Original Article

Role of SFGSI, microbial culture and qSOFA as predictive factors in determining the survival rate in Fournier Gangrene patient

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ABSTRACT

الأهداف: دراسة درجة مؤشر فورنييه المبسطة لمرض الغرغرينا الشديدة (SFGSI) وعدد الأنواع في نتائج مزرعة الدم للتنبؤ بالوفاة لدى مرضى فورنييه الغرغرينا (FG) من حيث قدرتها التنبؤية.

المنهجية: خلال الفترة من يناير 2017م إلى يوليو 2022م، حصلنا على السجلات الطبية للأفراد الذين خضعوا لعملية جراحية طارئة لـFG. تم فحص مجموعه 80 مريضا للحصول على البيانات السريرية مثل العمر، والجنس ومؤشرات المختبرية، والمسببات، والبكتيريا المعزولة، ومعدل الوفيات.

النتائج: حددنا فروق ذات دلالة إحصائية بين درجات SFGSI p>0.0001و (qSOFA) p=0.002 في تحديد معدل البقاء على قيد الحياة لمرضى FG. كانت حساسية ونوعية درجة SFGSI في التنبؤ بالوفيات 90.1% و88.3% على التوالي، في حين كانت درجة حساسية وخصوصية qSOFA على التوالي 88.2% و86.2%. تشكل الإشريكية القولونية 56.2% من البكتيريا، تليها عنقودية حالة للدم، والمكورات العنقودية الذهبية، والزائفة الزنجارية، والكلبسيلا الرئوية. على أساس نتائج مزرعة البكتيريا، سجلت الزائفة الزنجارية أعلى معدل للوفيات (100%)، تليها العنقوديات الذهبيّة 75%،عنقودية حالة للدم 30%، والإشريكية القولونية 20%،

الخلاصة: يمكن التنبؤ بمعدل البقاء على قيد الحياة لمرضى FG باستخدام حساسية وخصوصية درجات SFGSI وqSOFA معًا. المرضى المصابون بالزنجارية لديهم أكبر معدل وفيات (100%) مقارنة بالمجموعات الأخرى.

Objectives: To examine the simplified Fournier Gangrene Severe Index Score (SFGSI) and the number of species in culture findings for predicting death in Fournier Gangrene (FG) patients in terms of their predictive power.

Methods: From January 2017 to July 2022, the medical records of individuals undergoing emergency surgery for FG were obtained. A total of 80 patients were examined for clinical data such as age, gender, laboratory parameters, etiology, isolated bacteria, and mortality rate.

Results: We identified a statistically significant mean difference between SFGSI (p<0.0001) and quickSOFA (qSOFA) scores (p=0.002) in determining the survival rate of FG patients. The sensitivity and specificity of the SFGSI score in predicting mortality were 90.1% and 88.3% respectively, whereas the sensitivity and specificity of the qSOFA score were 88.2% and 86.2%. *E. Coli* comprised 56.2% of the bacteria, followed by *S. Haemolyticus*, *S. Aureus*, *P. Aeruginosa*, and *K. Pneumoniae*. On the basis of bacterial culture results, *P. Aeruginosa* had the highest fatality rate (100%) followed by *S. Aureus* (75%), *S. Haemolyticus* (30%), and *E. Coli* (20%), in that order.

Conclusion: The survival rate of FG patients can be predicted using the sensitivity and specificity of the SFGSI and qSOFA scores together. *P. Aeruginosa*-infected patients have the greatest mortality rate (100%) compared to the other groups.

Keywords: Fournier gangrene, SFGSI, qSOFA, survival rate, microbial culture

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Fournier gangrene (FG) is a kind of necrotizing fasciitis that affects the external genital and perineal regions, causes gangrene of the skin and subcutaneous layer and may lead to multi-organ failure.[1] Dr. Jean Alfred Fournier was the one who categorized this illness as fulminant penile and scrotal gangrene.[2] According to epidemiological statistics, the incidence rate of FG in the general male population is approximately 1.6 cases per 100,000 males, with a rate of approximately 3.3 cases per 100,000 males over the age of 50.[1,3] The death rate for this condition ranged depending on clinical condition but can reach up to 40%.[1]

