International Surgery Journal
Gupta M et al. Int Surg J. 2020 Jun;7(6):1852-1856
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: http://dx.doi.org/10.18203/2349-2902.isj20202395

Original Research Article

Clinical and laboratory risk indicator for necrotizing fasciitis score in predicting the outcomes in necrotizing soft tissue infection patients

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Received: 06 March 2020
Revised: 11 April 2020
Accepted: 30 April 2020

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ABSTRACT

Background: Necrotizing soft tissue infection (NSTI) is a serious condition that can be diagnosed on a high index of suspicion and require urgent surgical treatment. NSTI involved epidermis and dermis but more frequently it affects the deeper layer of adipose tissue, fascia, and muscle. NSTI diagnosis and its treatment include emergent surgical intervention and the use of appropriate antibiotics. In this study, we have been evaluated the laboratory risk indicator for necrotizing fasciitis (LRINEC) score in predicting the outcomes in patients of NSTI.
Methods: We have conducted a prospective study of 36 patients with NSTI. The LRINEC score, predisposing factors, etiology, risk factors, causative microbiological organisms have been studied.
Results: LRINEC score >8 is associated with NSTI in all cases. The mortality and morbidity, length of stay including ICU stay increases with an increase in LRINEC score. The most common microorganism was found to be *E. coli* followed by *Klebsiella*.
Conclusions: Although, we used the emergent and liberal debridement and appropriate antibiotic and resuscitation. In this study, morbidity, mortality, and length of hospital stay all are increased with respect to the increase in LRINEC score.

Keywords: LRINEC score, Necrotizing fasciitis, NSTI

INTRODUCTION

Necrotizing soft tissue infection (NSTI) is a serious condition that can be diagnosed on a high index of suspicion and require urgent surgical treatment.[1,2] Even NSTI is rare but frequently causes severe illness which can lead to even death or disability.[3] These infections having an unpredictable presentation and their clinical course.[4] The common etiology is minor trauma/surgery but in few cases the etiology is idiopathic.[5,6] The patients who are having decreased immunity or suffering from diabetes mellitus have more chances to develop NSTI. There are many classifications that can classify the NSTI but on the basis of microbiological or the involvement of soft tissue is the most important classification.[7,8] Polymicrobial infection is the Type I infection which includes species of gram-positive cocci, gram-negative rods, and anaerobes.[9-11] Type II infections include β-haemolytic *Streptococci, Staphylococcal* species.[12,13] The diagnosis of NSTI is difficult at the early stage of the disease and might be not correctly diagnosed in most of the patients.[14-17] The gold standard for the NSTI is a

surgical exploration and tissue histopathology.[18] The mortality and the morbidity of NSTI patients depend on early detection, urgent and liberal debridement of all necrotic soft tissue, delaying in the diagnosis, as well as operative procedure, consistently increased the morbidity and mortality.[17,19,20]

For the assessment of NSTI there are multiple scoring systems, but they frequently and widely adopted scoring system is the laboratory risk indicator for necrotizing fasciitis score (LRINEC) score, which was reported by Wong and colleagues.[21] The LRINEC score has the capability to precisely diagnose the necrotizing fasciitis.[22] The LRINEC score has 6 parameters which are C-reactive protein, WBC count, haemoglobin level, serum sodium level, serum creatinine level, and serum glucose level (Table 1).[23] The LRINEC score ranges from 0 to 13 and NSTI patients can be categorized according to the risk in 3 categories as shown in Table 2.[23]

Table 1: Six different variables included in the laboratory risk indicator for necrotizing fasciitis score.

Value	LRINEC score points	Value	LRINEC score points
C-reactive protein, mg/l		**Sodium level, mmol/l**	
<150	0	≥135	0
>150	4	<135	2
WBC counts, cells/mm^3		**Creatinine level, mg/dl**	
<15	0	≤1.6	0
15-25	1	>1.6	2
>25	2		
Haemoglobin, g/dl		**Glucose level, mg/dl**	
>13.5	0	≤180	0
11-13.5	1		
<11	2	>180	1

Table 2: Risk category and associated LRINEC score.

