

Prognostic value of the shock index in Fournier's gangrene: a retrospective cohort study comparing established mortality scoring systems

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ABSTRACT

BACKGROUND: Fournier's gangrene is a rapidly progressive, life-threatening necrotizing infection of the perineal and genital regions, associated with persistently high mortality despite advances in surgical and intensive care. Early and reliable prognostic assessment is essential for improving patient outcomes. This study aimed to evaluate the prognostic performance of the Shock Index (SI) in predicting mortality in patients with Fournier's gangrene and to compare its discriminatory ability with established scoring systems.

METHODS: This retrospective cohort study included adult patients diagnosed with Fournier's gangrene who presented to the emergency department of a tertiary university hospital and underwent surgical debridement between January 2015 and December 2024. Demographic, clinical, and laboratory data were extracted from institutional and national electronic health records. Survivors and non-survivors were compared using appropriate statistical tests. Variables associated with mortality were assessed using logistic regression analysis. Receiver operating characteristic (ROC) analysis was performed to evaluate the predictive performance of SI and conventional scoring systems, and the optimal SI cut-off for mortality prediction was determined using Youden's index.

RESULTS: A total of 158 patients (mean age 62.3±13.4 years; 86.1% male) were included, with an overall mortality rate of 17.1%. Non-survivors were significantly older ($p<0.001$), and comorbidities including coronary artery disease, chronic heart failure, and chronic renal failure were significantly associated with mortality. At admission, non-survivors had higher heart and respiratory rates and lower systolic blood pressure. ROC analysis demonstrated that the Shock Index had the highest discriminatory performance for mortality prediction (area under the curve=0.952; 95% confidence interval 0.918–0.986; $p<0.001$), outperforming the Fournier Gangrene Severity Index, Uludağ Fournier Gangrene Severity Index, Laboratory Risk Indicator for Necrotizing Fasciitis, and quick Sequential Organ Failure Assessment. An optimal SI threshold of 0.866 yielded 92.6% sensitivity and 83.2% specificity.

CONCLUSION: The Shock Index demonstrated superior prognostic accuracy compared with conventional scoring systems in patients with Fournier's gangrene. Given its simplicity and reliance on two readily available hemodynamic parameters, SI represents a practical tool for early risk stratification. Prospective, multicenter studies are needed to further validate its clinical utility.

Keywords: Fournier's gangrene; mortality; prognosis; Shock index.

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INTRODUCTION

Fournier's gangrene (FG) is a rapidly progressive and potentially fatal condition. It represents a form of necrotizing fasciitis that develops as a result of blood clots in the skin, caused by infections leading to pus accumulation in the anorectal, perineal, or genitourinary regions.^[1] Despite the availability of broad-spectrum antibiotics and advances in intensive care and resuscitation, FG remains one of the most severe surgical infections, with a high mortality rate among acute conditions. As reported in the literature, mortality rates range between 10% and 30%.^[2-4] The rapidly progressive nature of the disease necessitates early diagnosis and aggressive surgical intervention. In this context, the identification of objective parameters capable of predicting mortality risk at an early stage is of critical clinical importance.

Several studies and meta-analyses have evaluated the prognostic performance of established scoring systems, including the Fournier's Gangrene Severity Index (FGSI), Uludağ Fournier's Gangrene Severity Index (UFGSI), Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC), and quick Sequential Organ Failure Assessment (qSOFA). Although these scoring systems are significantly associated with mortality, they have been criticized for their complexity, reliance on laboratory parameters, and limited applicability in emergency clinical settings.^[5,6] These limitations highlight the need for simpler, faster, and more readily accessible prognostic indicators.

In recent years, increasing attention has been directed toward novel and objective biomarkers for predicting mortality in FG. Among laboratory-based indicators of systemic inflammatory response, the neutrophil-to-lymphocyte ratio (NLR) and the C-reactive protein-to-albumin ratio (CAR) have been shown to correlate with mortality in various sepsis-related conditions. These ratios have also been shown to possess prognostic significance in patients with FG.^[7,8] Their availability through routine laboratory testing makes them attractive tools for early risk stratification in clinical practice.

Similarly, the Shock Index (SI), defined as the ratio of heart rate to systolic blood pressure, has been recognized as an early indicator of hemodynamic instability. Owing to its simplicity, the SI requires minimal laboratory data. It has demonstrated high accuracy in predicting mortality in patients with sepsis, trauma, and cardiovascular emergencies.^[9-11] However, data regarding the prognostic value of SI in Fournier's gangrene are limited, and direct comparative studies with existing scoring systems are scarce.

The present study comprehensively analyzed the clinical, laboratory, and surgical factors associated with mortality in patients treated for Fournier's gangrene. In addition, it evaluated the prognostic performance of SI in comparison with widely accepted scoring systems reported in the literature, including FGSI, UFGSI, LRINEC, and qSOFA. The aim was to determine an optimal threshold value for SI, calculated solely from vital signs, to predict mortality. This approach was in-

tended to facilitate early identification of high-risk cases and thereby improve treatment management in patients with Fournier's gangrene.

