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Original Article Emergency Medicine

Predicting mortality in necrotizing fasciitis: Retrospective evaluation of 69 cases

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ABSTRACT

OBJECTIVE: Necrotizing fasciitis (NF) is a severe and potentially life-threatening soft tissue infection characterized by rapid necrosis, primarily affecting the fascia and deep soft tissues. Despite its low incidence, NF poses significant challenges due to its aggressive nature and high mortality rates. This retrospective study aimed to assess clinical characteristics and prognostic factors influencing mortality rates among patients diagnosed with NF at a tertiary care facility.

METHODS: Patients diagnosed with NF at the emergency department of tertiary care hospital in Turkiye between August 1, 2017, and July 31, 2023, were included in the study. Demographic data, clinical features, underlying factors, laboratory findings, and outcomes were reviewed.

RESULTS: A total of 69 adult patients were included in the study. Among cases, 51 survived (73.5%) and 18 died (26.5%). There were 43 males (62.3%) and 26 females (37.7%) with a mean age of 55.8±16.1 years. The most common symptoms were pain/tenderness (84.1%), erythema (75.4%), local swelling (72.5%), and crepitus (44.9%). Diabetes mellitus, lower systolic blood pressure, higher pulse rates, elevated white blood cell counts, and polymicrobial infections were associated with poor outcomes ($p<0.001$, $p=0.020$, $p<0.001$, $p=0.016$, and $p<0.001$, respectively).

CONCLUSION: NF is a rare surgical emergency. Early diagnosis, prompt intervention, and multidisciplinary management are crucial in mitigating NF's devastating consequences. Recognizing poor prognosis factors in patients can guide their management.

Keywords: Emergency surgery; mortality; necrotizing fasciitis; prognosis; radiologic diagnostic performance.

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Necrotizing fasciitis (NF) represents severe and potentially life-threatening infections characterized by rapid tissue necrosis primarily affecting the fascia and deep soft tissues [1, 2]. The annual incidence of NF ranges from 0.3 to 15.5 cases per 100,000 globally [1, 3, 4]. While uncommon, these infections pose significant challenges due to their aggressive nature, often leading to systemic toxicity and high mortality rates [5, 6]. NF predominantly targets the extremities and genitourinary region but can affect any body part [6]. Predisposing factors such as diabetes mellitus, liver cirrhosis, and immunocompromised states heighten the risk of infection, emphasizing the importance of early recognition and intervention [1].

The diagnosis of NF relies heavily on clinical assessment, with typical features including erythema, warmth, and severe pain disproportionate to the wound size. However, accurate diagnosis may be challenging; it may require a combined evaluation of detailed patient history, predisposing factors, clinical conditions, physical examination findings, and laboratory results to aid in early identification [1, 5, 6].

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Despite advances in diagnostic approaches and treatment methods, including broad-spectrum antibiotics and surgical debridement, the mortality of NF has been over 20% in many reports [7]. Also, delayed diagnosis and treatment contribute to adverse outcomes, highlighting the need to understand prognostic indicators and mortality-associated risk factors better [1, 7]. This study aimed to assess clinical characteristics and delineate prognostic factors impacting mortality rates in this rare surgical emergency. It aims to improve clinical practice and patient care in managing NF.

Highlight key points

- The overall mortality rate among necrotizing fasciitis (NF) patients was 26.5% (18 of 69 cases).
- Most patients presented with pain (84.1%), erythema (75.4%), and local swelling (72.5%), which are key clinical signs for early recognition of NF.
- Among imaging modalities, CT (86.5%) and ultrasound (80.8%) had the highest sensitivity in supporting the diagnosis of NF.
- Diabetes mellitus, lower systolic blood pressure, higher heart rate, elevated WBC count, and polymicrobial infections were significantly associated with mortality.

