

Original Research Article

Correlation of the laboratory risk indicators for necrotizing fasciitis (LRINEC) score with the clinical features and surgical management of necrotizing soft tissue infections

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ABSTRACT

Background: Necrotizing fasciitis (NF) is a devastating soft tissue infection associated with potentially poor outcomes. The Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) score has been introduced as a diagnostic tool for NF. We aimed to correlate the clinical features of NSTI with the LRINEC score, its application to distinguish Necrotizing Fasciitis (NF) from other non NSTI and its utility in early surgical management of NSTI.

Methods: Patients were evaluated for various symptoms and signs at the time of admission and certain laboratory parameters were assessed. LRINEC score was then calculated. Correlation of the management and severity of infections with respective LRINEC score was then found out.

Results: LRINEC score for predicting conservative management of NSTI has a sensitivity of 81.8% and specificity of 98% while for predicting amputation and mortality shows a sensitivity of 100% and specificity of 84.5%.

Conclusions: The LRINEC score is a robust score capable of detecting even clinically early cases of necrotizing fasciitis.

Keywords: Infections, LRINEC, Necrotizing, Soft tissue

INTRODUCTION

Necrotizing Soft Tissue Infections (NSTI) are rapidly spreading inflammation and necrosis of skin, subcutaneous tissue and superficial fascia.^{1,2} NSTI are less common than subcutaneous abscess and cellulitis but are much more serious conditions whose severity may initially go unrecognized.

NSTI are characterized by the absence of clear boundaries or palpable limits which account for both the severity of the infection and frequent delay in recognizing its surgical nature. Lack of specific clinical features and characteristics in the early stages of disease is the main reason for the failure of early recognition of NSTI.³

Approximately 70 to 90 % of such infections are polymicrobial.⁴ NSTI are severe life-threatening soft tissue infection characterized by a fulminant course with high morbidity and mortality if not treated timely.⁵ Despite advances in modern medical and surgical care, its mortality ranges from 6 to 76 %.⁶ The differentiation of NSTI from other soft tissue infections is therefore critically important.

Although modalities such as ultrasonography, computed tomography, magnetic resonance imaging and frozen section biopsy have been shown to be useful in the early recognition of necrotizing fasciitis, routine application of these modalities in the evaluation of soft tissue infections has been limited by their cost and availability.⁷ The

mainstay of treatment of NSTI is early and complete surgical debridement with broad spectrum antibiotics, physiological support and a close intensive monitoring.⁸ Early recognition and aggressive serial debridement of all necrotic fascia and subcutaneous tissue are major prognostic determinants, and delay in operative intervention has been shown to increase morbidity and mortality.

Table 1: LRINEC score point.

| Laboratory parameter | LRINEC points |
|---|---------------|
| C-reactive protein (mg/l) | |
| < 150 | 0 |
| ≥ 150 | 4 |
| Total white blood cell count (μ l) | |
| < 15 | 0 |
| 15-25 | 1 |
| >25 | 2 |
| Hemoglobin (g/dl) | |
| >13.6 | 0 |
| 11-13.5 | 1 |
| < 10.9 | 2 |
| Sodium (mmol/l) | |
| ≥ 135 | 0 |
| < 135 | 2 |
| Creatinine (mg/dl) | |
| ≤ 1.6 | 0 |
| >1.6 | 2 |
| Glucose (mg/dl) | |
| ≤ 180 | 0 |
| >180 | 1 |

The Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) score (Table 1) described by Wong et al is one of the recently described diagnostic adjuncts for discriminating between necrotizing soft tissue infections and non-necrotizing soft tissue infections.⁹ It is based on routinely available laboratory investigations (Haemoglobin, Total Leukocyte Count, Blood Glucose, Serum Creatinine, Serum Sodium, C-reactive protein). Each variable if present provides a specific number of points towards the final score

The objectives of this study is to correlate the clinical features of NSTI with the LRINEC score, its application to distinguish Necrotizing Fasciitis (NF) from other non NSTI and its utility in early surgical management of NSTI.

METHODS

This study was conducted in the Department of Surgery in Vardhaman Mahavir Medical College and Safdarjung Hospital, over a period of 18 months. A total of 60 patients with severe soft tissue infections requiring admission and 48 hours antibiotics presenting to our

Emergency/Outpatient department meeting the inclusion criteria were taken for the study.

