Insights into necrotising fasciitis: A prospective pilot study in a Tertiary Care Hospital

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ABSTRACT

Introduction: Necrotising fasciitis, commonly referred to as "flesh-eating disease," is a rapidly spreading soft tissue infection characterised by extensive necrosis of the skin, subcutaneous tissue, and fascia while sparing the underlying muscle. Despite its low overall incidence, it is a significant soft tissue infection due to its rapid spread and associated high mortality risk.

Materials and Methods: This prospective pilot study aims to analyse 25 consecutive cases of necrotising fasciitis to assess various aspects, including age and sex incidence, microbial flora, role of co-morbidities in prognosis, and overall outcome. We conducted a descriptive study involving 25 patients aged 18-84 years diagnosed with necrotising fasciitis over a 6-month period (January 2022 to June 2022) at Saveetha Medical College.

Results: Of the 25 patients treated, 21 (84%) were male and 4 (21%) were female, resulting in a male-to-female ratio of 5.25. The age ranged from 18 to 84 years (Mean age: 50.24 ± Standard deviation, SD=14.175). Trauma was identified as the main precipitating factor in approximately 40% of cases, while Diabetes Mellitus (40%) emerged as the most common co-morbidity. Lower limb involvement was predominant in both male and female patients. The infection was mono-microbial in 32% of cases (Enterococci 16% + Bacteroides 16%) and poly-microbial in 68% with Streptococcus pyogenes + Escherichia coli being the most common organism combination. Wound debridement followed by split skin graft was the most common treatment modality (84%), with the number of debridement sessions varying based on infection severity (corresponding with higher LRINEC scores). Prolonged hospital stay was the most common complication, observed in 52% of cases.

Discussion: Our analysis revealed that necrotising fasciitis is more prevalent in individuals aged over 50 years with a male predominance. Streptococcus pyogenes with Escherichia coli was the predominant microflora, and Diabetes Mellitus emerged as the most common co-morbidity. Early recognition, prompt control of diabetes mellitus, aggressive surgical treatment, and supportive therapy are essential steps in managing necrotising fasciitis.

KEYWORDS:
Necrotising fasciitis, LRINEC score, Wound debridement

INTRODUCTION

Necrotising fasciitis (NF) is a rapidly spreading soft tissue infection characterised by extensive necrosis of the skin, subcutaneous tissue, and fascia while sparing the underlying muscle. It is often referred to as "suppurative fasciitis" or "flesh-eating disease." Despite its low overall incidence, NF is a significant soft tissue infection due to its rapid spread and associated high mortality risk. While the exact aetiology of NF remains unclear, it can develop following traumatic events or skin infections. It may also occur in patients following childbirth or those with burns. Factors predisposing individuals to NF include immunosuppression, chronic systemic diseases, and intravenous drug abuse. The Panton-Valentine leucocidin (PVL) toxin, produced by MRSA, has been implicated in its pathogenesis.

NF is classified into two types based on microbiological growth: Type 1 (Polymicrobial) infections involving a combination of aerobic and anaerobic organisms, and Type 2 (Monomicrobial) infections. A third type is reserved for myonecrosis caused by Clostridial infections. Diagnosis of NF relies on clinical and laboratory findings. Clinical presentation typically includes oedema and prominent signs of inflammation. The Laboratory Risk Indicator for Necrotising Fasciitis (LRINEC) score is increasingly used to assess the likelihood of NF, with a score of ≥6 indicating high suspicion. The primary approach to managing NF is surgical, with prompt wound debridement being the cornerstone of treatment. Microbial culture of debrided specimens guides specific antimicrobial coverage. Emerging modalities such as vacuum-assisted closure have shown promise in treatment. Our study aims to comprehensively assess the clinical features, laboratory parameters, prognostic factors, and treatment strategies employed in managing NF in a tertiary care hospital.