Several attempts have been made to determine the mortality rate of FG patients using a variety of methodologies. Fournier Gangrene Severity Index is the most prevalent rating technique (FGSI). Laor et al[4] developed this scoring system in 1995, which measures the predictive characteristics of FG to predict patient mortality. Laor et al[4] conducted a 15-year study on 13 patients diagnosed with FG. Greater than 9 suggested a 75% mortality rate, whilst 9 indicated a 78% survival rate.[4] An effort was made to establish a grading system that was both easier and more reliable so that it could be applied more easily in clinical practice. Tenorio et al[5] decreased the FGSI score to the Fournier Gangrene Severity Index (SFGSI) in 2014, which included only 3 variables: potassium levels, serum creatinine, and hematocrit, without sacrificing sensitivity or specificity. Among patients with FG, sepsis is frequently used to predict mortality.[5]

Patients who passed away had much higher rates of sepsis and ventilation than those who survived to the end of the study. According to a meta-analysis of 12 research conducted by El-Qushayri et al,[6] sepsis is the main cause of death. A SOFA score is calculated to determine the likelihood of organ failure. Due to the complexity and number of laboratory tests required for the scoring system, a streamlined method known as quickSOFA (qSOFA) was created.[6] State of consciousness, respiration rate, and systolic blood pressure are believed to have prognostic value for organ failure, similar to the SOFA score in patients outside the ICU. The qSOFA was able to predict mortality in FG patients with 88.2% sensitivity and 94.4% specificity, according to one study.[7]

Infections in patients with FG are caused by both aerobic and anaerobic bacteria, including Streptococcus group A. *Staphylococcus aureus (S. aureus)*, *Escherichia coli* (*E. Coli)*, and *Pseudomonas aeruginosa (P. aeruginosa)*. These bacteria originate from several places, including the urinary system, the digestive system, and the skin's native flora.[1] In immunocompromised such as patients with comorbidities infections are correlated with an improved risk of organ failure, a longer length of hospitalization, and a higher mortality rate.[5,6]

Although Fournier's gangrene is known to be caused by a variety of microbes and this polymicrobial finding, neither qSOFA nor SFGSI have adequate microbial culture tests.[1,5,7] This lack of microbial culture aims is to simplify the scoring system so that it can be carried out in areas that are difficult to carry out laboratory tests either due to lack of access or because of the high cost of laboratory tests.[5,7] This study was designed to compare the predictive efficiency of qSOFA and the number of species in culture findings to the commonly used SFGSI score system in predicting death in FG patients.

Methods. This study obtained ethical approval by The Health Research Ethical Committee of the Medical Faculty at Universitas Sumatera Utara (approval number: 904/KEPK/USU/2022), which adhered to the ethical principles outlined in the Declaration of Helsinki. All medical records of individuals who underwent emergency surgery for FG between January 2017 and July 2022 were reviewed retrospectively. The diagnosis was made using the clinical history and symptoms such as fever, erythema, edema, fluctuation, crepitation, and necrosis in the perianal, perineal, or genital regions. Individuals with perianal, periurethral, or scrotal abscesses devoid of necrosis and soft tissue extension were excluded. The urology department of Haji Adam Malik General Hospital did the procedure.

Age, gender, hospital stay duration, laboratory parameter, etiology, isolated microorganism, and mortality rate were examined as clinical factors. Upon admission, the levels of plasma glucose, hematocrit, potassium, and creatinine were among the laboratory results evaluated. The SFGSI, which used a punctuation system with the 3 variables, focused on the hematocrit, potassium, and creatinine level. The points assigned to each criteria were added to determine the SFGSI. Predicting mortality with a score greater than 2 has a sensitivity of 87% and a specificity of 75%. The threshold was set at 2. Additionally, qSOFA data were collected to determine the chance of severe sepsis.

Every devitalized tissue that was impacted underwent at least one aggressive debridement. Empirical antibiotic therapy was started in the emergency room, continued throughout the hospital stay, and only modified as needed based on the results of a microbiological analysis of tissue samples obtained during the initial debridement. During wound examinations, more debridement should be carried out if required until all devitalized tissues have been eliminated and the development of healthy granulation tissue has started.