The patients were informed about the study and written informed consent for the same was taken. The study protocol was approved by the local ethical committee.

Inclusion criteria

- Severe soft tissue infections patients requiring admission and 48 hours intravenous antibiotics coming to emergency and OPD of Safdarjung hospital.

Exclusion criteria

- Patients with age less than 13 years.
- Patients having simple boil, carbuncle, small abscesses.
- Patients having diabetic foot.
- Patients having collagen vascular disease.
- Patients having any associated malignancy.
- Female patients having pregnancy.

Patients were evaluated for various symptoms and signs at the time of admission and certain laboratory parameters were assessed. LRINEC score was then calculated. Patients were managed according to the severity of infection with aggressive fluid therapy and IV antibiotics, early and prompt debridement, fasciotomy, serial debridement, daily dressings, amputations, skin grafting and secondary closure. Correlation of the management and severity of infections with respective LRINEC score was then found out.

Statistical analysis

The data collected was put into Microsoft Excel format and then analysed using the 21st version of Statistical Package for Social Sciences (SPSS) for Windows. Categorical variables were presented as numbers and continuous data was presented as Mean±standard deviation or median (min-max) as appropriate. The comparison between qualitative data was determined by applying Chi-square or Fischer exact test. The continuous data was compared by Student T-test wherever required. P value ≤ 0.05 was taken as significant.

RESULTS

Of the 60 patients enrolled in the study, majority of them were in the age group of 51-60 years (33.33%) and a mean age of 46.22±11.706 years. Male to female ratio was 3:1. Most common site affected by the disease was lower limbs (68.33%).

Most of the patients had multiple risk factors predisposing them to NSTI, the most common being smoking (80%) followed by alcohol (58.33%), trauma

(43.33%), renal disease (11.67%) and liver disease (8.33%). Majority of the patients presented with multiple symptoms, most common being fever 52 patients (86%), tenderness 47 patients (78%), erythema 44 patients (73%), blackish discolouration 37 patients (61%), tachycardia 32 patients (53%) and bullae 23 patients (38%). The median LRINEC score in present study was 9. Of the 60 patients in present study (Table 2), 11 patients (18.3%) were treated conservatively with a mean LRINEC score of 6.36 ± 2.84 and belonged to the low risk category. 18 patients (30%) underwent extensive/serial debridement with a mean score of 8.67 ± 1.28 . 14 patients (23.33%) had to undergo fasciotomy with a mean score of 7.93 ± 0.92 . Amputation was performed in 16 patients

(26.67%) with a high mean score of 10.56 ± 1.03 and belonged to the high-risk category.

Table 2: Correlation of mean LRINEC score with various treatment modalities of NSTI.

| Management | No. of patients | Mean score \pm SD | P value |
|-------------------|-----------------|---------------------|---------|
| Conservative | 11 | 6.36 ± 2.84 | 0.001 |
| Debridement | 18 | 8.67 ± 1.28 | 0.948 |
| Fasciotomy | 14 | 7.93 ± 0.92 | 0.038 |
| Amputation | 16 | 10.56 ± 1.03 | <.0005 |
| Skin grafting | 16 | 8.69 ± 1.35 | 0.859 |
| Secondary closure | 13 | 7.85 ± 0.69 | 0.024 |

Table 3: Correlation between age, LRINEC score, duration of hospitalization.

| | | Age | LRINEC score | Duration of hospitalization |
|-----------------------------|-------------------------|---------|--------------|-----------------------------|
| Age | Correlation coefficient | | 0.678 | 0.162 |
| | Significance level P | | <0.0001 | 0.2154 |
| | N | | 60 | 60 |
| LRINEC score | Correlation coefficient | 0.678 | | 0.345 |
| | Significance level P | <0.0001 | | 0.0069 |
| | N | 60 | | 60 |
| Duration of hospitalization | Correlation coefficient | 0.162 | 0.345 | |
| | Significance level P | 0.2154 | 0.0069 | |
| | N | 60 | 60 | |