MATERIALS AND METHODS

The study was conducted after obtaining approval from the Institutional Ethics Committee (IEC) of Saveetha Medical College and Hospital, a tertiary care hospital in Chennai, Tamil Nadu, India, and aimed to comprehensively assess the clinical features, laboratory parameters, prognostic factors, and treatment strategies employed in managing NF. The LRINEC score, a validated tool, is calculated based on factors such as white blood cell count, haemoglobin, creatinine, sodium, and glucose levels, each of which can indicate systemic inflammation, anaemia, kidney dysfunction, electrolyte imbalance, or impaired immune function. A score

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Table I: Demographics and characteristics of the participants

S.NO	VARIABLES	Correlation coefficient	p-value
Age	<60 yr	20	80
	≥60 yr	5	20
Gender	Male	21	84
	Female	4	16
Co-morbid illness	Diabetes Mellitus	10	40
	Peripheral Vascular Disease	2	8
	Systemic Hypertension	1	4
	Chronic Kidney Disease	1	4
	Malignancy	1	4
Clinical stage at time of presentation	Stage 1	2	8
	Stage 2	6	24
	Stage 3	17	68
Microbial culture	Streptococcus pyogenes+ Escherichia coli	5	20
	Bacteroides	4	16
	Enterococcus	4	16
	MRSA	3	12
	Pseudomonas	2	8
	Streptococcus pyogenes+ Clostridium Perfingens	2	8
	Staphylococcus+ Proteus mirabilis	2	8
	Klebsiella Pneumonia+ Moraxella morganii	2	8
	Streptococcus pyogenes + Klebsiella pneumoniae	1	4
Lab parameters	**Component**	**Lab value mean**	**LRINEC component score mean**
	Haemoglobin	10.166	1.6±0.577
	TLC	16.376	0.68±0.476
	CRP	140.92	0.72±0.458
	Serum sodium	130.92	1.68±0.748
	Serum creatinine	1.14	0.64±0.952
	Blood glucose	125.4	0.68±0.476
	LRINEC	N/A	8.12±1.691

TLC- Total leucocyte count, CRP- C- reactive protein.

Table II: Correlation between clinical staging and Demographic variables

S.NO	VARIABLES	Correlation coefficient	p-value
1.	AGE#	0.017	0.934
2.	GENDER	-0.343	0.09
3.	COMORBID	-0.256	0.216
4.	MICROBIAL CULTURE	0.095	0.652
5.	ICU ADMISSION	-0.336	0.100
6.	MORTALITY	-0.219	0.293
7.	LIRENC SCORE#	0.710	<0.001*

#Continuous variable- The test used Pearson Correlation; Others- categorical variable- test used- Point Biserial Correlation; *p<0.01- Statistically significant

Table III: Correlation between LIRENC Score and demographic variable

S.NO	VARIABLES	Correlation coefficient	p-value
1.	AGE#	-0.099	0.639
2.	GENDER	-0.304	0.140
3.	COMORBID	-0.172	0.410
4.	MICROBIAL CULTURE	-0.080	0.704
5.	ICU ADMISSION	-0.316	0.124
6.	MORTALITY	-0.547	0.005*

#Continuous variable- The test used Pearson Correlation; Others- categorical variable- test used- Point Biserial Correlation; *p<0.01- Statistically significant

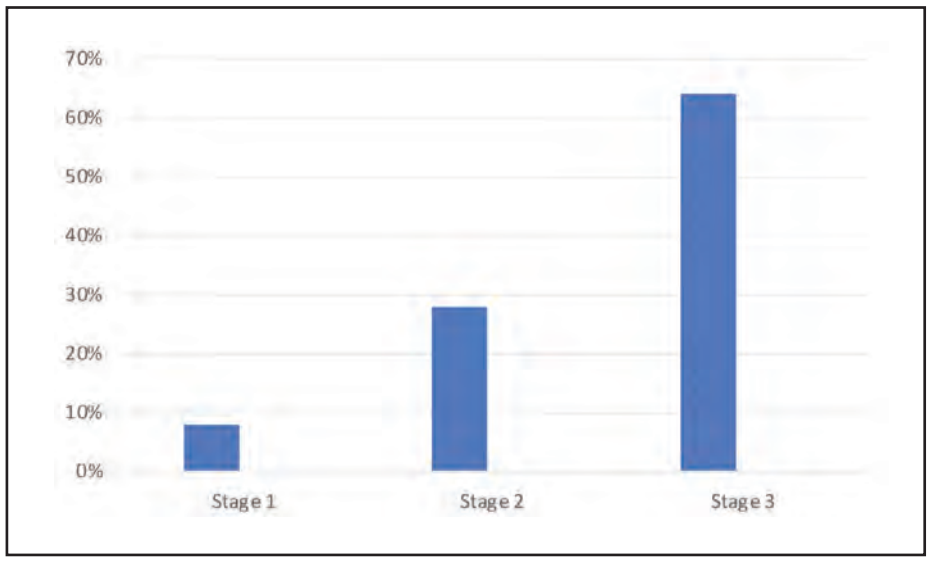

Fig. 1: Distribution of clinical staging of necrotising fasciitis at presentation

