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A Prospective Study of Patient with Necrotising Fasciitis in Relation to Clinical Feature and Bacteriological Profile

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Abstract: ***Necrotizing fasciitis (NF) is a rapidly progressive soft tissue infection associated with significant morbidity and mortality, necessitating early diagnosis and prompt surgical intervention. This prospective observational study was conducted to evaluate the clinical presentation, bacteriological profile, management, and outcomes of patients with NF admitted to a tertiary care teaching hospital in eastern Uttar Pradesh, India. A total of 140 patients with clinically diagnosed NF were enrolled. Demographic details, clinical features, comorbidities, microbiological findings, treatment, complications, and outcomes were recorded and analysed. Older adults were most commonly affected, with a slight male predominance. Diabetes mellitus was the most frequent comorbidity. Pain and swelling were present in all patients, while the perineum and lower limbs were the most commonly involved sites. Culture positivity was observed in 62.9% of cases, with* Staphylococcus aureus *being the most common isolate, followed by* Klebsiella *spp. and* Escherichia coli*. Multiple surgical debridement was the most frequently performed procedure, and more than half of the patients required intensive care. The overall recovery rate was 95%. Advanced age, diabetes mellitus, hypertension, chronic kidney disease, alcohol use, smoking, culture positivity, ICU admission, septic shock, acute respiratory distress syndrome, and multiple organ dysfunction syndrome were significantly associated with mortality. Early diagnosis, prompt aggressive surgical debridement, culture-guided antimicrobial therapy, and intensive supportive care remain the key determinants of favourable outcomes in patients with necrotizing fasciitis.***

Keywords: Bacteriological profile; Debridement; Necrotizing fasciitis; Surgical outcomes.

1. Introduction

Necrotizing fasciitis (NF), popularly termed “flesh-eating disease,” is an uncommon but highly aggressive infection of the deep fascia and subcutaneous tissue, characterised by rapid spread along fascial planes, extensive tissue destruction, and a considerable risk of systemic toxicity, organ failure, and death if not treated promptly [1, 2]. Although the infection can affect any part of the body, it most frequently involves the extremities, perineum, trunk, and abdominal wall, and its often-subtle initial presentation makes early diagnosis a persistent clinical challenge [3].

The infection usually begins after a minor injury, insect bite, surgical wound, injection, or other breach of skin integrity; however, in 20–50% of cases no definite portal of entry can be identified, which further delays recognition [4, 5]. Several host factors, including diabetes mellitus, obesity, smoking, chronic alcohol use, liver cirrhosis, malignancy, corticosteroid therapy, and chronic kidney disease, impair immune function and tissue perfusion and thereby increase susceptibility to NF and its associated mortality [6].

Globally, NF is considered rare, with reported incidence rates of 0.3 to 15 cases per 100,000 population annually, and considerably lower rates of approximately 0.4 per 100,000 in the United States [7, 8]. The true burden of disease in India remains poorly defined because of underreporting, weak surveillance, and the scarcity of prospective studies, even though the high prevalence of diabetes, malnutrition, and limited healthcare access in this setting would be expected to increase both incidence and severity [9].

Early NF often mimics more common and less severe soft tissue infections such as cellulitis or abscess, typically presenting with regional pain, oedema, erythema, and warmth, but a hallmark feature is pain that is disproportionate to the visible skin findings [10, 11]. As the disease advances, patients may develop skin discolouration, bullae, frank necrosis, crepitus from gas-forming organisms, and systemic features of sepsis such as fever, tachycardia, hypotension, and altered sensorium [12, 9]. Delay in diagnosis is strongly linked to septic shock, multiorgan failure, limb loss, and death, and reported mortality continues to range widely from 6% to 33% despite advances in surgical and critical care [13, 14].

Necrotizing fasciitis is classified microbiologically into polymicrobial (Type I), monomicrobial streptococcal or staphylococcal (Type II), marine organism-related (Type III),

and fungal (Type IV) disease, a distinction that has practical implications for empirical antimicrobial selection [2, 12]. Scoring systems such as the Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC), which uses six routine laboratory parameters, have been proposed to aid early diagnosis, but their reliability in early disease and across diverse populations remains debated and they have not been validated extensively in large prospective cohorts [15, 16].
Management of NF requires a multidisciplinary approach combining prompt, often repeated, surgical debridement with broad-spectrum intravenous antibiotics and intensive supportive care [17]. The rising prevalence of antimicrobial resistance, including multidrug-resistant Staphylococcus aureus and Gram-negative organisms, has further complicated treatment and underscores the importance of local bacteriological data to guide empirical therapy [18].

This prospective study was undertaken to characterise the clinical presentation and bacteriological pattern of NF in patients presenting to a tertiary care teaching hospital in eastern Uttar Pradesh, and to correlate these features with treatment outcome, with the aim of contributing region-specific evidence to guide early diagnosis, empirical antimicrobial selection, and prognostic assessment.

2. Materials and Methods

Study design and setting
This prospective observational study was conducted in the Department of General Surgery, Baba Raghav Das Medical College and Nehru Hospital, Gorakhpur, Uttar Pradesh, India, a tertiary care teaching hospital serving a large rural and urban population.

