ORIGINAL ARTICLE

To assess the diagnostic accuracy of LRINEC Score for prediction of necrotizing fasciitis in patients presenting with clinical skin and subcutaneous tissue infections

Muhammad Riaz Shahid[1], Usman Ghani[1], Muhammad Ayub Ashraf[2], Fahd Rashid[1], Muhammad Shahid[1], Fahim Khattak[1]

[1]Combined Military Hospital, Kohat Pakistan
[2]Combined Military Hospital, Lahore Pakistan

ABSTRACT

Background: Necrotizing fasciitis is an inflammatory disease that causes the skin, soft tissues, and fascia to break down. A strain of *Streptococcus pyogenes* bacteria is frequently the source of it, however mixed infections involving coliforms, anaerobes, and Gram-negative bacteria can also be to blame. Even with contemporary medical care, necrotizing fasciitis is associated with a significant fatality rate. The objective of this study is to determine the diagnostic accuracy of the Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) score for predicting necrotizing fasciitis in patients with cutaneous and subcutaneous tissue infections.

Material and Methods: This Cross-sectional study was conducted at Combined Military Hospital, Rawalpindi from May 2021 to October 2022. Hundred cases of probable necrotizing fasciitis coupled with clinical cutaneous or subcutaneous infections were included. They underwent clinical examinations and blood investigation (Sodium, Hemoglobin, total white cell count, Glucose, Creatinine, C-reactive protein (CRP), and biopsy for histopathology). Patients under the age of 15 or older than 75, with soft-tissue infections, undergone surgical debridement and without the result of CRP in the initial 48 hours of retention were excluded. LRINEC score ≥6 was used for labelling a case with necrotizing fasciitis. LRINEC score was then compared with results of histopathology and sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated using SPSS version 23.

Results: 35 (35%) out of total belonged to the age group between 46-55 years. Male and female ratio were 64 (64%) and 36 (36%). Diabetes mellitus was the most common etiological cause occurring in 56 (56%) patients. The sensitivity of the LRINEC scoring system was 79.7% and the specificity noted was 87.8%. The PPV was 90.4% and the NPV came out to be 75%**.**

Conclusions: LRINEC scoring system has a significant sensitivity and reasonable specificity in diagnosing cases of Necrotizing fasciitis among patients with severe soft-tissue infection. LRINEC score can be used for predicting the outcome of such cases.

Keywords: Laboratory risk indicator for necrotizing fasciitis (LRINEC), Necrotizing fasciitis, Subcutaneous tissue infections

BACKGROUND

An inflammatory condition characterized by the destruction of fascia, skin, and soft tissues is known as necrotizing fasciitis. It is often caused by a strain of Streptococcus pyogenes bacteria[1] but may also be caused by mixed infections including anaerobes, coliforms, and Gram-negative bacteria.[2] There is a high mortality rate associated with necrotizing fasciitis, even with modern medical care.[3]

People with advanced age, diabetes, obesity, immunosuppression, smoking, malnutrition, and steroid therapy are more likely to have the disease.[4] 52.1% to 70.8% of patients with necrotizing fasciitis are caused or influenced by diabetes.[5] Intoxicated individuals often develop painful, red, and gangrenous skin due to diminished blood circulation, which can facilitate the spread of infection along the fascial plane. The infectious process can rapidly spread, causing infection of the fascia and perifascial planes as well as secondary infection of the overlying and underlying skin, soft tissue, and muscle.[6]

Necrotizing fasciitis is difficult to diagnose because of its overlapping clinical presentation of certain soft tissue diseases e.g., cellulitis. Physicians have had difficulty diagnosing it for decades. Although advances in

Correspondence: Dr. Muhammad Riaz Shahid, Registrar Surgery, Combined Military Hospital, Kohat Pakistan

Email: ali_riaz2515@yahoo.com

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treatment have greatly reduced necrotizing fasciitis mortality, still, it is high at 20 to 30%.[7]

