, described by Wong et al.[4], is based on hematologic and biochemical changes in evaluation of the disease, and can be applied to establish the component of necrotizing pathology (Table 1). A LRINEC score of ≥6 should raise the suspicion of necrotizing fasciitis among patients with severe infection, and a score ≥8 is a high predictive of this disease.

The FGSI score system, described by Laor et al.[5], includes several prognostic factors which consist of laboratory and clinical parameters associated with a worse prognosis (Table 2). In literature, while A FGSI score >9 has 75% of non-survival, score <9 were associated with 78% survival.

The Uludag FGSI score system, described by Yilmazlar et al.[6], is a modified form of FGSI (Table 2). In addition to FGSI parameters, dissemination and age score is assessed in this score system.

Statistical analysis

Statistical analyses were performed with Statistical Package for the Social Sciences 15.0 software (SPSS Inc., Chicago, IL, USA). Distribution of data was determined by Kolmogorov-Smirnov test. Continuous variables were expressed as mean ± standard deviation, categorical variables as frequency and percent.

Continuous variables were compared with the Independent Sample t test or Mann-Whitney U test and categorical variables were compared using Pearson's Chi-square test for two groups. A p value < 0.05 was considered statistically significant.

Variable	Score
C-Reactive protein, mg/L	
<150	0
≥150	4
Total white cell count, per mm^3	
<15	0
15-25	1
>25	2
Haemoglobin, g/dL	
>13.5	0
11-13.5	1
<11	2
Sodium, mmol/L	
≥135	0
<135	2
Creatinine, µmol/L	
≥141	0
<141	2
Glucose, mmol/L	
≤10	0
>10	1

Table 1: Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) Score.

Results

The summary of demographic characteristics of study groups are shown in Table 3. According to the results, of the 52 patients studied, 47 survived and 5 non-survived; the overall mortality rate was 9.6%. There were 32 male and 20 female, and the mean ages of patients in surviving, in non-surviving group, and overall were comparable, as 56.46 (19-87), 62 (41-81) and 57 (19-87) years, respectively. Gender and age weren't factors affecting mortality (p=0.637 for gender and p=0.419 for mean age), whereas the mortality among male was vaguely higher compared to female.

The underlying etiologies of FG were identified in all patients. The commonest etiology was the skin infection in both groups (33 patients, 63.5%) and there was no statistically significant difference (p=0.846). The majority of anorectal disease consisted of perianal abscess. In patients with skin infections, etiologies were due to soft tissue infections in 24 patients, postoperative infection in 3 patients and trauma in 2 patients. Traumatic causes include percutaneous hydrocelectomy and accidentally, enema was applied to the perineal area.

Gangrenous involvement was extensive in 40.4% of patients while regional in 59.6%. The extensive involvement was higher in the non-surviving group. But, there was no significant difference between groups (p=0.383). The gangrene extended to the abdominal wall in only one patient. The mean duration of symptoms at the first admission and the length of stay at hospital were similar in both groups (p>0.05).

The 73% of patients (38 patients) had at least one co-morbid disease. The most common co-morbid disease was diabetes mellitus (DM) (46% - 24 patients). Neurological diseases such as paraplegia, quadriplegia were higher in the non-surviving group and was statistically significant (p=0.014). Tuberculosis infection was present in two patients. The two groups were similar with regard to single or multiple use of antibiotic (p>0.05).

In our study, FG severity scores, commonly used in the literature, were calculated and scores are shown in Table 3. The mean LRINEC score was 4.14 in surviving group, 6.80 in non-surviving group (overall 4.40). Despite the LRINEC score was higher in non-surviving group there was no statistically significant difference between groups (p=0.124). In addition, there wasn't a correlation between LRINEC score and the localization of gangrene. FGSI and Uludag FGSI scores were higher in non-surviving group than surviving group and there was statistically significant difference (p=0.001 for FGSI and p=0.002 for Uludag FGSI). But, Uludag FGSI and FGSI scores were similar in both groups.