Study Duration
The study was carried out over a period of 18–24 months, during which all eligible patients admitted with a clinical diagnosis of NF were enrolled consecutively.

Study Population
The study included 140 consecutive patients with a clinical diagnosis of necrotizing fasciitis admitted to the surgical wards or intensive care unit during the study period who met the inclusion criteria.

Inclusion Criteria
Patients of all age groups and both genders with a clinical diagnosis of necrotizing fasciitis who provided informed consent to participate were included.

Exclusion Criteria
Patients with other soft tissue infections not consistent with NF, those unwilling to participate, and those with incomplete clinical or laboratory data were excluded.

Ethical Considerations
The study was approved by the Institutional Human Ethics Committee, Baba Raghav Das Medical College, Gorakhpur (IEC No. 293(A)/IHEC/2025), and was conducted in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained from all patients or their attendants prior to enrolment, and confidentiality of patient information was maintained throughout the study.

Data Collection
Following admission, a detailed history was recorded for every patient, including demographic details (age, gender, residence, occupation), history of trauma or prior infection, and associated comorbidities such as diabetes mellitus, hypertension, chronic kidney disease, immunosuppression, alcohol use, and smoking. Presenting complaints including pain, swelling, fever, bullae, and discharge were documented. A comprehensive general and systemic examination was performed, with vital parameters recorded, and local examination was carried out to assess the site and extent of involvement, skin changes, presence of crepitus, and overall disease severity.

Laboratory and Microbiological Evaluation
Routine investigations, including complete blood count, blood sugar, renal function tests, serum electrolytes, and C-reactive protein, were performed in all patients. Pus or tissue samples were collected from the affected site under aseptic precautions and sent for culture and sensitivity testing. Cultures were categorised as sterile or non-sterile, and the isolated organisms along with their antibiotic sensitivity patterns were documented.

Treatment Protocol
All patients received empirical broad-spectrum intravenous antibiotics at admission, subsequently modified according to culture and sensitivity reports, together with supportive care comprising intravenous fluids, analgesics, and organ support as required. Surgical management consisted of debridement, performed once or repeatedly depending on the extent of necrosis, with fasciotomy performed when indicated and amputation reserved for non-salvageable limbs.

Outcome Measures
The primary outcome was recovery or death of the patient. Secondary outcomes included requirement of intensive care unit (ICU) admission and development of complications such as septic shock, acute kidney injury (AKI), acute respiratory distress syndrome (ARDS), and multiple organ dysfunction syndrome (MODS).

Statistical Analysis
Data were entered in Microsoft Excel and analysed using SPSS software (version 29.0). Categorical variables were expressed as number and percentage, and continuous variables as mean ± standard deviation. The chi-square test was used to assess associations between categorical variables, with Fisher's exact test applied where appropriate. A p-value of less than 0.05 was considered statistically significant.

3. Results

A total of 140 patients with a clinical diagnosis of necrotizing fasciitis were enrolled during the study period. The highest proportion of patients belonged to the age group of more than 60 years (26.43%), followed by 31–40 years (24.29%) and 41–50 years (22.14%), while patients below 30 years constituted the smallest group (10.00%). Males predominated slightly over females (54.29% vs. 45.71%), and the majority of patients were from rural areas (58.57%). Labourers (36.43%) and homemakers (28.57%) were the most common occupational groups. Diabetes mellitus (27.86%) was the

most prevalent comorbidity, followed by hypertension (22.86%), alcohol use (17.86%), smoking (15.00%), chronic kidney disease (8.57%), and immunosuppression (1.43%) (Table 1).

Table 1: Baseline Socio-demographic Characteristics and Comorbidities of Patients

Variable	Category	Frequency (n)	Percentage (%)
Age group (years)	<30	14	10
	31–40	34	24.29
	41–50	31	22.14
	51–60	24	17.14
	>60	37	26.43
Gender	Male	76	54.29
	Female	64	45.71
Residence	Rural	82	58.57
	Urban	58	41.43
Occupation	Labourer	51	36.43
	Student	10	7.14
	House maker	40	28.57
	Job	15	10.71
	Farmer	21	15
	Others	3	2.14
Diabetes Mellitus	Present	39	27.86
	Absent	101	72.14
Hypertension	Present	32	22.86
	Absent	108	77.14
CKD	Present	12	8.57
	Absent	128	91.43
Immunosuppression	Present	2	1.43
	Absent	138	98.57
Alcohol Use	Present	25	17.86
	Absent	115	82.14
Smoking	Present	21	15
	Absent	119	85

Pain and swelling were universal presenting complaints, observed in all 140 patients (100%), while fever (48.57%), bullae (51.43%), and crepitus (50.71%) were present in approximately half of the patients, reflecting variable disease severity at presentation. The perineum (Fournier's gangrene) was the most common site of infection (29.29%), followed by the lower limb (26.43%), upper limb (23.57%), and trunk/abdominal wall (20.71%) (Table 2/Fig. 1).

