Novel A Modified Scoring System for Predicting Fournier's Gangrene: An Analysis of 50 Patients

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Abstract:-Background: The aim is to enhance the scoring system for Fournier's gangrene patients, thereby facilitating the creation of more effective and feasible management strategies.

Methods: We analyzed 50 patients who underwent surgery for Fournier's gangrene in the last 5 years using logistic regression and a prospectively maintained database. We then adopted a novel scoring system that combined this data with Fournier's gangrene severity index (FGSI). We created a novel predictive scoring system based on the physiological score, age score, and the extent of gangrene.

Results: The 50 patients had a mortality rate of 21%. The new scoring system (MFGSI), with a threshold value of 9, observed a 94% probability of death with a score greater than 9. When the score is 9 or less, there is an 81% probability that death will occur. (P < 0.001). The receiver operating characteristics (ROC) analysis concluded that the new scoring system was more powerful than the FGSI (P = 0.002).

Conclusions: The power of the modified scoring system introduced in this study proves that in patients with Fournier's gangrene, the extent of the gangrene as well as the patient's age and physiological status have a significant effect on the outcome.

Key words: Fournier's gangrene, score, extent of gangrene

INTRODUCTION

Fournier's gangrene is a potentially fatal disease that causes necrotizing fasciitis in the genital and perineal area due to a synergistic poly microbic infection [1–5]. It is a surgical emergency and requires prompt surgical intervention [6–10]. Mortality rates in Fournier's gangrene range from 0 to 67% [1–25], which indicates that the outcome of patients with the disease is multifactorial. There are many predictive assessment scores used, such as Acute Physiology and Chronic Health Evaluation (APACHE) II [8, 17] or Fournier's Gangrene Severity Index (FGSI) score [1, 10–13].

Numerous factors influence the course of the disease and fall into three categories: disease-related, host-related, and physician-related. Physicians should prioritize early diagnosis, prompt surgical debridement without waiting for CT or other radiological confirmations, and appropriate and adequate antibiotic usage. When the synergic organism is much more virulent or the host has a lot of chronic comorbidities with immune deficiency, the disease spreads quickly, which will have an adverse impact on the disease's outcome [6, 7, 10, 15].

For patients with Fournier's gangrene, the FGSI may predict mortality at 75% and survival at 78% [8]. Many researchers find this scoring system useful, but we believe it has room for improvement to predict the prognosis and empower people to manage risk. [1, 10–13]; As a result, we evaluated the effect of the three sets of elements stated above on the outcome and developed a new scoring system by changing the FGSI. We can simply utilize the scoring method in ordinary clinical practice, taking into account the patient's acute physiological status, age, and the extent of the disease.

MATERIALS AND METHODS

After obtaining approval from the Institutional Ethics Committee, we retrospectively reviewed the prospectively maintained medical records of patients presenting with Fournier's gangrene to the Departments of General Surgery from 2018–24. The patients diagnosed to have the Fournier's gangrene in the anorectal and urogenital regions and had undergone surgical treatment for necrotizing soft tissue infections were included in the study. In these areas, the study excluded patients with single abscesses that did not cause necrotizing soft tissue infections.

MANAGEMENT

Based on patient admission data, APACHE II and FGSI scores are determined. All patients were treated on admission with empiric broad-spectrum parenteral antibiotics. Initial surgical debridement was carried out within the first 12 hours after admission. The subsequent antibiotics were prescribed based on the microbial cultures obtained in the operating room during each debridement sequence. The dressings

were changed once every 24 hours or more if needed. Wound exploration under anesthesia was done for all patients every 48 hours, and some patients required additional debridement in the successive days. This process is repeated till there is complete stop of infective foci and healthy granulation tissue is formed, and also the culture showed negative results. Wounds with large surface areas of healthy granulation tissues were treated with SSG. In addition, some patients had urinary or fecal diversion, and some needed intensive care in the ISCU. Negative pressure VAC therapy was used in a few cases, but not hyperbaric oxygen therapy. Nutritional support was carried out with correction of electrolyte deficiency and anemia by blood transfusion.

STUDY VARIABLES

We recorded the study variables, including age, gender, the duration of symptoms, the ratio of direct admission to the referral from other centers, the FGSI score, the presence of coexisting diseases, the origin of infection, the extent of gangrene, and the method of therapy. We also recorded the need for an intensive care unit (ICU) or ventilator, the number of days spent in the ICU, and the length of the hospital stay.