Vital signs and laboratory analysis of groups were summarized Table 4. The two groups were similar with respect to temperature and pulse (p>0.05). The average respiratory rate was higher in non-surviving group and was statistically significant (p=0.011). Laboratory analyzes except for serum potassium and urea levels were similar in both groups (p>0.05). The average serum potassium level was lower in non-surviving group while the average urea level was lower in surviving group

A. Physiological variables (Parameters of the FGSI score)									
	4	+3	+2	+1	0	+1	+2	+3	+4
Temperature (°C)	>41	>39		38.5-28.9	36-38.4	34-35.9	32-33.9	<31.9	<29.9
Pulse (bpm)	>180	140-179	110-139		70-109		55-69	40-54	<39
Respiratory rate (rpm)	>50	35-49		25-34	12-24	10-11	6-9		<5
Sodium (mmol/L)	>180	160-179	155-159	150-154	130-149		120-129	111-119	<110
Potassium (mmol/L)	>7	6-6.9		5.5-5.9		3.5-5.4	3-3.4	2.5-2.9	<2.5
Creatinine (mg/dL)	>3.5	2-3.4	1.5-1.9	0.6-1.4					<0.6
Hematocrit (%)	>60		50-59.9	46-49.9	30-45.9	20-29.9			<20
Leucocytes (x103/mm3)	>40		20-39.9	15-19.9	3-14.9	1-2.9			<1
Bicarbonate (mmol/dL)	>52	41-51.9		32-40.9	22-31.9		18-21.9	15-17.9	<15
B. Dissemination Score									
Fournier's gangrene confined to the urogenital and/or anorectal region, add 1 Fournier's gangrene confined to the pelvic region, add 2 Fournier's gangrene extending beyond the pelvic region, add 6									
C. Age Score									
Age ≥ 60 years, add 1									

Table 2: Uludag Fournier's gangrene severity index (Uludag FGSI).

(p=0.045 for potassium levels and p=0.002 for urea levels). Escherichia coli was the most frequently isolated microorganisms in culture (13.5%) and there were no difference between groups in terms of culture results (p=0.713). It was seen that culture was negative in 35 (73%) of the patients,

The requirements of the surgical treatment are shown in Table 5. Fecal diversion was performed to 7 patients in surviving group and 3 patients in non-surviving group. It was significantly higher in patients in the non-surviving group (p=0.043). Urinary diversion wasn't performed to any patient. The average number of debridement was similar in both groups, respectively, 2.51±1.73 times in surviving group and 2.40±1.14 times in non-surviving group. Reconstructive surgery was performed to 8 patients in the surviving group and orchiectomy was performed to only a patient.

Discussion

Fournier's gangrene, caused by synergistic aerobic and anaerobic organisms and described by Jean Alfred Fournier in 1883, is an important emergent surgical condition due to its rapidly expansion and life-threatening. Diagnosis, treatment and postoperative care of the disease require a multidisciplinary approach. Currently, the mortality rate is still high despite developments in diagnosis and treatment and early intervention. In this study, we aimed to investigate patients with FG, to identify the availability of the scoring systems, and to determine risk factors that affect mortality and morbidity.

Although the FG occurs at any age, it is usually considered a disease of adults and the incidence increases with age[7]. In literature, the mean age of the patients with FG is 50.9, and ranges from 40 to 61 years[2, 8]. In a population based epidemiologic study, Sorensen et al. introduced that an increasing patient age was the powerful independent predictor of mortality (p <0.0001)[9]. Although case series published were mostly from the urology clinic, there are clearly male predominance and the male/female ratio is about 10/1[8].

