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Original Article

Diagnostic value of pentraxin-3 in community-acquired pneumonia patients presenting to the emergency department

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ABSTRACT

Aims: Community-acquired pneumonia (CAP) is one of the most frequent causes of emergency department admissions and represents a major infectious disease requiring rapid diagnosis. This study aimed to evaluate the diagnostic value of pentraxin-3 (PTX-3) in patients presenting to the emergency department with CAP and to investigate its association with conventional inflammatory biomarkers and the pneumonia severity score based on confusion, urea, respiratory rate, blood pressure, and age ≥65 years (CURB-65).

Methods: This prospective, single-center study included 45 adult patients diagnosed with CAP and 42 healthy controls. Demographic characteristics and laboratory parameters, including white blood cell count, C-reactive protein (CRP), procalcitonin (PCT), and PTX-3 levels, were recorded. Diagnostic performance was evaluated using receiver operating characteristic (ROC) analysis, and correlations between PTX-3 and clinical parameters were analyzed.

Results: Median PTX-3 levels were significantly higher in the CAP group compared with controls (2.485 ng/ml vs. 0.981 ng/ml, $p<0.001$). ROC analysis demonstrated a high diagnostic performance of PTX-3 for distinguishing CAP patients from controls (AUC: 0.906; 95% CI: 0.846–0.965). An optimal cut-off value of 1.389 ng/ml yielded high sensitivity (93.33%) and acceptable specificity (73.17%). PTX-3 levels showed no significant correlation with CRP, PCT, white blood cell count, or CURB-65 score and did not differ significantly across CURB-65 severity groups.

Conclusion: PTX-3 appears to be a useful biomarker for identifying the presence of CAP rather than assessing disease severity or prognosis. Its high sensitivity suggests that PTX-3 may support early diagnosis and rapid clinical decision-making in time-critical emergency department settings.

Keywords: Community-acquired pneumonia, pentraxin-3, biomarkers, emergency department

INTRODUCTION

Community-acquired pneumonia (CAP) is a major global health problem frequently encountered in emergency departments and is associated with high morbidity and mortality worldwide.[1] Delays in early diagnosis and initiation of appropriate treatment, particularly in elderly patients and those with comorbid conditions, may lead to adverse clinical outcomes. Therefore, the rapid and accurate identification of CAP in the emergency department setting, along with timely initiation of appropriate therapy, is of critical importance for improving disease course and patient outcomes.

Several clinical scoring systems have been developed to assess disease severity and to guide decisions regarding the appropriate site of care for patients with pneumonia. Among these, the CURB-65 score—which includes parameters such as confusion, uremia, respiratory rate, blood pressure, and age—is particularly favored in emergency department settings due to its practical applicability and ability to provide rapid clinical guidance.[2] In recent years, the COVID-19 pandemic has substantially increased the burden of pneumonia on emergency departments and highlighted the vulnerability of healthcare systems to large-scale respiratory outbreaks. Moreover, growing scientific evidence suggests that similar pandemics may occur in the future, further emphasizing the need for rapid and reliable diagnostic approaches in the emergency setting.[3,4] In this context, it has been reported that emergency departments with high patient volumes require not only clinical pneumonia severity scores but also simpler, more practical inflammatory biomarkers with high predictive value to support rapid clinical decision-making.[5] In CAP, biochemical markers such as C-reactive protein (CRP) and procalcitonin (PCT) are widely used to assess disease severity and monitor response to treatment.[6] However, the diagnostic accuracy of these biomarkers, particularly their sensitivity in the early stages of the disease, remains controversial.

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Therefore, there is an ongoing need for novel biomarkers that can reflect the presence and severity of infection more rapidly and accurately in patients with CAP. In this context, pentraxin-3 (PTX-3), a long pentraxin and an acute-phase protein involved in the innate immune response to infection and inflammation, has recently attracted attention as a potential diagnostic biomarker in CAP. Moreover, PTX-3 has been reported to increase earlier than CRP in conditions such as acute lung injury and pneumonia and may be associated with disease severity and mortality.[7,8]

The aim of this study was to investigate the diagnostic value of PTX-3 in patients with CAP presenting to the emergency department. In addition, we aimed to evaluate the association of this biomarker with commonly used inflammatory markers, such as CRP and PCT, as well as with the CURB-65 pneumonia severity score.

METHODS

Ethics

Approval for the study was obtained from the Ankara Numune Training and Research Hospital Clinical Researches Ethics Committee (Date: 18.04.2019, Decision No: E-19-2667). The study was conducted in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained from all participants and/or their legal representatives prior to enrollment.

Study Design and Setting

This prospective study was conducted in the Emergency Medicine Department of a tertiary care hospital. Adult patients diagnosed with CAP who presented to the Emergency Department of Ankara Numune Training and Research Hospital between April 1 and June 1, 2019 were included in the study.

Study Population

Patients aged 18 years and older who presented to the emergency department and were diagnosed with CAP based on clinical, laboratory, and radiological findings were included in the study. The patient group consisted of 45 individuals who met these criteria and agreed to participate in the study. The control group comprised 42 healthy volunteers aged 18 years and older with no known acute or chronic systemic disease. Inclusion criteria were age ≥18 years and a diagnosis of CAP supported by clinical, laboratory, and/or radiological findings. Exclusion criteria included age under 18 years, receipt of immunosuppressive therapy within the previous month, history of active malignancy, pregnancy, trauma-related admission, and hospitalization for any reason within the preceding week.

Data Collection

All patient data were recorded prospectively. In the patient group, sociodemographic characteristics (age and sex), vital signs, white blood cell (WBC) count, neutrophil count, lymphocyte count, CRP, PCT and PTX-3 levels were recorded. The CURB-65 score was calculated for all patients in the CAP group. In the control group, sociodemographic characteristics and only PTX-3 levels were evaluated.

Definition

Diagnosis of pneumonia: Patients presenting to the emergency department with symptoms of lower respiratory tract infection, including fever, cough, dyspnea, sputum production, and general deterioration, were considered suspected cases of pneumonia. Patients with acute elevations in inflammatory markers accompanying clinical findings and radiological features consistent with pneumonia on thoracic computed tomography were included in the study with a diagnosis of CAP.[1] Microbiological testing was not systematically incorporated into the study protocol, and etiological classification of pneumonia (bacterial, viral, or atypical) was not performed.

The CURB-65 score was used to assess pneumonia severity. The score consists of the following criteria: presence of confusion, blood urea level >7 mmol/L, respiratory rate ≥30 breaths/min, systolic blood pressure <90 mmHg or diastolic blood pressure ≤60 mmHg, and age ≥65 years. One point was assigned for each criterion, and the total score was calculated accordingly. CURB-65 scores were classified as low risk (0–1), moderate risk (2), and high risk (≥3).[2]

Measurement of pentraxin-3: PTX-3 levels were measured using the enzyme-linked immunosorbent assay (ELISA) method with a commercially available human PTX-3 ELISA kit (YLA0361HU, Shanghai YL Biotech Co., Ltd.), in accordance with the manufacturer's instructions. The assay had a measurement range of 0.1–30 ng/ml and an analytical sensitivity of 0.05 ng/ml.

Outcomes

The primary outcome of this study was to assess the diagnostic value of PTX-3 in patients with CAP presenting to the emergency department. The secondary outcomes were to evaluate the association between PTX-3 levels and established inflammatory biomarkers, including CRP and PCT, as well as the CURB-65 pneumonia severity score.

Statistical Analysis

The data analyses were performed using SPSS (Statistical Package for the Social Sciences) for Windows, version 16.0 (SPSS Inc., Chicago, IL, USA). The normality of data distribution was assessed using the Shapiro–Wilk test. Descriptive statistics were presented as mean±standard deviation for normally distributed variables and as median with interquartile range (IQR) for non-normally distributed variables. Categorical variables were expressed as numbers and percentages. Comparisons between two independent groups were performed using the Mann–Whitney U test for non-normally distributed continuous variables and the Chi-square test or Fisher's exact test for categorical variables. For comparisons among more than two independent groups with non-normally distributed variables, the Kruskal–Wallis test was used, followed by Bonferroni correction for post hoc pairwise comparisons. The diagnostic performance of PTX-3 was evaluated using receiver operating characteristic (ROC) curve analysis, and sensitivity, specificity, positive predictive value, and negative predictive value were calculated. Correlation analyses for non-normally distributed variables were conducted using Spearman's rank correlation test. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 45 patients diagnosed with CAP and 42 healthy volunteers as the control group were included in the study. Baseline demographic characteristics and PTX-3 levels were compared between the patient and control groups. There

was no statistically significant difference between the groups in terms of gender distribution (p=0.358). The median age of the patient group was 76 years (IQR: 63–81), whereas the median age of the control group was 31 years (IQR: 26–34). The patient group was significantly older than the control group (p<0.001). PTX-3 levels were significantly higher in the patient group compared with the control group. The median PTX-3 level was 2.485 ng/ml (IQR: 1.870–3.427) in the patient group and 0.981 ng/ml (IQR: 0.520–1.583) in the control group (p<0.001) (Table 1).

Table 1. Comparison of demographic characteristics and pentraxin-3 levels between patient and control groups

Variable	Control group (n=42)	Patient group (n=45)	p-value
Gender, n (%)			
Male	25 (61.0)	23 (51.1)	0.358[a]
Female	16 (39.0)	22 (48.9)	
Age, years (median, IQR)	31 (26–34)	76 (63–81)	<0.001[b]
Pentraxin-3, ng/ml (median, IQR)	0.981 (0.520–1.583)	2.485 (1.870–3.427)	<0.001[b]

[a] Chi-square test, [b] Mann–Whitney U test, IQR: Interquartile range

ROC analysis was performed to evaluate the ability of PTX-3 to discriminate between patients and controls. The area under the curve (AUC) was 0.906 (95% confidence interval: 0.846–0.965), indicating excellent diagnostic performance, and the result was statistically significant (p<0.001) (Figure). Sensitivity, specificity, positive predictive value, and negative predictive value for different cut-off points are presented in Table 2. The highest Youden Index was observed at a cut-off value of 1.389 ng/ml (Table 2).

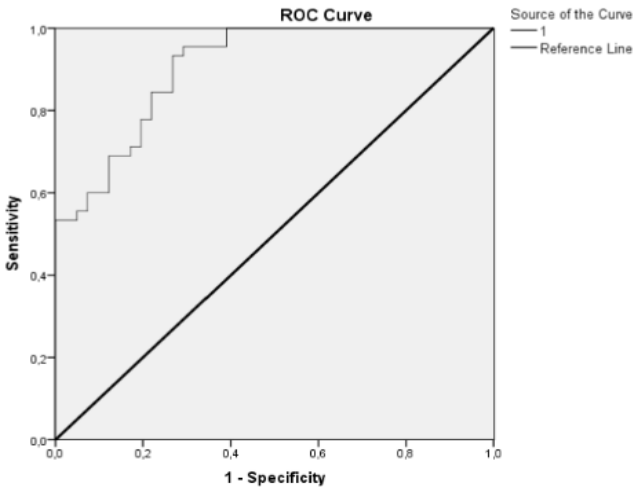

Figure. Receiver operating characteristic (ROC) curve of pentraxin-3 for distinguishing community-acquired pneumonia patients from controls

To evaluate the relationships between the studied biomarkers and the CURB-65 score, Spearman correlation analysis was performed. The analysis revealed that PTX-3 levels were not significantly correlated with PCT, CRP, WBC count, neutrophil count, lymphocyte count, or the CURB-65 score (all p>0.05) (Table 3).

