

Laboratory Risk Indicator for Necrotizing Fasciitis Score and their Outcomes

Dr Mohd Faizal Ansari¹, Dr. Sukhwinder Singh, Dr. R K Verma³, Dr. A V Mathur⁴

¹PG - 3

²Assistant Professor, Department of General Surgery

³Professor, Department of General Surgery

⁴Professor, Department of General Surgery

Abstract: *Background:* Necrotizing fasciitis (NF) poses a significant threat to life. Timely identification and surgical intervention are crucial factors associated with a higher survival rate. The Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) score, a laboratory - based tool, holds promise in averting adverse health outcomes, yet its effectiveness is a subject of debate. Reassessment is essential to validate and establish its utility in preventing morbidity and mortality. *Methods:* This study was conducted in Shri Mahant Indresh Hospital. Patients exhibiting signs and symptoms indicative of necrotizing fasciitis were admitted and provided with counselling for the investigation and treatment of necrotizing fasciitis and its associated complications. Information on patient characteristics and soft - tissue infection covariates was collected using a semi - structured pro forma. *Results:* Repeated surgical debridement and amputation and mortality were common in patients of NSTI with LRINEC score of ≥ 8 . These factors were found statistically significant for repeated debridements. The laboratory risk indicator for necrotizing fasciitis that showed statistically significant differences in LRINEC scores between the two groups were Total leucocyte count ($p < 0.05$), hemoglobin ($p < 0.05$), serum creatinine ($p < 0.05$), serum sodium ($p < 0.05$) and serum glucose ($p < 0.05$). *Conclusion:* The LRINEC score, which relies on easily accessible laboratory data, serves as a valuable and straightforward tool for prognostic prediction and risk stratification in cases of necrotizing fasciitis. The LRINEC score proves that days of hospitalization increased, higher chances of ICU stay, higher incidence of re - debridement, higher rate of amputation and grafting with higher score.

Keywords: Necrotizing fasciitis, LRINEC score, Laboratory risk indicator for necrotizing fasciitis

1. Introduction

Cases of necrotizing soft tissue infections have been recorded throughout history, and one of the earliest documented instances can be traced back to Hippocrates in the 5th century BC. In his writings, he described cases where individuals developed erysipelas, a severe skin infection, after seemingly minor accidents. These infections resulted in significant tissue loss, including flesh, sinews, and bones, leading to a considerable number of fatalities.^{1, 2} These infections encompass a wide range of clinical conditions, spanning from mild pyoderms to severe, life - threatening necrotising fasciitis. While streptococcal and staphylococcal species are the primary culprits in most cases, numerous other microorganisms have also been associated with these infections.³

In 1952, Wilson introduced the term 'necrotising fasciitis' to describe the primary feature of this infection, which involves the death of the fascia² and subcutaneous tissue while typically leaving the underlying muscle relatively unaffected.⁴ If not promptly identified and treated, this condition can advance swiftly, leading to systemic toxicity and in severe cases, fatality. When there's suspicion of this infection, the approach should include swift resuscitation, early surgical removal of affected tissue and the administration of broad - spectrum intravenous antibiotics.

An estimated 13 out of every million people are hospitalized annually due to necrotising fasciitis and tragically, 20.0 - 30.0% of these cases result in fatalities. Without the right

diagnosis and prompt treatment, the mortality rate can skyrocket to 100.0%.⁵ The most prevalent risk factors associated with necrotising fasciitis include diabetes mellitus (DM), immunodeficiency disorders, substance abuse and malnutrition.⁶ This type of infection can develop from a minor wound or even without any apparent trigger.⁷