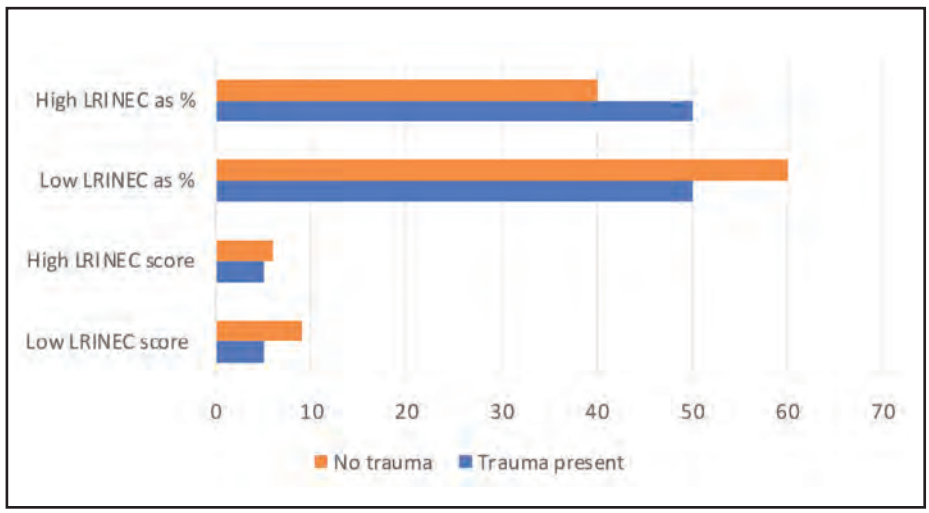

Fig. 2: Association of trauma with LRINEC score

of ≥6 is considered indicative of a high risk of necrotising fasciitis. This cross-sectional study included patients clinically diagnosed with necrotising fasciitis using convenience sampling, aged above 18 years old. A total of 25 adult patients of both sexes admitted to the Department of General Surgery at Saveetha Medical College and Hospital with a clinical diagnosis of necrotising fasciitis over a study period of 6 months were enrolled. Patients with diabetic foot ulcers, burn ulcers, skin malignancies, or cellulitis (after LRINEC score confirmation <6, along with the absence of a characteristic clinical course observed in necrotising fasciitis) were excluded from the study.

A comprehensive history was obtained, documenting the patient's age, sex, and presenting complaints along with the duration of symptoms. Specific inquiries were made regarding any preceding trauma, such as insect bites, acupuncture needle insertion, skin infections, or intravenous drug injections. Additionally, the history included chronic systemic diseases like diabetes, hypertension, peripheral vascular disease, malignancy, chronic kidney disease, and chronic alcohol intake. Any history of organ transplantation, use of immunosuppressant drugs, or corticosteroids was also noted.

A thorough general examination and assessment of vital signs were conducted to identify any undiagnosed chronic systemic diseases or signs suggestive of immunosuppression, such as oral candidiasis. The infection site was carefully examined for signs of inflammation, including erythema, swelling, warmth, and tenderness. Patients were categorised into clinical stages of necrotising fasciitis based on the extent of tissue involvement. Upon admission, laboratory assessments were performed, including haemoglobin levels, total leukocyte count, C-reactive protein, serum creatinine, serum sodium, and blood glucose levels. The LRINEC score was calculated for each patient to stratify the severity of the disease into low or high risk based on the score range.

Clinical risk factors for necrotising fasciitis are based on the patient's clinical presentation, such as trauma history and underlying medical conditions. Laboratory risk factors are based on laboratory test results, such as elevated white blood cell count and abnormal renal function tests. The LRINEC score is a tool to quantify laboratory risk, with scores ≥6 indicating high risk. Data analysis involved descriptive statistics and appropriate statistical tests. To minimise bias related to age and sex, the study population was representative of the general population of patients with necrotising fasciitis, and statistical methods were used to adjust for these factors.