Patients were categorized into low- (0–1 points), moderate- (2 points), and high-risk (3–5 points) groups according to their CURB-65 scores to assess pneumonia severity. The distribution of laboratory parameters across these severity groups was compared using the Kruskal–Wallis test. The analysis demonstrated that median PTX-3 levels did not differ significantly among the CURB-65 groups (p=0.411). In contrast, plasma PCT and CRP levels increased significantly with increasing pneumonia severity (p=0.001 and p=0.026, respectively). Bonferroni-adjusted post hoc analysis revealed that the significant difference in PCT levels was primarily driven by the high-risk group (CURB-65 ≥3). No significant differences were observed among CURB-65 groups with respect to WBC count, neutrophil count, or lymphocyte count (Table 4).

Table 2. Diagnostic performance of pentraxin-3 at different cut-off values in community-acquired pneumonia

Cut-off value (ng/ml)	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Youden Index
1.339	95.56	70.73	78.18	93.55	0.663
1.389	93.33	73.17	79.25	90.91	0.665
1.469	91.11	73.17	78.85	88.24	0.643
1.501	88.89	73.17	78.43	85.71	0.621
1.687	84.44	78.05	80.85	82.05	0.625

PPV: Positive predictive value, NPV: Negative predictive value

DISCUSSION

In this study, the diagnostic value of PTX-3 was evaluated in patients with CAP presenting to the emergency department, and PTX-3 demonstrated a high diagnostic performance in distinguishing patients from healthy controls. In contrast, PTX-3 levels were not significantly associated with the CURB-65 score, which reflects pneumonia severity. These findings suggest that PTX-3 may serve as a useful biomarker for identifying the presence of CAP rather than for assessing disease severity or prognosis.

In our study, the median age of patients diagnosed with CAP being in the eighth decade was consistent with the known epidemiology of the disease. It has been well documented in the literature that the incidence and severity of CAP increase with advancing age, with a marked rise in hospitalization rates and mortality, particularly among individuals aged 65 years and older.[9] Similarly, in a multicenter study including patients with CAP, the mean age was reported as 76.8 years, supporting the age distribution observed in our study.[10]

In the this study, the substantial age difference between the patient and control groups suggests that PTX-3 levels may have been influenced not only by the presence of pneumonia but also by age-related physiological changes. It is well established that aging is associated with alterations in inflammatory response dynamics and that baseline levels of certain inflammatory biomarkers, such as CRP, may increase with advancing age.[11] Therefore, the observed difference in PTX-3 levels should be interpreted with caution, as it may not be entirely attributable to pneumonia alone. In this study, the significantly higher PTX-3 levels observed in the patient group compared with the control group support the potential diagnostic value of PTX-3 in distinguishing the presence of pneumonia, despite the age difference between the groups. The ROC analysis and diagnostic performance

Table 3. Correlation analysis between pentraxin-3 and clinical and laboratory parameters

Parameter		PCT	CRP	WBC	Neutrophil	Lymphocyte	CURB-65
PTX-3	p-value	-0.181	-0.168	-0.077	-0.116	0.151	0.014
	rho	0.233	0.269	0.617	0.450	0.323	0.929

PCT: Procalcitonin, CRP: C-reactive protein, WBC: White blood cell count, CURB-65: Confusion, urea >7 mmol/L, Respiratory rate ≥30/min, low blood pressure, age ≥65 years; PTX-3: Pentraksin-3 (rho: Spearman's correlation coefficient).

Table 4. Distribution of laboratory parameters according to CURB-65 score groups

Parameter	CURB-65 score=0–1 (n=6) (median, IQR)	CURB-65 score=2 (n=12) (median, IQR)	CURB-65 score ≥3 (n=27) (median, IQR)	p-value
Pentraxin-3 (ng/ml)	2.18 (1.34–2.62)	2.47 (2.03–3.69)	2.61 (1.85–3.43)	0.411
Procalcitonin (ng/ml)	0.02 (0.00–0.78)	0.08 (0.04–0.56)	2.10 (0.60–9.90)	0.001
C-reactive protein (mg/L)	60.5 (33–148)	51.0 (37.5–88.5)	103.0 (70–275)	0.026
White blood cell count ($\times 10^9$/L)	9.2 (7.2–10.5)	10.7 (7.3–13.5)	13.0 (7.5–17.5)	0.213
Neutrophil count ($\times 10^9$/L)	7.3 (6.3–8.1)	8.4 (4.6–11.1)	10.6 (6.0–15.6)	0.189
Lymphocyte count ($\times 10^9$/L)	1.40 (0.60–1.80)	1.45 (1.10–2.35)	1.00 (0.60–1.60)	0.125

CURB-65: Confusion, urea >7 mmol/L, respiratory rate ≥30/min, low blood pressure, age ≥65 years, Kruskall Wallis test (with Bonferroni correction), IQR: Interquartile range

metrics across different cut-off values further reinforce this finding, demonstrating that PTX-3 has high sensitivity and acceptable specificity in discriminating patients from healthy individuals. This high diagnostic performance can likely be explained by the underlying pathophysiological mechanisms related to the unique synthesis and release characteristics of PTX-3 at the site of inflammation. Unlike classical short pentraxins such as CRP, PTX-3 is not primarily synthesized in the liver as an acute-phase reactant; rather, it is rapidly produced at the site of inflammation or infection by various immune and structural cells, including macrophages, dendritic cells, neutrophils, and endothelial cells.[12] In the presence of a pathogen causing pneumonia within lung tissue, PTX-3 released from these local cells plays a critical role in the early innate immune response. Acting as a pattern recognition molecule, PTX-3 recognizes microorganisms, facilitates the process of opsonization, and contributes to pathogen clearance through activation of the complement system.[13] Therefore, elevated plasma PTX-3 levels are more likely to reflect local and early inflammatory activity within the lung parenchyma rather than a liver-derived systemic inflammatory response. These biological properties help explain why PTX-3 emerges as a sensitive biomarker for the diagnosis of CAP, particularly in the early stages of infection.

In our study, the optimal cut-off value of 1.389 ng/ml for PTX-3 demonstrated high sensitivity and acceptable specificity. The high sensitivity observed in our study suggests that PTX-3 may serve as a supportive biomarker in the early diagnostic evaluation of pneumonia in emergency department settings. However, given its moderate specificity, it should not be considered a stand-alone rule-out test. Furthermore, the literature indicates that reported AUC values and cut-off points for the diagnostic performance of PTX-3 vary widely across studies. In a study by Shi et al.[14] evaluating patients with CAP, the optimal cut-off value for PTX-3 was identified at a markedly higher level of 32.26 ng/ml. In contrast, a study conducted in Egypt including patients with lower respiratory tract infections reported an AUC value for PTX-3 that was largely comparable to our findings.[15] Moreover, a recent meta-analysis including respiratory tract infections emphasized that the reported cut-off values for PTX-3 ranged widely from 0.3 to 100 ng/ml; this heterogeneity was attributed to differences in patient populations, sampling timing, and measurement methods used across studies.[16]

In our study, no significant correlation was observed between PTX-3 levels and CRP, PCT, WBC count, or the CURB-65 score. Similarly, no significant differences in PTX-3 levels were detected among severity groups stratified according to CURB-65 scores; in contrast, CRP and PCT levels increased significantly with higher CURB-65 scores. It is well established that biomarkers such as CRP and PCT are primarily associated with systemic inflammatory burden and disease severity.[17,18] Therefore, their parallel increase with the CURB-65 score—which reflects clinical severity and mortality risk—was an expected finding. In contrast, the local synthesis of PTX-3 at the site of infection rather than a systemic inflammatory response explains its primary diagnostic role in the early identification of infection rather than in reflecting the degree of systemic inflammation.[19] In the literature, PTX-3 has been reported to increase early in infectious diseases such as pneumonia and sepsis and to have diagnostic value; however, its correlation with disease severity scores and conventional inflammatory markers appears to be limited.[16,20]

Limitations

This study has several limitations. The substantial age difference between the patient and control groups represents one of the most important methodological limitations of our study. Age-related alterations in immune response and potential physiological differences in inflammatory biomarkers may have acted as confounding factors influencing PTX-3 levels. Therefore, our findings should be interpreted with caution. Second, the etiological pathogen responsible for pneumonia (bacterial, viral, or atypical) was not identified. Given that different pathogens may elicit distinct host immune responses and varying PTX-3 levels, pathogen-specific subgroup analyses could further clarify the diagnostic role of PTX-3. Despite these limitations, our study

provides valuable evidence regarding the potential utility of PTX-3 in the diagnosis of CAP in the emergency department setting.

CONCLUSION

This study demonstrated that PTX-3 stands out as a diagnostic biomarker for distinguishing the presence of disease rather than reflecting disease severity or prognosis. This feature suggests that PTX-3 may be a useful tool to support clinical decision-making processes for the early diagnosis of CAP, particularly in busy and time-constrained emergency department settings. The findings lay the groundwork for larger, multicenter, prospective studies to determine the clinical utility of PTX-3 and its optimal use strategies.

ETHICAL DECLARATIONS

Ethics Committee Approval

Approval for the study was obtained from the Ankara Numune Training and Research Hospital Clinical Researches Ethics Committee (Date: 18.04.2019, Decision No: E-19-2667).

Informed Consent

Written informed consent was obtained from all individual participants prior to their inclusion in the study. Participants were fully informed about the study's aims, procedures, potential risks and benefits, and their rights—including the right to withdraw at any time without consequence. All participants voluntarily signed a written informed consent form.

Peer Review Process

This manuscript was subject to external peer review.

Conflict of Interest

The authors declare no conflicts of interest related to this study.

Financial Disclosure

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Author Contributions

Concept: ES, UBK; Design: UBK; Control: ES; Resources: ES, UBK; Materials: AK; Data Collection and/or Processing: UBK, AK; Analysis and/or Interpretation: UBK, ES; Literature Review: ES, UBK; Writing the Article: ES, UBK, AK; Critical Review: ES, UBK, EK.

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Original Article

The effect of emergency department boarding time on mortality of hospitalized COVID-19 patients

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ABSTRACT

Aims: To investigate whether prolonged emergency department length of stay (ED-LOS) is associated with increased mortality and altered clinical outcomes in critically ill COVID-19 patients requiring intensive care admission. This study aimed to evaluate the association between ED-LOS and mortality among COVID-19 patients admitted to intensive care units (ICUs) during the pandemic.

Methods: This retrospective observational study included 258 adult patients who were admitted from the ED to COVID-19 ICUs between March 29, 2020, and January 17, 2021. Patients were categorized based on ED-LOS into two groups: "8 hours or less" and "more than 8 hours." Demographic data, comorbidities, PCR test results, ED-LOS, ICU length of stay, and mortality outcomes were collected and analyzed using the Mann-Whitney U and Chi-square tests.

