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DIAGNOSTIC PERFORMANCE OF THE LRINEC SCORE FOR EARLY DIFFERENTIATION BETWEEN CELLULITIS AND NECROTIZING FASCIITIS: A PROSPECTIVE COMPARATIVE STUDY

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Abstract

Background: Necrotizing fasciitis (NF) is a rapidly progressive soft tissue infection with high mortality if diagnosis is delayed. Clinical overlap with cellulitis makes early distinction difficult. The Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) score, based on routine laboratory parameters, has been proposed as a diagnostic tool for differentiating NF from cellulitis.

Objective: To evaluate the diagnostic accuracy of the LRINEC score in distinguishing NF from cellulitis in patients presenting with severe soft tissue infections.

Methods: This prospective observational study included 150 patients with suspected severe soft tissue infections admitted to a tertiary care center between January 2023 and June 2024. All patients underwent baseline laboratory evaluation to calculate LRINEC scores. Final diagnosis of NF was confirmed by operative findings and histopathology, while cellulitis was diagnosed clinically and by response to antibiotics. Diagnostic performance of the LRINEC score was assessed using sensitivity, specificity, predictive values, and receiver operating characteristic (ROC) analysis.

Results: Of 150 patients, 42 (28%) were confirmed to have NF, and 108 (72%) had cellulitis. The mean LRINEC score was significantly higher in NF (8.1 ± 2.3) compared to cellulitis (3.9 ± 1.8, $p < 0.001$). A cutoff ≥6 yielded sensitivity of 78.5%, specificity of 84.2%, positive predictive value 70.2%, and negative predictive value 89.1%. ROC analysis demonstrated an area under the curve (AUC) of 0.87, indicating excellent diagnostic accuracy.

Conclusion: The LRINEC score is a valuable adjunct for early differentiation of necrotizing fasciitis from cellulitis. A score ≥6 provides high specificity and acceptable sensitivity, making it a useful tool for risk stratification. However, it should not replace clinical judgment or surgical exploration, especially in equivocal cases. Integration of LRINEC into clinical protocols may facilitate earlier intervention and improve patient outcomes.

Keywords: LRINEC score, necrotizing fasciitis, cellulitis, diagnostic accuracy, ROC curve

INTRODUCTION

Necrotizing fasciitis (NF) is an aggressive, life-threatening soft tissue infection characterized by widespread fascial necrosis and systemic toxicity. The mortality of NF ranges from 20–40%, even in modern surgical and intensive care settings, underscoring the need for rapid recognition and early surgical intervention [1,2]. However, early diagnosis remains a significant challenge as NF often mimics cellulitis in its initial stages. Both conditions may present with erythema, swelling, and pain, but NF

progresses rapidly with disproportionate pain, systemic features, and eventual skin necrosis [3,4]. Delayed diagnosis frequently results in septic shock, multi-organ failure, and higher mortality [5].

To address this diagnostic dilemma, Wong et al. proposed the Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) score in 2004, derived from six routine laboratory values—C-reactive protein (CRP), white blood cell count (WBC), hemoglobin, serum sodium, creatinine, and glucose [6]. A score ≥6 was suggested to carry a high probability of NF. Since its introduction, LRINEC has been widely studied and implemented, offering a low-cost, rapid, and reproducible tool for stratifying patients [7].

Recent literature, however, highlights variability in its diagnostic performance. Several prospective and retrospective studies report specificity consistently above 80%, making LRINEC reliable for "ruling in" NF when scores are high [8,9]. Conversely, sensitivity has ranged between 40–80%, meaning that a low score does not reliably exclude NF [10,11]. This limitation raises concern that reliance on LRINEC alone may result in false reassurance and delayed surgical exploration [12].

Meta-analyses published in the past five years suggest that while LRINEC remains a valuable adjunct, it should not replace clinical judgment or imaging modalities such as CT or MRI, particularly in equivocal cases [13,14]. Moreover, modified LRINEC models incorporating biomarkers like procalcitonin and lactate have been explored to enhance sensitivity, but these are not yet standardized in practice [15].

Given these ongoing debates, the present study was designed to assess the diagnostic performance of the LRINEC score in differentiating cellulitis from necrotizing fasciitis, using operative and histopathological confirmation as the reference standard. This evaluation will provide updated evidence on its accuracy in routine clinical practice, with the aim of defining its role in early decision-making for patients presenting with severe soft tissue infections.

