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A Retrospective Evaluation of Cases of Necrotizing Fasciitis Presenting to the Emergency Department

Acil Servise Başvuran Nekrotizan Fasiit Olgularının Retrospektif Değerlendirmesi

Gürkan Altuntaş[1], Mümin Murat Yazıcı[1], İsmail Ataş[2], Meryem Kaçan[1], Özlem Bilir[1]

[1]*Recep Tayyip Erdoğan University Training and Research Hospital, Clinic of Emergency Medicine, Rize, Türkiye*

[2]*Rize State Hospital, Clinic of Emergency Medicine, Rize, Türkiye*

ABSTRACT

Background: This study set out to identify parameters of potential use in distinguishing soft tissue infections from necrotizing fasciitis (NF) and in predicting mortality during presentation to the emergency department.

Materials and Methods: Twenty-six patients presenting to the emergency department and diagnosed with NF were included in the study. Vital findings at presentation, laboratory, radiological, and microbiological tests, Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) score, Shock Index (SI), Systemic Inflammation Response Index (SIRI), and Systemic Immune-Inflammation Index (SII) values were calculated and recorded.

Results: Diabetes and immobilization were the principal risk factors in the 26 patients with NF, and the in-hospital mortality rate was 15.4%. Heart rate (p=0.030) and respiration rate (p<0.001) were significantly higher in the emergency department in this patient group than in the survivors, while systolic blood pressure (p=0.030) and fingertip pulse (p=0.001) oximetry values were significantly lower. The laboratory parameters of urea (p=0.030) and lactate (p=0.050) were higher in the mortal cases, while hemoglobin (p=0.030) and albumin (p=0.001) were lower. Additionally, SI values were significantly greater in the mortal group (p=0.040).

Conclusion: Personalized strategies in which predisposing factors and comorbid conditions are evaluated during admission need to be developed for early diagnosis and to prevent repeat presentations. A higher LRINEC score, low albumin, and elevated lactate are associated with increased mortality, and these clinical characteristics must be considered in patients diagnosed with NF.

Keywords: Necrotizing fasciitis, systemic inflammation response index, systemic immune-inflammation index, laboratory risk indicator for necrotizing fasciitis

ÖZ

Amaç: Bu çalışma, yumuşak doku enfeksiyonlarını, nekrotizan fasiitten (NF) ayırt etmede ve acil servise başvuru sırasında mortaliteyi öngörmede potansiyel olarak kullanılabilecek parametreleri tanımlamayı amaçlamaktadır.

Gereç ve Yöntemler: Acil servise başvuran ve NF tanısı alan 26 hasta çalışmaya dahil edildi. Başvuru anındaki vital bulgular, laboratuvar, radyolojik ve mikrobiyolojik testler, NF için Laboratuvar Risk Göstergesi (LRINEC) skoru, Şok İndeksi (SI), Sistemik İnflamasyon Yanıt İndeksi (SIRI) ve Sistemik İmmün-İnflamasyon İndeksi (SII) değerleri hesaplandı ve kaydedildi.

Bulgular: Diyabet ve immobilizasyon, NF'li 26 hastada başlıca risk faktörleriydi ve hastane içi mortalite oranı %15,4 idi. Bu hasta grubunda acil serviste kalp hızı (p=0.030) ve solunum hızı (p<0.001) sağ kalanlara göre anlamlı derecede yüksek, sistolik kan basıncı (p=0.030) ve parmak ucu nabız (p=0.001) oksimetre değerleri ise anlamlı derecede düşüktü. Laboratuvar parametrelerinden üre (p=0.030) ve laktat (p=0.050) ölümcül vakalarda daha yüksek, hemoglobin (p=0.030) ve albümin (p=0.001) ise daha düşüktü. Ek olarak, SI değerleri mortal grupta anlamlı olarak daha yüksekti (p=0.040).