Results: The median ED-LOS for all patients was 8 hours (IQR: 4-14). Among the 181 patients who died (70.2%), the median ED-LOS was 8 hours (IQR: 4-13.5), compared to 6 hours (IQR: 4-14) in survivors (p=0.216). The median time to mortality was 8 days in the ≤8-hour group and 6 days in the >8-hour group (p=0.701). ICU length of stay was 10.5 days (IQR: 4-17) in the ≤8-hour group and 9 days (IQR: 4-18) in the >8-hour group (p=0.627). No statistically significant association was found between ED-LOS and mortality or ICU stay duration.

Conclusion: While prolonged ED-LOS (>8 hours) was not independently associated with increased mortality statistically, it clinically correlated with earlier mortality and shorter ICU stays. These outcomes were primarily driven by the severe clinical presentations of the patients, such as ARDS and sepsis, which required extensive stabilization in the ED prior to ICU transfer.

Keywords: Emergency service, length of stay, COVID-19, intensive care units, hospital mortality, triage

INTRODUCTION

Since its emergence in late 2019, SARS-CoV-2 has caused a global pandemic with severe public health consequences, resulting in hundreds of millions of infections worldwide.[4,6] While the virus primarily targets the respiratory system and frequently presents with severe respiratory compromise, it can also affect multiple organ systems.[1,12] Although ongoing global efforts have led to the development of vaccines and targeted therapeutics, the rapid evolution of new variants and unequal resource distribution continue to present significant clinical challenges.[2,3]

During public health crises, emergency departments (EDs) serve as the vital frontline of the healthcare system. They act as critical entry points for patients requiring urgent evaluation, triage, and stabilization.[7] The efficient functioning of EDs is essential for managing acute patient surges, ensuring the timely initiation of critical care, and maintaining the overall resilience of the hospital infrastructure.

However, the unprecedented surge in Coronavirus Disease 2019 (COVID-19) cases frequently overwhelmed ED capacities, leading to severe overcrowding, prolonged waiting times, and potential delays in diagnosis, treatment, and hospital admission.[8] Previous studies have well-documented the adverse effects of ED overcrowding and extended emergency department length of stay (ED-LOS) on patient outcomes in acute conditions such as sepsis, acute myocardial infarction, and stroke.[9-11] For COVID-19 patients, who are highly susceptible to rapid clinical deterioration, delays in initiating appropriate definitive treatment can substantially increase mortality risk.[13]

Despite the known risks associated with prolonged ED-LOS, evidence specifically evaluating its impact on mortality in COVID-19 patients remains limited. Therefore, the objective of this study is to examine the relationship between ED waiting time and mortality among hospitalized COVID-19

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patients. By evaluating these critical time thresholds, we aim to provide streamlined insights to enhance triage systems and optimize patient management strategies during health crises.

METHODS

Ethics

Ethical approval has been obtained from the Gülhane Scientific Researches Ethics Committee of the University of Health Sciences (Date: 21.10.2021, Decision No: 2021-368). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Study Design

This single-center, retrospective observational study was conducted at a tertiary care hospital in Ankara, Turkiye, evaluating patients who presented to ED between March 29, 2020, and January 17, 2021.

Patient Selection

The study population consisted of adult patients (aged 18 years and older) who were admitted from the ED directly to the designated COVID-19 intensive care units (ICUs). The primary inclusion criterion was a confirmed need for ICU admission due to COVID-19 complications following initial ED evaluation. Patients were excluded from the study if they met any of the following criteria: missing clinical or demographic data, refusal of treatment following the admission decision, presentation to the ED in cardiac arrest, direct ICU admission from an external center without ED evaluation, inter-hospital transfers directly to the ICU, and absence of polymerase chain reaction (PCR) test results.

Data Collection

Following the first confirmed COVID-19 case in Turkiye, our hospital established comprehensive protocols for diagnosis, triage, and treatment. Suspected COVID-19 patients were evaluated in a designated, isolated area within the ED. All suspected patients underwent PCR testing and were assessed by an infectious diseases coordinator. Patient data were retrospectively extracted from the hospital's electronic information system and the Public Health Management System. The recorded variables included demographic characteristics (age, sex), comorbidities, PCR results and testing timing, specific treatment modalities (e.g., oxygen therapy, antivirals, corticosteroids, anticoagulation), and final clinical outcomes.

Outcomes

The primary outcome of the study was in-hospital mortality. The secondary outcome was the length of stay in the ICU. The primary independent variable was ED-LOS, defined as the time interval from the clinical decision to admit a patient to the ICU until the actual physical transfer occurred. Based on the Turkish Ministry of Health admission targets, patients were categorized into two analytical groups according to their ED-LOS: "8 hours or less" and "more than 8 hours".

Statistical Analysis

All data obtained in the study were analyzed using the IBM SPSS 20.0 (Chicago, IL, USA) statistical software. The fitness of discrete and continuous numerical variables to the normal distribution was tested with the Kolmogorov-Smirnov test. In descriptive statistics, discrete and continuous numerical variables were given as median (IQR 25-75), and categorical variables were presented as the number of cases and percentages (%). Categorical variables were evaluated using the Chi-square test, and continuous variables were evaluated using the Mann-Whitney U test. Results with a p-value of <0.05 were considered statistically significant.

RESULTS

A total of 318 patients aged 18 years and older were admitted to the COVID-19 ICUs through the ED between March 2020 and January 2021. After excluding 60 patients due to missing PCR results (n=7), direct ICU admissions from other centers (n=27), inter-hospital transfers (n=10), and pre-hospital cardiac arrests (n=16), 258 patients were included in the final analysis (**Figure**).

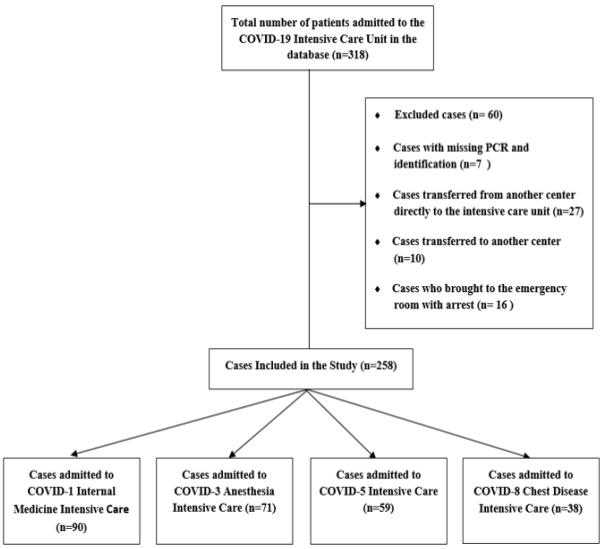

Figure. Flowchart of patient inclusion and exclusion criteria

The median age of the study population was 74 years (IQR: 65-83), and 112 (43.4%) were female. The most common comorbidity was hypertension (49.6%), followed by diabetes mellitus (40.3%). Among all patients, 129 (50%) had a positive PCR test upon admission (**Table 1**).

The median ED-LOS for the cohort was 8 hours (IQR: 4-14), the median ICU stay was 10 days (IQR: 4-17), and the median time to mortality was 7 days (IQR: 3-13.75). Of the total cohort, 181 patients (70.2%) died during hospitalization.

To address the severe clinical course explaining the mortality and the prolonged ED boarding times associated with critical stabilization, we analyzed the final clinical diagnoses of the 181 non-survivors. Among the deceased patients, the most frequent primary complication was acute respiratory distress syndrome (ARDS) and secondary bacterial pneumonia in 72 patients (39.8%). This was followed by cardiovascular complications in 46 patients (25.4%), sepsis in 44 patients (24.3%), and thromboembolic events in 19 patients (10.5%).

Patients who died had a significantly higher median age compared to survivors (77 vs. 69 years, p=.003). Mortality was not significantly associated with sex (p=.666) or most individual comorbidities; however, it was significantly higher among patients with Alzheimer's/dementia (p=.045) and malignancy (p=.050). The median ICU length of stay was

Table 1. Demographic and clinical characteristics of the study population

Age (year), median (IQR 25-75)	**74 (65-83)**
Sex, n (%)	
Female	112 (43.4%)
Male	146 (56.6%)
Comorbidity, n (%)	
Hypertension	128 (49.6)
Diabetes mellitus	104 (40.3)
Coronary artery disease	58 (22.5)
Chronic obstructive pulmonary disease	44 (17.1)
Congestive heart failure	40 (15.5)
Chronic renal disease	33 (12.8)
Alzheimer-dementia	29 (11.2)
Malignancy	28 (10.9)
Cerebrovascular event	16 (6.2)
Other	29 (11.2)
PCR result, n (%)	
Positive	129 (50)
Negative	129 (50)
PCR application day n (%)	
1-7 days	104 (40.3)
8-14 days	19 (7.4)
15 days and over	6 (2.3)
Negative	129 (50)
Length of stay, day, median (IQR 25-75)	
ED-LOS	8 (4-14)
Length of stay in ICU	10 (4-17)
Mortality day interval	7 (3-13.75)
Prognosis, n (%)	
Discharged	77 (29.8%)
Death	181 (70.2%)
Final diagnosis in deceased patients (n=181), n (%)	
ARDS & secondary bacterial pneumonia	72 (39.8%)
Cardiovascular complications	46 (25.4%)
Sepsis	44 (24.3%)
Thromboembolic events	19 (10.5%)

IQR: Interquartile range, PCR: Polymerase chain reaction, ED-LOS: Emergency department length of stay, ICU: Intensive care unit, ARDS: Acute respiratory distress syndrome

Table 2. Comparison of clinical variables between surviving and deceased patients

	Discharged (n=77)	Death (n=181)	p*-value
Age, year, median (IQR 25-75)	69 (59-78.5)	77 (66-84)	.003*
Sex, n (%)			
Female	42 (54.5%)	104 (57.5%)	.666**
Male	35 (45.5%)	77 (42.5%)	
Comorbidity, n (%)			
Hypertension	41 (53.2%)	87 (48.1%)	.446**
Diabetes mellitus	39 (50.6%)	65 (35.9%)	.270**
Coronary artery disease	21 (27.3%)	37 (20.4%)	.229**
Chronic obstructive pulmonary disease	11 (14.3%)	33 (18.2%)	.441**
Congestive heart failure	16 (20.8%)	24 (13.3%)	.127**
Chronic renal diseasew	12 (15.6%)	21 (11.6%)	.381**
Alzheimer-dementia	4 (5.2%)	25 (13.28%)	.045**
Malignancy	2 (2.6%)	26 (14.4%)	.050**
Cerebrovascular event	3 (3.9%)	13 (7.2%)	.406**
Other	4 (5.2%)	25 (13.8%	.045**
PCR result, n (%)			
Positive	36 (46.8%)	93 (51.4)	.496**
Negative	41 (53.2%)	88 (48.6%)	
PCR application day n (%)			
1-7 days	28 (36.4%)	76 (42%)	.577**
8-14 days	5 (6.5%)	14 (7.7%)	
15 days and over	3 (3.9%)	3 (1.7%)	
Negative	41 (53.2)	88 (48.6)	
Length of stay, day, median (IQR 25-75)			
ED-LOS	6 (4-14)	8 (4-13.5)	.216*
Length of stay in ICU	15 (10.5-20)	7 (3-13.5)	<0.001*
Mortality day interval		7 (3-13.75)	

IQR: Interquartile range, PCR: Polymerase chain reaction, ICU: Intensive care unit, ED-LOS: Emergency department length of stay, *: Mann-Whitney U test, **: Chi-square test

Table 3. Outcomes of patients based on emergency department length of stay

	Waiting for 8 hours or less (n=158)	Waiting more than 8 hours (n=100)	p*-value
Length of stay, day, median (IQR 25-75)			
Length of stay in the ICU	10.5 (4-17)	9 (4-18)	.627*
Mortality day interval	8 (3-14)	6 (3-12.5)	.701*
Mortality n (%)	107 (67.7%)	74 (74%)	.283**

IQR: Interquartile range, ICU: Intensive care unit, *: Mann-Whitney U test, **: Chi-square test

significantly shorter in non-survivors compared to survivors (7 vs. 15 days, p=.001). Overall, there was no statistically significant association between ED-LOS and mortality (p=.216) (Table 2).

