Section: General Surgery

Original Research Article

A PROGNOSTIC VALUE OF LRINEC (LABORATORY RISK INDICATORS FOR NECROTISING FASCITIS) FOR PREDICTING NECROTISING FASCITIS

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ABSTRACT

Background: Aim: To determine the prognostic value of LRINEC Score for predicting Necrotising fasciitis.
Materials and Methods: It is a longitudinal cohort (prognostic) study conducted in the Department of General Surgery in Government Medical College, Kozhikode, Kerala over a period of 18 months from July 2021 to December 2022 in 50 patients with soft tissue infection, requiring admission and at least 48 hours of intravenous antibiotics, coming to the emergency and OPD. The LRINEC score calculated for every patient from the laboratory investigations at the time of admission, was compared with the tissue biopsy report, which is the gold standard test for the diagnosis of Necrotising Fasciitis.
Results: The sensitivity and specificity of the LRINEC Score were 73.7% and 71% respectively for predicting Necrotizing Fasciitis. The positive predictive value and the negative predictive value of the score were calculated to be 60.9% and 81.5% respectively.
Conclusion: The LRINEC (Laboratory Risk Indicator for Necrotizing Fasciitis) score is based on routine laboratory investigations that are readily available, at most centres that can help distinguish Necrotizing Fasciitis from other soft tissue infections. LRINEC scoring system has a better positive predictive value in identifying the onset of necrotizing fasciitis and risk strategizing of the patients with severe soft tissue infections. This score can be used as an adjunct in the management of soft tissue infections especially in secondary care hospitals and may prevent delayed referral to tertiary centres where experienced surgeons, infectious disease and hyperbaric specialists may guide immediate operative and ancillary management, thereby improving the clinical outcome of the patient.
Keywords: Necrotising Fasciitis; LRINEC (Laboratory Risk Indicator for Necrotizing Fasciitis) Score.

INTRODUCTION

Skin and subcutaneous tissue infections are highly diverse with respect to etiology, causative organisms, incidence, clinical features, severity and complications. They may occur as single or recurrent episodes. The spectrum of deep soft tissue infections can range from localized bacterial, viral and parasitic lesions to rapidly spreading, tissue destructive infections like necrotizing fasciitis and myonecrosis.[1] When a patient presents with a soft tissue infection, the clinician faces the challenge of establishing a specific diagnosis and prescribing definitive treatment for the same. Even an experienced clinician may have difficulty in distinguishing between different forms of deep soft tissue infections during their early stages.[2]

Necrotizing soft tissue infections are most often fatal, characterized by extensive necrosis of the subcutaneous tissues and the fascia. Perhaps it is the most severe form of soft tissue infection and it is potentially limb and life threatening. In Spite of

advances in antibiotic therapy and intensive care, the mortality of necrotizing soft tissue infections is still high. The reported mortality of 30-40% reflects the inadequacy of early recognition of Necrotizing soft tissue infections.[3]

MATERIALS AND METHODS

Inclusion Criteria: All soft tissue infection patients requiring admission and at least 48 hours of intravenous antibiotics coming to emergency and OPD of department of General Surgery, MCH Kozhikode.

Exclusion Criteria

- Patients needing multiple admissions, only the first admission will be considered.
- Patients with Surgical site infections.

Sampling: SAMPLE SIZE(s): (s) = (z 2 x p x q) / e2, where z is the z - score, p is the specificity of the LRINEC score according to a study done by Kumar N et al,[13] in 2018 in the Department of Surgery in Vardhaman Mahavir Medical College and Safdarjung Hospital, India, q is (1-p) and e is the margin of error. On keeping margin of error to be 12% of "p", with a specificity of the LRINEC score to be 84% according to the previous study, the sample size is estimated to be 50.

Data Collection Method: Government Medical college, Kozhikode is a tertiary care hospital in the Kozhikode district of Kerala. Patients admitted in the Department of General surgery with severe soft tissue infections were considered for the study.