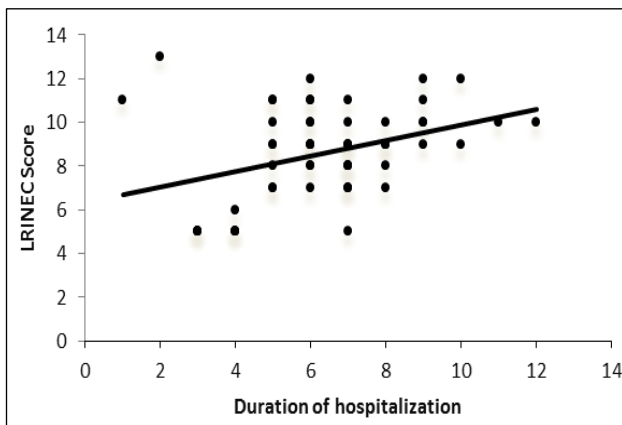


Figure 1: Correlation of LRINEC score with duration of hospitalization

Reconstructive procedures were performed in 29 patients with secondary closure in 13 patients (21.67%) and skin grafting in 16 patients (26.67%). Mean LRINEC in patients with secondary closure was lower than those with skin grafting (7.85 vs 8.69)

After applying Pearson correlation test, a higher LRINEC score was found to significantly correlate with longer

duration of hospitalization (Figure 1) (correlation coefficient of 0.345, p value 0.0069) (Table 3).

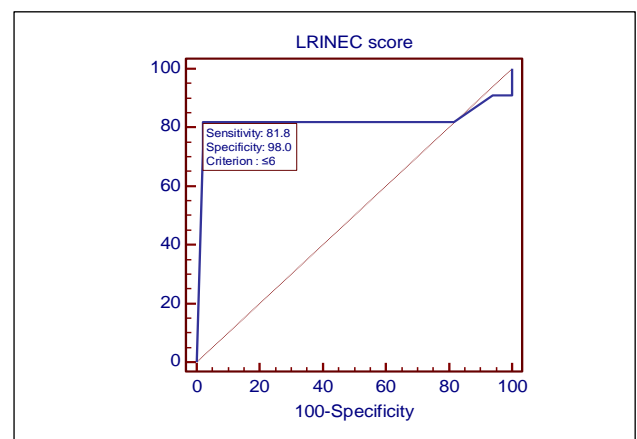


Figure 2: Area Under Curve for conservative management.

Receiver operator curve for LRINEC score for predicting conservative management shows a cutoff value of LRINEC score < 6 with Area under the ROC (AUC) of 0.820, sensitivity of 81.8% and specificity of 98% (Figure 2).

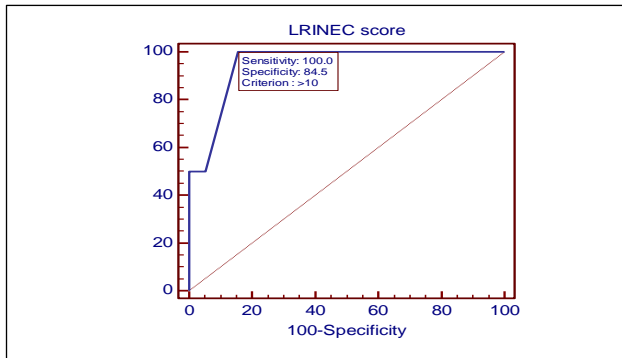


Figure 3: Area under curve for amputation and mortality

Finally, ROC for LRINEC score for predicting amputation and mortality shows a cut off value of LRINEC score > 10 with AUC of 0.948, sensitivity of 100% and specificity of 84.5% (Figure 3).

DISCUSSION

Necrotizing soft tissue infections are uncommon but life-threatening soft tissue infection characterized by a fulminant course and a high mortality.¹⁰ However, early clinical recognition of necrotizing fasciitis is difficult, as the disease is often indistinguishable from cellulitis or abscesses early in its evolution.

The knowledge of a precise NSTI classification, high clinical suspicion, differentiation between NSTI and non-NSTI early in its course and initial aggressive surgical treatment constitute the principles for successful management of this commonly encountered entity.¹¹

LRINEC score based on only six common biochemical laboratory parameters can stratify patients with soft tissue infections into necrotizing and non-necrotizing soft tissue infections.