When categorizing patients by ED-LOS, 158 (61.2%) waited 8 hours or less, while 100 (38.8%) waited more than 8 hours. ICU length of stay was slightly longer in the ≤8-hour group (10.5 vs. 9 days), and the median time to death was also longer (8 vs. 6 days), although these differences did not reach statistical significance (p=.627 and p=.701, respectively). Mortality rates were 67.7% in the ≤8-hour group and 74% in the >8-hour group (p=.283) (Table 3).

DISCUSSION

This study investigated the association between ED-LOS and mortality among hospitalized COVID-19 patients admitted to ICUs. While no statistically significant relationship was found between ED-LOS and mortality or ICU length of stay, our findings still offer important insights into patient flow dynamics and healthcare system capacity during crisis periods.

Our results showed that patients who died had a slightly longer median ED-LOS (8 hours) compared to those who survived. Furthermore, although not statistically significant, patients who waited more than 8 hours in the ED had earlier mortality and shorter ICU stays than those transferred within 8 hours. This trend may suggest that patients with more severe illness deteriorated faster despite ED management or were subject to systemic delays in reaching definitive care. Importantly, these patterns echo clinical intuition, even if they did not meet statistical thresholds.

Previous studies have produced mixed findings regarding the relationship between ED-LOS and outcomes. Asheim et al.[17] and Paton et al.[18] observed increased mortality risks with prolonged ED-LOS in general patient populations. In contrast, studies during the COVID-19 pandemic, such as those by Tuttle et al.[20] and Boudi et al.,[19] found that early ED-based interventions may buffer the effects of delayed ICU transfers. Conway et al.[21] similarly reported a significant association between COVID-19 diagnosis and ICU outcomes, although the overall impact on in-hospital mortality was limited, as COVID-19 patients constituted a small fraction of their ICU population. These discrepancies highlight

the evolving complexity of triage and resuscitation during pandemics where even high ED-LOS may be mitigated by structured emergency care protocols.

It is also important to consider that during the early stages of the pandemic, hospitals operated under extreme capacity constraints. National protocols in Turkiye advised ICU admissions within 4 to 8 hours, but ICU bed shortages often led to extended boarding times. In this context, the ED served not only as a triage zone but also as a provisional treatment area, potentially diluting the impact of prolonged ED-LOS on mortality.

Within the context of the Turkish healthcare system, local studies have similarly highlighted the challenges and outcomes associated with ED boarding during the pandemic. For instance, an analysis of COVID-19 admissions in Turkish EDs demonstrated that severe complications such as ARDS, multiorgan failure, and pulmonary embolism heavily dictated the need for ICU admission and correlated with extended stabilization periods in the ED.[27] Furthermore, multi-center evaluations of ED admissions in Turkiye during the pandemic have shown significant shifts in patient demographics and increased mortality rates associated with ED crowding and resource constraints.[28] These local findings align with our observation that while prolonged ED-LOS itself may not be the sole independent predictor of mortality, it is inextricably linked to the severity of the patient's initial presentation and the systemic burden on critical care resources.

Several studies have proposed thresholds for ED-LOS beyond which patient outcomes deteriorate. Groenland et al.[22] reported increased mortality for patients transferred to the ICU after more than 2.4 hours, while Plunkett et al.[23] recommended a maximum ED-LOS of 4–6 hours to reduce in-hospital mortality. Singer et al.[11] found that mortality and ICU admissions doubled when ED-LOS exceeded 6 hours, particularly beyond 24 hours. Chalfin et al.[24] further reinforced this threshold-based risk by showing that patients who remained in the ED for more than 6 hours had a significantly higher in-hospital mortality rate compared to those transferred earlier (17.4% vs. 12.9%). Similarly, Jones et al.[25] identified an 8% increase in 30-day all-cause mortality in patients with ED wait times exceeding 6 to 8 hours.

In our study, patients who waited 8 hours or less in the ED had a median mortality interval of 8 days (IQR: 3-14), compared to 6 days (IQR: 3-12.5) in those who waited more than 8 hours. Although this trend suggests earlier mortality among those with longer ED stays, the difference was not statistically significant.

Singer et al.[11] also reported that hospital length of stay increased from a mean of 5.6 days (SD±11.4) in patients with ED-LOS under 2 hours to 8.7 days (SD±16.3) in those with ED-LOS exceeding 24 hours. Ashkenazi et al.[26] applied the 4-hour target in EDs and found no significant association with mortality, though they did observe a modest increase in hospital stay duration. In our cohort, the median ICU length of stay was 10.5 days (IQR: 4-17) in patients who waited 8 hours or less in the ED, and 9 days (IQR: 4-18) in those who waited longer than 8 hours. This difference was not statistically significant.

Our findings suggest that ED-LOS alone may not fully capture the risk associated with delayed ICU admission especially in a well-structured ED where critical care is initiated promptly. Factors such as illness severity, ED resource adequacy, staff experience, and real-time triage decisions likely play a mediating role. Thus, we caution against interpreting ED-LOS in isolation and advocate for a systems-based approach to improving emergency care outcomes.

Limitations

This study has several limitations that should be considered. First, it was conducted at a single tertiary care hospital in Ankara, which may limit the generalizability of the findings to other healthcare settings with different patient flow dynamics and resources. Second, the retrospective design inherently carries risks of information bias and missing data. Unmeasured variables such as illness severity scores (e.g., SOFA or APACHE II) or specific oxygenation parameters could not be included, which might have influenced both ED-LOS and mortality outcomes. Third, the study did not capture the exact duration or quality of the physical transfer process from the ED to the ICU. Lastly, the binary ED-LOS threshold (≤8 vs. >8 hours), while based on national guidelines, may not reflect the most clinically nuanced cutoff, and future prospective, multicenter studies are warranted.

CONCLUSION

Although no statistically significant association was found between ED-LOS and mortality in COVID-19 ICU patients, our study revealed a clinically meaningful trend: patients who experienced prolonged ED boarding (>8 hours) exhibited earlier mortality and shorter ICU stays, suggesting that the impact of ED-LOS on patient outcomes may not be fully captured by mortality metrics alone. These findings contribute to the evolving literature by emphasizing the importance of care quality during the ED boarding period, rather than focusing solely on transfer time thresholds. To improve outcomes in critically ill populations, we advocate for emergency care models that integrate timely ICU transfers with strengthened ED-based critical care protocols. In preparation for future pandemics and disaster scenarios, we recommend targeted investments in ED surge capacity, early activation of critical care teams, dynamic triage systems, and continuous monitoring of ED-to-ICU transfer processes. Further large-scale, multicenter studies are warranted to evaluate the effectiveness of ED interventions in mitigating risks associated with ICU admission delays.

ETHICAL DECLARATIONS

Ethics Committee Approval

Ethical approval has been obtained from the Gülhane Scientific Researches Ethics Committee of the University of Health Sciences (Date: 21.10.2021, Decision No: 2021-368).

Informed Consent

This retrospective study used pre-existing anonymized patient data. No additional intervention was performed, and there was no direct patient contact. The study was approved by the Ethics Committee, and the requirement for written informed consent was waived by the ethics committee.

Peer Review Process

This manuscript was subject to external peer review.

Conflict of Interest
The authors declare no conflicts of interest related to this study.

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Author Contributions
Concept: MGÜ; Design: MGÜ, YY; Data Collection and/or Processing: YK, DÖ; Analysis and/or Interpretation: YK, DÖ; Literature Review: MGÜ, ABT; Writing the Article: MGÜ, YY; Critical Review: YY, YK, ABT.

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Original Article

Evaluation of the Shetty test to exclude fractures in patients with ankle injury in the emergency department

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ABSTRACT

Aims: Ankle sprains are a leading cause of emergency department (ED) admissions. This study aimed to compare the diagnostic performances of the Shetty test (ST) and Ottawa Ankle Rules (OAR) in excluding fractures among patients with traumatic ankle injuries.

Methods: This prospective study included 216 patients who presented to the ED. The sensitivity, specificity, predictive values, and accuracy of both ST and OAR were calculated and compared with radiographic findings.

Results: Fractures were detected in 55 (25%) patients in the study. For the ST, the sensitivity, specificity, and accuracy were 96.4 %, 61.5%, and 70.37 %, respectively. For the OAR, the sensitivity, specificity, and accuracy were 85.5%, 16.1%, and 33.80%, respectively. ROC analysis showed a significantly higher area under the curve (AUC) for ST (0.794) than for OAR (0.638) ($p<0.001$).

Conclusion: ST demonstrated superior sensitivity and specificity compared to OAR, suggesting that it is a valid and efficient method for determining the necessity of radiography in ankle injuries.

Keywords: Shetty test, ankle injury, Ottawa Ankle Rules, emergency medicine

INTRODUCTION

Ankle sprains are the most common cause of admission to the emergency department (ED).[1] The severity of ankle injuries may range from minor ligamentous sprains to severe fractures.[2] Following a physical examination, up to 80% of patients undergo radiography. However, clinically significant bone pathology is identified in only 15-20% of these patients.[3] In other words, if radiographic examinations were performed on all patients, 80% of patients would have undergone unnecessary radiographs. A number of decision-making tools have been formulated to reduce unnecessary radiation exposure of patients, as well as the length of waiting times in the ED and the unnecessary use of ED resources.[4]

The Ottawa Ankle Rules (OAR) is the most prevalent clinical decision-making instrument utilized globally for ankle damages.[4,5] A substantial body of investigation has been performed on OAR in a range of geographical contexts, with a substantial decline in the reliance on imaging.[6-8] Although OAR remains the current gold standard for imaging decision-making, it is assumed that the necessity for imaging in ankle trauma can be further reduced with the ST.[9] Given that the ST is more straightforward to implement than other tests, it is postulated that it may be more suitable for primary healthcare institutions and ED.[4] The Shetty test (ST) was first described by Shetty et al.[9] It is performed by having the patient seated with the plantar aspect of the injured foot on the physician's palm. If the patient is unable to perform the test or experiences increased pain, the result is considered to be positive. A positive test result indicated the possibility of an ankle fracture. If the patient is able to step, the test result is negative, indicating that radiography is not indicated.