Sonuç: Erken tanı ve tekrarlayan başvuruların önlenmesi için, yatış sırasında predispozan faktörlerin ve komorbid durumların değerlendirildiği kişiselleştirilmiş stratejilerin geliştirilmesi gerekmektedir. Yüksek LRINEC skoru, düşük albümin ve yüksek laktat artmış mortalite ile ilişkilidir ve bu klinik özellikler NF tanısı alan hastalarda göz önünde bulundurulmalıdır

Anahtar Kelimeler: Nekrotizan fasiit, sistemik inflamasyon yanıt indeksi, sistemik immün-inflamasyon indeksi, nekrotizan fasiit için laboratuvar risk göstergesi

Address for Correspondence: Mümin Murat Yazıcı, Recep Tayyip Erdoğan University Training and Research Hospital, Clinic of Emergency Medicine, Rize, Türkiye
E-mail: mmuratyazici53@gmail.com **ORCID ID:** orcid.org/0000-0003-1957-7283
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Introduction

Necrotizing fasciitis (NF) is a rare but potentially fatal disease characterized by widespread necrosis of subcutaneous tissue extending along the fascia. Mortality rates exhibit societal variations but can be as high as 100% if left untreated, despite advances in medical care services (1). A traumatic lesion on the surface of the body or a complicated intra-abdominal infection is frequently involved in the etiology. The spread of infection and necrosis depends on the specific characteristics of the host and pathogenic bacteria. NF is classified into four types depending on microbiological findings. The most common form is the polymicrobial type (Type 1) seen in individuals with comorbid diseases, such as diabetes. Two or more pathogens are involved in this manifestation, and the most common sites are the perineum and the trunk (2). Early diagnosis is essential if mortality is to be prevented. The most frequent symptoms are local pain, swelling, and edema associated with the development of infection. However, critical manifestations such as sepsis and multiorgan failure can also be encountered following rapid progression of necrosis. Pain is particularly disproportionate to clinical findings. Patients require rapid and aggressive treatments, including antibiotherapy, surgical debridement, and intensive care management (3).

The clinical manifestation is the most important factor in diagnosis (4). Although laboratory results are not specific, the use of various scoring systems and biomarkers is recommended for early diagnosis and for classifying the disease according to risk categories (5-7). Based on the conclusion that oxidative stress and inflammation cause changes in erythrocyte and platelet functions, laboratory parameters such as red blood cell distribution width (RDW), platelet count (PC), and mean platelet volume have been employed in diagnosis (8-10). The Systemic Inflammation Response Index (SIRI) and Systemic Immune-Inflammation Index (SII), indicators of systemic inflammation and cellular immunity, can also serve as useful guides. However, studies involving biochemical markers and scoring systems, employed in differential diagnosis, have largely focused on indications for surgery and for predicting admission to the intensive care unit (ICU), rather than for diagnosis. The purpose of the present study was to identify effective parameters in the evaluation of early diagnosis and prognosis, capable of distinguishing NF from soft tissue infections, by determining characteristics of the process commencing from admission to the emergency department.

Materials and Methods

Study Design

This study represents a retrospective examination of patients diagnosed with NF in the emergency department of a tertiary hospital between January 2019 and December 2023. Local ethical approval was obtained from the Recep Tayyip Erdoğan University Non-Interventional Clinical Research Ethics Committee prior to commencement (approval number: 2024/216, dated: 15.08.2024).

The local computer-based Hospital Information Management System (HIMS), in which patients' records are kept, was used during the collection of clinical and radiological data. Patients younger than 18 years of age, those with a history of chronic kidney disease, known pressure ulcers due to compression or immobilization, or incomplete clinical or radiological data were excluded. The study included twenty-six patients diagnosed with NF in the emergency department and admitted, depending on their clinical condition, to any clinic or to the ICU for follow-up and treatment.