In our study, we found that the mean age of the patient was 57 years consistent with the literature. In contrast to the literature, the male/female ratio was 8/5, since patients were obtained from different clinics such as emergency, surgery. The mortality rate varies from 0% to 88%. In a comprehensive study,

Feature	Surviving (n=47)	Non-Surviving (n=5)	Overall (n=52)	"p"
Gender (M/F)	28/19	4/1	32/20	0.637
Mean age	56.46±16.63	62.00±18.81	57.00±16.41	0.419
Etiology				0.846
Anorectal diseases	*14*	1	15(28.8%)	
Urogenital diseases	*3*	0	3 (5.7%)	
Skin	*29*	4	33 (63.5%)	
Incarcerated inguinal hernia	*1*	0	1 (1.9%)	
Gangrene localization				0.383
Extensive involvement	18	3	21 (40.4%)	
Regional involvement	*29*	2	31 (59.6%)	
Duration of symptoms (day)	3.49±1.45	3.80±1.30	3.52±1.43	0.682
Duration of hospitalization (day)	29.72±34.50	22.80±18.87	29.05±33.25	0.95
Comorbidities				0.014#
Diabetes mellitus	21	3	24 (46.2%)	
Hypertension	*11*	1	12 (23.1%)	
Neurological disease#	*4*	3	7 (13.5%)	
Cancer	*2*	0	2 (3.8%)	
Renal failure	*3*	1	4 (7.7%)	
Tuberculosis	*2*	0	2 (3.8%)	
Use of antibiotic				0.637
Single	*19*	1	20 (38.5%)	
Multiple	*28*	4	32 (61.5%)	
FG severity scores				
FGSI	1.44±1.89	8.00±4.30	**2.07±2.91**	**0.001**
Uludag FGSI	3.29±2.62	11.00±5.52	4.03±3.72	**0.002**

Table 3: The demographic features of groups.

Eke[8] reported a total mortality rate of 16%; and Sorensen et al.[9] found mortality rates of 7.5% in men and 12.8% in women. However, there was no significant difference. Ersoz et al.[10], in their series of 52 patients, found that there was no significant difference between male and female in terms of the mortality. In contrast to, Czymek et al.[11], in their study of 38 patients, found that mortality was significantly higher among female (p = 0.0011). In our study, although men were more in non-surviving group than surviving group, gender wasn't a factor affecting mortality.

Features	Surviving (n=47)	Non-Surviving (n=5)	Overall (n=52)	"p"
Vital Signs				
Temperature (°C)	36.72±0.85	36.94±1.41	36.74±0.90	0.732
Pulse (bpm)	78.70±9.30	92.00±16.43	79.98±10.71	0.111
Respiratory rate (rpm)	20.21±1.98	22.80±2.04	**20.46±2.11**	0.011
Laboratory results				
Leukocyte count (x1000/mm3)	11.65±5.31	14.21±2.45	11.89±5.15	0.124
Haemoglobin (g/dL)	12.31±2.38	10.92±2.76	12.18±2.43	0.368
Hematocrit (%)	*37.17±7.17*	31.92±8.13	36.67±7.35	0.214
Serum sodium (mmol/L)	134.48±18.58	135.94±4.51	134.62±17.70	0.514
Serum potassium (mmol/L)	4.07±0.45	3.20±1.11	3.99±0.59	**0.045**
Serum creatinine (mg/dL)	0.87±0.27	2.16±1.16	1.00±0.76	0.054
Serum bicarbonate (mmol/L)	24.74±2.10	28.40±21.49	25.78±9.11	1
Serum glucose (mg/dL)	197.00±121.92	265.60±136.47	204.48±123.58	0.257
Serum urea (mg/dL)	36.99±20.28	107.60±70.65	43.78±34.70	**0.002**
C-reactive protein (mg/dL)	11.57±10.12	22.99±17.45	12.67±11.30	0.091
Wound culture results				0.713
Escherichia coli	6	1	7 (13.5%)	
Acinetobacter	*1*	0	1 (1.9%)	
Streptococcus spp.	*2*	0	2 (3.8%)	
Klebsiella	*1*	0	1 (1.9%)	
Proteus	1	*0*	1 (1.9%)	
Staphylococcus aureus	*1*	1	2 (3.8%)	
Non-reproduction	*35*	3	38 (73.1%)	

Table 4: Vital signs and laboratory analysis.