Only a few studies have investigated the effectiveness of ST in the relevant literature.[9,10] Furthermore, only two studies in the literature have compared it with OAR.[4,11] This study aimed to compare the usefulness of OAR and ST in predicting fractures in patients with ankle injury.

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METHODS

This study was conducted on patients who had sustained ankle injuries and presented at the authors' institution between 14/03/2019 and 26/08/2021. This study was approved by the Ethics Committee for Clinical Researches at Antalya Training and Research Hospital (Date: 25.07.2019, Decision No: 17/11). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki. The authors followed the applicable EQUATOR Network (https://www.equator-network.org/) guidelines during the conduct of this research project.

Patients who received pain medication, pregnant patients, patients who were uncooperative or unconscious, patients with isolated toe injuries and open fractures, patients who were admitted for a period exceeding 24 h, and patients who were unable to consent were excluded from the study.

The chart in **Figure 1** was used during patient evaluation. During the strategy, the patient's age, gender, OAR and ST results, X-ray results, and treatment outcomes were documented on the patient follow-up form. Prior to the commencement of the study, emergency physicians (EPs) underwent training in ST and OAR. Subsequently, they were tasked with recruiting patients for the study. The EP performed the OAR at the time of admission. Subsequently, the same EP administered the ST after the patient was placed on a stretcher. A radiologist subsequently analyzed the X-ray images. The patients were evaluated according to their sex, mechanism of injury, OAR Test results, ST results, and radiographic imaging results. Patients with fractures were evaluated by orthopedic surgeons and informed about their subsequent treatment plans.

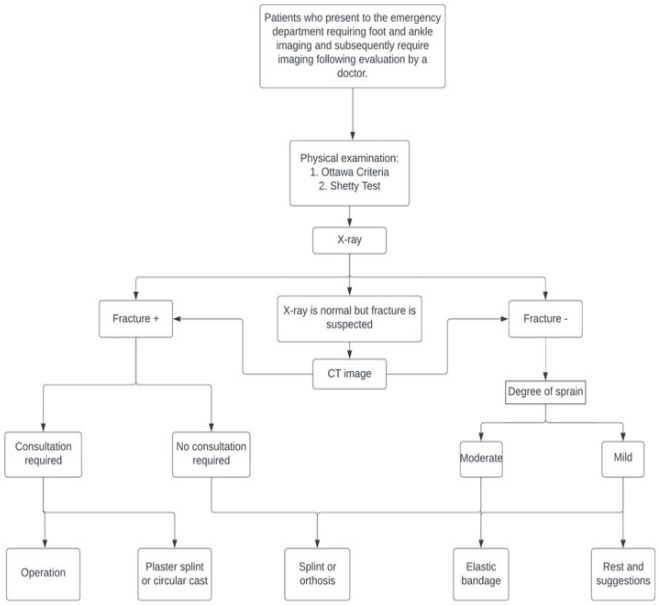

Figure 1. The patient evaluation methodology in study flowchart

According to the OAR, ankle radiographs are performed in the presence of pain on the distal 6 cm of the posterior edge of either malleolus and/or incapability to bear weight immediately after the injury or to take four steps in the ED. Foot images were obtained if there was bone tenderness at the base of the fifth metatarsal bone or over the navicular bone.[5] The ST was applied when the patients were seated with their feet unsupported and their knees flexed. The provider's hand helped the plantar aspect of the injured foot, and the patient was instructed to "push his feet down" to achieve plantar flexion at the ankle, affecting weight bearing (**Figure 2**). Should the pain level escalate or should the test not be conducted, the result will be deemed positive. Conversely, the test was considered negative if the pain level remained unchanged. Subsequently, the patient was invited to undergo an ankle radiograph to exclude the possibility of a fracture. Subsequently, the results were compared with the radiographic results.

Figure 2. Shetty test technique demonstration: The physician supports the entire foot while instructing the patient to push the foot downwards simulating "weight-bearing"

Sample Size

A power analysis was conducted to determine the required sample size. A total of 150 patients were required to achieve 80% power, a p-value of less than 0.05, and a moderate effect size. The study included 312 patients, which was 30% more than the sample size. Ninety-six patients who met the exclusion criteria were excluded, resulting in 216 patients being included in the study.

Statistical Analysis

The data collected for analysis were analyzed using SPSS (version 21). After determining the types of data, descriptive statistics for categorical data were conducted, and percentage and frequency information was presented. The Chi-square test was used to analyze categorical data. For data exhibiting a normal distribution as determined by distribution, the mean and standard deviation were used for description. The Chi-square test was employed to compare categorical data, while the t-test was used to analyze numerical data. Following the Chi-square and Fisher's exact tests, the observed comparison ratios were identified, and the McNemar test was used to analyze the strength of the tests. A p-value of less than 0.005 was considered significant for the data.

RESULTS

The study included 216 patients who met the previously described inclusion criteria. The analysis population consisted of 96 (44.4%) female and 120 (55.6%) male participants, with

a mean age of 34.17±15.46 years (range: 7-72 years). Direct trauma was the most prevalent mechanism of injury, affecting 102 individuals (47.2%), followed by inversion (38%), eversion (6.02%), plantar flexion (5.09%), and other mechanisms (3.7%). A total of 115 patients (53.2%) exhibited ST (+), 101 patients (46.8%) exhibited ST (–), 182 patients (84.3%) exhibited OAR (+), and 34 patients (15.7%) exhibited OAR (–).

In the radiographic evaluation, a fracture was identified in 55 (25%) patients, whereas no fracture was observed in 161 (75%) patients. Of the patients, 40 (72.7%) exhibited fractures in the foot zone, including the 5th metatarsal, calcaneus, navicular, cuneiform, and cuboid bones. In the ankle area, lateral malleolus fractures were identified in 11 patients (20%), medial malleolus fractures in 3 patients (5.4%), and distal tibia fractures in 1 patient (1.8%). Regarding disposition, of the 210 patients discharged from the ED, 117 received medical treatment and 93 were splinted. Six patients were admitted to the hospital and underwent a surgical intervention. **Table 1** presents the patient characteristics and clinical data.

Table 1. Demographic and clinical data of the patients

Variables		n	%
Number of patients		216	100
Age (years)		34±15.46	
Sex	Female	96	44.44
	Male	120	55.56
Mechanism of injury	Direct trauma	102	47.2
	Inversion	82	38
	Eversion	13	6.02
	Plantar flexion	11	5.09
	Other	8	3.7
OAR	Negative	34	15.7
	Positive	182	84.3
ST	Negative	101	46.8
	Positive	115	53.2
Fracture on X-ray	Negative	161	75
	Positive	55	25
Fracture type*	Tibia distal	1	1.8
	Lateral malleol	11	20
	Medial malleol	3	5.4
	Cuneiform	3	5.4
	5th metatarsal	28	50.9
	Navicular	4	7.3
	Calcaneus	3	5.4
	Cuboid	2	3.6
Treatment	Medical	117	54.2
	Splint	93	43
	Hospitalization and surgery	6	2.8

OAR: Ottawa Ankle Rules, ST: Shetty test. * Percentages in this section were calculated for 55 patients with fractures

The patients were categorized into two groups: those with and without fractures. After performing the ST and OAR, the outcomes were compared between the two groups. The ST was positive in 96.4% of patients with fractures and 38.5% of patients without fractures. Conversely, the ST was negative in 61.5% of patients without fractures and in 3.6% of patients with fractures. The differences in the ST results between the groups were statistically significant (p<0.001). Negative OAR results were found in 16.1% of patients without fractures and 14.5% of patients with fractures. The OAR positivity rate was 83.9% in the non-fracture group and 85.5% in the fracture group, with no statistically significant differences between the groups (p=0.778). Pearson Chi-square analysis indicated a statistically significant difference in patients undergoing the Shetty and Ottawa tests based on the presence or absence of radiological fractures (p<0.001) (**Table 2**).

Table 2. Distribution and comparison of patients with and without fractures

Test		Fracture (n=55)	Non-fracture (n=161)	p value
ST	Positive	53 (96.4)	62 (38.5)	<.001*
	Negative	2 (3.6)	99 (61.5)	
OAR	Positive	47 (85.5)	135 (83.9)	0.778*
	Negative	8 (14.5)	26 (16.1)	

OAR: Ottawa Ankle Rules, ST: Shetty test. *Pearson's Chi-squared test

After our analysis, the sensitivity and specificity of the two tests, along with PPV, NPV, and LR values, were determined. The ST showed a sensitivity of 96.4%, specificity of 61.5%, PPV of 46.1%, NPV of 98%, positive LR of 2.504, negative LR of 0.059, and an accuracy of 70.37% (**Figure 3**). For OAR, the sensitivity, specificity, PPV, NPV, positive LR, negative LR, and accuracy were 85.5 %, 16.1%, 25.8%, 76.5%, 1.02, 0.90, and 33.80 %, respectively (**Figure 4**).

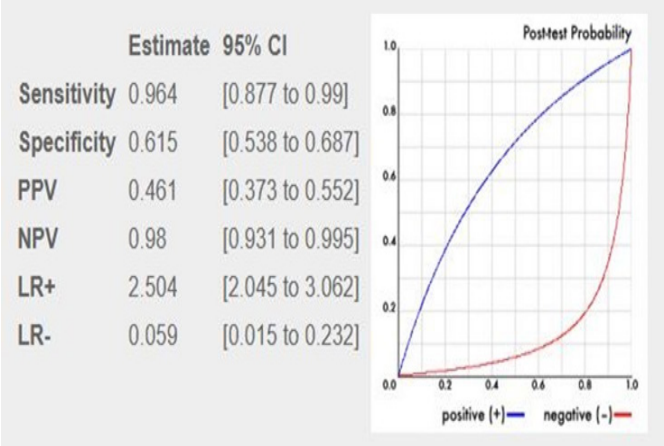

Figure 3. Sensitivity, specificity, PPV, and NPV values indicating the success of the ST in predicting the need for radiography
CI: Confidence interval, ST: Shetty test, PPV: Positive predictive value, NPV: Negative predictive value, LR+: Likelihood ratio for a positive test result, LR-: Likelihood ratio for a negative test result

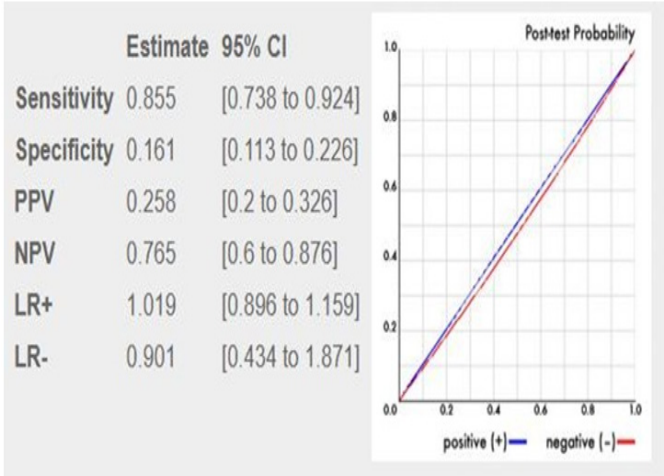

Figure 4. Sensitivity, specificity, PPV, and NPV values indicating the success of the OAR in predicting the need for radiography
CI: Confidence interval, OAR: Ottawa Ankle Rules, PPV: Positive predictive value, NPV: Negative predictive value, LR+: Likelihood ratio for a positive test result, LR-: Likelihood ratio for a negative test result

To evaluate the efficacy of the two tests, receiver operating characteristic (ROC) analysis was conducted (**Table 3**). The area under the curve (AUC) for the ST was 0.794±0.022 (95% CI, 0.750-0.838), while the AUC for the OAR test was 0.638±0.026 (95% CI, 0.586-0.690) (p<0.001).