It is possible to reduce morbidity and mortality rates of necrotizing fasciitis by early diagnosis and surgical treatment. In simple terms, the longer the delay, the more tissue is lost, and sepsis occurs, resulting in a higher death rate. Due to the lack of clinical symptoms of necrotizing fasciitis on the onset, patients with necrotizing fasciitis today have a high mortality rate which is increased by a lack of early diagnosis and treatment. Reducing the interval between presentation and definitive treatment can help in improved patient outcomes and this can be achieved by diagnosing the case early with accurate tests.[8]

An easy-to-follow standardized scoring system with high positive and negative predictive values is needed for early diagnosis of necrotizing fasciitis that can help us to treat the cases timely. According to Wong *et al.*[9], of A Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) scoring system in 2004, it demonstrated a 92% positive predictive value and a 96% negative predictive value for diagnosis necrotizing fasciitis. In their original proposal, Wall *et al.*[10] suggested Lrinec scoring system in 2000, which was then modified by Wong *et al.*[9] in 2004.

LRINEC scores are determined by the following few hematological and biochemical laboratory tests routinely performed in a laboratory. These include total white cell count, creatinine, hemoglobin, serum sodium, plasma glucose level, and C reactive protein (CRP).

We planned our study keeping in mind that our country Pakistan is a developing country with a high disease mortality rate (70%).[3] Our resources are scarce. So, we are in dire need of early diagnosis of necrotizing fasciitis that can help us to treat the cases timely, therefore, help us to reduce mortality and morbidity. So, we designed this study to determine the diagnostic accuracy of the LRINEC score in predicting necrotizing fasciitis in cutaneous and subcutaneous infections.

MATERIAL AND METHODS

A total of 100 patients during a period of 18 months (May 2021 to October 2022) were recruited in this cross-sectional study after taking approval from the institutional review board (IRB) via reference number 291 at the surgical department of Combined Military Hospital Rawalpindi. After a thorough literature search and by using the WHO calculator a sample size of 23 was obtained, keeping a 5% margin of error, 95% confidence level, prevalence of 0.015%, and power of the test of 80%.[11] A maximum number of available participants during the study period were recruited because a large number of cases of Necrotizing Fasciitis with Clinical Skin and Subcutaneous Tissue Infections were reported.

Patients who were suspected of having necrotizing fasciitis with clinical skin and subcutaneous tissue infections and had symptoms that suggested soft tissue infections underwent clinical examination and blood investigations. Patients with ages> 15 years and < 75 years belonging to either gender were included.

Patients under the age of 15 or older than 75. Patients who took a minimum of three antibiotic doses before a presentation or were on antibiotic therapy for the last 48 hours were also excluded. Cases with soft-tissue infections who have undergone surgical debridement were excluded too. Patients with burns or furuncles that do not appear to have cellulitis and patients without CRP results within the first 48 hours of reporting to hospital were excluded from the study.

Informed consent was obtained from all study participants and research was explained to them. Then after a thorough history taking, all consenting necrotizing fasciitis patients underwent investigations: A 5ml venous blood was obtained for analysis of Sodium, Total white cell count, Hemoglobin, Creatinine, C-reactive protein (CRP). Biopsy was obtained for histopathology. All laboratory investigations were conducted as per documented standard operating procedures of the institute. LRINEC ≥ 6 was used for establishing a diagnosis of necrotizing fasciitis. By using a 2×2 table data was entered in SPSS version 23 and was analyzed. Positive and negative predictive value (PPV, NPV) was determined. The gold standard test used for labeling patients with necrotizing fasciitis irrespective of the result of the LRINEC scoring system as a result of biopsy for histopathology. LRINEC scoring system used is shown in Table-I as below.