Table 2: Clinical Presentation and Site of Infection at Admission

Variable	Category	Frequency (n)	Percentage (%)
Clinical Presentation	Pain – Present	140	100
	Pain – Absent	0	0
	Swelling – Present	140	100
	Swelling – Absent	0	0
	Fever – Present	68	48.57
	Fever – Absent	72	51.43
	Bullae – Present	72	51.43
	Bullae – Absent	68	48.57
	Crepitus – Present	71	50.71
	Crepitus – Absent	69	49.29
Site of Infection	Lower limb	37	26.43
	Upper limb	33	23.57
	Perineum (Fournier's)	41	29.29
	Trunk/Abdominal	29	20.71

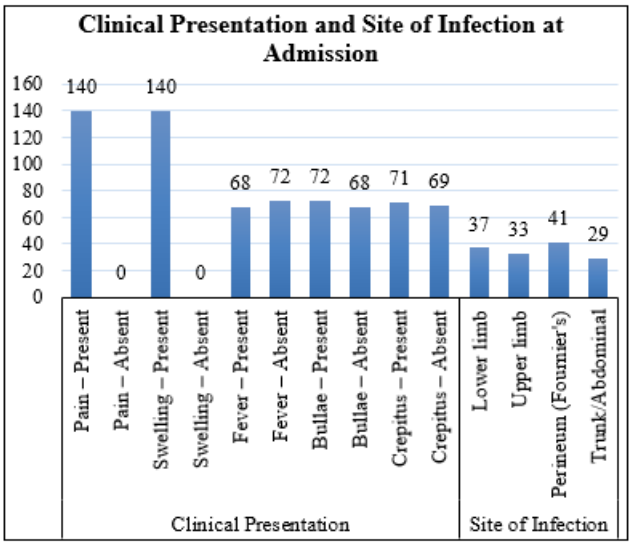

Figure 1: Clinical Presentation and Site of Infection at Admission

Culture and sensitivity testing yielded growth in 88 of 140 patients (62.86%), while 37.14% of samples were sterile. Among the culture-positive specimens, Staphylococcus aureus (MSSA) was the most frequently isolated organism (21.59%), followed by Klebsiella spp. (18.18%) and Escherichia coli (15.91%), while Streptococcus pyogenes, methicillin-resistant Staphylococcus aureus (MRSA), and Pseudomonas aeruginosa each accounted for 14.77% of isolates, indicating a predominantly bacterial and mixed Gram-positive/Gram-negative aetiology (Table 3/Fig. 2).

Table 3: Distribution of Culture Results and Isolated Organisms

Variable	Category	Frequency (n)	Percentage (%)
Culture Result	Sterile	52	37.14
	Non-sterile	88	62.86
Organisms Isolated	Streptococcus pyogenes	13	14.77
	Staphylococcus aureus (MSSA)	19	21.59
	MRSA	13	14.77
	Escherichia coli	14	15.91
	Klebsiella spp.	16	18.18
	Pseudomonas aeruginosa	13	14.77

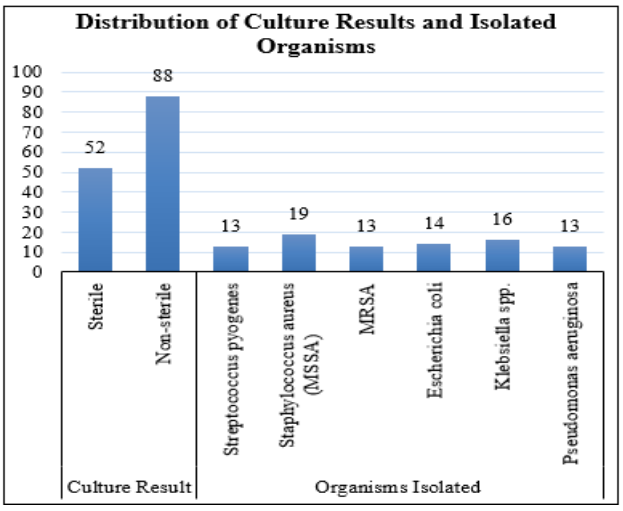

Figure 2: Distribution of Culture Results and Isolated Organisms

Multiple debridement was the most frequently performed surgical procedure (49.29%), followed by single debridement (33.57%), fasciotomy (9.29%), and amputation (7.86%); no patient required skin grafting. Intensive care unit admission was required in 54.29% of patients. Septic shock was the leading complication (25.00%), followed by acute kidney injury (10.71%), multiple organ dysfunction syndrome (8.57%), and acute respiratory distress syndrome (5.71%). Despite the considerable burden of complications, the overall outcome was favourable, with 133 patients (95.00%) recovering and 7 patients (5.00%) succumbing to the illness (Table 4).

Table 4: Distribution of Treatment, ICU Requirement, Complications, and Outcome

Variable	Category	Frequency (n)	Percentage (%)
Treatment	Debridement	47	33.57
	Multiple debridement	69	49.29
	Amputation	11	7.86
	Skin grafting	0	0
	Fasciotomy	13	9.29
ICU Requirement	Yes	76	54.29
	No	64	45.71
Complications	Septic shock	35	25
	Acute kidney injury (AKI)	15	10.71
	Acute respiratory distress syndrome (ARDS)	8	5.71
	Multiple organ dysfunction syndrome (MODS)	12	8.57
Outcome	Recovered	133	95
	Died	7	5

On analysis of socio-demographic factors and comorbidities in relation to outcome, age group showed a significant association with mortality ($\chi 2 = 11.42$, $p = 0.022$), with the highest proportion of deaths occurring among patients above 60 years (57.14%). Diabetes mellitus ($p = 0.008$), hypertension ($p = 0.036$), chronic kidney disease ($p = 0.048$), alcohol use ($p = 0.007$), and smoking ($p < 0.001$) were each significantly associated with mortality, whereas gender ($p = 0.345$), residence ($p = 0.920$), occupation ($p = 0.323$), and immunosuppression ($p = 0.739$) showed no significant association with outcome (Table 5/Fig. 3).