Risk category	LRINEC score	Probability of NSTI, %
Low	≤5	<50
Intermediate	6-7	50-75
High	≥8	>75

The current study aimed to predict the parameter over management of NSTI like a number of debridement, need for limb amputation, ICU stays, the total length of hospital stay depending on the clinical parameters and LRINEC score.

This study assessed the common causative organism for NSTI and sensitive group of antibiotics to treat them, which would help us to device antibiotic regimen for these patients.

METHODS

A prospective study was conducted of patients with NSTI presented between January 2017 to March 2018 in the department of aesthetic, reconstructive and plastic surgery in the central region of India.

The patients with chronic diabetic foot and age bellow 18 years were excluded from the study. The study was preceded as per the Declaration of Helsinki and consent was obtained from each patient before participation in the study. Clinical assessment included the history of presenting illness, comorbidities, history of abuse substance, and previous treatments.

Clinical assessments of NSTI include number, size, site, and extent of discolored skin patches or the presence or absence of blisters, Pain disproportionate to the disease, erythema, discharge, surrounding indurations, and presence of subcutaneous emphysema, anaesthesia, fever, and systemic toxicity. Peripheral pulses were also examined followed by Doppler assessment in all cases of NSTI of the limb to rule out any peripheral vascular disease.

Operative procedure

The LRINEC score was recorded and evaluated on admission. Then the patient underwent debridement of all unhealthy skin and soft tissue up to the healthy bleeding or healthy-looking tissue. Pus culture and histopathologic tissue were obtained from the deep tissue. For histopathological examination, it was tried to obtain tissue in chunk which includes necrotic skin, subcutaneous tissue, underlying fascia, and muscle (if myonecrosis). Then hemostasis was confirmed. A thorough wash of wound with betadine and normal saline was given. Hemostasis was reconfirmed. The wound dressing was done.

Dressing of wound was opened after 24 hours. The wound was again reassessed for further necrosis of skin and soft tissue and the patient was checked for the further need of debridement. If yes then the patient was again taken for debridement. After 48 hours LRINEC score of the patient was again reassessed. After pus culture report antibiotics were changed according to culture sensitivity. Once the wound appears infection-free; the plan for the reconstruction of the wound was done. The wound was assessed whether it needs skin grafting or flap reconstruction. All Patients who had necrotizing soft tissue infection of limbs were explained regarding the post-operative physiotherapy.

SPSS (V 20.0) was used for statistical analysis.

RESULTS

In present study, we 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 (Figure 1).

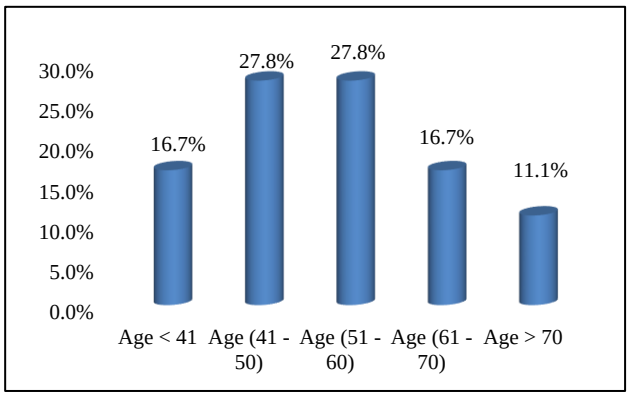

Figure 1: Age distribution.