Table 3. The ROC analysis of the tests in prediction of fracture

	AUC	SE	%95 CI	p value
Shetty	0.7946	0.02244	0.7506 to 0.8386	<0.001
OAR	0.6382	0.02666	0.5860 to 0.6905	<0.001

ROC: Receiver operating characteristics, AUC: Area under the curve, SE: Standard error, CI: Confidence interval, OAR: Ottawa Ankle Rules

DISCUSSION

Ankle sprains are common among the general population, and their treatment is a standard procedure in the ED.[12] To manage ankle sprains, clinicians utilize a combination of physical examinations and radiographic evaluations. Comprehensive palpation of the injured ankle is essential for evaluating the surrounding anatomical structures. In certain circumstances, patients are promptly transferred to the radiology department.[9] In certain instances, the presence of significant swelling may render the examination of the ankle more challenging.[13] Therefore, it is crucial to identify techniques that can be used to evaluate the necessity of radiographs.

To exclude fractures, patients have traditionally undergone plain radiography. However, clinically important fractures are observed in only 15% of cases.[14] Therefore, the primary concern at this juncture is the potential for unnecessary radiation exposure.[15] Stiell et al.[5] formed the OAR to predict the necessity of radiographs in acute ankle damage and to avoid unnecessary imaging. The OAR defines a time- and resource-saving approach that effectively prevents unnecessary radiation exposure in patients. In the ED, it is evaluated that applying these guidelines for patients with acute ankle injuries will reduce unneeded radiographs by 30-40%.[2] Nevertheless, despite their efficacy, the widespread implementation of OAR has not been successful due to the complexity of certain components of the test.[16-22]

In 2013, Vijay Shetty developed a clinical trial, designated the ST, which is straightforward to achieve, cost-effective, and minimizes the potential radiation danger.[9] Although OAR is currently the gold standard for screening before imaging, it is postulated that the ST, a simple physical examination technique, will safely reduce the need for imaging in ankle trauma.[10] Ojeda et al.[21] demonstrated that the ST is a straightforward, quick, and reproducible clinical screening tool for determining whether radiography is indicated in foot and ankle damage. In this study, the sensitivity, specificity, PPV, and NPV of ST were 100%, 95%, 71%, and 100%, respectively. In a separate study involving 50 patients with ankle injuries, the sensitivity of ST in detecting fractures was 100%, specificity was 91.4%, PPV was 42.8%, NPV was 100%, and the diagnostic accuracy of the test was 92%.[9] In our study, the sensitivity of ST in detecting fractures was 96.4%, which is similar to the findings in the literature. However, its specificity was 61.5%, which differs from that reported in the literature.

A review of the publications reveals a paucity of studies that have reached the performance of OAR and ST in patients with ankle trauma who were admitted to the ED.[4,11] In a study instructed by Ak et al.[11] demonstrated that the performance of the OAR and ST in patients with ankle trauma admitted to the ED was reached. In their study, the sensitivity of the OAR was 97.22%, specificity was 48.89%, PPV was 50.36%, NPV was 97.06%, positive LR (LR+) was 1.9, and negative LR (LR+) was 0.06. The sensitivity and specificity of ST were 51.39% and 85.93%, respectively. PPV was 66.07%, NPV was 76.82%, and the positive (LR+) and negative (LR-) likelihood ratios were 3.65 and 0.57, respectively. Therefore, owing to its high sensitivity (97.2%), the OAR can be used as a screening tool for ankle trauma. However, ST was inadequate for ruling out ankle fractures. In a study conducted by Avınca et al.[4] reported the OAR sensitivity was 85.71%, specificity was 82.61%, PPV was 60%, NPV was 95%, positive (LR-) of 4.93, negative (LR-) of 0.17, and overall accuracy was 83.33%. The sensitivity and specificity of ST were 82.86% and 77.39%, respectively. The PPV was 52.73%, NPV was 93.68%, and the positive (LR+) and negative (LR-) likelihood ratios were 3.66 and 0.22, respectively. The overall accuracy was 78.67%. Although the sensitivity of the ST and OAR resulted in similar percentages (82.86 vs. 85.71%), the specificity of the OAR was higher. The authors further suggested that a combined test method could be employed based on the findings of recent studies.

In our study, the sensitivity and specificity of ST were superior to those of OAR (96.4 vs. 85.5% and 61.5 vs. 16.1%, respectively). In our study, fractures were detected in only two of 101 patients with a negative ST, whereas fractures were detected in eight of 34 patients with a negative OAR assessment. This indicates that the NPV of ST is superior to that of OAR in ruling out fractures. A comparison between the ST and OAR informed that the ST was more useful than the OAR in detecting fractures (p<0.0001).

Limitations

It is important to consider the limitations of this study, which include the following: First, the patient population was limited to those presenting to the ED of a single hospital, which may limit the generalizability of our findings. Furthermore, all ST and OAR assessments were conducted by EPs in a single setting, which could potentially introduce bias related to the specific practices and protocols of that institution. The observation period did not include any children or toddlers. Another limitation of this study is its reliance on radiographic imaging as the definitive method for diagnosing fractures. This approach may not capture all the clinically significant injuries.

CONCLUSION

This study shows that ST exhibits higher sensitivity and specificity than OAR in predicting the necessity of radiographic imaging for patients with ankle injuries. The simplicity and ease of use of ST make it a viable option for primary healthcare settings and ED, potentially reducing unnecessary radiation exposure and optimizing resource utilization. While the ST shows promise as an effective clinical decision-making tool, further multicenter studies with larger and more diverse patient populations are necessary to confirm its generalizability and robustness of the results. Incorporating both ST and OAR into clinical practice could enhance the accuracy of ankle fracture diagnosis, thereby

improving patient outcomes and streamlining emergency care protocols.

ETHICAL DECLARATIONS

Ethics Committee Approval

This study was approved by the Ethics Committee for Clinical Researches at Antalya Training and Research Hospital (Date: 25.07.2019, Decision No: 17/11).

Informed Consent

Written informed consent was obtained from all individual participants prior to their inclusion in the study. Participants were fully informed about the study's aims, procedures, potential risks and benefits, and their rights—including the right to withdraw at any time without consequence. All participants voluntarily signed a written informed consent form.

Peer Review Process

This manuscript was subject to external peer review.

Conflict of Interest

The authors declare no conflicts of interest related to this study.

Financial Disclosure

The authors received no financial support for the conduct or publication of this research.

Author Contributions

Concept: CD, FY, ÖK; Design: CD, FY, ÖK, ÖZ; Control: CD, FY, CK; Resources: CD, FY, YFY, TAD; Materials: CD, FY, EDA; Data Collection and/or Processing: CD, FY, EDA; Analysis and/or Interpretation: FY, CK, IB; Literature Review: FY, CK, YFY; Writing the Article: CD, FY, TAD; Critical Review: FY, CK, IB, FYF.

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Case Report

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The first reported case of Fournier's gangrene presenting with penoscrotal necrosis due to *Acinetobacter baumannii* in a patient with Buerger disease

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ABSTRACT

Buerger disease (thromboangiitis obliterans) is a non-atherosclerotic inflammatory occlusive vasculopathy that predominantly affects the distal extremities of young and middle-aged male smokers. Genital involvement is extremely rare due to rich collateral circulation. Fournier's gangrene is a rapidly progressive necrotizing infection of the perineal and genital region with high mortality. We report a 66-year-old man with long-standing Buerger disease and heavy smoking history who presented with sepsis, acute urinary retention, and progressive penoscrotal necrosis. Despite broad-spectrum antibiotic therapy and multidisciplinary surgical management, including extensive debridement, glansectomy with corporo-urethral reconstruction, and subsequent partial penectomy, the disease progressed. Tissue cultures revealed *Acinetobacter baumannii* and *Escherichia coli*. Recurrent necrosis required repeated debridements, but the patient died from septic shock and multiorgan failure. This case is the first reported coexistence of Buerger disease and Fournier's gangrene leading to penoscrotal necrosis requiring partial penectomy with isolation of *Acinetobacter baumannii*.

Keywords: Thromboangiitis obliterans, Fournier's gangrene, penile disease, necrotizing fasciitis, *Acinetobacter baumannii*

INTRODUCTION

Buerger disease (thromboangiitis obliterans) is a chronic inflammatory occlusive disease of small- and medium-sized vessels, predominantly affecting young and middle-aged male smokers. It mainly involves the distal arteries of the extremities, often leading to ischemic ulcers, gangrene, and amputations.[1] Involvement of visceral or genital organs is exceedingly rare because of their rich collateral blood supply.[2]

Fournier's gangrene is a fulminant form of necrotizing fasciitis of the perineal and genital region, characterized by rapid progression, severe systemic toxicity, and high mortality. Predisposing factors include diabetes, alcoholism, malignancy, chronic renal failure, pressure ulcers, and vascular diseases.[3]

Cases of Fournier's gangrene with penile or scrotal necrosis and isolation of *Acinetobacter baumannii* have been reported in the literature.[4-7] However, cases of Buerger disease presenting with penile necrosis remain extremely rare.[8-11] To the best of our knowledge, this is the first reported case in which Buerger disease was complicated by Fournier's gangrene associated with *Acinetobacter baumannii*, resulting in penoscrotal necrosis requiring partial penectomy. This fatal case of Fournier's gangrene and penile necrosis in the setting of long-standing Buerger disease required partial penectomy and repeated debridements.

CASE

A 66-year-old man was admitted to the emergency department on 29 June 2023 with dysuria for three days, difficulty in swallowing for ten days, and pain over sacroiliac pressure ulcers. His medical history included hypertension and Buerger disease diagnosed six years earlier. Because of progressive ischemic complications, he had undergone multiple amputations: right below-knee amputation in 2018, left above-knee amputation in 2021, and right above-knee amputation in 2023. He had a heavy smoking history of approximately 50 pack-years and reported alcohol use for about ten years.

On initial evaluation in the emergency department, the patient was febrile and tachycardic, and empirical intravenous antibiotic therapy with vancomycin and meropenem were promptly initiated.

On admission, urinary ultrasonography showed no hydronephrosis; however, the bladder volume was

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approximately 1000 ml, which was consistent with acute urinary retention, and a Foley catheter was inserted.