A longitudinal cohort (prognostic) study was conducted in the Department of General Surgery in Government Medical college, Kozhikode over a period of 18 months from July 2021 to December 2022 using STARD guidelines.

RESULTS

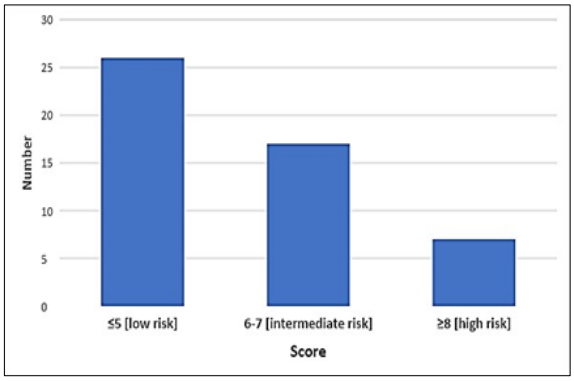

Figure 2: Distribution of participants according to LRINEC Score

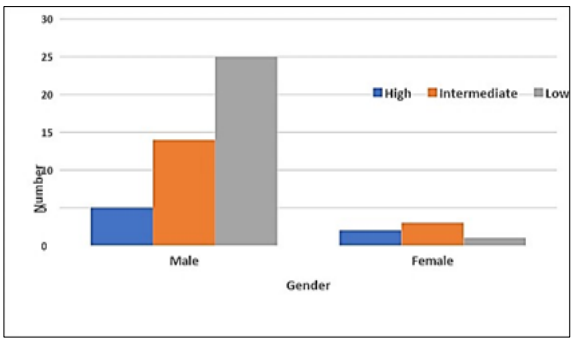

Figure 3: Gender distribution according to LRINEC Score

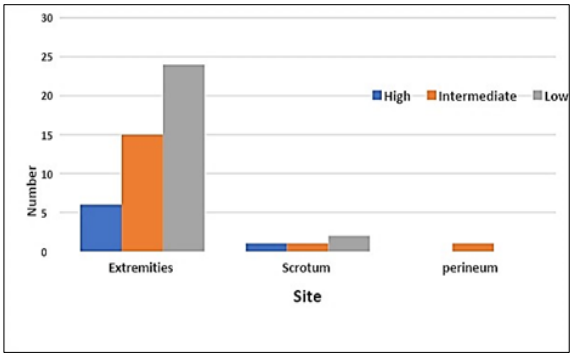

Figure 4: Lesion site distribution according to LRINEC Score

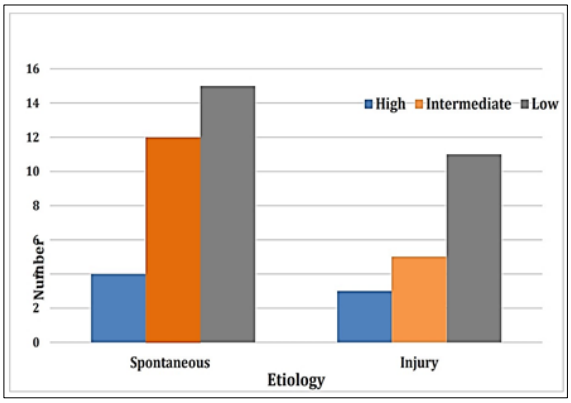

Figure 5: Etiology distribution according to LRINEC Score

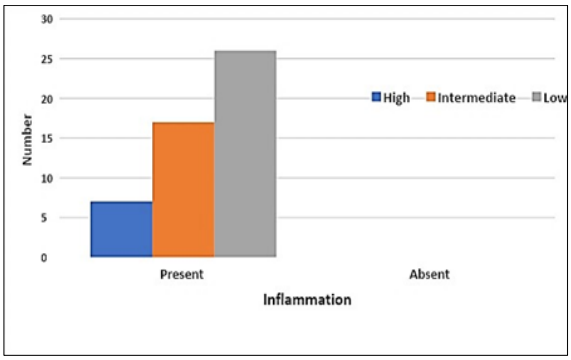

Figure 6: Distribution of Inflammation according to LRINEC Score

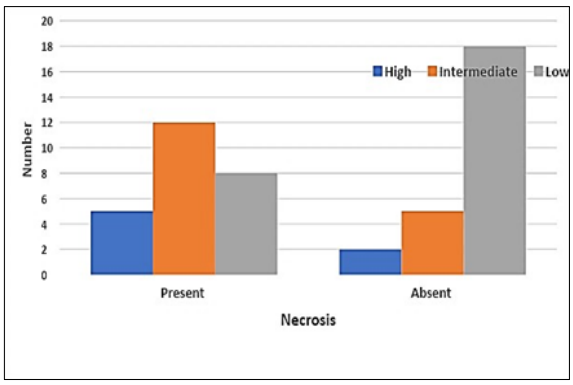

Figure 7: Distribution of Necrosis according to LRINEC Score

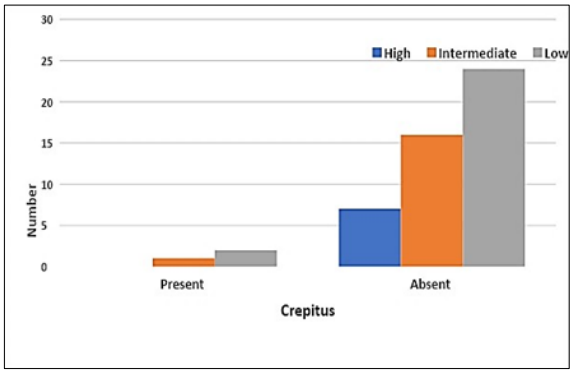