Co-morbid systemic diseases associated with Fournier's gangrene were DM, alcohol misuse, malignancy, chronic steroid use, lymphoproliferative diseases, malnutrition, and Human Immunodeficiency Virus (HIV) infection[1]. DM is the most common of these, and in literature, the prevalence of DM among FG patients various between 50 and 70 percent[12]. In the present study, the most common co-morbid disease is DM (46%). No co-morbid disease was detected in fourteen patients. Even though DM and hypertension were the leading predisposing factor for FG, they were

not found to effect mortality. Contrary to, neurological diseases, especially paraplegia, third most frequent co-morbid disease, were determined in 60% of patients in non-surviving group and found to be a prognostic factor for mortality ($p < 0.014$).

Feature	Surviving (n=47)	Non-Surviving (n=5)	Overall (n=52)	"p"
Fecal diversion	7	3	10	**0.043**
Urinary diversion	0	0	0	
Debridements number	2.51±1.73	2.40±1.14	2.50±1.67	0.797
Reconstructive surgery	8	0	8	
Orchiectomy	1	0	1	

Table 5: Surgical treatment requirements.

Perianal infection is the most common etiological cause in patients with FG[13, 14]. The three most common sources of infection were gastrointestinal tract (30-50%), genitourinary tract (20-40%), and skin injuries (20%)[15]. Hernia repair, trauma, scrotal abscesses, urethral strictures, haemorrhoid banding, traumatic, and allergic reactions are rare[2]. In our study, the two most common etiological causes were soft tissue infections (64%) and anorectal diseases (29%). One of two traumatic causes was percutaneous hydrocelectomy, the other was case that enema was accidentally applied to the perineal area.

The most important first step for the treatment of FG's is early intervention therapy. The elapsed time after the onset of the disease is important because the fascial necrosis rate per hour can be as high as 2-3 cm[16]. In a study by Jeong et al., has been reported a clearly relationship between mortality and time of presentation[17]. However, we didn't detect such a relationship in our study. Wide wounds in FG patients usually take a long time to heal and thus require a long hospitalization time. Even though Ersay et al.[18] have found that a longer hospitalization time was a factor affecting survival, in our study, duration of hospitalization was not effective on mortality (p=0.950).

The most important second step for the treatment of FG's is surgical debridement of necrotic tissues. The skin, fascia and muscles by affected gangrene should be widely excised with radical debridement. Repetitive and extensive debridements should be performed without hesitation until the lively, bright and bleeding tissues will be seen '[1]. Repetitive debridements increase the length of hospital stay, and this state may be associated with mortality. Benjelloun et al.,[19] in their study, reported that the mean number of debridements had no effect on mortality, but there was a relationship between the mean number of debridements with diabetic and non-diabetic patients. Similarly, Canbaz et al.[20] and Altarac et al.[21] found that there was no a relationship between the mean numbers of debridements with mortality. In our study we also found similar results.

The most important third step for the treatment of FG's is antibiotic therapy. In FG, there is suppurative bacterial infection, and cultures from the wound generally show polymicrobial infections by aerobes and anaerobes, which include coliforms, klebsiella, streptococci, clostridia, bacteroids, and corynbacteria[16]. While the most commonly isolated aerobic microorganism are Escherichia coli, Klebsiella pneumonia, and Staphylococcus aureus, the most commonly isolated anaerobic microorganism is Bacteriodes fragilis[1].

In our study, in 27% of patients (14 patients) were positive in culture. The most common pathogens isolated from the culture were Escherichia coli, streptococcus spp. and Staphylococcus aureus, respectively, in accordance with the literature. Empiric broad spectrum antibiotic therapy should be instituted as soon as possible, until the culture results could make adjusted the therapy. The antibiotic regimen chosen must have a high degree of effectiveness against aerobic and anaerobic microorganisms. Classically triple therapy is usually recommended. This therapy includes third generation cephalosporin or aminoglycosides, plus penicillin and metronidazole. New clinical guidelines currently recommend the use of Carbapenems (Imipenem, meropenem, ertapenem) or piperazilinetazobactam[1].