RESULTS

Out of 100 patients suspected of having necrotizing fasciitis, 35 (35%) belonged to the age group between 46-55 years indicating that soft tissue infections occur more with advancing age. 64 (64%) patients were male and 36 (36%) were females. Diabetes mellitus was the most common etiological cause occurring in 56 (56%)

patients followed by trauma which was reported in 29 (29%) patients. Details are given in Table-II.

In LRINEC scoring high Random blood glucose levels was the most common abnormality associated with Necrotizing fasciitis having been reported in 75 (75%) patients. The second most common abnormality was Hb <13 g/dl, which was present in 68 (68%) of the total 100 (100%) patients, followed by Sodium – 61 (61%), TLC-53 (53%), CRP-52 (52%) and Creatinine in 44 (44%) patients was reported as abnormal. Out of 100, 42 (42%) patients LRINEC score was ≤5, and 58 cases (68%) had LRINEC scores≥6 as shown in Figure-1-A and 1-B below.

In a comparison of the result of histopathology reports with the LRINEC scoring system, 47 (47%) cases were noted as true positive (TP) whereas 36 (36%) patients were True negatives (TN). Only 12 (12%) patients were reported to be false positives and 5 (5%) as false negatives in comparison with histopathology. In our study sensitivity was calculated to be 79.7% and specificity as 87.8%. PPV was 90.4% and NPV came out to be 75% as shown in Table-III.

Table-I: LRINEC scoring scale used.

Laboratory Parameters	LRINEC Score
CRP	
< 150 mg/l	0
≥ 150	4
Total white cell count (microliter)	
<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
Serum creatinine (mg/dl)	
<1.6 or = 1.6	0
>1.6	2
Glucose (mg/dl)	
<180 or = 180	0
>180	1

Table-II: Etiological classification of necrotizing fasciitis.

Etiology	Frequency	Percentage
Unknown	3	3.0%
Diabetes	56	56.0%
Trauma	29	29.0%
Bites	6	6.0%
CKD	6	6.0%
Total	**100**	**100.%**

Table-III: Comparison of histopathology results with LRINEC scoring system for diagnosing necrotizing fasciitis.

Histopathology	LRINEC scoring system		p-Value
	Positive	Negative	
Positive	47 (47.0%) TP	5 (5.0%) FN	<0.0001
Negative	12 (12.0%) FP	36 (36.0%) TN	

Sensitivity= TP/(TP+FN)= 47/(47+5)*100=79.7%
Specificity= TN/(TN+FP)= 36/(36+12)*100=87.8%
Positive Predictive Value= TP/(TP+FP)*100= 47/(47+12)= 90.4%
Negative Predictive Value= TN/(TN+FN)*100=36/(36+5)= 75.0%

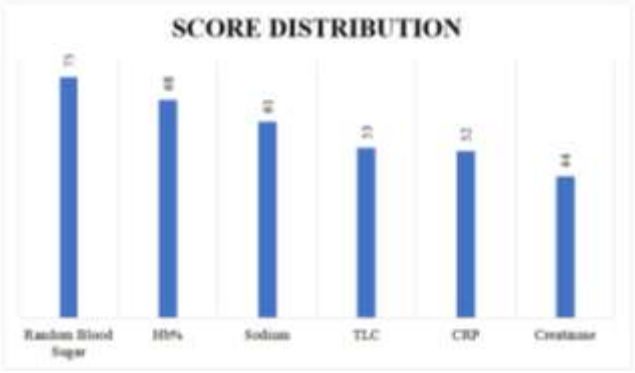

Figure-IA: Showing LRINEC Score abnormalities in patients

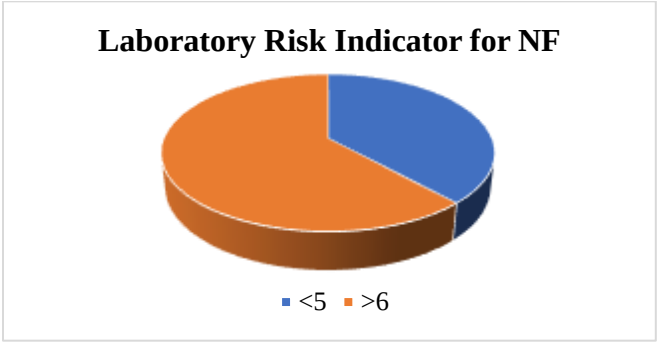

Figure-1B: Showing Risk Indicator for necrotizing fasciitis.