MATERIALS AND METHODS

Study Design and Ethical Approval

The study was designed as a single-center retrospective cohort study. Ethical committee approval was granted by the Trakya University Faculty of Medicine Non-Interventional Clinical Research Ethics Committee (Decision No: 2025/491, Date: 03/11/2025). The study was conducted in accordance with the ethical principles of the Declaration of Helsinki, as revised in 2013. Due to the retrospective design, patient confidentiality was strictly maintained, all data were anonymized, and informed consent was waived.

Participants

Patients who presented to the emergency department between January 1, 2015 and December 31, 2024 and were diagnosed with Fournier's gangrene based on clinical, laboratory, and radiological findings were included. All patients underwent surgical debridement at the Departments of General Surgery and Urology, Trakya University Faculty of Medicine. Data for eligible cases were obtained through retrospective review of the hospital information management system and clinical archives.

Inclusion Criteria

- Adult patients aged ≥ 18 years
- Non-pregnant patients
- Availability of complete clinical, laboratory, and treatment records
- Patients who underwent surgical debridement.

Exclusion Criteria

- Patients younger than 18 years
- Pregnant patients
- Missing essential clinical and laboratory data
- Patients with clinically diagnosed Fournier's gangrene who died before surgical evaluation and debridement.

Clarification

Three patients with clinically confirmed Fournier's gangrene experienced cardiac arrest during transfer or shortly after admission to the emergency department and required advanced resuscitation, including intubation and continuous vasoactive/inotropic support. Under these conditions, heart rate and systolic blood pressure do not reliably reflect intrinsic hemodynamic status. Therefore, the corresponding Shock Index values were considered pharmacologically influenced and unsuitable for prognostic analysis. These cases were included in the screening population but excluded from the final analytical cohort.

Between January 1, 2015 and December 31, 2024, a total of 168 patients were clinically diagnosed with Fournier's gangrene. The patient selection process and exclusions are illustrated in the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) flow diagram (Fig. 1).

Data Collection and Variables

Data for this study were collected retrospectively from the hospital information management system and clinical records. Missing or incomplete data were verified and supplemented, when available, using the national electronic health record platform "e-Nabız."^[12] The primary outcome was in-hospital all-cause mortality, defined as death occurring during the index hospitalization from emergency department admission to discharge or death, as determined from institutional and national electronic health records. Variables were categorized into demographic characteristics, clinical findings, laboratory parameters, treatment modalities, and mortality outcomes. Demographic data included age, sex, and the presence of comorbidities. The comorbid conditions evaluated included diabetes mellitus, hypertension, coronary artery disease, cerebrovascular disease, chronic heart failure, and chronic renal failure.

Clinical data included the patients' general condition and vital signs at admission to the emergency department. The following parameters were recorded: body temperature (T, °C), heart rate (HR, beats/minute), systolic blood pressure (SBP, mmHg), and respiratory rate (RR, breaths/minute). Level of consciousness was assessed using the Glasgow Coma Scale (GCS), and systemic response was evaluated using the qSOFA score. Additionally, the Shock Index was calculated as the ratio of heart rate to systolic blood pressure at presentation.

Laboratory data were obtained from routine biochemical and hematological tests performed at emergency admission. To assess the metabolic and inflammatory burden of the disease, blood glucose, urea, creatinine, sodium (Na), potassium (K), bicarbonate (HCO₃), albumin, C-reactive protein (CRP), and hemoglobin A1c (HbA1c) levels were analyzed. Hematological parameters included hemoglobin (Hb), hematocrit (Hct), white blood cell count (WBC), neutrophils (NEU), lymphocytes (LYM), monocytes (MONO), and platelet count (PLT). Additionally, derived inflammatory markers, including the NLR and CAR, were calculated.

Treatment-related variables included the surgical and medical approaches applied to patients. Surgical variables comprised the number of debridements, additional surgical procedures performed in conjunction with debridement (e.g., diversion procedures), and the wound care method (wet dressing or negative-pressure wound therapy [vacuum-assisted closure, VAC]).

Time-dependent clinical variables included the interval between emergency department presentation and surgical intervention (minutes), length of hospital stay (days), and length of intensive care unit stay (days).

The dataset was structured to include all key parameters incorporated in validated prognostic models for FG. These variables were analyzed to identify factors associated with mortality. Established scoring systems were calculated for each patient to enable direct comparison with the Shock Index.

Scoring Systems

This study evaluated prognostic scoring systems widely accepted in the literature for predicting mortality in FG. For each patient, the FGSI, UFGSI, LRINEC, and qSOFA scores were calculated.

The FGSI is based on nine physiological and laboratory parameters: body temperature, heart rate, respiratory rate, serum sodium, potassium, creatinine, bicarbonate, hematocrit, and leukocyte count. Each parameter is scored from 0 to 4, with a total score ≥ 9 indicating a high risk of mortality.

The UFGSI incorporates all FGSI parameters with the addition of two variables: patient age and the anatomical extent of infection.

The LRINEC score was developed for the early diagnosis and severity assessment of necrotizing soft tissue infections and is based on C-reactive protein, leukocyte count, hemoglobin, sodium, creatinine, and glucose levels.