Initial laboratory evaluation demonstrated marked systemic inflammation and cytopenias. Hemoglobin was 10.4 g/dl, hematocrit 32.4%, and platelet count 64×10^9/L, indicating anemia and thrombocytopenia. White blood cell count was 5.43×10^9/L with neutrophil predominance (85.1%). Procalcitonin was markedly elevated at >100 ng/ml, consistent with severe bacterial sepsis. Venous blood gas analysis revealed metabolic acidosis with pH 7.32, bicarbonate 16.4 mmol/L, and lactate 2.3 mmol/L. Based on admission laboratory findings together with the presence of fever and tachycardia, the Fournier Gangrene Severity Index (FGSI) score was calculated as 11.

The patient was subsequently admitted to the intensive care unit with a diagnosis of sepsis.

Antimicrobial therapy was continued with meropenem and colistin on 16 July 2023, and urology was consulted on 19 July 2023 for progressive penile discoloration and necrosis. Physical examination revealed necrotic and infected penile skin with involvement of the left hemiscrotum, and findings were compatible with Fournier's gangrene (**Figure 1**).

Figure 1. Clinical appearance of Fournier's gangrene associated with Buerger disease, showing penile, perineal, thigh, and hip necrosis (**a)** Anterior view of the penis with necrotic glans and distal shaft, **b)** Ventral view showing the same penile necrosis, **c)** Appearance of necrosis involving the perineum, proximal thigh, and gluteal area, **d)** Necrotic right hip region with tissue sloughing)

On 20 July 2023, a multidisciplinary surgical intervention involving general surgery, urology, and orthopedics was performed. General surgery first carried out extensive gluteal and perineal debridement. Because of severe perianal involvement and infected decubitus ulcers extending from the anus to the sacrum, a Hartmann colostomy was performed by the general surgery team.

The patient was then transferred to the urology team. A 16 French Foley catheter was placed. The penile skin and left hemiscrotum were necrotic and infected. The penis was degloved, and necrotic tissues of the penile shaft, left hemiscrotum, left inguinal region, and medial thigh, including Buck's fascia, were excised. Both testes were macroscopically viable. The glans penis was hard, black, and completely necrotic. Therefore, the glans was separated from the corpora cavernosa using blunt and sharp dissection and removed en bloc. The incisions of both corpora cavernosa were closed primarily with 2/0 polypropylene sutures. After spatulation of the urethral mucosa, it was everted and sutured to the corpora cavernosa and corpus spongiosum at eight points using 3/0 polyglactin 910 sutures. Thus, glansectomy with tunica albuginea approximation, corporo-urethral reconstruction, and debridement of the necrotic areas involving the left hemiscrotum, inguinal region, and medial thigh was completed (**Figure 2, 3**). The orthopedic surgery team subsequently performed right hip disarticulation because of extensive necrosis involving the thigh tissues. Histopathological examination revealed findings consistent with Fournier's gangrene.

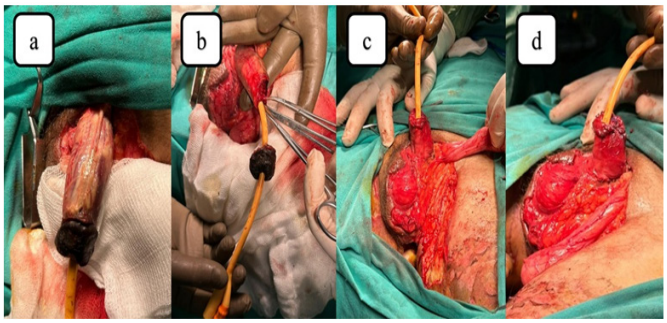

Figure 2. Intraoperative steps of the first operation showing glansectomy, corporo-urethral reconstruction, and debridement of the left hemiscrotum, left inguinal region, and medial aspect of the left thigh (**a)** Necrotic glans exposed after initial debridement, **b)** Excision of the necrotic glans, **c)** Final appearance after corporo-urethral reconstruction, ventral view, **d)** Final appearance after corporo-urethral reconstruction, lateral view)

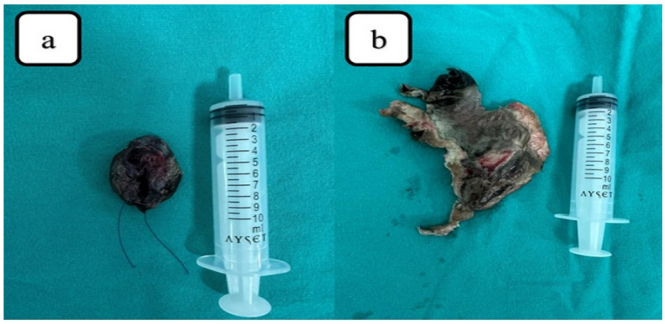

Figure 3. Macroscopic appearance of the glans and left hemiscrotum after surgical excision (**a)** Necrotic glans, **b)** Necrotic tissue from the left hemiscrotum)

Postoperatively, laboratory findings showed persistent but slightly improved septic markers. Hemoglobin decreased to 9.2 g/dl and hematocrit to 27.4%, while platelet count remained low at 62×10^9/L. White blood cell count was 5.40×10^9/L. Procalcitonin decreased but remained markedly elevated at 84.03 ng/ml. Venous lactate increased to 2.7 mmol/L. Metabolic acidosis persisted with pH 7.34 and bicarbonate 17.3 mmol/L.

On postoperative day one, the surgical sites were initially acceptable. However, by postoperative day four, progressive tissue necrosis and purulent discharge were observed at the perineal and penile wound sites, and repeat surgical debridement was required.

During the second operation, additional necrotic tissues of the penile shaft were identified and excised. Because of further ischemic involvement of the distal penile tissue, partial penectomy was performed (**Figure 4**). The urethra was again spatulated and everted to the corporal tissues to maintain a patent urethral opening. Tissue cultures obtained from the debrided necrotic areas grew *Acinetobacter baumannii* and *Escherichia coli*.

Despite repeated debridement, broad-spectrum antibiotics, and intensive supportive care, the patient's clinical condition progressively deteriorated due to septic shock and multiorgan failure. He died on 28 July 2023.

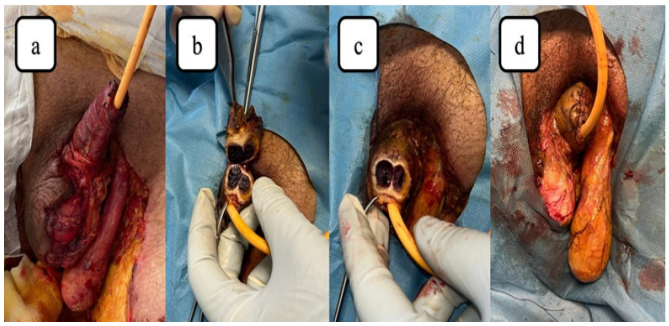

Figure 4. Intraoperative views during the second operation showing partial penectomy and corporo-urethral reconstruction (**a**) Exposed penile tissues with infected necrosis after glansectomy, showing recurrent necrosis following the first operation, **b**) Necrotic tissue and intracorporeal hematoma in the corpus cavernosum, **c**) Corpora cavernosa after partial penectomy, **d**) Final appearance after partial penectomy with tunica albuginea approximation and corporo-urethral reconstruction)

DISCUSSION

Buerger disease is strongly associated with tobacco use and typically affects the distal extremities. Genital involvement is rare because of the extensive collateral circulation of the penis. However, in advanced disease with long-standing vascular compromise, as in our patient, ischemic complications may develop in unusual sites. There is no definitive treatment for Buerger disease, and complete smoking cessation remains the most essential part of its management.[12]

Fournier's gangrene is a rapidly progressive necrotizing infection of the perineum and genital region, with reported mortality rates of around 40%.[3] Fournier's gangrene is typically a community-acquired polymicrobial infection, most commonly involving anaerobic organisms such as *Bacteroides* and *Prevotella*, gram-negative enteric bacteria including *Escherichia coli*, and gram-positive cocci; emerging pathogens such as *Candida* species and methicillin-resistant *Staphylococcus aureus* have also been increasingly reported.[13] Predisposing conditions include diabetes, chronic renal failure, malignancy, alcohol abuse, pressure ulcers, and vascular disease.[3] Poor prognosis is associated with severe sepsis, extensive disease involvement, advanced age, and high comorbidity burden. Scoring systems such as the FGSI may assist in prognostic assessment; in our patient, an FGSI score of 11 reflected a high-risk clinical profile consistent with the fatal septic course.[14] The management of Fournier's gangrene is based on early recognition, immediate initiation of broad-spectrum antibiotics, aggressive hemodynamic resuscitation, and prompt, repeated radical surgical debridement, with adjunctive supportive and reconstructive measures applied as clinically indicated.[3]

In this patient, several predisposing factors were present: severe Buerger disease with multiple amputations, heavy smoking, pressure ulcers, possible malnutrition, and systemic infection. These conditions likely facilitated both ischemic penile necrosis and the development of Fournier's gangrene. The complete necrosis of the glans required partial penectomy, which is rarely necessary in Fournier's gangrene and usually reflects advanced disease.

Penile necrosis in Buerger disease has been reported only rarely in the literature.[8-11] The strength of this case lies in reporting, to the best of our knowledge, the first documented coexistence of Buerger disease and Fournier's gangrene resulting in penile necrosis requiring partial penectomy, with *Acinetobacter baumannii* isolated from tissue cultures. The main limitation of this article is that it is based on a single case, which limits the ability to draw general conclusions or establish definitive causal relationships.

Several important lessons can be drawn from this case, as patients with advanced Buerger disease may develop ischemic complications in atypical locations including the genital region, and in such patients Fournier's gangrene can progress rapidly and become fatal despite aggressive multidisciplinary treatment. Finally, smoking cessation remains the most critical preventive strategy in Buerger disease.

CONCLUSION

Buerger disease can rarely predispose to catastrophic genital ischemia. Fournier's gangrene complicated by penile necrosis is a surgical emergency with high mortality. This case highlights that Fournier's gangrene may progress rapidly in patients with severe vascular disease, necessitating early multidisciplinary intervention. Despite prompt recognition, aggressive surgical debridement, and intensive supportive care, the prognosis remains poor in severe cases with significant comorbidities.

ETHICAL DECLARATIONS

Informed Consent

Written informed consent was obtained from the patient included in this report. Signed consent forms are retained by the authors and are available upon request.

Peer Review Process

This report underwent external peer review.

Conflict of Interest

The authors declare no conflicts of interest.

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This case report did not receive any financial support.

Author Contributions

Concept: ÇÖ, BCÖ, HÖ, MBY; Design: ÇÖ, BCÖ, HÖ, MBY; Control: ÇÖ, BCÖ, HÖ, MBY; Resources: ÇÖ, BCÖ, HÖ, MBY; Materials: ÇÖ, BCÖ, HÖ, MBY; Data Collection and/or Processing: ÇÖ, BCÖ, HÖ, MBY; Analysis and/or Interpretation: ÇÖ, HÖ, MBY; Literature Review: ÇÖ, HÖ, MBY; Writing the Article: ÇÖ, BCÖ; Critical Review: ÇÖ, BCÖ, HÖ, MBY.