DISCUSSION

Necrotizing fasciitis is a rapidly progressive inflammatory infection of the deep fascia associated with a high morbidity and mortality. The infection may follow trauma or occur around foreign bodies in surgical wounds. Diabetes, trauma, and immunodeficiency states are the most common risk factors for necrotizing fasciitis. Early diagnosis and prompt treatment with antibiotics can significantly reduce patient grievances. Necrotizing fasciitis still has significant morbidity and mortality, despite the latest advances in laboratory diagnosis and pharmaceutical therapies. The application

of a biochemical-based scoring system may lead to an improved diagnostic process.[12]

The clinical importance of the LRINEC score for early detection of necrotizing fasciitis has been evaluated by many studies However, few studies are available in which the LRINEC score has been evaluated for diagnosing and predicting outcomes in necrotizing fasciitis. If the diagnosis of necrotizing fasciitis is based solely on LRINEC scoring it can cause a bias in the study because LRINEC scoring does not include a clinical picture of patients. Our study demonstrated that patients with Diabetes Mellitus and other comorbidities have abnormal baseline investigations. Chao *et al.* **[13]** demonstrated that an LRINEC score of 2% or greater than 2 was adaptive in 71% of cases with 11.9-fold increased risk for the presence of necrotizing fasciitis, 83% precise with 85% PPV. that the average LRINEC scoring of 2 or greater was 85% positive predictive, 83% precise, and 71% adaptive (P<0.0001). They also documented that LRINEC score and hemorrhagic bullous or blistering lesion are predictors of necrotizing fasciitis.

Su *et al.* [14] in a multicentered retrospective observational cohort study determined the relationship between LRINEC score and duration of hospital stay ultimately leading to morbidity or mortality. They included a total of 100 cases with LRINEC scores≥ 6 and compared them with 109 cases having LRINEC scores <6. They noted gross differences in amputation (p 0.02) and mortality (p 0.04) between the two groups. Corbin *et al.* [15] demonstrated that complication rate was high in patients with LRINEC score above 6 as compared to cases with LRINEC score < 6. The overall mortality rate of 15 patients was three in a study conducted by Swain et al. The overall LRINEC score determined by them in all death cases was 9 (range 6-13).**[16]** Another study was done by Colak *et al* **[17]** in the year 2015 in Turkey on 25 patients. There was a statistically significant increase in diabetic complications (52%), followed by peripheral circulatory disorders (24%). A similar frequency of Diabetes was noted in our study (56%) but in ours, trauma was the second most frequent etiological cause of necrotizing fasciitis. They also documented that LRINEC scores and mean the number of debridement were higher in the non-surviving group and concluded that the LRINEC score can be used to predict mortality in necrotizing fasciitis.

A literature review was conducted by Wong and Wang to highlight recent advances available for diagnosing necrotizing fasciitis. They discussed the diagnostic use of magnetic resonance imaging (MRI), ultrasound (USG), LRINEC score, tissue oxygen saturation, and frozen section. They documented a high PPV and NPV of LRINEC score and suggested using it frequently for diagnosing necrotizing fasciitis. On the whole, the quality of available evidence in favor of LRINEC may be low but none the less it has been shown that the LRINEC score is a useful tool in the diagnosis of necrotizing fasciitis and it is recommended that to evaluate its diagnostic accuracy further.[18]

LRINEC score comprises only laboratory data which is one of the weak points of this scoring system, where clinicians argue that it should include vital signs as well. Another point of discussion is that this score has two cut-off values, which has always been a source of confusion among clinicians.**[19]** It is important to note that the LRINEC score is an important diagnostic tool, but it requires more research and experimentation before it can be widely utilized as a screening tool. Until a standardized guideline is developed, clinicians should use other diagnostic modalities if necrotizing fasciitis is suspected until a scoring system with adequate accuracy can be utilized in clinical practice.