The study included 28 (77.7%) male, and 8 (22.23%) female patients with NSTI. Out of a total of 22 (61.10%), patients reported a history of diabetes and 14 (38.90%) non-diabetic. 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%). The mortality was reported in 5 (13.9%) followed by amputation 4 (11.1%). It was observed that 18 patients had LRINEC score ≤8 where no mortality was reported. Whereas 18 patients had LRINEC score >8 and reported mortality 5 (27.8%) with a significance value of 0.016. The mortality was reported in 2 male patients followed by 3 deaths in female patients with a significance value of 0.029. For morbidity, there was no case of amputation below the LRINEC score of 8 followed by 4 (22.2%) of amputation reported in LRINEC score >8 with a significance value of 0.034. It was found that there was no statistically significant difference in length of hospital stay in both groups (LRINEC score ≤8 and >8). The maximum number of patients who endure 2 successive surgeries was 16 (44%) followed by 3 consecutive surgeries i.e. 10 (27%). The finding of the LRINEC score was statistically significant (0.009) for pre and post-operative condition i.e. 9±2.11 and 8.3±2.318 respectively. In this septic shock presented by 10 patients; 4 (40%) reported death and 26 presented no septic shock; 1 (3.8%) reported death with a significance value of 0.005. The sensitivity of the LRINEC ≥8 for NF was 87.88%, with a specificity of 100% (Figure 2).

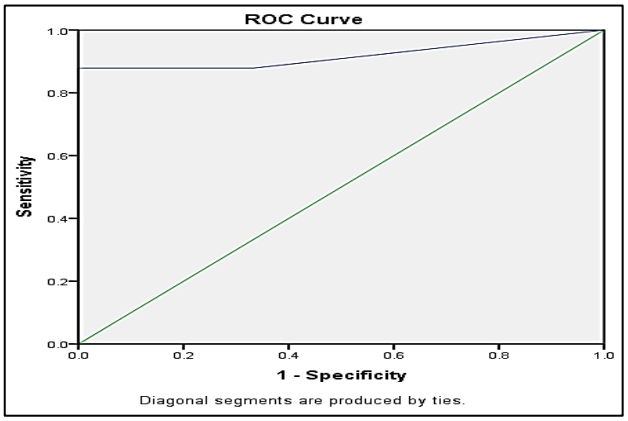

Figure 2: Sensitivity and specificity analysis.

This has a good correlation with NF (p value 0.018 and area under the ROC 0.919) with good sensitivity (87.88%) and specificity (100%) (Table 3). Most importantly, a score ≥8 had high PPV meaning the presence of disease can be determined with confidence.

Table 3: Correlation with NF.

Optimal cut of point	AUC	Std. error	Asymptotic 95% confidence interval		P value
			Lower bound	Upper bound	
8.0	0.919	0.048	0.82	1.00	0.018

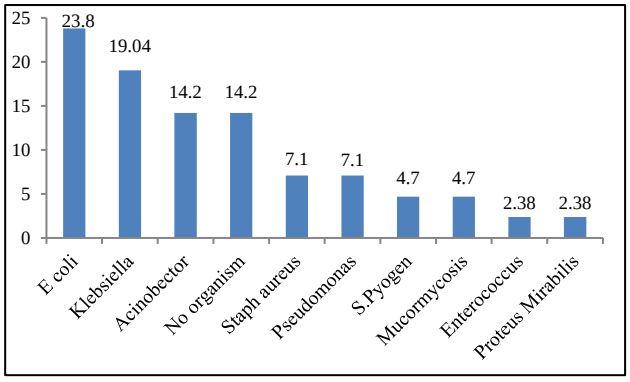

Figure 3: Diagnosed microorganisms in NSTI.

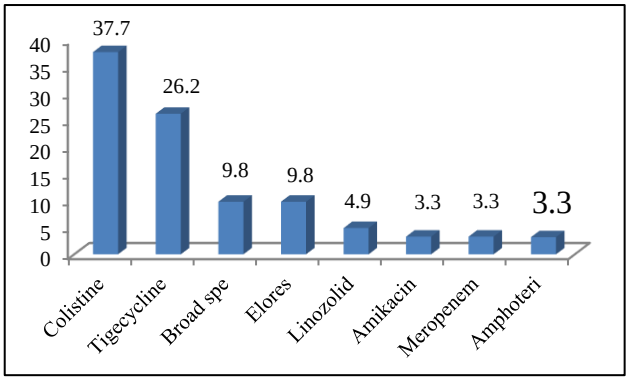

Figure 4: Antibiotic used for NSTI.