Dependence solely on a physical examination for diagnosis presents considerable challenges. Although diagnostic tools like magnetic resonance imaging (MRI), computed tomography (CT), and frozen section biopsy can assist in the early detection of necrotizing fasciitis, their cost and limited availability impose constraints on their routine use for evaluating soft tissue infections.⁸ The Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) is a scoring system derived from six commonly conducted laboratory tests. Originally designed, it serves the purpose of facilitating the early differentiation of necrotizing fasciitis from other severe soft tissue infections.⁹ Numerous studies have examined the effectiveness of the LRINEC score in promptly diagnosing necrotising fasciitis. These studies have concluded that the LRINEC score can effectively identify and categorize patients with necrotising fasciitis into different risk groups, thus helping allocate hospital resources more appropriately for their management.¹⁰ Nonetheless, only a limited number of studies have detected a connection between LRINEC scoring values and patient outcomes in cases of necrotising fasciitis.¹¹

The use of diagnostic scoring systems holds promise in preventing significant morbidity and mortality by ensuring

the precise identification of necrotising fasciitis. Up to this point, there have been no comprehensive literature reviews that have reached a consensus regarding the LRINEC score. We aimed to investigate the outcomes associated with the Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) score. The present study is done in all the patients who were diagnosed as a case of necrotising soft tissue infection. Patients' clinical presentation, associated risk factors, causative organisms and their response to treatment and need for surgical intervention and course in the hospital in response to treatment were studied as per protocol, and the factors associated with morbidity and mortality were analysed.

2. Methods

This hospital - based observational prospective study on 100 patients of Necrotizing Soft Tissue Infection (NSTI) presenting over 18 months at Shri Mahant Indires Hospital was done. The study included all patients diagnosed with necrotizing fasciitis based on clinical assessments, while those with non - necrotizing soft tissue infections and individuals who declined to provide informed consent for participation were excluded from the study. All eligible patients received thorough counselling and were provided with clear explanations regarding the study's nature and objectives. Stringent measures were implemented to ensure the utmost confidentiality and privacy. Data was collected as per the proforma which included detailed history and examination of the patients. The participants were informed that the study aimed to gain a deeper understanding of their condition, improve treatment approaches, and evaluate its outcomes. Written consent was obtained from all participants who agreed to take part in the research. Complete history, examination, management and outcome of the NSTI were recorded as per the proforma attached.

Statistical Analysis:

Microsoft Excel was used in creating the database and producing graphs, and the Statistical Package for the Social Sciences (SPSS) version 23 for Windows was employed for data analysis. For quantitative data with a normal distribution, descriptive statistics such as mean and standard deviation (\pm SD) were utilized. The parametric independent Student's t - test was employed for comparing continuous data between two independent groups. The comparison of discrete (categorical) groups was conducted using the chi -

square (χ^2) test. Statistical significance was established at p values less than 0.05 ($p < 0.05$).

3. Results and Observation

All the 100 patients of the 10 to 75 years age group who presented with NSTI were studied and found that patients between 41 - 70 years of age were commonly affected in the case of NSTI (45%). Males are more commonly affected by NSTI (70%). Lower limbs are most commonly affected in NSTI (60%) (Table 1).

In our study, the prevailing organism identified was Staphylococcus aureus, with E. coli being the subsequent most frequently isolated organism in patients with necrotizing soft tissue infections (20% and 12%, respectively). No organism was isolated in 45% of patients in aerobic culture media. Repeated surgical debridement amputation and mortality was common in patients of NSTI with LRINEC score of ≥ 8 . These factors were found statistically significant for repeated debridements. The variables that showed statistically significant differences in LRINEC scores between the two groups were Total leucocyte count ($p < 0.05$), haemoglobin ($p < 0.05$), serum creatinine ($p < 0.05$), serum sodium ($p < 0.05$) and serum glucose ($p < 0.05$).