Table 5: Association of Socio-demographic Characteristics and Comorbidities with Clinical Outcome

Variable	Category	Recovered n (%)	Died n (%)	χ^2	p-value
Age group (years)	<30	14 (10.53)	0 (0.00)	11.42	0.022
	31–40	34 (25.56)	0 (0.00)		
	41–50	30 (22.56)	1 (14.29)		
	51–60	22 (16.54)	2 (28.57)		
	>60	33 (24.81)	4 (57.14)		
Gender	Male	71 (53.38)	5 (71.43)	0.89	0.345
	Female	62 (46.62)	2 (28.57)		
Residence	Rural	78 (58.65)	4 (57.14)	0.01	0.92
	Urban	55 (41.35)	3 (42.86)		
Occupation	Labourer	47 (35.34)	4 (57.14)	5.82	0.323
	Student	10 (7.52)	0 (0.00)		
	House maker	40 (30.08)	0 (0.00)		
	Job	13 (9.77)	2 (28.57)		
	Farmer	20 (15.04)	1 (14.29)		
	Others	3 (2.26)	0 (0.00)		
Diabetes Mellitus	Yes	34 (25.56)	5 (71.43)	6.94	0.008*
Hypertension	Yes	28 (21.05)	4 (57.14)	4.37	0.036*
CKD	Yes	10 (7.52)	2 (28.57)	3.92	0.048*
Immuno-suppression	Yes	2 (1.50)	0 (0.00)	0.11	0.739
Alcohol Use	Yes	21 (15.79)	4 (57.14)	7.12	0.007*
Smoking	Yes	16 (12.03)	5 (71.43)	12.84	<0.001*

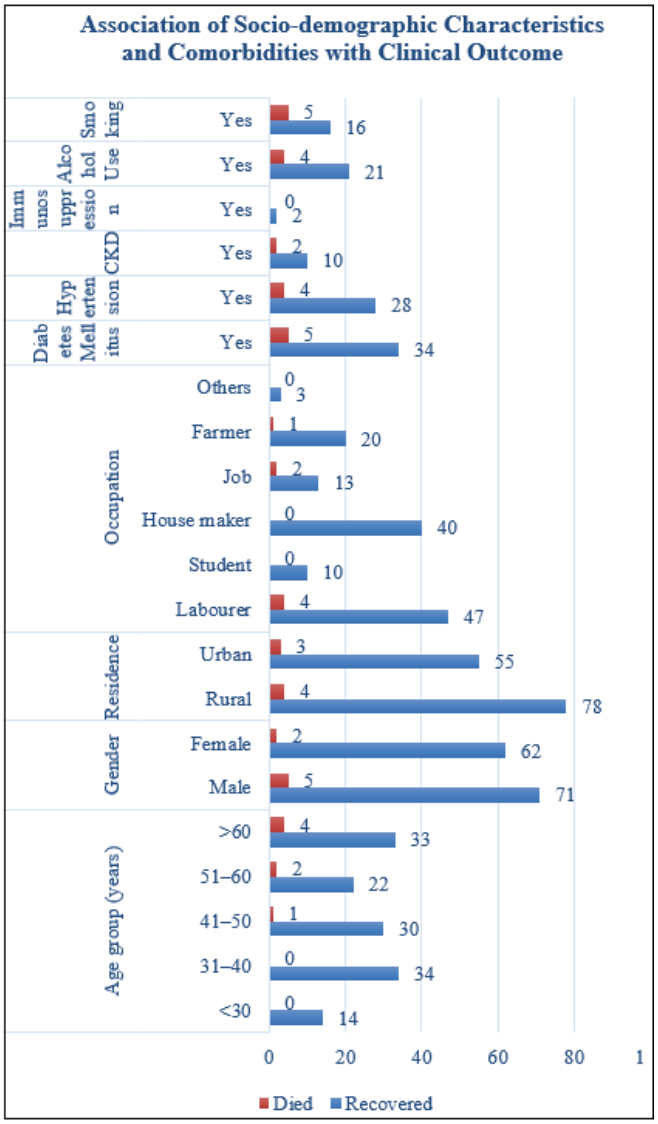

Figure 3: Association of Socio-demographic Characteristics and Comorbidities with Clinical Outcome

Neither the site of infection ($p = 0.892$) nor the type of surgical treatment ($p = 0.906$) was significantly associated with outcome. However, culture positivity was significantly associated with mortality ($p = 0.009$), as all seven patients who died had non-sterile cultures. Patients who required ICU admission had significantly higher mortality than those who did not ($p = 0.014$). Among complications, septic shock ($p = 0.003$), acute respiratory distress syndrome ($p = 0.014$), and multiple organ dysfunction syndrome ($p < 0.001$) were significantly associated with poor outcome, whereas acute kidney injury was not ($p = 0.106$) (Table 6/Fig. 4).