The qSOFA score is derived from three parameters: respiratory rate, systolic blood pressure, and mental status (Glasgow Coma Scale ≤ 13). Each parameter is assigned 1 point, yield-

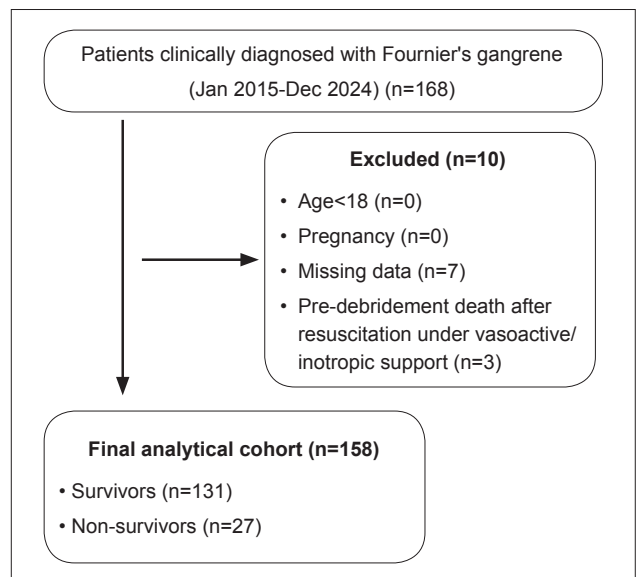


Figure 1. STROBE-compliant flow diagram illustrating patient screening, application of inclusion and exclusion criteria, and final cohort composition. *Three patients with clinically confirmed Fournier's gangrene died before surgical debridement after resuscitation under vasoactive/inotropic support and were excluded from the analytical cohort, as their hemodynamic measurements were considered non-representative.*

ing a total score ranging from 0 to 3; a score ≥ 2 indicates an increased risk of mortality.

The Shock Index is defined as the ratio of heart rate to systolic blood pressure. In this study, in addition to established scoring systems used in Fournier's gangrene, SI was also calculated as a prognostic parameter.

Statistical Analysis

Statistical analyses were performed using Jamovi (version 2.5.5; The Jamovi Project, Sydney, Australia). An a priori power analysis was conducted using G*Power (version 3.1) with $\alpha=0.05$, power $(1-\beta)=0.80$, an effect size of 0.8 (large), and an allocation ratio (N_1/N_2) of 0.20, based on an estimated mortality rate of approximately 20% in patients with FG. The required sample size was calculated as 96. The distribution of continuous variables were assessed using the Shapiro–Wilk test. Normally distributed variables are presented as mean \pm standard deviation, whereas non-normally distributed variables are expressed as median (interquartile range).

Categorical variables were compared using the chi-square test or Fisher's exact test, as appropriate. Continuous variables were compared between two groups using the Student's t-test or the Mann–Whitney U test, depending on data distribution.

Variables that showed a statistically significant association with mortality in univariate analyses, along with clinically relevant confounders (including age and major comorbidities), were entered into a multivariable binomial logistic regression model to identify independent predictors of mortality. Adjusted odds ratios (OR) with 95% confidence intervals (CI) were calculated to assess the independent prognostic value of the Shock Index. Receiver operating characteristic (ROC) curve analysis was performed to compare the performance of prognostic scoring systems (FGSI, UFGSI, LRINEC, qSOFA, and SI) in predicting mortality. Area under the curve (AUC) values, along with sensitivity and specificity for each scoring system, were calculated.

Furthermore, the optimal cut-off value for the SI for predicting mortality was determined using the Youden index. A p-value <0.05 was considered statistically significant in all analyses.

RESULTS

A total of 158 patients who met the inclusion criteria were included in the study. The mean age was 62.3 ± 13.4 years and was significantly higher in patients with fatal outcomes ($p < 0.001$). The male-to-female ratio was 86.1% to 13.9%; however, mortality was significantly higher among female patients ($p=0.004$).

Table 1. Demographic characteristics and comorbidities of patients with Fournier's gangrene according to survival status

	All patients (n=158)	Survivors (n=131)	Non-survivors (n=27)	p-value
Age (years)	62.3 \pm 13.4	60.2 \pm 13.0	72.6 \pm 10.1	<0.001 ^a
Sex				
Female	22 (13.9%)	13 (9.9%)	9 (33.3%)	
Male	136 (86.1%)	118 (90.1%)	18 (66.7%)	0.004 ^b
Comorbidities				
Diabetes mellitus (+)	89 (56.3%)	72 (55%)	17 (63%)	
Diabetes mellitus (-)	69 (43.7%)	59 (45%)	10 (37%)	0.445 ^c
Hypertension (+)	56 (35.4%)	42 (32%)	14 (51.9%)	
Hypertension (-)	102 (64.6%)	89 (68%)	13 (48.1%)	0.050 ^c
Cerebrovascular disease (+)	12 (7.6%)	8 (6.1%)	4 (14.8%)	
Cerebrovascular disease (-)	146 (92.4%)	123 (93.9%)	23 (85.2%)	0.120 ^c
Coronary artery disease (+)	29 (18.4%)	19 (14.5%)	10 (37%)	
Coronary artery disease (-)	129 (81.6%)	112 (85.5%)	17 (63%)	0.012 ^b
Chronic heart failure (+)	23 (14.6%)	15 (11.5%)	8 (29.6%)	
Chronic heart failure (-)	135 (85.4%)	116 (88.5%)	19 (70.4%)	0.031 ^b
Chronic renal failure (+)	17 (10.8%)	11 (8.4%)	6 (22.2%)	
Chronic renal failure (-)	141 (89.2%)	120 (91.6%)	21 (77.8%)	<0.001 ^b