Table 1: Demographic details and baseline characteristics

Variables	No. of cases (n=100)	Percentage	
Age in years	≤ 30	16	16
	31 - 40	20	20
	41 - 50	13	13
	51 - 60	22	22
	61 - 70	23	23
Progression of disease (days)	≤ 7	39	39
	> 7	61	61
Site involvement	Abdomen	2	2
	Perineum	18	18
	Buttock	12	12
	Lower limb	60	60
	Upper limb	8	8
LRINEC Score	≤ 5	46	46
	6 - 7	11	11
	≥ 8	43	43

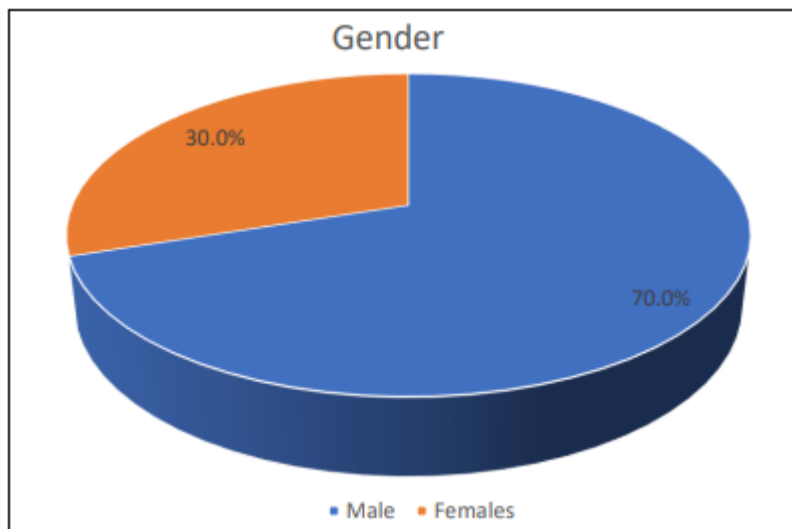


Figure 1: Distribution of patients on the basis of gender

Table 2: Correlation of blood parameters findings with LRNIC Score

Variables		LRNIC Score			p - value
		≤5 (n=46)	6 - 7 (n=11)	≥8 (n=43)	
C - Reactive Protein (CRP) (mg/L)	≤150	46	11	43	1.00
	>150	0	0	0	
Total leucocyte count (per mm ³)	<15				<0.001
	15 - 25	14	0	0	
	>25	32	8	6	
Haemoglobin levels (g/dl)	>13.5	0	3	37	<0.001
	11.1 - 13.5	3	0	0	
	<11.0	43	11	43	
Serum Sodium (mmol/L)	≥135	43	0	0	<0.001
	<135	3	11	43	
Serum Creatinine (mg/dl)	≤1.6	40	5	0	<0.001
	>1.6	6	6	43	
Serum Glucose (mg/dl)	≤180	46	9	32	<0.001
	>180	0	2	11	

Table 3: Association of LRNIC Score with duration of stay

Variables		LRNIC Score			p - value
		≤5 (n=46)	6 - 7 (n=11)	≥8 (n=43)	
Length of hospitalization (days)	≤10	43	5	4	<0.001
	11 - 20	3	6	27	
	>20	0	0	12	
ICU Stay	Yes	0	1	16	<0.001
	No	46	10	27	

Table 4: Association between LRNIC Score and need for debridement, need for re surgery (grafting), need for amputation and Mortality

Variables		LRNIC Score			p - value
		≤5 (n=46)	6 - 7 (n=11)	≥8 (n=43)	
Need for debridement	Yes	1	9	43	<0.001
	No	45	2	0	
Need for grafting	Yes	0	3	23	<0.001
	No	46	8	20	
Need for amputation	Yes	0	0	6	<0.001
	No	46	10	38	
Mortality	Yes	0	0	3	0.150
	Discharged	46	11	40	

Table 5: Table showing Sensitivity, Specificity and Accuracy of the LRINEC score in detecting the Mortality

Statistic	Value
Cut - off	6.5
Sensitivity	100%
Specificity	52.60%
Accuracy	91.60%

4. Discussion

The diagnosis of NF primarily relies on clinical examination, which can be challenging due to its resemblance to other skin and soft tissue infections. Therefore, in 2004, Wong CH et al¹² introduced a scoring system known as LRINEC and they showed that it is useful for 75 distinguishing NF from other SSTIs. Subsequent studies have demonstrated the effectiveness of the LRINEC score in promptly diagnosing NF. To calculate the LRINEC score, parameters such as haemoglobin levels, total leukocyte count, serum sodium, serum creatinine, C - reactive protein, and blood glucose levels are assessed upon admission, resulting in a specific score. A score of ≥ 6 is considered highly suggestive of NF.^{13, 14} A higher LRINEC score (≥ 8) is associated with a decreased survival rate in patients with NF.