Clinical Parameters

The medical records of the patients diagnosed with NF in the emergency department were examined retrospectively. Using a standardized data collection page, clinical data (age, sex, comorbid diseases, systolic/diastolic blood pressures, heart rate, body temperature, presentation symptoms, examination findings, and treatments administered), laboratory data (complete blood count, biochemistry, and blood gas parameters), radiological findings, pathological and microbiological parameters, and hospital outcome were recorded. The HMIS was used to determine any emergency department or clinic presentation due to a symptom that might be associated with NF prior to diagnosis. The laboratory risk indicator for necrotizing fasciitis (LRINEC) score (11), Shock Index (SI), Modified SI (MSI), SIRI, and SII values were calculated and recorded. The cut-off value of parameters such as SII and SIRI, which have recently been frequently evaluated as predictors of mortality in many diseases, could not be calculated due to data limitations. However, the values obtained in the living and deceased patients' groups were compared.

Patients receive fluid resuscitation depending on their clinical conditions, during presentation to the emergency department. However, vasopressor therapy is applied in case of presentation with septic shock and/or lack of response to the fluid administered. Broad-spectrum antibiotherapy is initiated while awaiting the culture sensitivity test results.

Patients are treated and followed up in the ICU or other clinics, depending on their clinical condition. In addition, a stoma is created to prevent fecal wound contamination in conjunction with wide surgical debridement of necrotic tissue. The treatment received by patients with NF in the emergency department, the areas in the hospital where they were followed up as inpatients, whether or not surgical treatment was applied, and the length of hospital stay were also recorded. In addition, 6-month, and 1-year mortality rates of the patients were recorded. For this purpose, the status of the patients was inquired by calling the patients' telephone numbers registered on the HIS, and in case of death, the information about when the patient died was confirmed from his/her relatives.

Statistical Analysis

All statistical analyses were performed using Jamovi v.1.6 software (Jamovi Project Computer Software, version 1.6. Sydney, Australia). A 5% significance level for Type 1 errors was used in all analyses. Depending on the normality status, continuous variables were expressed as mean and standard deviation (SD) or median and interquartile ranges (IQR). The Shapiro-Wilk test and Q-Q plots were applied to evaluate whether data were normally distributed. Categorical data were presented as frequency (n) and percentage (%). Comparisons of continuous variables were performed using the Mann-Whitney U test for non-normally distributed groups.

Results

Twenty-six patients diagnosed with NF in the emergency department between January 2019 and December 2023 were included in the data analysis. All the patients' are shown in Table 1. The patients' mean age was 62.5±13.8 (37-92) years, and 69.2% (n=18) were men. Primary infection

Table 1. The patients' demographic data and baseline characteristics

Characteristics, n=26	Value
Gender (male), n (%)	18 (69.2)
Age (years), mean ± SD (minimum-maximum)	62.5±13.8 (37-92)
Comorbidities	
Hypertension, n (%)	14 (53.8)
diabetes, n (%)	20 (76.9)
stroke, n (%)	3 (11.5)
neoplasia, n (%)	6 (23.1)
Predisposing factor	
Immobility, n (%)	7 (26.9)
operation, n (%)	6 (23.1)
obesity, n (%)	3 (11.5)
Presentation symptom	
Testicular pain-swelling, n (%)	7 (26.9)
lesion in the gluteal region, n (%)	6 (23.1)
rash-pain in the suprapubic region, n (%)	4 (15.4)
rash-pain in the lower extremity, n (%)	3 (11.5)
Lesion site	
Gluteal region, n (%)	7 (26.9)
scrotum-perineum, n (%)	4 (15.4)
suprapubic region, n (%)	4 (15.4)
lower extremity, n (%)	4 (15.4)
Lesion appearance	
Erythema, n (%)	15 (57.7)
necrosis, n (%)	8 (30.8)
Physical examination findings	
Rash-tenderness in the gluteal region, n (%)	7 (26.9)
rash-tenderness in the scrotum t, n (%)	6 (23.1)
rash-edema in the suprapubic region, n (%)	5 (19.2)
rash-crepitation-tenderness in the leg, n (%)	4 (15.4)
Vital Signs	
Systolic blood pressure (mmHg), median (IQR)	120 (116-130)
diastolic blood pressure (mmHg), median (IQR)	70 (60.3-80)
pulse rate (min), median (IQR)	95.5 (83.3-104)
temperature (0C), median (IQR)	36.6 (36.4-37.2)
Length of stay in the ED (minute), median (IQR)	194 (138-347)
Time from Hospitalisation to Surgery (hour), median (IQR)	2.3 (1.0-32.8)
Blood culture positivity, n (%)	4 (15.4)