Continuous variables are presented as mean \pm standard deviation; categorical variables are presented as number (percentage). ^aFisher's exact test; ^bPearson's chi-square test; ^cStudent's t-test.

Table 2. Vital parameters of patients with Fournier's gangrene at admission according to survival status

	All patients	Survivors (n=131)	Non-survivors (n=27)	p-value
Body temperature (°C)	36.7 (0.547)	36.6 (0.5)	37.1 (0.95)	0.003
Heart rate (/min)	90 (21.8)	88 (16)	113 (15.5)	<0.001
Respiratory rate (/min)	18 (7)	18 (7)	20 (10)	0.001
Systolic blood pressure (mmHg)	120 (20)	120 (18)	108 (15)	<0.001

Data are presented as median (interquartile range). Comparisons between survivors and non-survivors were performed using the Mann–Whitney U test.

Table 3. Laboratory findings and derived ratios of patients with Fournier's gangrene according to survival status

	All patients	Survivors (n=131)	Non-survivors (n=27)	p-value
Glucose (mg/dL)	148 (125)	143 (127)	166 (83.5)	0.074 ^x
HbA1c	6.8 (2.8)	6.7 (2.9)	7.2 (2.1)	0.259 ^x
Urea (mg/dL)	47 (45)	41 (36.5)	115 (108)	<0.001 ^x
Creatinine (mg/dL)	0.97 (0.645)	0.9 (0.485)	2.5 (2.43)	<0.001 ^x
Sodium (mmol/L)	135±4.05	135±4.09	134±3.73	0.150 ^q
Potassium (mmol/L)	4.4 (1)	4.3 (1)	5.2 (1.35)	<0.001 ^x
Bicarbonate (HCO ₃) (mEq/L)	22 (7.75)	23 (7)	18 (6.5)	0.030 ^x
Albumin (g/dL)	2.74±0.568	2.78±0.571	2.51±0.503	0.021 ^q
CRP (mg/L)	51.9 (224)	39.1 (146)	311 (198)	<0.001 ^x
CAR	24 (81.3)	13.2 (60.7)	121 (88.7)	<0.001 ^x
Hemoglobin (g/dL)	12±2.32	12.1±2.40	11.1±1.65	0.027 ^q
Hematocrit (%)	35±5.74	35.5±5.79	32.7±4.91	0.020 ^q
Platelet (10×10 ³ /μL)	304 (177)	315 (173)	261 (148)	0.30 ^x
Neutrophils (10×10 ³ /μL)	14.1 (9.29)	14.1 (9.86)	14.2 (6.64)	0.363 ^x
Lymphocytes (10×10 ³ /μL)	1.21 (1.02)	1.30 (1.16)	0.80 (0.630)	0.001 ^x
Monocytes (10×10 ³ /μL)	1.09 (0.68)	1.10 (0.725)	0.77 (0.725)	0.005 ^x
White blood cells (10×10 ³ /μL)	17.9 (8.82)	17.9 (9.4)	17.8 (7.2)	0.365 ^x
NLR	11.5 (15)	9.86 (14)	16.5 (28)	0.008 ^x

Continuous variables are presented as mean ± standard deviation or median (interquartile range). CAR: C-reactive protein-to-albumin ratio; CRP: C-reactive protein; NLR: Neutrophil-to-lymphocyte ratio. ^xMann–Whitney U test; ^qStudent's t-test.

The most common comorbidities were diabetes mellitus (56.3%) and hypertension (35.4%). Coronary artery disease, chronic heart failure, and chronic renal failure were significantly associated with mortality ($p=0.012$, $p=0.031$, and $p<0.001$, respectively). The distribution of demographic characteristics and comorbidities is presented in Table 1.

As shown in Table 2, all vital parameters measured at admission were significantly associated with mortality. In patients with fatal outcomes, body temperature (37.1°C, interquartile range [IQR]: 0.95), heart rate (113/min, IQR: 15.5), and respiratory rate (20/min, IQR: 10) were significantly higher,

whereas systolic blood pressure (108 mmHg, IQR: 15) was lower.