Hospital wards handled the majority of patient care. Patients with severe sepsis who needed mechanical breathing or hemodynamic support were treated in the intensive care unit (ICU).

Statistical analysis. Data analysis was carried out using IBM SPSS Statistics for Windows, version 22 (IBM Corp., Armonk, N.Y., USA). The number of each variable was obtained using univariate analysis to determine whether the patient survived or perished throughout the follow-up period. Mean and standard deviation were utilized to represent numerical data, whereas percentages were employed to represent categorical data. If the data distribution was normal, the unpaired t-test was employed to compare between groups of living and deceased patients, as well as between numerical and categorical variables. The Mann-Whitney test was used in cases where the data distribution was not uniform. A bivariate analysis between categorical variables was conducted using the Chi-square test.

Results. Eighty patients were diagnosed with the mean average was 37.2±0.7 years old. The death rate was 22.5% (18 out of 80 subjects). The findings of the culture revealed that 56.2% of the bacteria were *E. Coli*, followed by *Staphylococcus Haemolyticus (S. haemolyticus)*, *S. Aureus*, *P. Aeruginosa*, and *K. Pneumoniae*. Additionally, 72% of the microorganisms in the culture were ESBL-positive. Patients infected with *P. Aeruginosa* had the greatest death rate (100%) based on bacterial culture results, followed by *S. Aureus* (75%), *S. Haemolyticus* (30%), and *E. coli* (20%), in that order. The random blood glucose (RGB) of the participants in this research was 153.3±75.7 mg/dl on average. On 28 patients (approximately 35%), a lithotomy surgery was conducted (Table 1).

We discovered a significant mean difference in SFGSI score with a $p<0.0001$ and a significant mean difference in qSOFA score with a $p=0.002$.

The sensitivity and specificity of the SFGSI score in predicting mortality were 90.1% and 88.3%, while those of the qSOFA score were 88.2% and 86.4%.

The receiving operating characteristic (ROC) area of qSOFA dan SFGSI score in patients have relatively high rate of sensitivity and specificity which were displayed in Figure 1.

Table 1 - Sample baseline characteristics.

Variables	n (%)
Age (years) Mean±SD	37.2±0.7 (23-85)
Mortality	18 (22.5%)
Escherichia coli (E. coli)	9 (50.0%)
Staphylococcus haemolyticus (S. Haemolyticus)	3 (16.6%)
Staphylococcus aureus (S. Aureus)	3 (16.6%)
Pseudomonas aeruginosa (P. Aeruginosa)	3 (16.6%)
SFGSI Mean ± SD	1.8±0.4
qSOFA Score Mean±SD	1.6±0.3
Culture Results	
E. coli	45 (56.2%)
S. haemolyticus	10 (12.5%)
S. aureus	4 (5.0%)
P. aeruginosa	3 (5.0%)
K. pneumoniae	3 (3.7%)
Negative	15 (17.6%)
Extended spectrum beta-lactamase (ESBL)	
(+)	36 (72.0%)
(-)	14 (28.0%)
Fatality rate based on bacterial culture	
P. Aeruginosa	3/3 (100%)
S. Aureus	3/4 (75.0%)
S. Haemolyticus	3/10 (30.0%)
E. Coli	9/45 (20.0%)
Random blood glucose (RGB) (mg/dl), mean±SD	153.3±75.7
Cystotomy	
Yes	28 (35.0%)
No	52 (65.0%)

SFGSI: Simplified Fournier Gangrene Severe Index Score, qSOFA: quickSOFA, SD: standard deviation

Table 2 - SFGSI and qSOFA score of FG patients.

Parameter	Group (Survived) n=62	Group 2 (Death) n=18	*p*-value
SFGSI	1.5±0.4	2.3±0.5	<0.0001
qSOFA	1.8±0.4	2.1±0.3	0.002

SFGSI: simplified Fournier Gangrene Severe Index Score, qSOFA: quickSOFA, FG: Fournier Gangrene

Discussion. The FG is a unique kind of necrotizing fasciitis affecting the perianal, perineal, and external genitalia. This type of infection may be highly contagious and spread swiftly. The fatality rate could reach up to 40% if left untreated.[1] However, this disease is quite uncommon in prosperous nations. A 5-year retrospective analysis undertaken by Noegroho et al[7] uncovered a total of 83 persons with the diagnosis. Eighty people participated in our study. Consequently, the prevalence of FG patients varied across centers.