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Clinical Image

DOI: 10.51271/ICJEM-0077

Neurogenic stunning myocardium: a rare clinical condition

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CASE

A 34-year-old female patient with no known chronic illness was brought to the emergency department with complaints of nausea, vomiting, and subsequent fainting. Her blood pressure was 155/90 mmHg, heart rate 130 beats per minute (bpm), and blood glucose 150 mg/dl. Bilateral pulses were palpable; there was no pulse deficit, blood pressure differential, or nuchal rigidity. Neurological examination revealed unconsciousness, isochoric pupils, and a Glasgow Coma Scale (GCS) score of 3. She was rapidly intubated. Electrocardiography (ECG) showed elevation and reciprocal depression consistent with widespread anterolateral myocardial infarction (**Figure 1**). An emergency cranial brain computed tomography (CT) was planned for the patient with a GCS score of 3. Widespread subarachnoid hemorrhage (SAH) and interventricular hemorrhage were detected (**Figure 2**). Bedside echocardiography revealed global hypokinetic areas, and a troponin level of 571 ng/L (high-sensitive troponin normal range 0-14 ng/L) suggested left main coronary artery (LMCA)+left anterior descending (LAD) occlusion. The patient was referred to the coronary angiography laboratory, but no vascular occlusion was observed. The patient was admitted to the multidisciplinary intensive care unit. Endovascular cerebral artery aneurysm treatment was performed using primary coil embolization technique. Regression consistent with SAH was observed in the bilateral frontoparietotemporal muscles, falx cerebri, Sylvian fissures, and perimesencephalic cisterns.

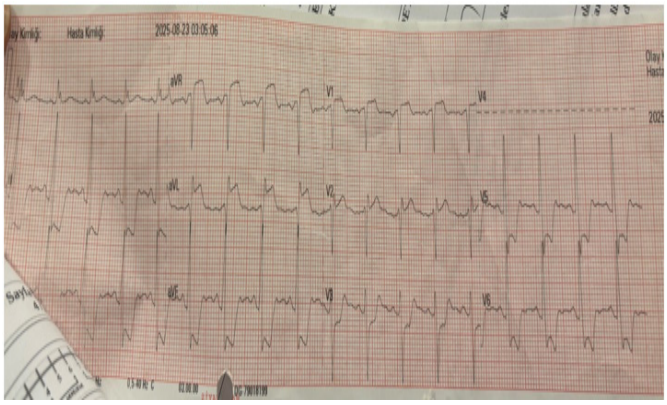

Figure 1. Electrocardiography (ECG) showed elevation and reciprocal depression

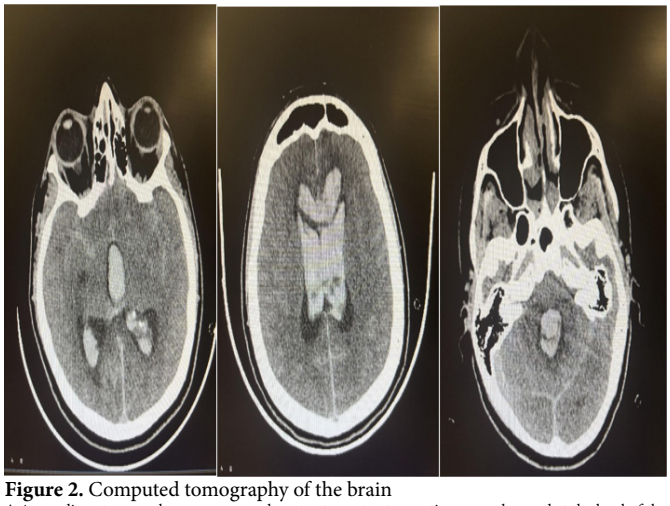

Figure 2. Computed tomography of the brain
A 4 mm diameter saccular aneurysm and contrast agent extravasation were observed at the level of the left anterior cerebral artery A3 branch. Density and dilation consistent with intraventricular hemorrhage were seen in the lateral ventricles, specifically in the 3rd and 4th ventricles. Increased density consistent with subarachnoid hemorrhage was detected in the bilateral high frontal hemispheric cortical sulci, falx cerebri, Sylvian fissures, and perimesencephalic cisterns.

Neurogenic stunned myocardial disorder (NSM) is a condition resulting from autonomic nervous system dysregulation following a neurological event such as stroke, SAH, or seizure, and can clinically manifest with any type of cardiac disorder.[1,2] Clinically, NSM can present with ventricular wall motion abnormalities and a clinical picture very similar to myocardial infarction, often with ischemic ECG changes, elevated troponin levels, and decreased cardiac function.[3,4] Cardiac intervention may sometimes be necessary to differentiate it clinically from cardiac events, as in this case.

ETHICAL DECLARATIONS

Informed Consent

Written informed consent was obtained from the patient included in this report. Signed consent forms are retained by the authors and are available upon request.

Peer Review Process

This report underwent external peer review.

Conflict of Interest

The authors declare no conflicts of interest.

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Author Contributions
Concept: AY, TS, RHG; Design: AY, TS; Data Collection and Processing: TS, RHG; Analysis and Interpretation: TS, AY; Literature Review:AY, TS; Writing the Article: AY; Critical Review: AY.

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Letter to the Editor

The importance of inflammatory indices in the early diagnosis and prognostic evaluation of patients with crush syndrome

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Keywords: Crush syndrome, Systemic Inflammation Response Index (SIRI), disaster medicine

Dear Editor,

I read with interest the paper by Kablan et al.,[1] "The importance of inflammatory indices in the early diagnosis and prognostic evaluation of patients with crush syndrome." The authors report a retrospective analysis of patients affected by the February 6, 2023 Hatay earthquake who were admitted to Ankara Etlik City Hospital between January 1 and December 31, 2023, and they evaluate the clinical usefulness of complete blood count based inflammatory indices in the diagnosis of crush syndrome.

In disaster medicine, timely triage and appropriate prioritization for close monitoring are essential in crush syndrome. However, field conditions rarely allow comprehensive and repeated laboratory testing for every patient. Having served in tent hospitals during the 1999 and 2023 earthquakes, I experienced substantial diagnostic constraints, particularly in the early hours when patient volume was high and logistics were challenging. In many cases, biochemical tests such as creatine kinase, electrolytes, and blood gas analysis could not be obtained simultaneously or repeated as needed, whereas a complete blood count was more consistently available. From this perspective, indices derived from hemogram parameters, including SII, SIRI, and PIV, are clinically relevant tools for early decision-making in resource-limited settings. The feasibility of this approach is supported by the simple calculation of SIRI (neutrophils multiplied by monocytes, divided by lymphocytes).

The most notable result is that SIRI was the only independent predictor in the multivariable logistic regression model (beta 0.2687; p 0.026; odds ratio 1.308; 95% confidence interval 1.032 to 1.660). This finding suggests that SIRI preserves discriminative value after adjustment for other variables. The ROC analysis also supports this observation, showing good diagnostic performance for SIRI (AUC 0.811; 95% confidence interval 0.720 to 0.903). The reported AUC values for SII (0.710), PIV (0.764), and NLR (0.746) indicate that SIRI performs at least comparably and, in several comparisons, better. Pairwise analyses further strengthen the message: SII showed lower discriminative ability than SIRI and PIV (SII versus SIRI p less than 0.001; SII versus PIV p 0.010), and SIRI outperformed NLR (SIRI versus NLR p 0.014).

These findings are also relevant for settings where testing is minimal. Even when biochemistry is delayed, SIRI obtained from an early complete blood count may assist decisions regarding monitoring intensity and prioritization, together with clinical assessment and variables such as entrapment duration. In addition, the authors note that studies specifically evaluating SII, SIRI, and PIV in crush syndrome are limited, and this work therefore addresses an important gap in the literature.

Limitations related to sample size, retrospective design, and the small number of deaths are important for generalizability, and the authors appropriately acknowledge these constraints. Prospective, multicenter validation that reflects disaster field realities, and direct comparisons with established multivariable scoring approaches, would further clarify the role of SIRI, particularly in scenarios where only complete blood count data are available.

In conclusion, Kablan et al. provide evidence that SIRI is a promising and practical biomarker for early diagnosis in crush syndrome, with clear relevance to the constraints frequently encountered in disaster settings. I congratulate the authors and your journal on this clinically meaningful contribution.

ETHICAL DECLARATIONS

Peer Review Process

This letter was externally peer-reviewed.

Conflict of Interest

The author declare no conflicts of interest.

Financial Disclosure

No financial support was received for the preparation or publication of this letter.

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Author Contributions

The author is solely responsible for the entirety of conception, execution, analysis, and writing of the manuscript.

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The Intercontinental Journal of
Emergency Medicine

Letter to the Editor

Author reply "The importance of inflammatory indices in the early diagnosis and prognostic evaluation of patients with crush syndrome "

Ali Kablan*[1], Emine Sarcan[1], Gamze Avcıoğlu[2], Seval Kablan[3]

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Dear Editor,

We would like to thank you for your interest in our manuscript, your careful evaluation of our study, and the constructive feedback you have provided. Highlighting the importance of easily accessible and practical biomarkers in clinical conditions such as crush syndrome—where time is critical and diagnostic resources are often limited in disaster medicine—reflects the primary objective of our study.

In our study, we aimed to evaluate the diagnostic and prognostic value of inflammatory indices derived from complete blood count parameters in patients diagnosed with crush syndrome following the February 6, 2023 Hatay earthquake. Our findings demonstrate that systemic inflammation and tissue injury were markedly increased in this patient group, and that the Systemic Inflammation Response Index (SIRI), in particular, emerged as an independent predictor in multivariate analyses. The fact that only SIRI remained statistically significant in logistic regression analysis and demonstrated good discriminative power in ROC analysis further highlights this index as a prominent prognostic marker.

Under disaster conditions, it may not always be possible to obtain biochemical tests simultaneously or repeatedly. In contrast, complete blood count results are often available at an early stage. Therefore, we believe that hemogram-based indices such as SIRI, when used in conjunction with variables such as clinical assessment and duration of entrapment, may contribute to patient monitoring and early decision-making processes.[1] In this respect, we consider that our study offers an approach that is more compatible with field realities.

The limited sample size, retrospective design, and relatively low number of mortality cases constitute important limitations in terms of generalizability. These limitations have been clearly stated in our study. Nevertheless, the limited number of studies in the literature that evaluate SII, SIRI, and PIV together and comparatively in crush syndrome increases the original value of our work.

In the future, we believe that multicenter and prospectively designed studies are needed to directly compare SIRI with existing clinical scoring systems and to more clearly elucidate its contribution, particularly in scenarios where only complete blood count data are available.

We would like to thank you once again for your valuable evaluation and for your contribution to our study.

Sincerely,

REFERENCE

1. Zhou Q, Su S, You W, Wang T, Ren T, Zhu L. Systemic Inflammation Response Index as a prognostic marker in cancer patients: a systematic review and meta-analysis of 38 cohorts. *Dose Response*. 2021;19(4): 15593258211064744. doi:10.1177/15593258211064744

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