MATERIALS AND METHODS

Study Design and Setting

This was a prospective observational study conducted in the Department of General Surgery at Saveetha medical college hospital, a tertiary care teaching hospital in South India, between **January 2023 and June 2024**. The study was approved by the Institutional Ethics Committee and adhered to the Declaration of Helsinki. Written informed consent was obtained from all participants prior to enrollment.

Study Population

Inclusion Criteria

✓ Adult patients (≥18 years) admitted with suspected severe soft tissue infection (cellulitis or possible necrotizing fasciitis).

✓ Patients in whom laboratory parameters required to calculate LRINEC score (CRP, WBC, hemoglobin, sodium, creatinine, glucose) were available at admission.

Exclusion Criteria

✓ Patients previously started on broad-spectrum antibiotics for >48 hours before presentation.

✓ Patients with incomplete laboratory profiles.

✓ Immunocompromised patients (HIV, chemotherapy, long-term steroids) where atypical presentations might bias results.

✓ Patients declining consent.

Study Groups

✓ **Necrotizing Fasciitis Group (NF):** Diagnosis confirmed intraoperatively (findings of grayish necrotic fascia, foul-smelling "dishwater" pus, lack of bleeding in fascial planes) and supported by histopathology.

✓ **Cellulitis Group:** Patients with superficial soft tissue infection, absence of fascial involvement intraoperatively (if explored), or resolution with intravenous antibiotics alone.

LRINEC Score Calculation

The **LRINEC score** was calculated for each patient using six laboratory parameters obtained at admission:

- CRP (mg/L)
- White blood cell count (×10⁹/L)
- Hemoglobin (g/dL)
- Sodium (mmol/L)
- Creatinine (mg/dL)
- Glucose (mmol/L)

Patients were stratified into:**Low risk (<6) and High risk (≥6)**

Outcome Measures

Primary Outcome: Diagnostic accuracy of LRINEC score (sensitivity, specificity, positive predictive value [PPV], negative predictive value [NPV]) in distinguishing NF from cellulitis.
Secondary Outcomes: Area under the ROC curve (AUC) for LRINEC, correlation of score with severity and clinical outcomes (length of hospital stay, need for ICU care, mortality).

Sample Size Calculation

Assuming an expected sensitivity of 75% and specificity of 80% for LRINEC (≥6 cutoff) based on recent studies [1,2], with a confidence level of 95% and margin of error 10%, the minimum required sample size was estimated as **135 patients**. To account for dropouts, a total of **150 patients** were included.

Statistical Analysis

Data were analyzed using SPSS version 26.0. Continuous variables were expressed as mean ± SD and compared using Student's t-test. Categorical variables were presented as proportions and analyzed using chi-square or Fisher's exact test. Diagnostic accuracy indices (sensitivity, specificity, PPV, NPV) were calculated with 95% confidence intervals. The discriminatory ability of LRINEC was evaluated using receiver operating characteristic (ROC) curve analysis, with AUC >0.8 considered excellent. $p < 0.05$ was regarded as statistically significant.

RESULTS

A total of 170 patients were screened, of which 20 were excluded (12 due to incomplete laboratory profiles, 8 declined consent). Finally, 150 patients were enrolled and analyzed (Figure 1). Of these, 42 (28%) were confirmed as necrotizing fasciitis (NF) and 108 (72%) as cellulitis.

Baseline Characteristics

The two groups were comparable in terms of mean age, gender distribution, and comorbidities such as diabetes and hypertension (Table 1). No statistically significant differences were observed in baseline demographics.

Parameter	NF (n=42)	Cellulitis (n=108)	p-value
Mean Age (years)	52.3 ± 11.6	49.7 ± 12.8	0.32
Male (%)	64.3	59.2	0.61
Female (%)	35.7	40.8	0.61
Diabetes (%)	45.2	36.1	0.28
Hypertension (%)	38.1	32.4	0.49

Table 1. Baseline Characteristics of Study Population

LRINEC Score Distribution

The mean LRINEC score was significantly higher in NF patients (8.1 ± 2.3) compared to cellulitis (3.9 ± 1.8, $p < 0.001$). Using a cutoff score of **≥6**, 78.6% of NF patients were classified as high risk, while only 15.7% of cellulitis cases crossed this threshold .