Table 6: Association of Clinical Characteristics, Treatment, ICU Requirement, Complications, and Culture Findings with Clinical Outcome

Variable	Category	Recovered (n=133) n (%)	Died (n=7) n (%)	χ^2	p-value
Site of Infection	Lower limb	35 (26.32)	2 (28.57)	0.62	0.892
	Upper limb	31 (23.31)	2 (28.57)		
	Perineum (Fournier's)	39 (29.32)	2 (28.57)		
	Trunk/ Abdominal	28 (21.05)	1 (14.29)		
Culture	Sterile	52 (39.10)	0 (0.00)	6.72	0.009*
	Non-sterile	81 (60.90)	7 (100.00)		
Treatment	Debridement	45 (33.83)	2 (28.57)	1.02	0.906
	Multiple debridement	65 (48.87)	4 (57.14)		
	Amputation	10 (7.52)	1 (14.29)		
	Skin grafting	0 (0.00)	0 (0.00)		
	Fasciotomy	13 (9.77)	0 (0.00)		
ICU Requirement	Yes	69 (51.88)	7 (100.00)	5.96	0.014*
	No	64 (48.12)	0 (0.00)		
Septic Shock	Yes	30 (22.56)	5 (71.43)	8.94	0.003*
Acute Kidney Injury (AKI)	Yes	13 (9.77)	2 (28.57)	2.61	0.106
Acute Respiratory Distress Syndrome (ARDS)	Yes	6 (4.51)	2 (28.57)	6.02	0.014*
Multiple Organ Dysfunction Syndrome (MODS)	Yes	8 (6.02)	4 (57.14)	16.21	<0.001*

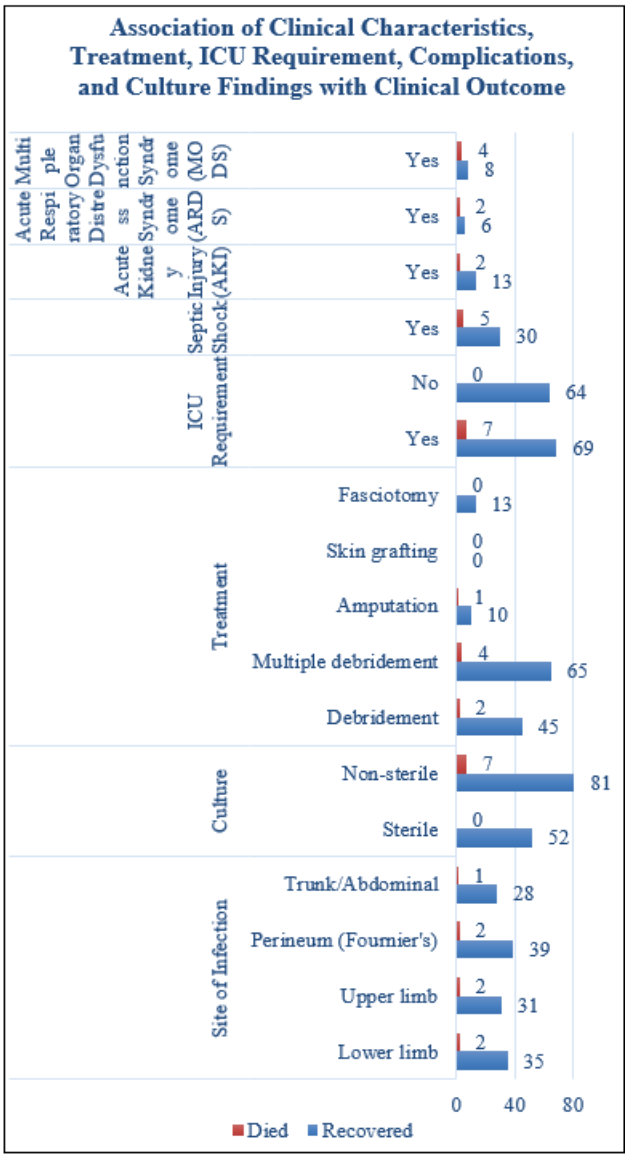

Figure 4. Association of Clinical Characteristics, Treatment, ICU Requirement, Complications, and Culture Findings with Clinical Outcome

4. Discussion

In the present study, necrotizing fasciitis predominantly affected older individuals, with the largest proportion of patients (26.43%) above 60 years of age, followed by the 31–40- year (24.29%) and 41–50 year (22.14%) groups, while patients under 30 years formed the smallest group (10.00%). This age distribution is broadly consistent with previous reports; **Molewa et al.** described a median age of 45.5 years, **Shirah et al.** found that 71.6% of patients were between 40 and 60 years, and **Abd El-Hamid El-Kady et al.** reported a mean age of 60.11 ± 13.57 years, reflecting a higher burden among elderly patients [18–20]. Similarly, **Karthikayan et al.** reported a mean age of 43.96 ± 19.3 years, and **Halbhavi et al.** noted the highest number of cases in the 61–70 year group [21, 22]. Indian studies by **Mittal et al.** and **Rajendran et al.** likewise found most patients in the 40–60 year range, while **Kancharapu et al.** reported peak incidence in the 51–60 year group [5, 23, 24]. The predominance of NF among older adults is likely explained by age-related

immunosenescence, higher prevalence of chronic disease, and delayed presentation to healthcare facilities.