Laboratory findings were evaluated using the first blood samples obtained at emergency admission. Data distribution was assessed using the Shapiro–Wilk test. The Student's t-test was applied to normally distributed variables, while the Mann–Whitney U test was used for non-normally distributed variables. Biochemical analysis demonstrated that urea ($p<0.001$), creatinine ($p<0.001$), and CRP ($p<0.001$) levels were significantly higher in patients with mortality, whereas albumin ($p<0.021$) levels were significantly lower. Hematolog-

Table 4. Time-dependent and treatment-related variables of patients with Fournier's gangrene according to survival status

	All patients	Survivors (n=131)	Non-survivors (n=27)	p-value
Time from admission to surgery (min)	232 (231)	216 (240)	240 (214)	0.616 ^x
Length of hospital stay (days)	16 (18)	17 (15.5)	12 (33.5)	0.850 ^x
ICU stay (days)	0 (2)	0 (0)	9 (33.5)	<0.001 ^x
Number of debridements	2 (3)	2 (3)	3 (3)	0.323 ^x
Wound management				
Wet dressing	133 (84.2%)	113 (86.3%)	19 (70.4%)	
Vacuum-assisted closure	25 (15.8%)	18 (13.7%)	8 (29.6%)	0.042 ^y
Diversion				
Yes	30 (18.9%)	19 (14.5%)	11 (40.7%)	
No	128 (91.1%)	112 (85.5%)	16 (59.3%)	0.002 ^z

Continuous variables are presented as median (interquartile range); categorical variables are presented as number (percentage). ^xMann-Whitney U test; ^yFisher's exact test; ^zPearson's chi-square test. ICU: Intensive care unit.

Table 5. Multivariable logistic regression analysis identifying independent predictors of in-hospital mortality

	Adjusted OR	95% CI	p-value
Shock Index (continuous)	4.77×10 ⁶	5637.20–4.03×10 ⁹	<0.001
Age (years)	1.05	0.998–1.11	0.093
Coronary artery dis-ease	1.10	0.09–13.60	0.940
Chronic heart failure	3.32	0.34–32.64	0.304
Chronic renal failure	2.79	0.40–19.63	0.302

OR: Odds ratio; CI: Confidence interval. All variables were entered simultaneously into the multivariable model. The odds ratio for the Shock Index represents the effect per one-unit increase in the continuous SI value.

ical analysis revealed that hemoglobin ($p=0.027$), hematocrit ($p=0.027$), and lymphocyte counts ($p<0.001$) were significantly lower in patients who died.

The CAR and NLR, both indicators of systemic inflammatory response, were significantly higher in patients with fatal outcomes (121, IQR: 88.7; and 16.5, IQR: 28, respectively). Both parameters showed a strong association with mortality ($p<0.001$ and $p=0.008$, respectively) (Table 3).

Analysis of time- and treatment-related variables (Table 4) revealed significant associations between mortality and intensive care unit length of stay ($p<0.001$), diversion procedures ($p=0.002$), and wound care method ($p=0.042$). Patients with fatal outcomes had longer ICU stays (9 days, IQR: 33.5) and higher rates of diversion procedures (40.7%). Additionally, the relationship between wound care method and debridement frequency was evaluated. The median number of debridements was higher in patients treated with (4, IQR: 2) compared to those treated with wet dressings (2, IQR: 2),

and this difference was statistically significant ($p<0.001$).

In multivariable logistic regression analysis adjusted for age and major comorbidities (Table 5), the Shock Index remained an independent predictor of in-hospital mortality (adjusted OR=4.77×10⁶, 95% CI: 5637.20–4.03×10⁹, $p<0.001$). Age and comorbid conditions, including coronary artery disease, chronic heart failure, and chronic renal failure, were not independently associated with mortality after adjustment.

To further evaluate the prognostic value of the Shock Index in FG, an initial binomial logistic regression analysis demonstrated a significant association between SI and mortality ($p<0.001$). ROC analysis was subsequently performed to assess its discriminatory performance and to compare it with established scoring systems (FGSI, UFGSI, LRINEC, and qSOFA). The results showed that SI had the highest discriminatory power among the evaluated parameters (AUC=0.952, 95% CI: 0.918–0.986, $p<0.001$). SI demonstrated superior discriminatory performance for predicting mortality com-

Table 6. Cut-off values of Shock Index for predicting mortality based on Youden's Index

Cut-off	Sensitivity (%)	Specificity (%)	Youden's Index
0.802	100.0	71.0	0.710
0.835	96.3	79.4	0.757
0.866*	92.6	83.2	0.758
0.891	88.9	86.3	0.751
0.898	85.2	88.5	0.737
0.939	81.5	91.6	0.731
0.975	77.8	94.7	0.724
0.987	74.1	96.2	0.703
1.024	63.0	97.7	0.607
1.043	55.6	98.5	0.540
1.092	40.7	99.2	0.400
1.178	25.9	100.0	0.259

OR: Odds ratio; CI: Confidence interval. All variables were entered simultaneously into the multivariable model. The odds ratio for the Shock Index represents the effect per one-unit increase in the continuous SI value.

pared with FGSI (AUC: 0.882), UFGSI (AUC: 0.862), qSOFA (AUC: 0.826), and LRINEC (AUC: 0.769). Although all scoring systems showed significant predictive value, SI achieved the best combination of sensitivity and specificity, indicating high overall diagnostic accuracy (Fig. 2).