STRATIFYING THE EXTENT OF GANGRENE

The Chi-square test was used to stratify the patients into three groups based on the operative findings data and on statistical differences in their mortality means were formed.

1. The anorectal or urogenital region, which includes the perianal area, the perineum, the scrotum, and the penis or vulva, is the exclusive location for Fournier's gangrene (grade I gangrene).
2. The previously mentioned regions, along with the pubic region or thigh-pelvic region (grade II gangrene), are where Fournier's gangrene is most located. Underwear best describes this area.
3. Fournier’s gangrene, which extended beyond the pelvic region (grade III gangrene) (Fig. 1).

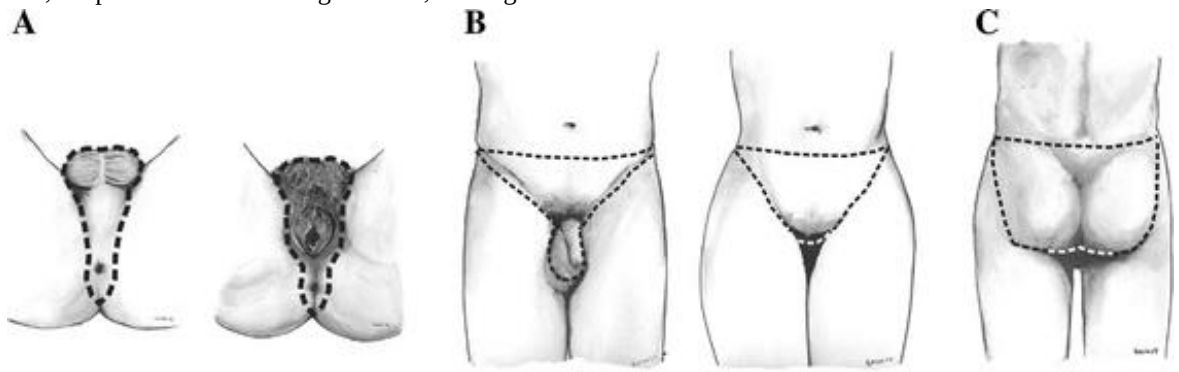

Fig. 1: Anatomical limit-based grading. A. grade I dissemination. B. grade II dissemination, front view in man and woman and back. Extension of the disease to all other parts was considered grade III dissemination.

STATISTICAL ANALYSIS

Wilcoxon test was used for continuous variables, the Kruskal-Wallis test for more than two groups, and Pearson's chi square or Fischer's exact test for categorical variables. The FGSI scores' cutoff values for mortality was calculated using Receiver Operating Characteristics (ROC) analysis. The data are presented as means, standard error of mean (SEM; parametric), or medians and ranges (nonparametric), as appropriate. Value of $P < 0.05$.

A multivariate logistic regression model was obtained using variables that significantly differed between survivors and non-survivors ($P < 0.001$).

We performed the statistical analyses using the Statistical Package for Social Sciences (SPSS®) for Windows Ver.15.0 and MedCalc Ver.7.2.1.0.

MODIFIED FOURNIER’S SEVERITY INDEX

The multivariate analysis identified significant factors that we added to the FGSI to create Modified Fournier's Gangrene Severity Index (MFGSI) (Table 1), based on the study proposed by Yilmazlar T et al [5]. Using the ROC analysis, the threshold MFGSI scores for mortality was calculated. Pearson's chi-square test analyzed the effectiveness of the MFGSI. Finally, we used ROC analysis to compare the FGSI and MFGSI.