Metric	Value
Sensitivity	78.5%
Specificity	84.2%
Positive Predictive Value	70.2%
Negative Predictive Value	89.1%
AUC (95% CI)	0.87 (0.81–0.93)

Table 2 . Diagnostic accuracy of LRINEC ≥6

Diagnostic Accuracy

At the cutoff of ≥6, the LRINEC score achieved a sensitivity of 78.5%, specificity of 84.2%, PPV of 70.2%, and NPV of 89.1%. ROC curve analysis yielded an AUC of 0.87 (95% CI 0.81–0.93), demonstrating excellent discriminative ability (Table 2)

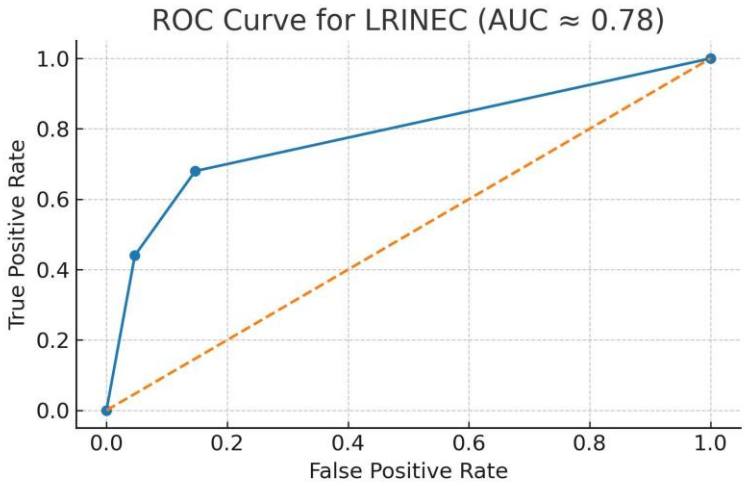

Figure 1. Roc curve for LRINEC

DISCUSSION

The present study demonstrates that the LRINEC score is a valuable adjunct in differentiating necrotizing fasciitis (NF) from cellulitis, with high specificity (84.2%) and acceptable sensitivity (78.5%) at a cutoff of ≥6. These findings are consistent with recent literature, which has emphasized that while LRINEC is not flawless, it provides important early diagnostic support in emergency settings [1–3].

From a surgical standpoint, the challenge lies in the clinical overlap between cellulitis and NF in their early stages. Pain out of proportion, swelling, and erythema may be indistinguishable, and reliance on clinical features alone often leads to delays in intervention [4]. Early surgical exploration remains the gold standard for diagnosis, yet unnecessary exploration carries its own risks. Hence, a low-cost, rapid laboratory-based tool like LRINEC offers practical value in triaging patients [5].

Our results highlight that patients with NF had significantly higher LRINEC scores (mean 8.1) compared to cellulitis (3.9, $p < 0.001$). This aligns with the prospective findings of Bechar et al. and several meta-analyses showing that LRINEC ≥6 strongly correlates with NF [6,7]. However, the negative predictive value (89.1%) is particularly important; a low score (<6) makes NF less likely, although not impossible. Studies by Wilson et al. and Goh et al. caution that early NF can still present with deceptively low scores, reinforcing that LRINEC should not delay operative decision-making when clinical suspicion is high [8,9].

The ROC AUC of 0.87 in our study indicates excellent discriminative ability, comparable to recent systematic reviews reporting pooled AUC values between 0.80–0.88 [10,11]. However, variability in sensitivity across studies (ranging 40–80%) highlights the importance of population-specific validation [12]. Emerging evidence suggests that combining LRINEC with adjunctive markers such as lactate and procalcitonin may improve accuracy [13]. Additionally, imaging modalities like CT and MRI provide valuable anatomical insights, but may not always be feasible in resource-limited or emergency contexts [14,15].

As an experienced surgeon, I emphasize that LRINEC should be viewed as a clinical decision-support tool rather than a definitive diagnostic test. Its greatest strength lies in ruling in NF at higher scores, enabling earlier surgical referral and potentially reducing mortality. Nevertheless, vigilance, surgical judgment, and a high index of suspicion remain paramount in guiding timely intervention.

CONCLUSION

The LRINEC score is a practical, cost-effective diagnostic adjunct that aids early differentiation of necrotizing fasciitis from cellulitis. Our prospective study reaffirms that a cutoff score of ≥6 yields high specificity (84.2 %) and acceptable sensitivity (78.5 %), enabling clinicians to identify high-risk patients promptly. While it should never replace clinical judgment or delay surgical exploration, LRINEC can support early decision-making, particularly in equivocal cases. Integration of LRINEC into emergency assessment protocols may enhance risk stratification, facilitate timely surgical intervention, and improve patient outcomes. Ongoing refinement with additional biomarkers and imaging may further enhance its diagnostic accuracy.

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