The aim of our study was to establish the validity of the LRINEC scoring system in diagnosing cases of necrotizing fasciitis by comparing it with the gold standard of histopathology reports. With considerable sensitivity and fairly high specificity, our study has shown that LRINEC scoring is an adequate, easy, and fast tool to assess the risk of developing necrotizing fasciitis in patients presenting with skin and subcutaneous tissue infections.

LIMITATION OF THE STUDY

This was a small, single-centered study with limitations on time and resources. We used only laboratory parameters and determined their validity in assessing the LRINEC score. Further multicentered studies with the inclusion of vital signs in addition to laboratory scores are suggested for a better diagnosis of necrotizing fasciitis.

CONCLUSION

LRINEC scoring system has a significant sensitivity and reasonable specificity. It can be used as an effective

diagnostic tool in labeling cases with necrotizing fasciitis. By using the LRINEC scoring system we can not only diagnose necrotizing fasciitis cases early but also manage and treat them promptly which can help us to reduce the overall morbidity and mortality of this disease. However, it is important to consider the clinical aspects of patients alongside the scoring system for effective management and improved outcomes in patients with necrotizing fasciitis.

CONFLICT OF INTEREST

None

GRANT SUPPORT & FINANCIAL DISCLOSURE

Declared none

AUTHOR CONTRIBUTION

Muhammad Riaz Shahid: Idea conception, study design, acquisition of data, Manuscript drafting

Usman Ghani: Data collection

Muhammad Ayub Ashraf: Substantial contributions to analysis and interpretation of data