IQR: Interquartile range (25p, 75p), SD: Standard deviation, ED: Emergency department

was commonly located in the gluteal region (26.9%), and immobilization was the most frequent predisposing factor in these patients.

The results of laboratory tests during presentation to the emergency department are given in Table 2. Median values for disease risk indicators and their association with mortality are shown in Table 3. Statistical analyses of vital signs are presented in Table 4. All patients with preliminary diagnoses of NF on the basis of history, physical examination, and laboratory tests were started on prophylactic antibiotics in the emergency department, and two received vasopressor therapy due to instability. Edema and swelling in the scrotum, were observed at bedside ultrasound (USG) in three patients (11.5%). Edema and gas were observed in 65.3% (n=17) of the patients between soft tissues in the scrotum, gluteal region, and abdominal anterior wall at the computed tomography.

A total of 80.8% of the patients were transferred from the emergency department to the clinic for surgical procedures, and 19.2% were admitted to the ICU. The median length of hospital stay was 22 days (IQR: 15.3-33.8). Repeated presentations to hospital due to soft tissue infection occurred in all cases, and all patients underwent surgical debridement after admission. Pathological evaluation of the lesion site revealed suppurative inflammation and necrosis in 46.2% of the samples. The most common agent at microbiological analysis was *Escherichia coli* at 23.1% and coagulase-negative Staphylococcus infection at 19.2%.

The in-hospital mortality rate was 15.4% (n=4), six-month mortality was 23.1% (n=6), and one-year mortality was 34.6% (n=9). Heart rate (survivor group median value 88 (IQR: 78-97), non-survivor group median value 99 (IQR: 93-110), p=0.030) and respiration rate (survivor group median value 16 (IQR: 16-20), non-survivor group median value 20 (IQR: 19-25), p<0.001) in the emergency department were significantly higher in this patient group than in the survivors; while SBP (survivor group median value 120 (IQR: 120-130), non-survivor group median value 110 (IQR: 100-120), p=0.030) and fingertip pulse oximetry values (survivor group median value 95 (IQR: 93-96), non-survivor group median value 90 (IQR: 89-93), p=0.001) were significantly lower in the non-survivor group. Statistical analyses of vital signs are presented in Table 4. Urea (survivor group median value 41 (IQR: 29.8-85.3), non-survivor group median value 111 (IQR: 86.8-133), p=0.030) and lactate (survivor group median value 1.9 (IQR: 1.4-2.5), non-survivor group median value 3.0 (IQR: 2.6-3.9), p=0.050) values were higher in the mortal cases, while hemoglobin (survivor group median

Table 2. The patients' laboratory findings

Parameter	Value
Hemoglobin (g/dL), median (IQR)	11.3 (9.3-12.6)
Leukocyte (10^3/μL), median (IQR)	15.5 (13.8-18.5)
Neutrophil (10^3/μL), median (IQR)	13.6 (11.1-16.5)
Lymphocyte (10^3/μL), median (IQR)	1.10 (0.8-1.66)
Platelet (10^3/μL), median (IQR)	335 (224-386)
RDW (fL), median (IQR)	44.7 (41.2-47.8)
MPV (fL), median (IQR)	9.30 (8.70-10.4)
PDW (fL), median (IQR)	16.1 (15.8-16.3)
Urea (mg/dL), median (IQR)	53 (32-90)
Albumin, (g/dL), median (IQR)	27 (23.9-30.5)
Sodium (mmol/L), median (IQR)	133 (127-135)
Lactate (mmol/L), median (IQR)	1.95 (1.52-2.75)