Figure 8: Distribution of Crepitus according to LRINEC Score

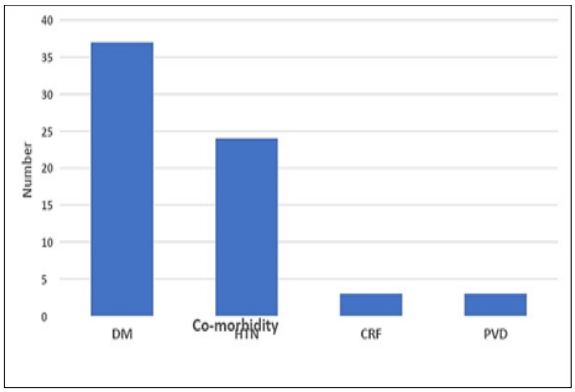

Figure 9: Distribution of Comorbidities among the participants

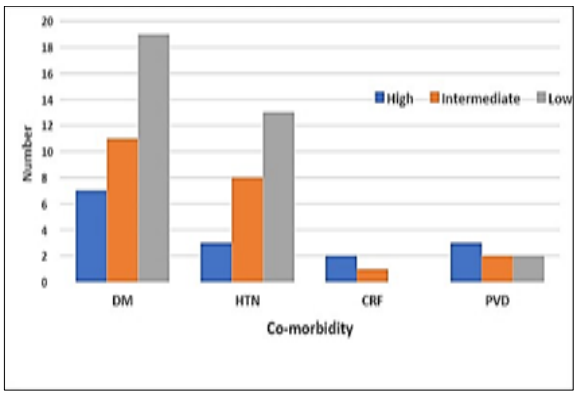

Figure 10: Distribution of comorbidities according to LRINEC Score

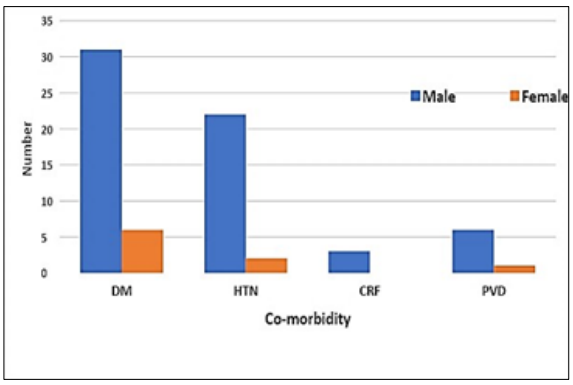

Figure 11: Distribution of Comorbidities according to gender

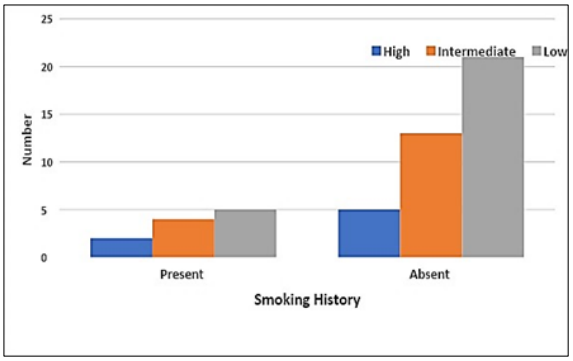

Figure 12: Distribution of Smoking history according to LRINEC Score

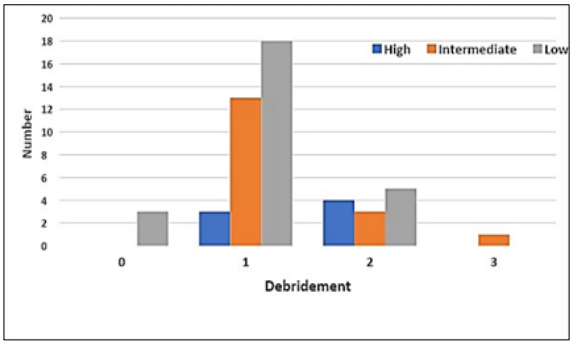

Figure 13: Distribution of the number of debridements according to LRINEC Score

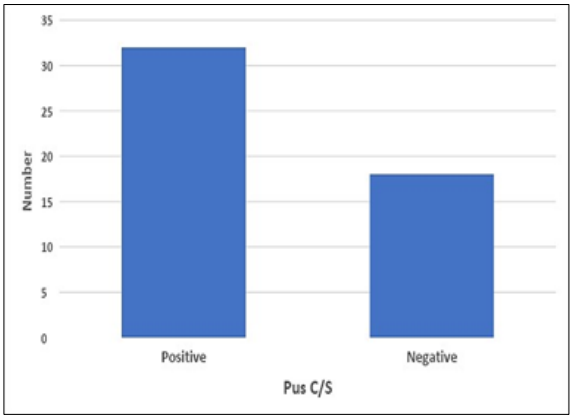

Figure 14: Distribution of Puc C/S results among the participants

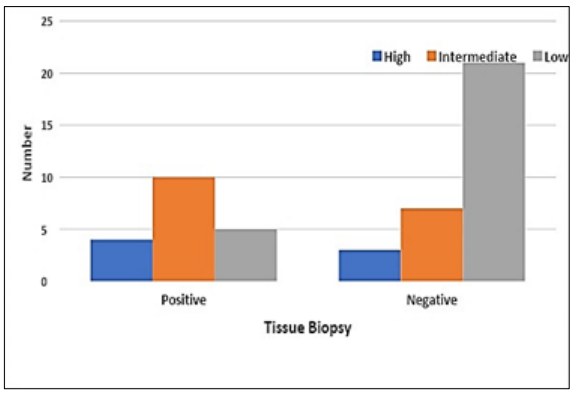

Figure 15: Distribution of Tissue biopsy report according to LRINEC Score

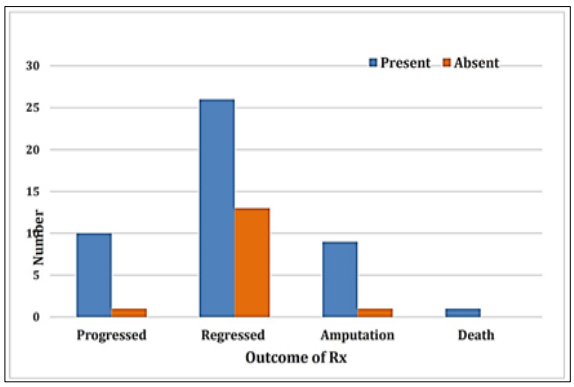