The Sepsis-3 task group advised utilizing the SOFA score to evaluate organ dysfunction caused by sepsis. Due to the difficulty of assessing all laboratory needs for the SOFA score in diverse healthcare settings, qSOFA was preferred. We applied the qSOFA score in this inquiry.[7] Persons with a score of 2 had an associated 78% mortality rate. According to El-Qushayri et al,[6] multiple organ failure (66%) and sepsis (76%) were the

Table 3 - Sensitivity and specificity of SFGSI and qSOFA Score.

Parameters	SFGSI (95% CI)	qSOFA(95% CI)	*P*-value*	r^2
Sensitivity	90.1% (0.704-1.096)	88.2% (0.690 – 1.070)	0.0001	0.732
Specificity	88.3% (0.696 – 1.064)	86.2% (0.676 – 1.044)		0.691

*Pearson correlation test, SFGSI: simplified Fournier Gangrene Severe Index Score, qSOFA: quickSOFA, FG: Fournier Gangrene, CI: confidence interval

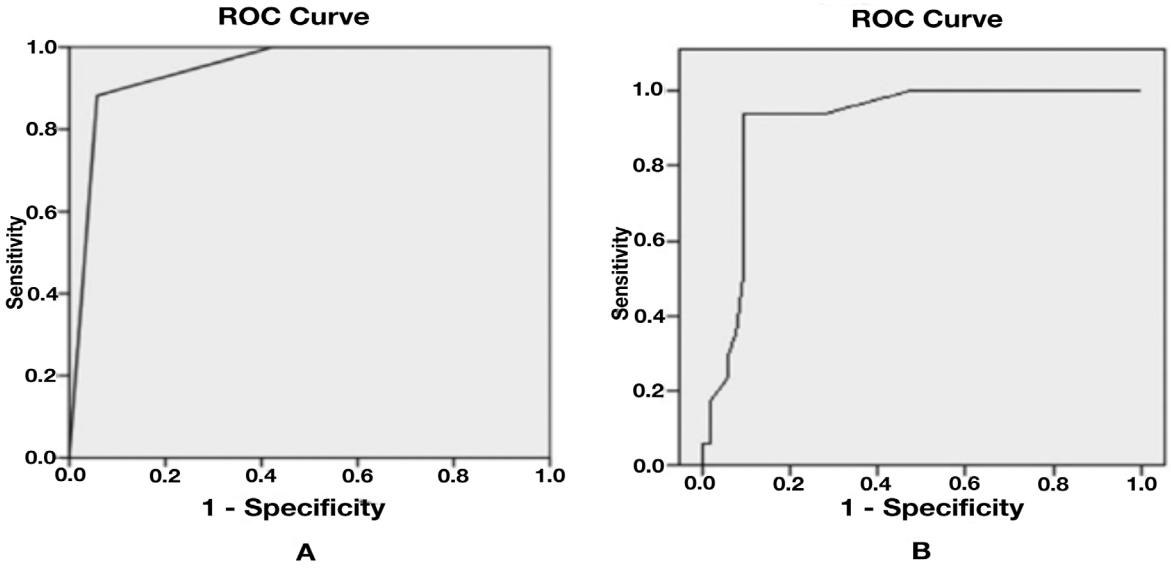

Figure 1 - Receiving operating characteristic (ROC) area of (**a**) qSOFA and (**b**) SFGSI score in patients with FG. SFGSI: Simplified Fournier Gangrene Severe Index Score, qSOFA: quickSOFA, FG: Fournier Gangrene

2 main causes of mortality in patients with FG. The high prevalence of diabetes among FG patients may contribute to this.[6]