In our study, we have applied single antibiotic therapy (generally third generation cephalosporin or imipenem) in 38% of patients, multiple antibiotic therapies (cephalosporin+aminoglycosides or cephalosporin + aminoglycosides + metronidazole) in 62% of patients. Despite multiple antibiotic therapies was used in 80% of patients in non-surviving group, there was no effect on mortality.

If there are anal insufficiency, rectum perforation, excessive necrosis in the perineum, fecal contamination or a fistula, anorectal region and sphincter are affected from gangrene, gastrointestinal diversion operation should be performed to prevent dissemination. Similarly, if there is extensive urethral

or penile involvement, some authors recommend suprapubic cystostomy[22, 23]. Orchiectomy and penile amputation are rarely required in patients of FG now that the blood supply to the testicles is generally preserved[2]. Canbaz et al.[20] compared risk factors affecting the prognosis of 18 patients, found that the intestinal diversion rate was 22.2%, but this was not statistically significant. Koukouras et al.,[24] found that colostomy rate was 55.5%, cystostomy rate was 37.7% of, and orchiectomy rate was 26.6%. In our study, the colostomy was performed to 7 patients in surviving group, 3 patients in non-surviving group and 10 patients in overall, respectively. It was significantly higher in patients in the non-surviving group (p=0.043). Urinary diversion wasn't performed to any patient.

The common results of aggressive surgical debridement are large tissue defects. Therefore, wound care forms an important part of treatment. Daily wound care is made with sterile saline sponges and wound baths with antiseptic. In local wound care, some authors stated that when used topically, sodium hypochlorite or hydrogen peroxide is beneficial. Some studies show that hyperbaric oxygen (HBO) therapy reduces systemic toxicity, borders necrosis, and mortality. However, the use of HBO is limited because of possible brain and lung complications of oxygen toxicity and high cost. In addition, the precise effect of HBO therapy has not been shown yet for routinely use in clinical trials[25].

The most important final step of management of FG is the closure of a large wound defects. The majority of cases, especially small defects, are closed simply by secondary heal. But, the split - thickness skin grafts are preferred to close the wound in large defects. In recent years, vacuum-assisted closure (VAC), increasingly gained popularity, provides an important contribution by accelerate wound healing at this stage of the disease, which is quite troublesome[25]. In our study, only 8 patients (15.4%) in surviving group were performed reconstructive surgery.

The laboratory findings at admission in FG are leukocytosis, hyponatremia, uremia, thrombocytopenia, hypokalemia, hipoproteinemia, hyperglycemia, anemia, elevated levels of creatinine and lactate[3]. Altarac et al.,[21] found that creatinine and potassium levels were higher in surviving group while there were no difference between the groups in terms of sodium levels. Canbaz et al.[20] did not find differences between groups according to leukocyte count. Moreover, in this study, hyponatremia was observed more often in the surviving group (p = 0.039). In our study, although the mean leukocyte count was high, the mean hemoglobin levels were low, there was no significant difference. In addition, there were no significant differences between groups in terms of creatinine, bicarbonate, sodium, glucose and CRP levels. Moreover, in contrast to the studies of Altarac et al.[21] potassium levels were lower and serum urea levels were higher in the non-surviving group.

On physical examination at admission, sudden onset of pain, swelling and hyperemia are seen on gangrene localization. Fluctuant, crepitation, and wound dehiscence are seen in advanced stages of the disease and delayed admission. In addition, high fever, increased pulse and respiratory rate may be accompanied[1]. In a study, Ferreira et al.[26] found that the most common admission forms were swelling, fever and pain. Similarly, Ersay et al.[18] established that the most common complaints were scrotal pain, tachycardia, fever, and crepitation. Altarac et al.,[21] in a series of 41 patients, found that there was no significant difference between groups in terms of temperature, but they identified that pulse and respiratory rate were higher in the surviving group. In our study, the most common complaints were swelling, pain, and hyperemia on gangrene localization. In addition, while there were no difference between groups according to temperature and pulse, in accordance with the literature, respiratory rate was higher in the surviving group (p=0.011).