In the present study, the majority of the cases were in the age group ranging from 51 to 70 years (45.0%) and with male predominance (70.0%). The progression of the disease was for more than 7 days in 61.0% cases. In 60.0% cases the site of involvement was lower limb. LRINEC was more than equals to 8 in 43.0% cases whereas less than equals to 5 in 46.0% cases. Our findings were in accordance with **Mukhopadhyay M et al¹⁵** who reported mean age as 48.7 years (range 27 - 75 years) by 46.57 years (range 15 - 83 years), 51 male (85.0%) and 9 female patients (15.0%) in their findings and 56.6% lower limb site involvement by **Kalaivani V et al¹⁶**, and 55 years by **Latifi R et al.¹⁷**

Gupta M et al¹⁸ who reported that they have enrolled a total of 36 patients of NSTI with a mean age of 52.9 ± 13.6 years with the most affected age group of 41 - 50 years. The study included 28 (77.7%) male, and 8 (22.23%) female patients with NSTI. **Harikrishnan CP et al¹⁹** also reported 90.0% male patients and 10.0% female whereas **Zhao JC et al²⁰** reported 82.0% male and 18.0% female patients. **El - Menyar A et al²¹** who found that lower limbs were majorly infected (49.0%) followed by Perineum & genitalia (35.3%). According to **Saini N et al²²** most commonly affected site in NSTI is the lower limb (63.33%), followed by the upper limb (16.67%), scrotum/perineum (13.33%), and abdominal wall (6.67%). According to **Gupta M et al¹⁸** most of the patients reported NSTI of lower limb 24 (58.5%) followed by trunk 10 (24.3%), perineum 4 (9.7%), and upper limb 3 (7.3%)

In our study it was found that out of 100 patients, 46 patients (46%) who have < 6 LRINEC score and 54 patients (54%) have ≥ 6 LRINEC score. The variables that showed statistically significant differences in LRINEC scores between the two groups were Total leucocyte count ($p < 0.05$), haemoglobin ($p < 0.05$), serum creatinine ($p < 0.05$), serum sodium ($p < 0.05$) and serum glucose ($p < 0.05$). This shows that the cases with LRINEC of more than 6 had abnormal blood parameters. Our findings were comparable to the findings of **Saini N et al²²** who reported mean blood glucose was 124.03 ± 29.05 , Hb was 10.16 ± 2.29 , S. Cr was 1.87 ± 1.69 , S. Sodium was 131.63 ± 5.2 and mean TLC was 17008.67 ± 6174.57 . LRINEC ≥ 6 was in 56.67%. **Syed A et al²³** reported in their study that 25 patients had a LRINEC score of ≥ 6 (56.8%) and 19 patients had a LRINEC score of

< 6 . For LRINEC score calculation, HB%, TLC, serum sodium, serum creatinine, C - reactive protein and blood glucose values of the patient are measured on admission. Score of ≤ 6 indicated the most likely diagnosis of NF. A strong positivity for NF from laboratory findings was observed with elevated CRP, elevated WBC, low haemoglobin, decreased sodium, and increased creatinine. Depending on the severity, treatment differed from patient to patient. Still the essential steps in the treatment are early diagnosis, surgical debridement, amputation of extremity in high - risk patients, wound care, antimicrobial therapy, and intensive supportive care.²⁴