Surgical treatment modalities included debridement of necrotic tissue, fasciotomy, disarticulation of digits, or vacuum-assisted closure. Repeat sessions of surgical debridement were conducted until complete removal of infected tissue was achieved. Empirical antimicrobial therapy was initiated promptly and adjusted based on microbial culture and sensitivity reports. Patients were closely monitored on a daily basis to track disease progression and response to treatment. The overall outcome, including cure, hospital stay, admission to intensive care, or mortality, was documented for each patient. Data collected were tabulated using MS Excel and analysed using SPSS 20.0 for statistical analysis.

RESULTS

After eliminating bias regarding age and sex by noting consecutive fitting of the inclusion criteria, it was found that the mean age of patients presenting with necrotising fasciitis was 50.24 years. Among the study population, 80% were aged <60 years, while 20% were aged ≥60 years. Male patients constituted the majority, accounting for 84% of the cases diagnosed with necrotising fasciitis, whereas females comprised 16%.

The mean clinical staging at admission was 2.56±0.651, reflecting the severity of the condition upon presentation. Diabetes emerged as the most prevalent comorbidity, affecting 40% of the patient cohort, followed by peripheral vascular disease (8%). A notable 40% of patients had a history of trauma preceding the development of necrotising fasciitis, shown in Table I, with males being disproportionately affected (80% male vs. 20% female).
Culture analysis revealed polymicrobial infections in 48% of cases, with the most common combination being Streptococcus + Escherichia coli (20%). Streptococcus emerged as the predominant organism overall, accounting for 32% of cases, emphasising its role in the pathogenesis of necrotising fasciitis.

Upon admission, patients exhibited abnormal laboratory findings indicative of systemic inflammation and organ dysfunction. The mean haemoglobin level was 10.166 g/dL, suggesting varying degrees of anaemia. Elevated levels of total leukocyte count (TLC) at 16.376 cells/mm3 and C-reactive protein (CRP) at 140.92 mg/L indicated an active inflammatory process. Serum sodium levels averaged 130.92 mEq/L, while serum creatinine and blood glucose levels were within normal limits at 1.14 mg/dL and 125.4 mg/dL, respectively Table I. The mean LRINEC score, a validated tool for predicting necrotising fasciitis, was 8.12±1.691, highlighting the severity of the disease in the study cohort.

Table II displays the correlation between clinical staging and various demographic variables. The Pearson correlation test was used for continuous variables, while the Point Biserial correlation test was used for categorical variables. Notably, the LIRENC score showed a statistically significant correlation ($r=0.710$, $p<0.001$) with clinical staging.

Figure 2 illustrates the association between trauma history and LRINEC scores in patients diagnosed with necrotising fasciitis. Among patients with a history of trauma, an equal number (50%) presented with low and high LRINEC scores, indicating a balanced distribution of disease severity. Conversely, among patients without a history of trauma, a higher percentage (60%) exhibited low LRINEC scores compared to those with high LRINEC scores (40%). This suggests a potential correlation between trauma history and LRINEC scores, with trauma possibly influencing the severity of necrotising fasciitis.

Table III presents the correlation between the LIRENC score and various demographic variables. Among the variables analysed, mortality showed a statistically significant negative correlation with the LIRENC score ($r=-0.547$, $p=0.005$), indicating that higher LIRENC scores are associated with lower mortality rates. Other demographic variables, including age, gender, comorbid conditions, microbial culture results, and ICU admission, did not show statistically significant correlations with the LIRENC.

DISCUSSION

Necrotising fasciitis (NF) presents a formidable challenge in both diagnosis and management, characterised by rapid tissue necrosis and potentially fatal outcomes. Its aetiology encompasses a spectrum of traumatic events,[1] from minor injuries to major surgical interventions, underscoring the diverse array of precipitating factors. Contributing to this complexity are predisposing conditions such as diabetes mellitus, immunosuppression, peripheral vascular disease,[2] and intravenous drug abuse,[3] each serving to heighten susceptibility to NF. This intricate interplay of risk factors underscores the multifaceted nature of the disease and emphasises the importance of comprehensive risk assessment in clinical practice.