Figure 17: Distribution of the outcome of treatment among Diabetic participants

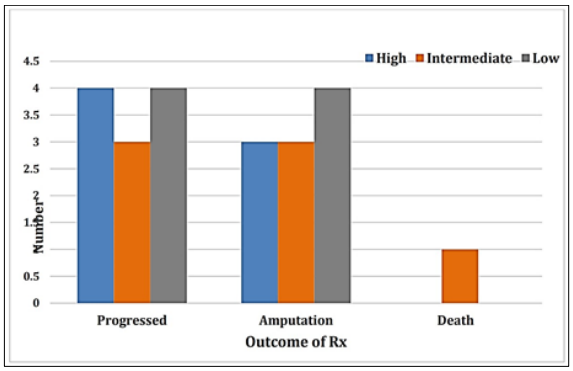

Figure 16: Distribution of the outcome of treatment according to LRINEC Score

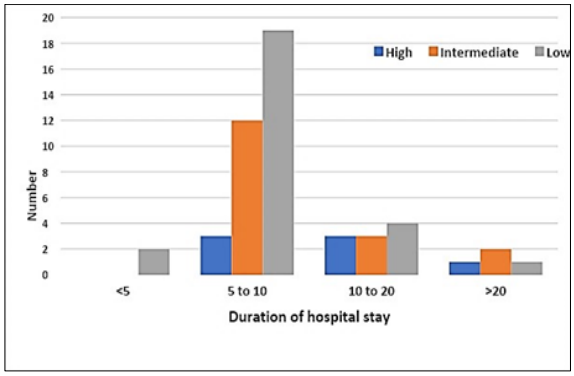

Figure 18: Distribution of the duration of hospital stay according to the LRINEC Score

Table 1: Distribution of participants according to LRINEC score [N=50]

LRINEC score	Number
≤5 [low risk]	26
6-7 [intermediate risk]	17
≥8 [high risk]	7

Table 2: Mean Age of all the participants [N=50]

Age [in year]	
Means ± SD	59.2 ± 13.0

Table 3: Gender Distribution according to LRINEC Score [N=50]

Gender		Risk Category		P value
	High	Intermediate	Low	
Male	5	14	25	0.137
Female	2	3	1	

Table 4: Lesion site Distribution according to LRINEC Score [N=50]

Site		Risk Category		P value
	High	Intermediate	Low	
Extremities	6	15	24	0.658
Scrotum	1	1	2	
perineum	0	1	0	

Table 5: Etiology distribution according to LRINEC Score[N=50]

Injury		Risk Category		p value
	High	Intermediate	Low	
Spontaneous	4	12	15	0.668
Non-spontaneous	3	5	11	

Table 6: Distribution of Inflammation according to LRINEC Score [N=50]

Inflammation		Risk Category	
	High	Intermediate	Low
Present	7	17	26
Absent	0	0	0

Table 7: Distribution of Necrosis according to LRINEC Score [N=50]

Necrosis	Risk Category			P value
	High	Intermediate	Low	
Present	5	12	8	0.01
Absent	2	5	18	

Table 8: Distribution of Crepitus according to LRINEC Score [N=50]

Crepitus	Risk Category			P value
	High	Intermediate	Low	
Present	0	1	2	0.748
Absent	7	16	24	

Table 9: Distribution of Comorbidities among the participants [N=50]

Comorbidities	Number
DM	
➢ Present	37
➢ Absent	13
HTN	
➢ Present	24
➢ Absent	26
CRF	
➢ Present	3
➢ Absent	47
PVD	
➢ Present	3
➢ Absent	47

Table 10: Distribution of comorbidities according to LRINEC Score [N=50]