Following ROC analysis, the optimal cut-off value of the SI for predicting mortality was determined using Youden's index. An SI value of 0.866 was identified as the optimal threshold, yielding a sensitivity of 92.6% and a specificity of 83.2%

(Youden index=0.758) (Table 6). These findings highlight the potential utility of SI as a prognostic tool in the assessment of Fournier's gangrene.

DISCUSSION

Fournier's gangrene is a severe infection that requires a multidisciplinary approach and is associated with high mortality rates despite advances in modern treatment.^[13] Although prompt surgical debridement and broad-spectrum antibiotic therapy are the cornerstones of management, mortality rates remain substantial, suggesting that the determinants of prognosis are not yet fully understood. Early identification of patients at high risk of mortality is therefore critical for effective clinical management. To achieve this, a range of prognostic scoring systems are used, including FGSI, UFGSI, LRINEC, and qSOFA.^[14-16] However, the computational complexity and reliance on laboratory parameters limit their practical applicability, particularly in emergency settings. This has led to a growing demand for more practical, rapid, and easily applicable prognostic indicators.

The mortality rate of 17.1% observed in this study is consistent with rates reported in the literature.^[2-4] Previous studies have shown that advanced age is associated with poorer prognosis in FG. The etiology of this phenomenon has been attributed to several factors. Firstly, there is a weakening of the immune response, which is characteristic of advanced age. Secondly, there is an increased burden of comorbidities, i.e., the presence of more than one disease or condition in an individual. Thirdly, there are decreased systemic reserves, i.e., the body's ability to respond to stress and maintain bodily functions.^[2,17] The findings of this study are consistent with the literature, as the mean age of patients who died was significantly higher than that of survivors.

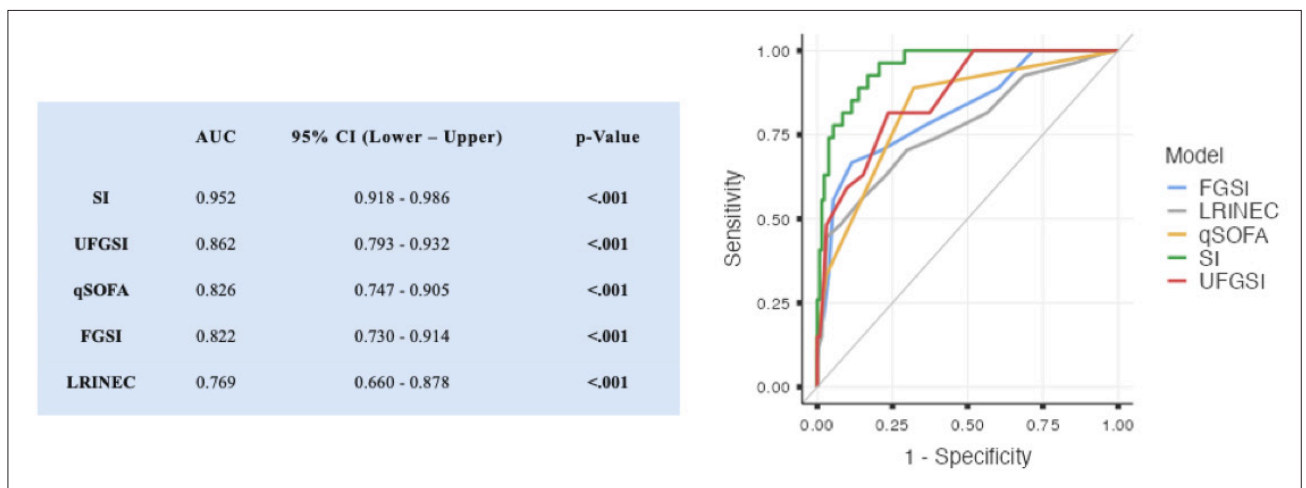


Figure 2. Comparison of receiver operating characteristic curves and corresponding area under the curve values demonstrating the diagnostic performance of mortality prediction models, including the Shock Index, in patients with Fournier's gangrene. AUC: Area under the curve; CI: Confidence interval; FGSI: Fournier Gangrene Severity Index; LRINEC: Laboratory Risk Indicator for Necrotizing Fasciitis; qSOFA: Quick Sequential Organ Failure Assessment; SI: Shock Index; UFGSI: Uludağ Fournier Gangrene Severity Index.

When comorbidities were examined, diabetes mellitus (DM) was the most prevalent, accounting for 56.3% of cases. However, no statistically significant association was found between DM and mortality. Similarly, Yanar et al.^[18] reported that, although DM was the most common comorbid condition, it was not significantly associated with mortality. These findings suggest that DM may predispose individuals to the development of FG through impaired tissue perfusion and suppression of the immune response, but it appears to play a secondary role in determining disease prognosis. Previous studies have documented that cardiac and renal dysfunction complicate the maintenance of hemodynamic stability in FG and significantly impact mortality.^[19,20] In line with these findings, the present study demonstrated that coronary artery disease, chronic heart failure, and chronic renal failure were significantly associated with mortality.