The clinical manifestation of NF typically unfolds in distinct stages, beginning with local signs of inflammation and progressing to more severe manifestations characterised by bullae formation and extensive tissue necrosis. Despite advances in medical technology, early diagnosis remains challenging due to the absence of specific clinical markers, leading to delays in treatment initiation and potentially adverse outcomes. However, adjunctive diagnostic tools, such as frozen section biopsy, offer promise in enhancing diagnostic accuracy and guiding timely surgical intervention, thereby improving patient prognosis and outcomes. The timing of treatment initiation following admission emerges as a critical prognostic factor in NF management,

highlighting the urgency of prompt recognition and intervention. Delayed surgical intervention beyond 24 hours is associated with unfavourable outcomes, underscoring the imperative of expedited therapeutic measures.[4] Central to NF management is aggressive wound debridement, aimed at removing necrotic tissue and controlling microbial proliferation. This cornerstone approach, coupled with meticulous monitoring and supportive care, forms the backbone of NF treatment strategies.

Microbiological analysis reveals a predominance of polymicrobial infections in NF cases,[5] implicating a diverse array of bacterial species in disease pathogenesis. The most common organisms implicated in necrotising fasciitis are Bacteroides, aerobic streptococci, staphylococci, Enterococci, Clostridium and gram-negative rods.[2] There are two types of necrotising fasciitis, classified on the basis of microbiological growth: Type 1 infections (Polymicrobial) with a combination of aerobic and anaerobic organisms and Type 2 infections (Monomicrobial).[6] A third type is reserved for myonecrosis caused by Clostridial infections. The LRINEC scoring system serves as a valuable tool in identifying disease severity and guiding therapeutic interventions.[7] However, its application must be tempered with clinical judgment, considering its inherent limitations and the dynamic nature of NF progression. Emerging modalities, including advanced imaging techniques (MRI, CT), and innovative wound care approaches (negative pressure wound therapy, tissue engineering), offer promising avenues for enhancing diagnostic accuracy and optimising therapeutic outcomes in NF.8 Additionally, multidisciplinary rehabilitation programs play a pivotal role in addressing long-term sequelae and improving overall patient quality of life post-NF.

Our study findings corroborate the significant impact of comorbidities, advanced age, and gender on NF outcomes.[9] Diabetes mellitus emerged as the most prevalent comorbidity, associated with adverse outcomes and prolonged hospital stays. Similarly, advanced age and male gender were identified as risk factors for NF, aligning with previous research findings.[10] These observations underscore the importance of tailored management approaches that account for individual patient characteristics and underlying health conditions.

CONCLUSION

A comprehensive understanding of the multifaceted nature of NF is paramount for effective management and improved patient outcomes. Early recognition, prompt intervention, and multidisciplinary collaboration are essential components of successful NF management strategies, aimed at mitigating morbidity and mortality associated with this life-threatening condition. Necrotising fasciitis, although rare, poses a significant threat due to its potential for rapid deterioration and systemic toxaemia. Our study highlights the critical importance of early diagnosis and aggressive management strategies in mitigating patient morbidity and mortality associated with this devastating condition.

Our findings underscore several key epidemiological and clinical observations. Specifically, we observed a higher incidence of necrotising fasciitis in individuals aged over 50 years, with a notable male predominance. Furthermore, our microbiological analysis revealed Streptococcus pyogenes and Escherichia coli as the predominant pathogens implicated in the disease process. Importantly, we identified diabetes mellitus as the most common comorbidity associated with necrotising fasciitis, emphasising the significance of prompt control of this condition in NF management protocols. Based on our findings, we advocate for a multidisciplinary approach that prioritises early recognition, aggressive surgical intervention, and supportive therapy as essential components of effective NF management strategies.

Further research into novel diagnostic modalities and therapeutic interventions is warranted to enhance our understanding and management of this challenging condition. By implementing proactive measures and adopting a comprehensive approach to patient care, we can strive to improve outcomes and reduce the burden of necrotising fasciitis on affected individuals and healthcare systems alike.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interests that would prejudice the impartially of this scientific work.

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