MATERIALS AND METHODS

Study Settings

We retrospectively reviewed all adult (>18 years) necrotizing fasciitis cases diagnosed at the Emergency Department of Bolu Izzet Baysal Training and Research Hospital between August 1, 2017, and July 31, 2023. The hospital is a tertiary education and research hospital with an annual volume of approximately 180,000 adult patient presentations to ED. Bolu Abant Izzet Baysal University Clinical Research Ethics Committee approved the study protocol (protocol number: 2023/258, dated: 22.08.2023), and the Declaration of Helsinki was complied with throughout the study.

Patient records were accessed through the hospital information operating system and patient files in the hospital archive. Patients who were clinically diagnosed with NF by ED physicians and consulted with surgical departments and infectious diseases were analyzed. Surgical findings (fascia that does not adhere to the adjacent layer, presence of necrotic fascia, and foul-smelling discharge) and histopathological results (typically shows infiltration of neutrophils and bacterial clusters between collagen bundles with focal necrosis) were used to confirm the diagnosis of NF. Autopsy results of patients who were clinically diagnosed with NF but died in the ED before they could go to surgery were analyzed in this sense and included (n=2). Patients with better clinical conditions were followed closely with antibiotherapy and did not undergo surgery but were followed up by infectious diseases and surgery departments with the diagnosis of NF were also included (n=3) in the study. Demographic data, clinical features, underlying factors, location of the infection, duration of symptoms, comorbidities, microbiological, laboratory, and radiological findings, and outcomes were analyzed.

Table 1. Characteristics and outcomes of necrotizing fasciitis patients eligible for the study (n=69)

Characteristics	(%)
Age (years), mean±SD	55.8±16.1
Male, (%)	62.3
Symptoms, (%)	
Pain/tenderness	84.1
Erythema	75.4
Local swelling	72.5
Crepitus	44.9
Purulent discharge	40.6
Time from onset of symptoms to emergency visit (days), median (IQR)	3 (2–5)
Predisposing process, (%)	
Trauma	15.9
Injection	7.2
Other medical procedures	11.6
Undefined etiology	65.2
Outcome, (%)	
Ward admission	62.3
ICU admission	31.9
Death in ED	5.8
Mortality, (%)	26.1

ICU: Intensive care unit; IQR: Interquartile range; n: Number; SD: Standard deviation.

Statistical Analysis

The SPSS (IBM Statistical Package for Social Sciences) for Windows 23.0 (Armonk, New York: IBM Corp.) and R program (Vienna, Austria: The R Foundation)

TABLE 2. Comparisons of the baseline characteristics according to survival

Characteristics, (%, column percentages)	Total (n=69)	Survival (n=51)	Non-survival (n=18)	p
Age (years), mean±SD	55.8±16.1	54.1±16.9	60.6±13.0	0.140*
Male, (%)	62.3	62.7	61.1	0.902#
Diabetes mellitus	55.1	43.1	88.9	**0.001**#
Hypertension, (%)	33.3	29.4	44.4	0.245
Site of infection, (%)				0.831#
Genitourinary	37.7	37.3	38.9	
Extremities	33.3	31.4	38.9	
Gluteal region	11.6	5.9	11.1	
Head and neck	8.7	13.7	5.6	
Abdomen	7.2	9.8	5.6	
Thorax	1.4	2.0	0.0	
Time from onset of symptoms to emergency visit (days), median (IQR)	3.0 (2.0–5.5)	3.0 (1.0–7.0)	4.0 (2.8–10.0)	0.813**
Symptoms, (%)				
Pain/tenderness	84.1	82.4	88.9	0.715+
Erythema	75.4	78.4	66.7	0351+
Swelling/edema	72.5	76.5	61.1	0.232+
Crepitus	44.9	41.2	55.6	0.292#
Purulent discharge	40.6	45.1	27.8	0.198#

IQR: Interquartile range; *: Student-t test; **: Mann Whitney U; #: Pearson chi-square; +: Fisher's exact test.

were used for statistical analysis. Shapiro-Wilk test was used to evaluate the distribution of data. Categorical variables are presented as numbers with percentages, and numerical variables as medians with interquartile ranges. For comparisons between groups, the chi-squared test was used for categorical variables, and the Mann–Whitney U test was used for numerical variables. Statistical significance was set at $p<0.05$.