The most common microorganism diagnosed in NSTI was *E. coli* followed by *Klebsiella* (Figure 3).

The monomicrobial culture was positive in 24 (66.7%) followed by polymicrobial culture 6 (16.7%) whereas 6 (16.7%) patients reported the absence of microorganisms. The most commonly used antibiotic was colistin followed by tigecycline (Figure 4).

Most of the patients treated by a combination of two antibiotics 19 (52.8%) followed by single antibiotic 8 (22.2%), broad-spectrum antibiotic 6 (16.7%), and combination of three antibiotic i.e. 3 (8.3%).

DISCUSSION

NSTI is a serious condition that can be diagnosed on a high index of suspicion and require urgent surgical treatment. In our findings, the average age was 52.9 years (range 28-84 years) which was reported as 48.7 years (range 27-75 years) by Mukhopadhyay et al, 46.57 years (range 15-83 years) by Kalaivani et al, and 55 years by Latifi et al.[24-26] Present study reported 28 male (77.7%) and 8 female (22.3%) patients whereas Kalaivani et al reported 51 male (85%) and 9 female patients (15%) in their findings.[25] Harikrishnan et al also reported 90% male patients and 10% female whereas Zhao et al reported 82% male and 18% female patients.[27,28] Diabetes mellitus (61.1%) was found to be the most common comorbidities in our study which was reported as 53.3% and 36% by Kalaivani et al and Hua et al respectively.[17,25] Lower limb (58.5%) was found to be the most common site with NSTI which was reported as 56.6% by Kalaivani et al.[25] In this study, the sensitivity of the LRINEC ≥8 for NF was 87.88%, with a specificity of 100%. The positive and negative predictive values were 100% and 42.86%, respectively. Similarly, the finding was reported by Narasimhan et al; the sensitivity of the LRINEC ≥5 for NF was 76.3%, with a specificity of 93.1% whereas positive and negative predictive values were 95.5 and 88.1%, respectively.[29] The literature represented the mortality rate resulting from NSTI ranges from 9.3 to 76% which was found to be 13.9% in present study and total morbidities were 11.1%.[30] A similar finding has been reported for mortality as 16.5%, 17%, 15.2%, and 17.7% by Latifi et al, Kao et al, Lee et al, and Goh et al respectively.[16,26,31,32] In present finding no death was reported in LRINEC score ≤8 groups compared to LRINEC score >8 i.e. 27.8% and 22.2% of mortality and mortality respectively. The previous findings also reported the higher mortality rate in LRINEC score >8 group.[24,33]

Present findings demonstrated a higher length of stay (17±10 days) in the LRINEC score >8 groups. Bozkurt et al also reported longer hospitalization times and were more probable to die compared to patients with lower LRINEC scores.[34] We observe that the incidence of death was higher in females compared to males. The previous findings also suggest a similar finding.[14,35] The higher mortality rate (20%) was reported in the 41-50 years age group. The previous study also reported a significant finding over mortality in older age.[17,35]

In this study, monomicrobial culture was positive in 66.7% out of which *E. coli* was a prominent culture. Previous studies also reported *E. coli* as the most prominent diagnosed microorganism in NSTI.[25,36,37] In present study, the most commonly used antibiotic was Colistine followed by Tigecycline. Menyar et al reported that Tazocin, Clindamycin, and Meropenem were frequently used antibiotics.[38]