Males were more commonly affected than females in this cohort (54.29% vs. 45.71%), a pattern consistent with, though less pronounced than, previous studies. **Molewa et al.** reported 66.04% male patients, **Shirah et al.** found a male-to-female ratio of approximately 2:1, **Rajendran et al.** reported 76% male predominance, and **Karthikayan et al.** and **Halbhavi et al.** reported 80.5% and 80.67% male patients respectively [19–23]. The relatively modest male predominance observed here may reflect differences in occupational exposure and health-seeking behaviour in the study population. Consistent with the observation by **Sharma et al.** that gender was not significantly associated with mortality, gender also showed no significant association with outcome in the present cohort ($p = 0.345$), suggesting that while males may be more frequently affected, survival once the disease develops is largely independent of gender [25].

The majority of patients in this study were from rural areas (58.57%), in keeping with the observations of **Rajendran et al.**, who highlighted those delayed healthcare access and poorer socioeconomic conditions in rural populations contribute to disease progression and severity, and of **Shirah et al.**, who reported that a substantial proportion of patients came from non-urban backgrounds [23, 20]. Occupationally, labourers (36.43%) and homemakers (28.57%) formed the largest groups, consistent with the association between manual and outdoor occupations and exposure to trauma and wound contamination described by **Rajendran et al.** and **Mittal et al.** [5, 23]. Residence, however, was not significantly associated with mortality in this cohort ($p = 0.920$), suggesting that final outcome is influenced more by disease severity and comorbidity burden than by place of residence alone, a finding echoed by **Sharma et al.** [25].

Diabetes mellitus was the most common comorbidity (27.86%), followed by hypertension (22.86%), findings that align with the well-established role of diabetes as the principal predisposing factor for NF through impaired neutrophil function and microvascular disease [26, 27]. Importantly, diabetes ($p = 0.008$), hypertension ($p = 0.036$), chronic kidney disease ($p = 0.048$), alcohol use ($p = 0.007$), and smoking ($p < 0.001$) were all significantly associated with mortality in this study, underscoring the cumulative impact of metabolic and lifestyle-related comorbidities on survival, a pattern consistent with previous literature identifying these factors as independent predictors of poor prognosis [28, 29].
Pain and swelling were present in all patients (100%), confirming their status as the most consistent and reliable early warning signs of NF, while fever (48.57%), bullae (51.43%), and crepitus (50.71%) were present in roughly half of the cohort, indicating variable severity at presentation. These findings closely mirror those of **Rajendran et al.**, who reported pain and fever in all patients and bullae in 48%, and of **Shirah et al.**, who observed tenderness in 89.9% and bullae in 62.6% of patients, although **Molewa et al.** found crepitus to be uncommon, highlighting that classical signs may not always be present and that clinical suspicion should not rely on any single feature [19, 20, 23].

The perineum (Fournier's gangrene) was the most common site of involvement in this study (29.29%), followed by the lower limb (26.43%), upper limb (23.57%), and trunk/abdominal wall (20.71%). This distribution differs somewhat from several previous reports in which the lower limb predominated, such as those of **Molewa et al.** (32.08%) and **Rajendran et al.** (36%), as well as **Shirah et al.**, who found lower limb involvement in more than 60% of cases [19, 20, 23]. The relatively higher perineal involvement observed here may reflect delayed presentation, poor perineal hygiene, and a higher prevalence of urogenital risk factors in the rural population served by this centre; nevertheless, site of infection was not significantly associated with mortality ($p = 0.892$), suggesting that anatomical location alone does not determine prognosis once treatment is initiated.

Culture positivity was seen in 62.86% of patients, consistent with the polymicrobial and mixed aerobic-anaerobic nature of NF described extensively in the literature [1, 30]. Staphylococcus aureus was the leading isolate (21.59%), followed by Klebsiella spp. (18.18%) and Escherichia coli (15.91%), a pattern broadly comparable to that reported by **Molewa et al.**, who identified Staphylococcus aureus as the predominant Gram-positive organism and Escherichia coli as the predominant Gram-negative organism, and by **Halbhavi et al.**, who reported Staphylococcus aureus (45.28%) and Pseudomonas aeruginosa (38.33%) as the leading isolates [19, 22]. **Rajendran et al.** similarly reported Escherichia coli in 74% of their predominantly polymicrobial infections [23]. The presence of MRSA among the isolates in this study (14.77%) reinforces the importance of including anti-MRSA cover in empirical antibiotic regimens pending culture results. Notably, culture positivity was significantly associated with mortality in this cohort ($p = 0.009$), as all patients who died had non-sterile cultures, emphasising the prognostic value of microbiological confirmation and the importance of aggressive source control in culture-positive disease.