RESULTS

During the period analyzed by the study, 69 patients were diagnosed with NF in the ED. The patients' mean (SD) age was 55.8±16.1 years, and 62.3% (n=43) were male. The main characteristics of the patients are given in Table 1.

The median (IQR) time for the onset of the patient's complaints was 3 (2–5) days, and a significant event preceded the complaints of 24 patients. Eleven of these were trauma-related, 5 were injections into the area, and 8 were other medical procedures (cryotherapy, birth, dental interventions, biopsy, abscess drainage) (Table 1).

Of the 69 patients, 18 (26.5%) died and 51 (73.5%) survived. Baseline comparisons between surviving and non-surviving patients with NF are shown in Table 2. Diabetes mellitus was seen more frequently in patients who resulted in mortality (88.9%) than in surviving patients (43.1%) ($p<0.001$, Pearson chi-square). No difference was detected in terms of other parameters (Table 2).

When the admission vitals of the patients were examined, the systolic blood pressures of the patients who resulted in mortality (97.7±30.8) were lower than the patients who survived (117.0±16.5) ($p=0.020$, Student-t test). Initial pulse rates were higher in patients who resulted in mortality (111.6±20.0) than in surviving patients (88.7±20.6) ($p<0.001$, Student-t Test). When the culture results were examined, polymicrobial organisms were more common in patients who resulted in mortality ($p<0.001$, Pearson chi-square) (Table 3). Microorganisms grown in culture are summarized in Table 4.

Direct radiography examination was performed on 19 patients, and 9 had findings in favor of NF. There were findings favoring NF in 21 of 26 patients evaluated by ul-

Table 3. Comparisons of initial vitals, laboratory and culture results according to survival

Variable, median (IQR)	Total (n=69)	Survival (n=51)	Non-survival (n=18)	p
Initial vitals				
Systolic BP (mmHg)	112±22.6	117.0±16.5	97.7±30.8	**0.020***
Diastolic BP (mmHg)	66.3±14.8	68.2±11.4	61.1±21.5	0.083*
Pulse	94.7±22.7	88.7±20.6	111.6±20.0	**<0.001***
Fever (celsius)	37.4±0.7	37.4±0.7	37.6±0.9	0.371*
White blood cell (/mcL)	19569±9573	17940±8751	24186±10529	**0.016***
C-reactive protein, mg/L	206.0±111.3	193.5±99.7	241.4±136.2	0.118*
Culture results, (%)[&]				**<0.001[#]**
Monomicrobial	54.5	64.7	20.0	
Polymicrobial	25.8	13.7	66.7	
No organysm identified	19.7	21.6	13.3	

BP: Blood pressure; IQR: Interquartiller range; *: Student-t Test; **: Mann-Whitney U; #: Pearson Chi-Square; +: Fisher's Exact Test. &: Culture was not performed in three patients, the evaluation is based on 66 patients.

Table 4. Microorganisms grown in culture

Microorganism, (%, column percentages)	Total (n=66)	Survival (n=51)	Non-survival (n=15)
Acinetobacter species	4.5	2.0	13.3
Aeromonas hydrophila	7.6	3.9	20.0
Bacteroides fragilis	3.0	2.0	6.7
Enterobacter species	10.6	11.8	6.7
Enterococcus	13.6	13.7	13.3
Escherichia coli	13.6	13.7	13.3
Group A *Streptococcus*	12.1	9.8	20.0
Group B *Streptococcus*	1.5	2.0	0.0
Klebsiella pneumonia	7.6	5.9	13.3
MRSA	12.1	11.8	13.3
MSSA	13.6	13.7	13.3
Proteus mirabilis	10.6	11.8	6.7
Pseudomonas aeruginosa	6.0	5.9	6.7
Serratia marcescens	4.5	3.9	6.7
Vibrio vulnificus	1.5	0.0	6.7