CONCLUSION

The LRINEC score is quick, safe, reproducible, non-invasive, cost-effective, easily calculated, and having high sensitivity and specificity to predict and early recognition of NSTI. Despite of its early diagnostic role, could be used for risk stratification and prognosis of NSTI.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Eron LJ. Managing skin and soft tissue infections: expert panel recommendations on key decision points. J Antimicrob Chemother. 2003;52(90001):3-17.
2. Goldstein EJC, Anaya DA, Dellinger EP. Necrotizing soft-tissue infection: diagnosis and management. Clin Infect Dis. 2007;44(5):705-10.
3. Das DK, Baker MG, Venugopal K. Risk factors, microbiological findings and outcomes of necrotizing fasciitis in New Zealand: A retrospective chart review. BMC Infect Dis. 2012;12:6-10.
4. McHenry CR, Piotrowski JJ, Petrinic D, Malangoni MA. Determinants of mortality for necrotizing soft-tissue infections. Ann Surg. 1995;221(5):558-65.
5. Freischlag JA, Ajalat G, Busuttill RW. Treatment of necrotizing soft tissue infections. The need for a new approach. Am J Surg. 1985;149(6):751-5.
6. Fugitt JB, Puckett ML, Quigley MM, Kerr SM. Necrotizing fasciitis. Radiographics. 2004;24(5):1472-6.
7. Dellinger EP. Severe necrotizing soft-tissue infections. JAMA. 1981;246(15):1717.
8. Kaiser RE CF. Progressive necrotizing surgical infections: a unified approach. J Trauma. 1981;21:349-55.
9. Salcido RS. Necrotizing fasciitis: reviewing the causes and treatment strategies. Adv Skin Wound Care. 2007;20(5):9-11.
10. Schwartz S, Kightlinger E, De Virgilio C. Predictors of mortality and limb loss in necrotizing soft tissue infections. Am Surg. 2013;79(10):1102-5.