All vital parameters measured at emergency admission showed a statistically significant correlation with mortality. Specifically, systolic blood pressure was significantly lower and heart rate significantly higher in fatal cases. Consistent with these results, the literature indicates that low systolic blood pressure and tachycardia are markers of poor prognosis in FG. In a meta-analysis, Eke N. reported that systemic hypotension independently increased mortality,^[21] while Sorensen et al.^[22] identified tachycardia and hypotension as early indicators of shock in fatal cases. In a similar vein, Ouanes et al.^[23] reported that mortality was significantly higher in patients with a heart rate ≥ 89 /min, and approximately doubled in those with an SBP ≤ 115 mmHg. When considered alongside the existing literature, these findings suggest that early hemodynamic assessment in FG may serve as an important prognostic indicator of mortality.

Laboratory findings indicated that an increased systemic inflammatory response had a statistically significant impact on mortality. In particular, the CAR showed a significant association with mortality. Özgül and Uzmay^[24] reported an AUC value of 0.907, demonstrating the high accuracy of CAR in predicting mortality in Fournier's gangrene. Several studies have also shown that the neutrophil-to-lymphocyte ratio, another marker of systemic inflammation, is an independent prognostic indicator of mortality.^[25,26] Consistent with these findings, NLR was also statistically significant in mortality cases in the present study. However, there is some controversy regarding its predictive value. In a study of 109 FG patients, Raizhanda et al.^[27] reported that NLR alone is not a reliable predictor. These findings suggest that laboratory markers should be used as complementary tools within the clinical context rather than as standalone predictors of mortality.

The analysis further demonstrated that mortality rates were higher in patients requiring prolonged intensive care unit stays and in those who underwent diversion. Both variables showed a statistically significant association with mortality. These findings indicate that more aggressive surgical interventions and prolonged critical care are markers of advanced dis-

ease and higher-risk cases. The findings of the present study are consistent with those of previous research, which indicate that the duration of intensive care unit stay is significantly longer in cases with a fatal outcome in FG.^[28,29] Ozturk et al.^[30] reported that diversion is more frequently preferred in the presence of anal sphincter involvement and perineal contamination, and that this approach may be associated with higher mortality rates. In their study, Korkut et al.^[31] hypothesized that diversion in FG patients may be associated with mortality. However, this association is not causal; rather, it is considered an indicator reflecting the advanced stage of the disease.

The findings of the present study indicate that the number of repeated debridements is not directly correlated with mortality, suggesting that surgical success depends not only on the frequency of intervention but also on the timing and extent of the procedure. Consistent with these results, Özlül-erden et al.^[32] in a study aimed at predicting poor prognosis in FG, reported no statistically significant association between the number of debridements and mortality. Moreover, the literature emphasizes that early, extensive, and radical debridement may reduce mortality by limiting the progression of necrotic tissue.^[33,34] No significant difference in mortality was observed between wound care methods (wet dressing versus negative pressure wound therapy [VAC]). Similarly, Yanaral et al.^[35] highlighted that, in FG, prognosis is more strongly influenced by regular wound care and sustained infection control than by the specific wound care techniques itself.

A comparison of established prognostic scoring systems for Fournier's gangrene (FGSI, UFGSI, LRINEC, and qSOFA) with the Shock Index demonstrated that SI had superior prognostic performance, with a greater ability to discriminate between survivors and non-survivors. These findings suggest that SI is a practical and effective tool for early mortality risk assessment, particularly during the initial clinical evaluation. The identified optimal SI cut-off value represents a critical threshold above which the risk of mortality increases substantially in patients with Fournier's gangrene. In multivariable logistic regression analysis adjusted for age and major comorbidities, the Shock Index remained an independent predictor of in-hospital mortality. Laboratory and treatment-related variables were excluded from the multivariable model due to the limited number of mortality events and the risk of multicollinearity. Moreover, individual vital signs were intentionally excluded, as the Shock Index is directly derived from heart rate and systolic blood pressure.

The high discriminatory performance of the Shock Index observed in our cohort may be attributable to the relatively homogeneous disease severity among surgically treated patients, as well as the exclusion of cases with pharmacologically altered hemodynamic measurements prior to definitive evaluation. In addition, the Shock Index directly reflects early hemodynamic compromise, a key determinant of mortality in necrotizing infections.

The calculation of SI is straightforward, requiring only systolic blood pressure and heart rate. This simplicity enables early risk stratification without the need for laboratory data or complex calculations, making it a practical tool for clinical decision-making in emergency departments and intensive care settings. Consistent with the literature, İnal et al.^[36] and Kumar et al.^[37] reported a strong association between SI and mortality in critically ill patients with multiple trauma, sepsis, and shock. In the context of Fournier's gangrene, previous studies have suggested a potential association between SI and adverse outcomes; however, direct comparisons with established prognostic scoring systems remain limited.^[9,38]

The findings of this study should be interpreted in light of several limitations. The retrospective, single-center design may limit generalizability and introduce selection bias. Although all consecutive patients who underwent surgical debridement were included, those who died prior to surgical evaluation were excluded, as their recorded vital signs were obtained under active resuscitation and vasoactive or inotropic support. Consequently, SI measurements in these cases were considered non-representative of the underlying disease physiology. However, this exclusion may have introduced survivorship bias and contributed to an overestimation of the predictive performance of the Shock Index.