IQR: Interquartile Range (25p, 75p), RDW: Red blood cell distribution width, MPV: Mean platelet volume, PDW: Platelet distribution width

Table 3. Factors associated with mortality

Factors	Surviving group	Non-surviving group*	p
LRINEC, median (IQR)	7.50 (6-9)	7.50 (7-8)	0.970
SI, median (IQR)	0.7 (0.6-0.8)	0.85 (0.8-1.1)	**0.040**
MSI, median (IQR)	1.0 (0.9-1.2)	1.3 (1.3-1.6)	0.100
SIRI, median (IQR)	7.3 (4.5-13.2)	6.4 (5.4-10.8)	0.970
SII, median (IQR)	2565 (1581-4449)	4996 (3918-8493)	0.130
Urea (mg/dL), median (IQR)	41.0 (29.8-85.3)	111 (86.8-133)	**0.030**
Albumin, (g/mL), median (IQR)	27.5 (25.3-32.5)	21.0 (21.0-22.3)	**0.008**
Lactate (mmol/L), median (IQR)	1.9 (1.4-2.5)	3.0 (2.6-3.9)	0.050
Hemoglobin (g/dL), median (IQR)	11.7 (9.9-12.8)	9.0 (8.0-10.1)	**0.030**

*: In hospital. The Mann-Whitney U test was used for statistical analysis.
IQR: Interquartile Range (25p, 75p), LRINEC: Laboratory risk indicator for necrotizing fasciitis, SI: Shock Index, MSI: Modified Shock Index, SIRI: Systemic Inflammation Response Index, SII: Systemic Immune-Inflammation Index

Table 4. Relationship of vital signs between surviving and non-surviving groups

Vital signs	Surviving group	Non-surviving group*	p
SBP (mmHg), median (IQR)	120 (120-130)	110 (100-120)	**0.030**
DBP (mmHg), median (IQR)	75 (70-80)	70 (60-70)	0.135
Heart Rate (/min), median (IQR)	88 (78-97)	99 (93-110)	**0.030**
RR (min), median (IQR)	16 (16-20)	20 (19-25)	**0.001**
Fingertip pulse (%), median (IQR)	95 (93-96)	90 (89-93)	**0.001**
Fever (0C), median (IQR)	36.6 (36.5-36.9)	36.8 (36.4-37.3)	0.773

*: In hospital. The Mann-Whitney U test was used for statistical analysis.
IQR: Interquartile Range (25p, 75p), SBP: Systolic blood pressure, DBP: Diastolic blood pressure, RR: Respiratory rate

value 11.7 (IQR: 9.9-12.8), non-survivor group median value 9.0 (IQR: 8.0-10.1), p=0.030) and albumin (survivor group median value 27.5 (IQR: 25.3-32.5), non-survivor group median value 21.0 (IQR: 21.0-22.3), p=0.001) were lower. The SI was also significantly higher in this patient group (survivor group: median value 0.7, IQR: 0.6-0.8; non-survivor group: median value 0.85, IQR: 0.8-1.1; p=0.040) (Table 3).

Discussion

In this Retrospective study of 26 cases of community-acquired NF, low albumin and elevation in lactate values were more closely associated with mortality than the other laboratory data. In their multicenter study from 2019, Madsen et al. (12) also observed that an increased lactate value was correlated with mortality. In addition, while high SI on admission was associated with mortality, fever, one of the classic symptoms of infection, was not present in the majority of patients, in agreement with most studies in the literature (13,14).

NF is a life-threatening condition that is frequently diagnosed late or incorrectly due to the absence of typical symptoms. It is important to distinguish NF from soft tissue infection by determining patients' debridement needs and addressing potential poor outcomes in the emergency department (4). All our patients presented to the hospital repeatedly due to current symptoms, but superficial infections were also observed to have progressed to NF due to inappropriate treatment. To evaluate predisposing factors and comorbid conditions, in particular, the development of personalized strategies is necessary. While the incidence of NF in immobile and diabetic individuals was noteworthy in this research, this is inconsistent with some previous studies (12,15) and may derive from societal variations. Considering all these reasons, it is important to plan frequent visits, and follow-up through home care services for patients with predisposing factors such as immobility and comorbid diseases. These patients often present to the emergency department due to soft tissue infection. In addition, patients who apply as outpatients should be followed up closely.