Multiple debridement was the most common surgical intervention (49.29%), consistent with the well-recognised principle that repeated surgical debridement is the cornerstone of NF management [20, 23]. Amputation was required in 7.86% of patients, a rate lower than the 22% and 27.5% reported by **Kancharapu et al.** and **Sharma et al.** respectively, possibly reflecting earlier presentation or more aggressive early debridement in this cohort [24, 25]. Type of surgical treatment showed no significant association with mortality ($p = 0.906$), indicating that outcome is determined less by the specific surgical modality than by the timeliness and adequacy of source control and the presence of systemic complications.

Intensive care unit admission was required in 54.29% of patients, and was significantly associated with mortality ($p = 0.014$), with all patients who died having required ICU care. Septic shock was the most frequent complication (25.00%) and was significantly associated with mortality ($p = 0.003$), as were acute respiratory distress syndrome ($p = 0.014$) and multiple organ dysfunction syndrome ($p < 0.001$), while acute kidney injury showed no significant association ($p = 0.106$). These findings are consistent with previous studies identifying septic shock and multiorgan failure as the principal determinants of mortality in NF, and reinforce that

systemic decompensation, rather than any single local factor, drives adverse outcome [31, 32].

The overall mortality rate in this study was 5.00%, which compares favourably with previously reported rates ranging from 6% to 33% [13,14], and is lower than the 7.1%, 11.33%, 12%, and 20.9% reported by **Shirah et al., Halbhavi et al., Kancharapu et al.,** and **Wang et al.** respectively [20, 22, 24, 33]. This relatively low mortality may reflect the benefit of prompt admission, early and repeated surgical debridement, appropriate empirical antibiotic therapy, and the availability of intensive care support at this tertiary centre, although it may also be influenced by referral patterns and the exclusion of patients with incomplete data.

Taken together, the present findings confirm that advancing age, diabetes mellitus, hypertension, chronic kidney disease, alcohol use, smoking, culture positivity, ICU requirement, septic shock, acute respiratory distress syndrome, and multiple organ dysfunction syndrome are important predictors of mortality in necrotizing fasciitis, and highlight the continuing importance of early diagnosis, prompt and repeated surgical debridement, targeted antimicrobial therapy, and vigilant critical care support in improving survival.

5. Conclusion

Necrotizing fasciitis predominantly affected older adults, with a slight male predominance, and diabetes mellitus was the most common comorbidity. Pain and swelling were the universal presenting features, while the perineum and lower limbs were the most frequently involved sites. *Staphylococcus aureus* was the most common organism isolated, followed by *Klebsiella* spp. and *Escherichia coli*. Multiple surgical debridement with appropriate antibiotic therapy resulted in a high recovery rate. Advanced age, diabetes mellitus, hypertension, chronic kidney disease, alcohol use, smoking, culture positivity, ICU admission, septic shock, ARDS, and MODS were significant predictors of mortality. Early diagnosis, prompt aggressive surgical debridement, culture-guided antimicrobial therapy, and intensive supportive care are essential to improve outcomes and reduce mortality in patients with necrotizing fasciitis.