Necrotizing soft tissue infections are associated with severe sepsis more often than non-necrotizing soft tissue infections. LRINEC score predicts the presence of NSTI based on the severity of sepsis and ultimately aiding in the early recognition of NSTI and its management.

Few studies have been done correlating LRINEC score with the clinical features of NSTI and using it in the early surgical management of this lethal entity. Present study design was simple and results comparable with other studies conducted before.

Majority of the patients in present study were in the age group of 51 – 60 years (33.33%) with a mean age of 46.22 ± 11.706 years which was comparable to studies conducted by Paramythiotis et al, Yi – Chun Su et al.^{12,6}

There was a male preponderance with a male to female ratio was 3:1. This was similar to that seen in the study

by Wall et al. In another study by Anaya et al, male to female ratio was found to be 3:2. The reason for this preponderance could be because of increased prevalence of predisposing factors like smoking, alcohol consumption and lower limb trauma in males.^{13,14}

In present study, most common site affected by the disease was lower limbs (68.33%) followed by scrotum/perineum (20%), upper limb (8.33%), and abdominal wall (3.33%).

Avalahalli et al also reported lower limb as the commonest site for NSTI (86% cases) in their study of 50 patients. In contrast to this, upper limb was the most common site afflicted in a study done by Wall et al. This can be attributed to the fact that most of the patients in that study were IV drug abusers (71%).^{15,13}

Most common risk factor in present study was smoking (80%). Compared to this, the most common risk factor in the study conducted by Wall et al was intravenous drug abuse (71%) while in the study by Yi – Chun Su et al, diabetes mellitus was the commonest predisposing factor. However, patients with diabetes mellitus were excluded from present study.^{13,6}

In present study, patients presented with many symptoms most common being fever (86%), tenderness (78%), erythema (73%), blackish discolouration (61%), tachycardia (53%) and bullae (38%).

Most of the patients presented with more than one symptom. In a 2015 study by Borschitz et al, 52% patients of NSTI had fever making it the most common symptom. 76% patients had more than one symptom. Compared to this, in the study by Yi – Chun Su, et al, the most common symptom was tenderness (86%), erythema (85%), tachycardia (47%), bullae formation (44%) and fever (33%).^{16,6}

Aggressive fluid therapy, early and aggressive surgical treatment were pivotal in outcome with 18 patients undergoing debridement, 14 patients undergoing fasciotomy and 16 patients requiring amputation (LRINEC score > 10) while 11 patients were managed conservatively on broad spectrum IV antibiotics (LRINEC score < 6). Skin grafting was done in 16 patients and secondary closure was achieved in 13 patients.

Unfortunately, 2 patients had presented late to us with signs of severe septic shock and multiorgan dysfunction syndrome, because of which surgical intervention could not be done in them, finally resulting in their death.

Watson et al carried out a review study in 33 patients of NSTI. Each patient required an average of two tissue debridement before reconstruction. Skin grafting including flap placement was done in 15 patients and amputation was done in 3 patients. 60% had a LRINEC

score > 6 and 40% had a score of < 6. In another study of 60 patients by Mukhopadhyay, amputation was needed only in the high-risk group. A mortality rate of 6.67% (4 patients) was also noted in this study.^{17,18}

The median LRINEC score in present study is 9. After applying Pearson correlation test, a higher LRINEC score was found to significantly correlate with a longer time to operation and longer duration of hospitalization.

Patients with LRINEC score of < 6 responded well to expectant management and had shorter hospital stay. Score between 6 to 10 needed aggressive and serial debridement and had longer hospital stay.

Score more than 10 was associated with grave outcome. Such patient needed limb sacrificing surgeries and in spite of best efforts mortality remains an issue. In the recent study by Borschitz, a modified LRINEC score has been suggested with incorporation of RBC count, serum fibrinogen level, pain, fever, pulse rate and acute renal injury.¹⁶

CONCLUSION

In developing countries, where resources are limited, precise clinical acumen has pivotal role in the management of NSTI and LRINEC score will greatly help in predicting necrotizing soft tissue infections. Because of its cost effectiveness, availability and ease of use, it is recommended as a part in the holistic approach of treatment of NSTI.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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