	High Abnormal Values				Normal	Low abnormal values			
Variable	+4	+3	+2	+1	0	+1	+2	+3	+4
Temperature ©	>41	39-40.9	-	38.5-35.9	36-38.4	34-35.9	32-33.9	30-31.9	<29.9
Heart rate	>180	140-179	110-139	-	70-109	-	55-69	40-54	<39
Respiratory rate	>50	35-49	-	25-34	12-24	10-11	6-9	-	<5
Serum Na (mmol/L)	>180	160-179	155-159	150-154	130-149	-	120-129	11-119	<110
Serum K**(mmol/L)	>7	6-6.9	-	5.5-5.9	3.5-5.4	3-3.4	2.5-2.9	-	<2.5
Serum Creatinine	>3.5	2-3.4	1.5-1.9	-	.6-1.4	-	<0.6	-	-
Haematocrit	>60	-	50-59.9	46-49.4	30-45.9	-	20-29.9	-	<20
WBC	>40	-	20-39.9	15.19.9	3-14.9	-	1-2.9	-	<1
Serum Bicarbonate	>52	41-51.9	-	32-40.9	22-31.9	-	18-21.9	15-17.9	<15

Table 1: The Modified Fournier's gangrene severity index. MFGSI = A+B+C

RESULTS

This study included a total of 50 patients who met the inclusion criteria. Out of 50 patients, eleven of them did not respond to treatment and succumbed to the disease, and 39 patients survived with a mortality rate of 22%. Analyses revealed that sepsis, multiorgan failure, and cardiogenic shock were the causes of the mortality in the patients. Septic shock in five patients, multi-organ failure in four patients, and cardiogenic shock in two patients were the causes of death.

Demography:

We studied and tabulated the patients' demographic variables in Table 2.

. Our study included 36 men and 14 women with a median age of 57 (24–85) years. We found that most survivors were younger than disease victims. (*P* = 0.002). ROC analysis revealed a threshold value of 60 years for mortality (area under ROC curve: 0.709, 95% CI: 38.5–81.8). Sex was not associated with mortality.

Factors	Survivors (39)	Dead (11)	*P*
Age (median)	55 (24–85)	62 (47–77)	0.002*
Gender (female/male)	9/30	5/6	0.084
Symptom duration (day; median)	7 (1–15)	7 (4–25)	0.426
Percent of referred patients	77.4	82.4	0.430
The FGSI score (median)	4 (0–23)	14 (3–23)	<0.001*
Presence of DM	57%	58%	0.971
Etiology (anorectal/urogenital)	16/23	6/5	0.240
The extent of the disease (grades I, II, and III) is an important consideration.	21,11, 7	0, 4, 7	<0.001[b]
Fecal diversion (total number)	7	4	0.212
Urinary diversion (total number)	2	1	0.352
Need for ICU	5	7	<0.001*
A ventilator is needed.	2	6	<0.001*
The median length of the ICU stay was 14 days.	8 (1–12)	7 (1–22)	0.638
Length of hospital stay (days; median)	14 (3–57)	7 (2–32)	0.002*

Table 2: Variables describing survivors and non-survivors

The duration of symptoms was similar between the survivors and the deceased. The secondary care hospitals referred 34 patients (68%) to us.

The median FGSI score for the overall group was 4 (0–23). The median FGSI score for survivors was 4 (0–11) and for non-survivors 14 (3–23), which was statistically significant (P < 0.001). FGSI value of 11, as shown as the area under the ROC curve was the cutoff for mortality (sensitivity: 64.7%; specificity: 100%; 95% CI: 0.744–0.914).

15 of our patients had no coexisting diseases; however, in the remaining 35 patients, the most common coexisting disease was type II diabetes mellitus (DM). There were 24 patients (58%) with DM. Among the survivors and non-survivors there was no difference in the incidence of Diabetes Melitus. There were no immunocompromised patients. 28 patients had urogenital diseases that caused Fournier's gangrene; 20 patients had anorectal diseases; and 2 women had skin lesions. There was no significant difference in mortality rates between patients with Fournier's

gangrene originating from anorectal or urogenital regions.

There were 21 patients with grade I disseminated disease, of which all had survived. Fifteen patients had grade II disseminated disease, and four of them died. In Grade III disseminated disease, 14 patients experienced 50% mortality, resulting in 7 deaths. There was a significant difference between mortality rates in groups I and II (P = 0.024), groups II and III (P = 0.009), and groups I and III (P < 0.001).

Eleven patients underwent faecal diversion with temporary colostomies, while 3 patients required cystostomies for urinary diversion. Five patients underwent orchidectomy due to severe testicular destruction, while one patient underwent a penectomy with a perineal urethrostomy.

In the culture, 24 patients had polymicrobial infections, while only 4 patients had a negative culture. Escherichia coli was the most common infectious agent, followed by Proteus, enterococci, streptococci, and staphylococci. A patient with Candida albicans passed away. Anaerobic cultivation was impossible.