11. Miller LG, Perdreau-Remington F, Rieg G, Mehdi S, Perlroth J, Bayer AS, et al. Necrotizing fasciitis caused by community-associated methicillin-resistant Staphylococcus aureus in Los Angeles. New England Journal of Medicine. 2005 Apr 7;352(14):1445-53.
12. Howard RJ, Lieb S. Soft-Tissue infections caused by halophilic marine vibrios. Arch Surg. 1988;123(2):245-9.
13. Goodell KH, Jordan MR, Graham R, Cassidy C, Nasraway SA. Rapidly advancing necrotizing fasciitis caused by Photobacterium (Vibrio) damsela: A hyperaggressive variant. Crit Care Med. 2004;32(1):278-81.
14. Elliott DC, Kufera JA, Myers RAM. Necrotizing soft tissue infections: Risk factors for mortality and strategies for management. Ann Surg. 1996;224(5):672-83.
15. May AK. Skin and soft tissue infections. Surg Clin North Am. 2009;89(2):403-20.
16. Goh T, Goh LG, Ang CH, Wong CH. Early diagnosis of necrotizing fasciitis. Br J Surg. 2014;101(1):119-25.
17. Hua C, Sbidian E, Hemery F. Prognostic factors in necrotizing soft-tissue infections (NSTI): A cohort study. J Am Acad Dermatol. 2015;73(6):1006-12.
18. Hakkarainen TW, Kopari NM, Pham TN, Evans HL. Necrotizing soft tissue infections: Review and current concepts in treatment, systems of care, and outcomes. Curr Prob Surg. 2014;51(8):344-62.
19. Wong CH, Chang HC, Pasupathy S, Khin LW, Tan JL, Low CO. Necrotizing fasciitis: Clinical presentation, microbiology, and determinants of mortality. J Bone Jt Surg - Ser A. 2003;85(8):1454-60.
20. Voros D, Pissiotis C, Georgantas D, Katsaragakis S, Antoniou S, Papadimitriou J. Role of early and extensive surgery in the treatment of severe necrotizing soft tissue infection. Br J Surg. 1993;80(9):1190-1.
21. 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.
22. Bechar J, Sepehripour S, Hardwicke J, Filobbos G. Laboratory risk indicator for necrotising fasciitis (LRINEC) score for the assessment of early necrotising fasciitis: a systematic review of the literature. Ann Royal Coll Surg England. 2017;99(5):341-6.
23. Kulkarni M, Madhu C, Ramya S, Sowmya G, Vijay Kumar G. Necrotizing soft-tissue infection: Laboratory risk indicator for necrotizing soft tissue infections score. J Lab Physic. 2014;6(1):46.
24. Mukhopadhyay M. Necrotizing soft tissue infections: The role of the LRINEC score. Hell J Surg. 2016;88(1):31-4.
25. Kalaivani V, Hiremath BV, Indumathi VA. Necrotising soft tissue infection-risk factors for mortality. J Clin Diagn Res. 2013;7(8):1622-65.
26. Latifi R, Patel AS, Samson DJ. The roles of early surgery and comorbid conditions on outcomes of severe necrotizing soft-tissue infections. Eur J Trauma Emerg Surg. 2019;45(5):919-26.
27. Harikrishnan CP, Vakayil HJ. Necrotizing soft tissue infections: a clinical profile. Int Surg J. 2017;4(3):883-9.
28. Zhao JC, Zhang BR, Shi K. Necrotizing soft tissue infection: Clinical characteristics and outcomes at a reconstructive center in Jilin Province. BMC Infect Dis. 2017;17(1):1-8.
29. Narasimhan V, Ooi G, Weidlich S, Carson P. Laboratory risk indicator for necrotizing fasciitis score for early diagnosis of necrotizing fasciitis in Darwin. ANZ J Surg. 2018;88(1-2):45-9.
30. Fontes RA, Ogilvie CM, Miclau T. Necrotizing soft-tissue infections. J Am Acad Orthop Surg. 2000;8(3):151-8.
31. Kao LS, Lew DF, Arab SN. Local variations in the epidemiology, microbiology, and outcome of necrotizing soft-tissue infections: A multicenter study. Am J Surg. 2011;202(2):139-45.
32. Lee CY, Kuo LT, Peng KT, Hsu WH, Huang TW, Chou YC. Prognostic factors and monomicrobial necrotizing fasciitis: Gram-positive versus gram-negative pathogens. BMC Infect Dis. 2011;11.
33. Kincius M, Telksnys T, Trumbeckas D, Jievaltas M, Milonas D. Evaluation of LRINEC scale feasibility for predicting outcomes of Fournier gangrene. Surg Infect. 2016;17(4):448-53.
34. Bozkurt O, Sen V, Demir O, Esen A. Evaluation of the utility of different scoring systems (FGSI, LRINEC and NLR) in the management of Fournier's gangrene. Int Urol Nephrol. 2015;47(2):243-8.
35. Misiakos EP, Bagias G, Papadopoulos I. Early diagnosis and surgical treatment for necrotizing fasciitis: a multicenter study. Front Surg. 2017;4:1-7.
36. Service H, Park DC. Contemporary clinical trials. Health Serv Res. 2009;30(1):40-6.
37. Van Stigt SFL, De Vries J, Bijker JB. Review of 58 patients with necrotizing fasciitis in the Netherlands. World J Emerg Surg. 2016;11(1):7-12.
38. El-Menyar A, Asim M, Mudali IN, Mekkodathil A, Latifi R, Al-Thani H. The laboratory risk indicator for necrotizing fasciitis (LRINEC) scoring: The diagnostic and potential prognostic role. Scand J Trauma Resusc Emerg Med. 2017;25(1):1-9.

Cite this article as: Gupta M, Aggarwal A, Singh H, Khazanchi RK, Mahendru S, Brajesh V, et al. Clinical and laboratory risk indicator for necrotizing fasciitis score in predicting the outcomes in necrotizing soft tissue infection patients. Int Surg J 2020;7:1852-6.