Currently, many severity scoring systems have been developed to assess the prognosis of patients with FG. LRINEC score[4] is a laboratory risk indicator for necrotizing fasciitis score and includes no clinical parameters. In this scoring system, high score is a powerful indication of the formation of necrotizing fasciitis, and as long as the score increases, predictive power increases. In our study, we determined that there was no correlation between the LRINEC score and mortality.

FGSI scoring system, defined by Laor et al.[5], has been created by adapting from APACHE II score, is the most commonly used scoring system in the literature. This scoring system includes six laboratories and three clinic parameters. The FGSI scoring system determines severity of disease. Besides, this score is a powerful predictive value for mortality. As score increases, mortality rate increases. Articles in the literature show that 75% of mortality and 78% of life can be correctly estimated with

FGSI scoring system[1]. Altarac et al.[21] determined that the mean FGSI score was 6 in surviving group and 11 in non-surviving group and found that these values were statistically significant (p=0.0001). Ersay et al.[18] identified that there was correlation between FGSI score with duration of hospitalization and the number of debridement. Similarly, Canbaz et al.[20] found that FGSI score was higher in non-surviving group. We found that FGSI score was higher in non-surviving group (p=0.001). In addition, the survival rate was 94% and the death rate was 100% correctly identified.

Yilmazlar et al.[6] have described Uludag FGSI score by adding the age factor and degree of dissemination to FGSI score system. This scoring system is associated with mortality as the FGSI. Yilmazlar et al., in their studies, have correctly identified 94% of mortality and 81% of survival. In our study, the mean of Uludag FGSI score was significantly higher in the non-surviving group (p=0.002). In addition, the survival rate in patient with a score <9 was 95.8% and the death rate in patient with a score >9 was 50%, and these results was different from the findings of Yilmazlar et al.[6].

In conclusion, the mortality rate is still high in patient with FG despite the using different scoring systems for identify of prognosis and severity of disease. Because the most effective way to reduce morbidity and mortality is early diagnosis and treatment, early intervention should be performed, adequate fluid resuscitation should be provided, appropriate antibiotics should be preferred and daily wound care should be performed. In addition, patients with high risk of mortality should be determined using an updated scoring system and should be followed closely.

Study Limitations

The major limitation of this study is the small number of patients. There was not enough information in records of patients and all data couldn't be completely value because this was a retrospective study. In addition, the lack of a standard treatment plan since the treatment of FG was made many different clinics adversely affects the results of study.