Of the 50 patients, 13 required intensive care management. The median length of ICU stay was 8 (1–22) days. Eight of the total 50 patients had features of septic shock upon admission; all of them required mechanical respiratory support, and in spite of that, only 1 survived.

The overall length of hospital stay for the 80 patients was 10 (2–57) days. Survivors stayed in the hospital for a significantly longer period of time than non-survivors.

Logistic regression analysis results:

Variable including Age, the calculated FGSI score, the extent of the gangrene, and the requirement for treatment in the ICU were the critical factors that differed between survivors and non-survivors. The multivariate analysis revealed In people with Fournier's gangrene, FGSI score, age, and the severity of the disease were the only independent risk factors for death (Table 3). We used logistic regression results to determine how age and the extent of gangrene affected the FGSI. This led to the creation of a new scoring system for predicting how well a patient with Fournier's syndrome will do.

(Model $\lambda^2 = 29.190$; $P \leq 0.001$ *The FGSI Fournier's gangrene severity index is the standard error).*

Table 3: Significant factors affecting mortality in logistic regression analysis

Factors	Coefficient (β)	SE	Wald λ^2	*p*	Exp (β)
Age ≤60 years	2.240	0.763	8.619	0.003	9.393
FGSI	0.361	0.133	7.390	0.007	1.435
Grade I gangrene	–	–	11.821	0.003	-
Grade II gangrene	2.688	1.196	5.050	0.025	15.699
Grade III gangrene	4.088	1.210	11.412	0.001	59.599

To determine their effect on the scoring system, we examined the odds ratios of the two most important factors (gangrene severity and age). To simplify the contributing points, we rounded the odds ratio values to integers and split them by 10. The age odds ratio, for instance, was 9.393. When divided by ten, this equals 0.9393, and when rounded to an integer, it equals one, which is the point that goes toward the scoring system. Ages over 60 increased the FGSI score by one point.

To determine the extent of the gangrene's power in the logistic regression model, we utilized Grade I extended gangrene as the reference point. We did, however, record one point for grade I gangrene, because we cannot rule out the disease's existence. If the lesions only affected the perianal, urogenital, or perineum areas (grade I gangrene), we added an additional point to the patient's prior score. The odds ratio for grade II gangrene, a disease limited to the pelvic area, was 15.699. When divided by 10 and rounded up, it was equal to two. For illnesses that went beyond the pelvis, such as grade III gangrene, the chances ratio was 59.599. We divided this by ten and rounded it up to six. Subsequently, we added the age and extent of the gangrene scores to the FGSI score.

For the entire cohort, the median MFGSI was 8 (range 1–30), for survivors it was 7 (range 1–15), and for non-survivors it was 18 (range 9–30) (P < 0.001). ROC analysis found a threshold MFGSI value of 9 for mortality (area under the ROC curve: 0.947; 95% CI: 0.873–0.994). With a UFGSI threshold value of 9, a score of more than 9 related to a 94% chance of death, whereas a score of less than 9 was linked to an 81% chance of survival (Pearson's Chi-square test, P < 0.001). Patients with scores greater than 18 did not survive.

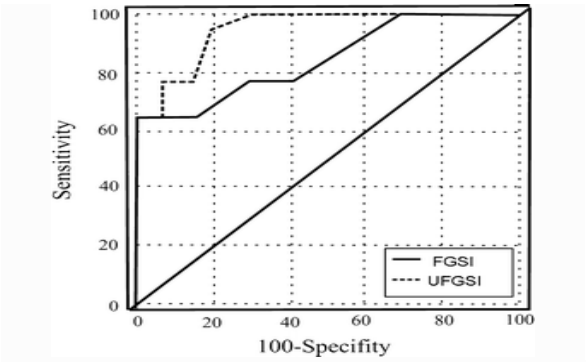

Fig. 2 displays the results of the ROC analysis comparing the two scoring systems. With a significance level of 0.002, the difference between the MFGSI and FGSI areas under ROC curves is 0.105 (Table 4).