The relatively small number of mortality events may increase the risk of overly optimistic discrimination estimates in ROC analyses and limit the number of variables that could be reliably included in the multivariable model. Furthermore, the Shock Index was calculated using single time-point vital signs recorded at emergency department admission, and dynamic hemodynamic changes during the clinical course were not assessed. External validation in independent cohorts was not performed; therefore, the identified cut-off value may not be directly generalizable to other populations or settings. Although multivariable adjustment was conducted for major confounders such as age and comorbidities, residual confounding cannot be entirely excluded. Prospective, multicenter studies with larger sample sizes are warranted to validate these findings and to further clarify the clinical utility of the Shock Index in Fournier's gangrene.

CONCLUSION

This study addresses an important gap in the literature by directly comparing the prognostic value of the Shock Index with that of widely used scoring systems in Fournier's gangrene. In emergency settings, where laboratory results may be delayed or access to comprehensive clinical data is limited, SI may serve as a rapid and practical tool for early risk stratification. However, further validation through prospective, multicenter studies across diverse patient populations is necessary to confirm its clinical reliability and generalizability.

Ethics Committee Approval: This study was approved by the Trakya University Faculty of Medicine Non-Interventional

Clinical Research Ethics Committee (Date: 03.11.2025, Decision No: 2025/491).

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ORİJİNAL ÇALIŞMA - ÖZ

Fournier gangreninde şok indeksinin prognostik değeri: Yerleşik mortalite puanlama sistemleriyle karşılaştırmalı retrospektif kohort çalışması

AMAC: Fournier gangreni, perineal ve genital bölgeleri tutan, hızlı ilerleyici ve yaşamı tehdit eden bir nekrotizan enfeksiyon olup, cerrahi ve yoğun bakım alanındaki gelişmelere rağmen mortalitesi yüksek seyretmektedir. Bu hastalarda erken ve güvenilir prognostik değerlendirme, klinik sonuçların iyileştirilmesi açısından kritik öneme sahiptir. Bu çalışmanın amacı, Şok İndeksi'nin (SI) Fournier gangreninde mortaliteyi öngörme performansını değerlendirmek ve ayırt ediciliğini mevcut skorlama sistemleri ile karşılaştırmaktır.

GEREÇ VE YÖNTEM: Bu retrospektif kohort çalışmasına, Ocak 2015–Aralık 2024 tarihleri arasında bir üçüncü basamak üniversite hastanesinin acil servisine başvuran ve cerrahi debridman uygulanan Fournier gangreni tanılı erişkin hastalar dahil edilmiştir. Demografik, klinik ve laboratuvar verileri kurumsal ve ulusal elektronik sağlık kayıtlarından elde edilmiştir. Sağ kalanlar ile kaybedilen hastalar uygun istatistiksel yöntemlerle karşılaştırılmış; mortalite ile ilişkili değişkenler lojistik regresyon analizine tabi tutulmuştur. Şok İndeksi ve diğer geleneksel skorlama sistemlerinin (FGSI, UFGSI, LRINEC, qSOFA) mortaliteyi öngörme performansı ROC analizi ile değerlendirilmiş; SI için optimal eşik değeri Youden indeksi kullanılarak belirlenmiştir.

BULGULAR: Çalışmaya dahil edilen 158 hastanın (ortalama yaş 62.3 ± 13.4 yıl; %86,1 erkek) genel mortalite oranı %17,1 idi. Kaybedilen hastalar anlamlı ölçüde daha ileri yaşta (p<0.001) ve koroner arter hastalığı, kronik kalp yetmezliği ile kronik böbrek yetmezliği mortalite ile ilişkili bulundu. Başvuru anında kaybedilen hastalarda kalp ve solunum hızı daha yüksek, sistolik kan basıncı ise daha düşüktü. ROC analizine göre Şok İndeksi mortaliteyi öngörmeye en yüksek ayırt edici güce sahipti (AUC=0.952; %95 GA 0.918–0.986; p<0.001) ve FGSI, UFGSI, LRINEC ve qSOFA skorlarını geride bıraktı. SI için belirlenen optimal eşik değeri (0.866) mortalite öngörümünde %92,6 duyarlılık ve %83,2 özgüllük sağladığı görüldü.

SONUÇ: Fournier gangreninde Şok İndeksi, geleneksel skorlama sistemlerine kıyasla üstün prognostik doğruluk göstermiştir. Yalnızca iki kolay erişilebilir hemodinamik parametreye dayanması nedeniyle erken risk sınıflandırmasında pratik ve uygulanabilir bir araç olarak öne çıkmaktadır. Bulguların doğrulanması için ileriye dönük çok merkezli çalışmalara ihtiyaç vardır.

Anahtar sözcükler: Fournier gangreni; mortalite; prognoz; şok indeksi.

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