References

1) Mallikarjuna MN, Vijayakumar A, Patil VS, Shivswamy BS. *Fournier's Gangrene: Current Practices*. ISRN Surg. 2012; 3(12): *1-8*.
2) Sroczyński M, Sebastian M, Rudnicki J, Sebastian A, Agrawal AK. *A complex approach to the treatment of Fournier's gangrene*. Adv Clin Exp Med. 2013; 22(1): *131-5*.
3) Mishra SP, Singh S, Gupta SK. *Necrotizing Soft Tissue Infections: Surgeon's Prospective*. Int J Inflam. 2013; 24(12): *1-7*.
4) Wong CH, Khin LW, Heng KS, Tan KC, Low CO. *The LRINEC (Laboratory Risk Indicator for Necrotizing Fasciitis) score: a tool for distinguishing necrotizing fasciitis from other soft tissue infections*. Crit Care Med. 2004; 32(7): *1535-41*.
5) Laor E, Palmer LS, Tolia BM, Reid RE, Winter HI. *Outcome prediction in patients with Fournier's gangrene*. J Urol. 1995; 154(1): *89-92*.
6) Yilmazlar T, Ozturk E, Ozguc H, Ercan I, Vuruskan H, et al. *Fournier's gangrene: an analysis of 80 patients and a novel scoring system*. Tech Coloproctol. 2010; 14(3): *217-23*.
7) Hosseini SJ, Rahmani M, Razzaghi M, Barghi M, Hosseini Moghaddam SM. *Fournier gangrene: a series of 12 patients*. Urol J. 2006; 3(3): *165-70*.
8) Eke N. *Fournier's gangrene: a review of 1726 cases*. Br J Surg. 2000; 87(6): *718-28*.
9) Sorensen MD, Krieger JN, Rivara FP, Broghammer JA, Klein MB, et al. *Fournier's Gangrene: population based epidemiology and outcomes*. J Urol. 2009; 181(5): *2120-6*.
10) Ersoz F, Sari S, Arikan S, Altiok M, Bektas H, et al. *Factors affecting mortality in Fournier's gangrene: experience with fifty-two patients*. Singapore Med J. 2012; 53(8): *537-40*.
11) Czymek R, Frank P, Limmer S, Schmidt A, Jungbluth T, et al. *Fournier's gangrene: is the female gender a risk factor?* Langenbecks Arch Surg. 2010; 395(2): *173-80*.
12) Dahm P, Roland FH, Vaslef SN, Moon RE, Price DT, et al. *Outcome analysis in patients with primary necrotizing fasciitis of the male genitalia*. Urology. 2000; 56(1): *31-6*.
13) Korkut M, Içöz G, Dayangaç M, Akgün E, Yeniay L, et al. *Outcome analysis in patients with Fournier's gangrene: report of 45 cases*. Dis Colon Rectum. 2003; 46(5): *649-52*.
14) Unal B, Kocer B, Ozel E, Bozkurt B, Yildirim O, et al. Fournier gangrene. *Approaches to diagnosis and treatment*. Saudi Med J. 2006; 27(7): *1038-43*.
15) Yaghan RJ, Al-Jaberi TM, Bani-Hani I. *Fournier's gangrene: changing face of the disease*. Dis Colon Rectum. 2000; 43(9): *1300-8*.
16) Thwaini A, Khan A, Malik A, Cherian J, Barua J, et al. *Fournier's gangrene and its emergency management*. Postgrad Med J. 2006; 82(970): *516-9*.
17) Jeong HJ, Park SC, Seo IY, Rim JS. *Prognostic factors in Fournier gangrene*. Int J Urol. 2005; 12(12): *1041-4*.
18) Ersay A, Yilmaz G, Akgun Y, Celik Y. *Factors affecting mortality of Fournier's gangrene: review of 70 patients*. ANZ J Surg. 2007; 77(1-2): *43-8*.
19) Benjelloun el B, Souiki T, Yakla N, Ousadden A, Mazaz K, et al. *Fournier's gangrene: our experience*

with 50 patients and analysis of factors affecting mortality. World J Emerg Surg. 2013; 8(1): *13-17*.
20) Canbaz H, Cağlikülekçi M, Altun U, Dirlik M, Türkmenoğlu O, et al. *Fournier's gangrene: analysis of risk factors affecting the prognosis and cost of therapy in 18 cases*. Ulus Travma Acil Cerrahi Derg. 2010; 16(1): *71-6*.
21) Altarac S, Katušin D, Crnica S, Papeš D, Rajković Z, et al. *Fournier's gangrene: etiology and outcome analysis of 41 patients*. Urol Int. 2012; 88(3): *289-93*.
22) Villanueva-Sáenz E, Martínez Hernández-Magro P, Valdés Ovalle M, Montes Vega J, Alvarez-Tostado F JF. *Experience in management of Fournier's gangrene*. Tech Coloproctol. 2002; 6(1): *5-13*.
23) Smith GL, Bunker CB, Dinneen MD. *Fournier's gangrene*. Br J Urol. 1998; 81(3): *347-55*.
24) Koukouras D, Kallidonis P, Panagopoulos C, Al-Aown A, Athanasopoulos A, et al. *Fournier's gangrene, a urologic and surgical emergency: presentation of a multi-institutional experience with 45 cases*. Urol Int. 2011; 86(2): *167-72*.
25) Ozturk E, Ozguc H, Yilmazlar T. *The use of vacuum assisted closure therapy in the management of Fournier's gangrene*. Am J Surg. 2009; 197(5): *660-5*.
26) Ferreira PC, Reis JC, Amarante JM, Silva AC, Pinho CJ, et al. *Fournier's gangrene: a review of 43 reconstructive cases*. Plast Reconstr Surg. 2007; 119(1): *175-84*.

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