References

[1] Sarani B, Strong M, Pascual J, et al. Necrotizing fasciitis: current concepts and review of the literature. *J Am Coll Surg* 2009; 208: 279–288.
[2] Puvanendran R, Huey JCM, Pasupathy S. Necrotizing fasciitis. *Can Fam Physician* 2009; 55: 981–987.
[3] Guliyeva G, Huayllani MT, Sharma NT, et al. Practical Review of Necrotizing Fasciitis: Principles and Evidence-based Management. *Plast Reconstr Surg Glob Open* 2024; 12: e5533.
[4] Sadasivan J, Maroju NK, Balasubramaniam A. Necrotizing Fasciitis. *Indian J Plast Surg* 2013; 46: 472–478.
[5] Mittal S, Singh B, Mittal R, et al. A prospective study of cases with necrotising fasciitis: our experience at a tertiary care teaching hospital. *International Surgery Journal* 2017; 4: 3326–3329.
[6] Mustafa AD, Varshney K, Rao T, et al. Necrotising Fasciitis in Patients with Diabetes: A Systematic Review of Mortality-Associated Clinical Factors. *Int Wound J* 2026; 23: e70844.
[7] CHEN LL, FASOLKA B, TREACY C. Necrotizing fasciitis: A comprehensive review. *Nursing* 2020; 50: 34–40.
[8] Wallace HA, Perera TB. Necrotizing Fasciitis. In: *StatPearls*. Treasure Island (FL): StatPearls Publishing, 2026.
[9] Salib M, Salib J, Hildenbrandt EA, et al. Rapidly Progressive Necrotizing Fasciitis of the Lower Limb Following Self-Drainage of an Abscess: Prompt Recognition and Initial Management at a District Healthcare Centre. *Cureus*. Epub ahead of print 30 August 2025.
[10] Joshi A, Alomar T, Kaune DF, et al. A case of necrotizing fasciitis initially misdiagnosed as cellulitis. *Int J Surg Case Rep* 2024; 118: 109701.
[11] Kiat HJ, En Natalie YH, Fatimah L. Necrotizing Fasciitis: How Reliable are the Cutaneous Signs? *J Emerg Trauma Shock* 2017; 10: 205–210.
[12] Davoudian P, Flint NJ. Necrotizing fasciitis. *Continuing Education in Anaesthesia Critical Care & Pain* 2012; 12: 245–250.
[13] Haider A, Virji SN, Dildar M, et al. Time against tissue: case reports of fungal necrotizing fasciitis and the cost of delayed aggressive interventions. *BMC Infect Dis* 2025; 26: 68.
[14] Rajan K, Manivannan, Manimaran R. Delayed Presentation as the Principal Determinant of Poor Outcomes in Diabetic Necrotizing Fasciitis: A Prospective Comparative Study. *Genetics and Molecular Research* 2026; 25: 1–8.
[15] Bechar J, Sepehripour S, Hardwicke J, et al. Laboratory risk indicator for necrotising fasciitis (LRINEC) score for the assessment of early necrotising fasciitis: a systematic review of the literature. *Ann R Coll Surg Engl* 2017; 99: 341–346.
[16] Ramesh AA, Selvaraj K, K BR, et al. Distribution of Necrotizing fasciitis Using the Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) Score Among Patients Attending a Tertiary Hospital in Chennai. *Cureus*; 16: e73755.
[17] Aydin A, Revend L, Revend D, et al. Necrotizing fasciitis of the head and neck – clinical features, diagnostics, and management strategies. *Oncoscience* 2025; 12: 219–225.
[18] Abd El-Hamid El-Kady R, Ahmed Mansour A, ElGuindy AMF. Necrotizing Fasciitis: A Retrospective Review of the Microbiological Aspects and Factors Associated with Multi-Drug Resistance from a Saudi Tertiary Care Hospital. *Int J Gen Med* 2025; 18: 3983–4000.
[19] Molewa MC, Ogonowski-Bizos A, Els M, et al. The microbiological profile of necrotising fasciitis at a secondary level hospital in Gauteng. *S Afr J Infect Dis* 2024; 39: 542.
[20] Hamza Assad S, Ibraheem Abdulaziz Z, Osama Abdulqader S, et al. Necrotizing Fasciitis: Analysis of the Clinical, Microbiological Pattern, and Factors Associated with Mortality. *Int J Surg Res Pract*; 9. Epub ahead of print 30 June 2022.

[21] Karthikayan VR, Gupta A, Kumar NGP. Clinical and Bacteriological Profile of Necrotising Fasciitis at a Tertiary Care Hospital, New Delhi: An Observational Study. *International Journal of Anatomy, Radiology and Surgery* 2024; 13: SO09-SO13.
[22] Halbhavi SN, Reddy R, Kalburgi EB, et al. Clinical and microbiological profile of necrotizing fasciitis. *Int Surg J* 2018; 5: 2119.
[23] Senthil Prabu M, Rajendran K. Clinical profile and outcome of the patients with necrotising fasciitis in a tertiary care teaching hospital at rural Puducherry, India. *IP Journal of Surgery and Allied Sciences* 2021; 3: 101–106.
[24] Kancharapu RM, Gurugubelli SR, Badipatla VN, et al. Clinico-Pathological Evaluation and Management of Necrotizing Fasciitis in a Tertiary Care Hospital. *International Journal of Academic Medicine and Pharmacy* 2023; 5: 149–158.
[25] Sharma P, Karthik N, Badkur M, et al. Clinical Profile and Outcomes of Patients With Necrotizing Soft Tissue Infections: A Prospective Observational Study. *Cureus*. Epub ahead of print 30 June 2025. DOI: 10.7759/cureus.87035.
[26] Goh T, Goh LG, Ang CH, et al. Early diagnosis of necrotizing fasciitis. *Br J Surg* 2014; 101: e119-125.
[27] Angoules AG, Kontakis G, Drakoulakis E, et al. Necrotising fasciitis of upper and lower limb: a systematic review. *Injury* 2007; 38 Suppl 5: S19-26.
[28] Elliott DC, Kufera JA, Myers RA. Necrotizing soft tissue infections. Risk factors for mortality and strategies for management. *Ann Surg* 1996; 224: 672–683.
[29] Krieg A, Dizdar L, Verde PE, et al. Predictors of mortality for necrotizing soft-tissue infections: a retrospective analysis of 64 cases. *Langenbecks Arch Surg* 2014; 399: 333–341.
[30] Suzuki H, Muramatsu K, Kubo T, et al. Factors associated with mortality among patients with necrotizing soft tissue infections: An analysis of 4597 cases using the Diagnosis Procedure Combination Database. *Int J Infect Dis* 2021; 102: 73–78.
[31] Jabbour G, El-Menyar A, Peralta R, et al. Pattern and predictors of mortality in necrotizing fasciitis patients in a single tertiary hospital. *World J Emerg Surg* 2016; 11: 40.
[32] Kumar T, Kaushik R, Singh S, et al. Determinants of Mortality in Necrotizing Soft Tissue Infections. *Hellenic J Surg* 2020; 92: 159–164.
[33] Wang J-M, Lim H-K. Necrotizing fasciitis: eight-year experience and literature review. *Braz J Infect Dis* 2014; 18: 137–143.