The patients with a LRINEC score of ≥ 6 was more likely to have a prolonged hospitalization, with 45.0% of them staying in the hospital for more than 10 days, Length of hospitalization shows a statistically significant difference with LRINEC scores ($p < 0.05$). Patients with an LRINEC score of ≥ 6 were more likely to require ICU admission, with 17 cases needing ICU care, compared to 0% of patients with a LRINEC score of < 6 . ICU stay shows a statistically significant difference with LRINEC scores ($p < 0.05$). Need of amputation, mortality, need of debridement and need of grafting was significantly higher in LRINEC score of ≥ 6 . **Su YC et al²⁵** in Taiwan shows patients with a LRINEC score of more than or equal to 6 have a higher mortality rate as well as an amputation rate. **Corbin V et al²⁶** in France shows that in patients with LRINEC score above 6, the complication rate was higher than, in patients with a score below 6. **Colak E et al²⁷** in turkey, the mean number of debridement and LRINEC score was higher in the non - surviving group. **Gupta M et al¹⁸** reported that among the 18 patients with an LRINEC score of ≤ 8 , no instances of mortality were observed. In contrast, among the 18 patients with an LRINEC score > 8 , there was a reported mortality of 5 (27.8%) with a significance value of 0.016. Regarding morbidity, there were no cases of amputation when the LRINEC score was below 8, but in the LRINEC score > 8 group, 4 cases (22.2%) of amputation were reported, showing a significance value of 0.034. **Swain R et al²⁸** retrospectively studied patients with necrotising fasciitis over a five - year period, recruiting 15 patients with the disease between 2006 and 2011. Of these patients, the mean LRINEC score varied for patients who survived and those who died. The LRINEC score was comparatively higher for patients who died (LRINEC 9) versus those who survived (LRINEC 6.5) with necrotising fasciitis.

The cutoff value of LRINEC in our study was 6.5 with sensitivity 100.0%, specificity 52.6% and accuracy 91.6%. It had lower specificity (52.6%), meaning that it had a higher false - positive rate. The overall accuracy of the test was 91.6%, indicating that it had a high overall correct classification rate. The probability of having NF in patients with a LRINEC score of 6 or higher was calculated as 92.0% in the study of **Su Y et al.²⁵**

Wong C et al²⁹ reported that mortality also significantly increases in patients with LRINEC score of 6 or higher and sensitivity to be 89.9% and specificity to be 96.9%. The NPV and PPV of LRINEC score in predicting NF were found to be 96.0% and 92.0%, respectively, in their study. Holland studied a group of 28 patients who had received

surgery because of suspected NF. Ten patients were diagnosed with NF postoperatively. The results showed a sensitivity of 80.0%, specificity of 67.0%, positive predictive value of 57.0% and negative predictive value of 86.0%.³⁰

Biswas M and Ray B³¹ reported in their study that receiver operator curve for LRINEC score for predicting conservative management shows a cut - off value of LRINEC score ≤ 6 with Area under the ROC (AUC) of 0.820, sensitivity of 81.8% and specificity of 98%. In a study by **Narasimhan et al³²**, they found the sensitivity in detecting necrotizing fasciitis (NF) to be 76.3% and specificity of 88.1% In a study by **Zacharias N et al³³** reported sensitivity of 100.0% and specificity of 50.0%.

LRINEC score greatly helped in the categorization of patients into different risk groups, planning of treatment modality and prediction of outcome. The management of NSTI and LRINEC scores will greatly help in predicting necrotizing soft tissue infections. Because of its cost - effectiveness, availability and ease of use, it is recommended to be a part of the holistic approach to the treatment of necrotizing soft tissue infections.

5. Conclusion

Necrotizing fasciitis is an extremely aggressive condition necessitating prompt therapeutic intervention to enhance patient outcomes, setting it apart from milder soft tissue infections. This affliction predominantly affects males in their fourth to sixth decades of life. The LRINEC score, which relies on easily accessible laboratory data, serves as a valuable and straightforward tool for prognostic prediction and risk stratification in cases of necrotizing fasciitis. The LRINEC score proves that days of hospitalization increased, higher chances of ICU stays, higher incidence of re - debridement, higher rate of amputation and grafting with higher score. Incorporating the management of necrotizing soft tissue infections alongside LRINEC scores is instrumental in forecasting these conditions. Given its cost - effectiveness, accessibility, and ease of use, we recommend its inclusion as a vital component of the holistic approach to treating necrotizing soft tissue infections.

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