Fahd Rashid: Substantial contributions to concept, study design, Critical review

Muhammad Shahid: Critical review, revisions

Fahim Khattak Manuscript drafting

REFERENCES

1. Tessier JM, Sanders J, Sartelli M, Ulrych J, De Simone B, Grabowski J, *et al*. Necrotizing soft tissue infections: A focused review of pathophysiology, diagnosis, operative management, antimicrobial therapy, and pediatrics. Surg Infect. 2020; 21(2): 81-93. DOI: https://doi.org/10.1089/sur.2019.219
2. Desta R, Yee J. Necrotizing fasciitis. JETem. 2020; 5(2): 1-25. DOI: https://doi.org/10.21980/J84M1D
3. Fernando SM, Tran A, Cheng W, Rochwerg B, Kyeremanteng K, Seely AJ, *et al*. Necrotizing soft tissue infection: diagnostic accuracy of physical examination, imaging, and LRINEC score: A systematic review and meta-analysis. Ann Surg. 2019; 269(1): 58-65. DOI: https://doi.org/10.1097/sla.0000000000002774
4. Sophy FJ, Devi RL, Anubhav MP. Validation of laboratory risk indicator for necrotizing fasciitis scoring system for diagnosis of necrotizing fasciitis in patients presenting with soft-tissue infections. Int J Sci Study. 2021; 8(10): 166-9.
5. Chen PC, Tsai SH, Wang JC, Tzeng YS, Wang YC, Chu CM, *et al*. An elevated glycemic gap predicts adverse outcomes in diabetic patients with necrotizing fasciitis. PLoS One. 2019; 14(10): e0223126. DOI: https://doi.org/10.1371/journal.pone.0223126
6. Harasawa T, Kawai-Kowase K, Tamura JI, Nakamura M. Accurate and quick predictor of necrotizing soft tissue infection: usefulness of the LRINEC score and NSTI assessment score. J Infect Chemother. 2020; 26(4): 331-4. Doi: https://doi.org/10.1016/j.jiac.2019.10.007
7. Kumar M, Lal M. Predictors of mortality in necrotizing fasciitis. Formosan J Surg. 2021; 54(2): 52-60. DOI: http://dx.doi.org/10.4103/fjs.fjs_43_20
8. Wei XK, Huo JY, Yang Q, Li J. Early diagnosis of necrotizing fasciitis: Imaging techniques and their combined application. Int Wound J. 2024; 21(1): e14379. DOI: https://doi.org/10.1111/iwj.14379
9. Wong CH, Khin LW, Heng KS, Tan KC, Low CO. The LRINEC (Laboratory Risk Indicator for Necrotizing Fasciitis) score: A tool for distinguishing necrotizing fasciitis from other soft tissue infections. Crit Care Med. 2004; 32(7): 1535-41. DOI: https://doi.org/10.1097/01.ccm.0000129486.35458.7d
10. Wall DB, de Virgilio C, Black S, Klein SR. Objective criteria may assist in distinguishing necrotizing fasciitis from non-necrotizing soft tissue infection. The Am J Surg. 2000; 179(1): 17-20. DOI: https://doi.org/10.1016/S0002-9610(99)00259-7
11. Choi HK, Seo GH, Han E. The incidence and seasonal variation of necrotizing fasciitis in Korea: A nationwide cross-sectional study. Clin Microbiol Infect. 2020; 26(8): 1090-e1. DOI: https://doi.org/10.1016/j.cmi.2020.01.002
12. Stevens DL, Bryant AE, Goldstein EJ. Necrotizing soft tissue infections. Infect Dis Clin North Am. 2021; 35(1):135-55. DOI: https://doi.org/10.1016/j.idc.2020.10.004
13. Chao WN, Tsai SJ, Tsai CF, Su CH, Chan KS, Lee YT, *et al*. The laboratory risk indicator for necrotizing fasciitis score for discernment of necrotizing fasciitis originated from Vibrio vulnificus infections. J Trauma Acute Care Surg. 2012; 73(6): 1576-82. DOI: https://doi.org/10.1097/ta.0b013e318270d761
14. Su YC, Chen HW, Hong YC, Chen CT, Hsiao CT, Chen IC. Laboratory risk indicator for necrotizing fasciitis score and the outcomes. ANZ J Surg. 2008; 78(11): 968-72. DOI: https://doi.org/10.1111/j.1445-2197.2008.04713.x
15. Corbin V, Vidal M, Beytout J, Laurichesse H, D'Incan M, Souteyrand P, *et al* . Prognostic value of the LRINEC score (Laboratory Risk Indicator for Necrotizing Fasciitis) in soft tissue infections: a prospective study at Clermont-Ferrand University hospital. Ann Dermatol Venereol 2009; 137 (1): 5-11. DOI: https://doi.org/10.1016/j.annder.2009.12.002
16. Swain RA, Hatcher JC, Azadian BS, Soni N, De Souza B. A five-year review of necrotising fasciitis in a tertiary referral unit. Ann R Coll Surg Engl. 2013; 95(1): 57-60. DOI: https://doi.org/10.1308/003588413X13511609956093
17. Colak E, Ozlem N, Kucuk GO, Aktimur R, Kesmer S. Laboratory risk indicators for necrotizing fasciitis and associations with mortality. Turk J Emerg Med. 2014; 14(1): 15-9. DOI: https://doi.org/10.5505/1304.7361.2014.55476
18. Wong C, Wang Y. The diagnosis of necrotizing fasciitis. Curr Opin Infect Dis. 2005; 18: 101–6. DOI: https://doi.org/10.1097/01.qco.0000160896.74492.ea
19. Harasawa T, Kawai-Kowase K, Tamura JI, Nakamura M. Accurate and quick predictor of necrotizing soft tissue infection: usefulness of the LRINEC score and NSTI assessment score. J Infect Chemother. 2020; 26(4): 331-4. DOI: https://doi.org/10.1016/j.jiac.2019.10.007