MRSA: Methicillin- resistant *Staphylococcus aureus*; MSSA: Methicillin-sensitive *Staphylococcus aureus*. Since culture test was not performed in three patients, the analysis included 66 patients.

trasonography, 32 of 37 patients assessed by tomography, and 4 of 5 patients evaluated by MRI. The sensitivity of radiography, ultrasonography, CT, and MRI to assist in diagnosing NF is 47.4, 80.8, 86.5, and 80.0, respectively.

All patients received empirical antibiotic therapy, and 92.3% (n=60) underwent surgical intervention.

Four patients died in a very short time in the ED. Since these patients did not have enough time to be evaluated for surgery or transferred to the ward/intensive care unit, they were excluded from admission and length of stay analysis. When 65 patients were evaluated, mortality was observed in 85.7% of patients admitted to intensive care, while it was 14.3% in patients admitted to the ward (p<0.001, Fisher's exact test). The median length of stay in the hospital for patients admitted to the ward was 23.0 (14.0–36.0) days, while it was 11.0 (2.8–31.3) days for patients admitted to the intensive care unit (p=0.036, Mann Whitney U) (Table 5).

DISCUSSION

NF represents a formidable challenge in clinical practice due to its rapid progression, high mortality rates, and potential for devastating outcomes. In this retrospective study, we aimed to elucidate the clinical characteristics and prognostic factors influencing mortality rates among patients diagnosed with NF at our tertiary care facility. Our findings underscore the gravity of NF as a life-threatening condition, with a mortality rate of 26.5% observed in our cohort. This figure aligns with previously reported mortality rates exceeding 20%, highlighting the persistent therapeutic challenge posed by NF despite advances in diagnostic and treatment modalities [7].

Table 5. Comparison of outcomes according to survival (n=65)

Variable, (%, column percentages)	Total (n=65)	Survival (n=51)	Non-survival (n=14)	p
Admission status, (%)				**<0.001**+
Ward admission	62.3	80.4	14.3	
ICU admission	31.9	19.6	85.7	
Hospital length of stay (days), median (IQR)	23.0 (11.0–35.0)	23.0 (14.0–36.0)	11.0 (2.8–31.3)	**0.036***
Surgery, (%)	92.3	94.1	85.7	0.292+

ICU: Intensive care unit; IQR: Interquartiller range; *: Mann-Whitney U; +: Fisher's Exact Test. Since four patients died in a very short time in the ED they were excluded from admission and length of stay analysis.

The demographic profile of our cohort revealed a mean age of 55.8 years, with a predominance of male patients, consistent with existing literature suggesting a higher incidence of NF in older adults and males [5, 8]. Notably, diabetes mellitus emerged as a significant predisposing factor for mortality, with a markedly higher prevalence among non-surviving patients compared to survivors. This association underscores the importance of vigilant monitoring and aggressive management of diabetic patients presenting with suspected NF. It is also known that diabetic patients notice developing tissue defects later due to existing neuropathic damage. Especially elderly diabetic patients are a group that needs to be evaluated carefully in terms of skin injuries [9, 10].

Early diagnosis of NF is only possible by correctly evaluating the patient with a skeptical approach and identifying predisposing conditions that will confirm this suspicion. The clinical appearance of NF initially resembles simple cellulitis. It begins with basic signs of inflammation such as erythema, increased temperature, and pain [6]. Our study showed that 84% of the patients had pain, 75% had erythema, and 72% had edema and swelling. While 48% of the patients have all three of these symptoms, 37% have two symptoms and the rest are accompanied by at least one of these symptoms. Consistent with the literature, recognition of crepitus on examination was seen as less common (44.9%), but it is an important finding that strongly indicates suppuration [6]. Carefully examining these findings in the early stages plays a role in the early detection of NF. In case of suspected NF, the ED physician should request urgent surgical consultation. Fluid resuscitation, appropriate analgesia and cardiac monitoring should be performed to stabilize the patient. Empirical antibiotic therapy should be started without any delay [11].