Arora et al[8] predict the prognosis of individuals with FG. They found that a score of >9 correlate with mortality, Patient with lower FGSI score has higher survival rate.[8] Noegroho et al[7] analysis found that the sensitivity and specificity of the FGSI score were 72.73% and 95.65%, respectively. Hatipoglu et al[9] study found that FGSI scoring, combined with age and hematocrit level has significant influence to length of stay in the ICU.[9]

Our study predicted the death of FG patients using the SFGSI rather than the FGSI. Simple FGSI score consists of potassium, hematocrit, and creatinine test results. Arora et al[8] showed in a retrospective analysis that blood potassium, creatinine levels, hematocrit level had strong correlation to mortality.[8] Sparenborg et al[10] investigated the association between comorbidities and FGSI score and found that only 4 out of 9 measures were statistically significant: Creatinine (R=0.66), Bicarbonate (R=-0.63), white blood cell count (R=0.55), and Potassium (R=0.33). Increases in serum creatinine concentration are typical in people with renal failure.[10]

A qSOFA score threshold of 2 yielded sensitivities of 94.1%, 90.3%, 83.3%, and 97.9%, respectively, for sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV), according to a recent study by Noegroho et al[7] They found that there was a significant positive association (r=0.70) between the FGSI and the qSOFA score. This reveal that SFGSI and qSOFA score together may be a more accurate predictor of death in FG patients than qSOFA score alone.[4,7]

All FG patients require prophylactic broad-spectrum antibiotics and complete debridement. Subsequently, antibiotics were modified based on culture results.[8] Extended Spectrum Beta-Lactase (ESBL) *E. coli* was the most prevalent microorganism in our case, producing FG in 36 patients (41%) followed by *S. haemolyticus* (12.5%). Typically, *E. coli*, *K. pneumoniae*, *B. fragilis*, and *S. aureus* were isolated from the perineum and genital organs.[11]

The bulk of studies (30.3%) indicate that polymicrobial infection caused FG instances. *E. coli*, streptococcus, and enterococcus were among the most prevalent pathogens identified in the study, according to Kuzaka et al[2] In another investigation (13 patients), *E. coli* was identified in 13.2% of the cultures, followed by, Proteus, Klebsiella, Moraxella, Gemella, Enterococcus, Streptococcus, Staphylococcus, Bacteroides, Pseudoflavonifractor, Parabacteroides, Porphyromonas, Prevotella, Peptoniphilus, Peptostreptococcus, Actinomyces, Collinsella, and Lactobacillus.[2]

In our investigation, the mean random blood glucose level was 153.3±75.7 mg/dl. The FG is more prevalent in patients with immunocompromised states, such as diabetes mellitus. Diabetes mellitus is believed to affect between 36 and 56% of FG patients due to their small artery disease, impaired neuropathy, and immunosuppression.[11] According to Arora et al,[8] diabetes mellitus has association with higher mortality in FG. The majority of writers agree that one of the most important risk factors for FG is diabetes mellitus.[8]

In this study, 35% of patients underwent a cystostomy. Kuzaka et al[2] reported that 61.5% patients in undergo cystotomy.[2] In the study by Agwu et al[12] suprapubic cystostomy was primarily performed on patients with penile involvement since urethral catheterization was unsuitable.[12]

The results of bacterial growth in culture were significant as death predictors. Despite the availability of effective therapies, methicillin-resistant *S. aureus* (MRSA) and other multidrug-resistant bacterial infections are on the rise and are linked to an increased death rate. Our data revealed that infections caused by multidrug-resistant bacteria were proportionate to the higher mortality rate among patients.

This study shows that qSOFA and SFGSI scoring are relevant in determining survival rate. Microbial culture also plays a role and will improve the survival rate combined with the scoring. This can be input for clinicians to include examination of microbial cultures and for researchers to be able to further research which microbes infect the most Fournier Gangrene because this will influence the selection of appropriate antibiotics.

Study limitation. A limitation of this study include its retrospective and single-center design. However, case of Fournier Gangrene is rather rare and studies that compare prognoses based on SFGSI and qSOFA scoring followed by microbial culture are still few.

In conclusion, both SFGSI and qSOFA have a high degree of sensitivity and specificity. Microbial culture combined with both score systems could aid in estimate and improve FG patient's survival rate.

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