Although pain and rash in the lesion site are common characteristics, these are not specific. Scoring systems such as LRINEC and changes in laboratory parameters caused by inflammation are therefore modalities capable of assisting early diagnosis and predicting outcomes (5,10,16). Similarly, in the present study, LRINEC scores of 6 or above during emergency department presentations were found to be predictive, and all cases were started on antibiotic therapy. SIRI and SII, which have become important inflammatory indicators in recent years (17), also increased in this patient group. However, due to the limited nature of the data, we were unable to evaluate whether they can be employed as a prognostic factor. Mean Platelet Volume (MPV), platelet distribution width (PDW), RDW, neutrophil to lymphocyte ratio (NLR), and platelet to lymphocyte ratio (PLR) employed as markers of oxidative stress and inflammation were of no significance in terms of diagnosis or outcomes compared with the previous literature (10,18,19).

Imaging techniques used in combination with clinical suspicion can serve as a useful guide in the differentiation of soft tissue infections. Appearances of gas at CT, in addition to USG which is frequently employed in the emergency department since it can be used at the bedside, can prevent delays in treatment and false diagnoses. The visualization of gas between soft tissues in 65.3% of the present cases was a useful guide. Although all patients received surgical treatment, suppurative inflammation and necrosis were encountered in only 46.2% at pathological investigation. In agreement with the previous literature, the most common agents at microbiological analysis were *Escherichia coli* and coagulase-negative Staphylococci (12,20).

General mortality rates for the disease vary in the literature. This has been attributed to variations in age, underlying comorbid diseases, and the timing of antibiotherapy and surgical intervention (21,22). Consistent with a previous study, the mortality rate in the present study was 15.4%.

If NF is suspected or diagnosed, surgical debridement and exfoliation of the affected tissue should be performed

immediately (23). Especially in terms of survival, continuing debridement in the early period until healthy tissue is reached, broad-spectrum antibiotic treatment, aggressive fluid resuscitation, and follow-up in the ICU are important factors (24). In our study, the median hospitalisation time was 194 minutes and the median time from hospitalisation to surgery was 2.3 hours. These durations are valuable for NF, where speed in diagnosis and treatment is important. In studies with a larger number of cases, comparison of these times may be valuable, for determining the importance of time in the follow-up and treatment of NF.

There are several limitations of this study. Firstly, the retrospective study design makes it impossible to access much data. Another important limitation is that no sample calculation was made for the study. This may have been because the study was planned as a single-centre study with a limited sample, and this may have prevented obtaining definite findings. Due to the limited sample, cut-off values were not determined for scores that previously lacked a cut-off value. Furthermore, extensive studies are now needed on the subject.

Conclusion

In conclusion, due to the absence of typical symptoms and the risk of false diagnoses, determining risk factors is critical for managing this disease with high mortality rates. The use of laboratory parameters such as albumin and lactate, together with primary markers of infection and predisposing factors, should be considered in diagnosis in the emergency department and mortality.

Ethics

Ethics Committee Approval: Local ethical approval was obtained from the Recep Tayyip Erdoğan University Non-Interventional Clinical Research Ethics Committee prior to commencement (approval number: 2024/216, dated: 15.08.2024).

Informed Consent: Retrospective study.

Footnotes

Authorship Contributions

Concept: İ.A., M.K., Ö.B., Design: G.A., M.M.Y., Data Collection or Processing: G.A., M.M.Y., Ö.B., Analysis or Interpretation: M.M.Y., Literature Search: İ.A., M.K., Ö.B., Writing: G.A., Ö.B.

Conflict of Interest: No conflict of interest was declared by the authors.

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