The clinical presentation of NF often involves a rapid onset of symptoms; in our study, the majority of patients experienced symptoms within a median of 3 days preceding admission, which is consistent with prior studies [8]. Wong et al. [12] showed in their study that performing surgery later than 24 hours increases mortality by nine times. Therefore, it is essential to raise awareness of patients in order to reduce mortality [8, 12]. Trauma-related events, including injections and medical procedures, were identified as common antecedents to symptom onset, highlighting the potential for iatrogenic inoculation of pathogens in susceptible individuals [10, 13]. Therefore, after any medical procedure, patients should be informed about the possible side effects and advised to consult a healthcare institution in these cases [14].

While the primary diagnosis of NF is often made clinically, imaging modalities have guided diagnosis in many cases [15–18]. Although plain radiography, by demonstrating fascial gas accumulation, aids in diagnosis, its sensitivity is relatively low. CT offers higher sensitivity because of its ability to depict fascial edema, necrosis, and other specific findings [18]. Ultrasound, while user-dependent, provides rapid and bedside application convenience [16], and in our study, it demonstrated reasonable sensitivity (80.8%). Despite MRI's high sensitivity, its restricted accessibility and time-consuming nature serve as limiting factors to its utilization [17].

Hemodynamic instability at admission, reflected by lower systolic blood pressures and elevated pulse rates, emerged as prognostic indicators of poor outcomes, with non-surviving patients exhibiting more profound derangements in vital signs. Many studies have shown that the frequent cause of death in NF is sepsis and septic shock [5, 19]. Therefore, hemodynamic instability, which is an early indicator of this, is an important

indicator of mortality. In our study, while white blood cell levels were high in both groups, they were found to be higher in the group that resulted in mortality. This parameter, which is important in infection, may help predict the clinical course [20]. Microbiological analysis revealed a higher prevalence of polymicrobial infections among patients with resulting mortality. Many studies have shown that different microorganisms grow in NF cases [3, 5, 6, 10]. Since there is no dominance of a specific species, regional factors should be familiarized and antibiotic therapy should be planned immediately in cooperation with infectious diseases. Therefore, starting empirical antibiotic therapy (wide-spectrum) against appropriate pathogens at an early stage seems to be an important part of treatment [21, 22].

The critical role of intensive care unit (ICU) admission in managing severe cases of NF was evident in our study, with a significantly higher mortality rate observed among ICU-admitted patients compared to those managed on the ward. This finding showed the necessity of early recognition and aggressive intervention in high-risk patients to mitigate adverse outcomes [8].

Despite the retrospective nature of our study and inherent limitations, including potential selection bias and incomplete data capture, our findings contribute valuable insights into the clinical course and prognostic factors of NF. Future research endeavors should focus on prospective, multicenter studies to validate our findings and further elucidate optimal strategies for risk stratification, early diagnosis, and multidisciplinary management of NF.

Conclusion

NF remains a formidable surgical emergency associated with significant morbidity and mortality. Our study shows that some factors may help predict the risk of mortality and underscores the importance of vigilant clinical monitoring, early intervention, and multidisciplinary collaboration in mitigating the devastating consequences of NF.

Ethics Committee Approval: The Bolu Abant Izzet Baysal University Clinical Research Ethics Committee granted approval for this study (date: 22.08.2023, number: 2023/258).

Informed Consent: This study was conducted retrospectively, and informed consent was not obtained from the included cases. All data were anonymized in accordance with data protection regulations and used in this de-identified form.

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