Scoring system	Area under ROC curve	SE	95% CI
FGSI	0.843	0.0625	0.744–0.914
MFGSI	0.947	0.0386	0.873–0.994

1. Difference between areas: 0.105
2. Standard error: 0.0339
3. 95% confidence interval: 0.0381 to 0.171
4. Significance level: *P* = 0.002
5. *ROC* Receiver operator characteristics, *SE* Standard error,*CI* confidence interval

Table 4: FGSI Fournier's gangrene severity index, Modified Fournier's gangrene severity index

DISCUSSION

Using 50 patients with urogenital and anorectal region disease, the study aimed to develop a unique and simpler predicting system for patients with Fournier's gangrene. As a tertiary care hospital, we received numerous referrals from secondary care hospitals. Utilizing the innovative predictive scoring, we determined a noteworthy moderate mortality rate of 21% for patients suffering from Provider's gangrene.

This scoring system is unique in that it incorporates the classified extent of the gangrene into the study, along with the FGSI and age. Using this system, we can predict mortality from this disease with a probability of 94% and survival with a probability of 81%. FGSI was introduced by Laor and colleagues in 1995 [8]. Since the severity of the disease altered homeostasis, Laor and colleagues adjusted the APACHE II scoring system by using only the first section to produce the FGSI. The FGSI can predict mortality with a probability of 75% and survival with a probability of 78%.

Later, additional reports [1, 10–13] verified the use of the FGSI. These findings are also supported by our patient analysis. The FGSI value of 11 calculated a threshold mortality with a death probability of 100% and a survival probability of 65%. Our logistic regression model also identified the FGSI as an independent risk factor (OR: 1.435, P = 0.007). John Alfred Fournier described Fournier's gangrene [14] as possessing three main characteristics: unknown origin, young age, and male gender.

Similar to other necrotizing soft tissue infections, Fournier's gangrene primarily affects older patients [6, 7], and its occurrence typically results in a lower survival rate [2]. We also calculated a threshold age of 60 years in the ROC analysis (area under ROC curve: 0.709, 95% CI: 38.5–81.8). In patients with Fournier's gangrene, logistic regression analysis identified age as an independent risk factor for mortality.

Yilmazlar T ET ALL (7) reported the impact of the extent of the necrotizing soft tissue infection on the prognosis of individuals suffering from Fornier's gangrene. Eke N et al., Dahm P, Roland FH et al., have also repopulated the effect of the extent of the gangrene on mortality and morbidity [6, 10, 15]. However, the failure to grade the extent of the crime has been a major problem. Palmer and colleagues conducted a study on the limited impact of involved surface area and surgical debridement on survival in Fournier's gangrene. They reported the ratio of the gangrene affected area to the body surface area and concluded that a better survival rate occurs when the involved gangrene is less than five percent of the total body surface area [16]. This study was the only one to quantify disease severity. To quantify Fournier's gangrene, we grouped our patients' operative findings with the help of statistics.

In our study, we grouped and classified the extent of involvement into three grades of dissemination based on the operative findings. The logistic regression model proved the grade of dissemination to be an independent risk factor for mortality.

We constructed the Modified Fournier's gangrene severity index (MFGSI) by combining these logistic regression findings with literature knowledge. With a difference of 0.105 between the areas under the ROC curves of the MFGSI and FGSI, the MFGSI is a much better predictor of death (94% with a score of 9 or more and 81% with a score of 9 or less) than the FGSI. It is also easier to use in everyday clinical settings.

We can use MFGSI scores to guide patient management. Patients over 60 years of age and those with MFGSI scores exceeding 18 are more likely to die due to the increased spread of gangrene. Once experts identify these factors, they mark the patients as vulnerable and initiate high-intensive treatment to save them. Patients who have MFGSI scores less than 9 have a high probability of survival, and they may not need intensive care. We may treat them in the ward to avoid unnecessary expenses or morbidity in the ICU.

Limitation of study:

The main drawback of this study is its retrospective nature. Other prospective studies and independent observations should validate this modified scoring system.

CONCLUSION

Even with the well-defined treatment of the condition, there are still certain questions about Fournier's gangrene that need to be answered. It is more accurate to predict who will survive and who will not survive using the modified Fournier's gangrene score, which takes into account age and FGSI, as well as the spread and severity of the disease. Hence, it is evident that quantifying the extent of the disease may help determine more precise outcome predictions for patients with Fournier's gangrene.

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