Comorbidities	Risk Category			P value
	High	Intermediate	Low	
DM				
➢ Present	7	11	19	0.198
➢ Absent	0	6	7	
HTN				
➢ Present	3	8	13	0.941
➢ Absent	4	9	13	
CRF				
➢ Present	2	1	0	**0.01**
➢ Absent	5	16	26	
PVD				
➢ Present	3	2	2	**0.04**
➢ Absent	4	15	24	

Table 11: Distribution of Comorbidities according to gender [N=50]

Comorbidities	Ge	nder	P value
	Male		Female
DM			
➢ Present	31		6	0.292
➢ Absent	13		0	
HTN			
➢ Present	22		2	0.741
➢ Absent	22		4	
CRF			
➢ Present	3		0	0.798
➢ Absent	41		6	
PVD			
➢ Present	6		1	0.669
➢ Absent	38		5	

Table 12: Distribution of Smoking history according to LRINEC Score [N=50]

Smoking History	Risk Category			P value
	High	Intermediate	Low	
Present	2	4	5	0.854
Absent	5	13	21	

Table 13: Distribution of the number of debridements according to LRINEC Score [N=50]

Number of Debridement	Risk Category			P value
	High	Intermediate	Low	
0	0	0	3	0.158
1	3	13	18	
2	4	3	5	
3	0	1	0	

Table 14: Distribution of Puc C/S results among the participants [N=50]

Pus C/S	Number
Positive Negative	32 18

Table 15: Distribution of Tissue biopsy report according to LRINEC Score [N=50]

Tissue Biopsy	Risk Category			P value
	High	Intermediate	Low	
Positive Negative	4 3	10 7	5 21	**0.02**

Table 16: Distribution of the outcome of treatment according to LRINEC Score [N=22]

Outcome of treatment	Risk Category			P value
	High	Intermediate	Low	
Progressed	4	3	4	0.673
Amputation	3	3	4	
Death	0	1	0	

Table 17: Distribution of the outcome of treatment among Diabetic participants [N=50]

Outcome of treatment	D	M		P value
	Present		Absent	
Progressed	10		1	0.07
Regressed	26		13	
Amputation	9		1	
Death	1		0	

Table 18: Distribution of the duration of hospital stay according to the LRINEC Score [N=50]

Duration of hospital stay	Risk Category			P value
	High	Intermediate	Low	
<5	0	0	2	0.426
5-10	3	12	19	
10-20	3	3	4	
>20	1	2	1	

Table 19: Correlation of LRINEC Score with Histopathology Findings [N=50]

LRINEC Score	Histopathology		Total	P value
	Necrotizing Fasciitis	No Necrotizing Fasciitis		
<6 ≥6	5 14	22 9	27 23	**0.04**
Total	19	31	50	

Sensitivity = 14*100/19 = 73.7%
Specificity = 22*100/31 = 71.0%
PPV = 14*100/23 = 60.9%
NPV = 22*100/27 = 81.5%
Accuracy = 36*100/50 = 72.0%

DISCUSSION

Present cohort study was conducted among 50 soft tissue infection patients who were attended and admitted in the Department of General Surgery, Government Medical college, Kozhikode,Kerala with an aim of determining the prognostic value of LRINEC Score for predicting necrotising fasciitis. Inclusion criteria was all soft tissue infection patients requiring admission and at least 48 hours of intravenous antibiotics.

Table 1 and figure 2 show that 26, 7 & 7 participants have an LRINEC score of ≤5 [low risk], 6-7 [intermediate risk] & ≥8 [high risk] respectively.
The LRINEC score is a measure of these changes and predicts the presence of necrotizing fasciitis. Other non-necrotising soft tissue infections (e.g. cellulitis and abscesses) rarely cause an inflammatory state severe enough to cause such disturbances in the laboratory biochemical parameters.[4]
Table 2 shows that the mean age of participants was 59.2 years with 13.0 SD. Epidemiologic studies

suggest that patients with advanced age are at a greater risk for
NF and one out of five patients may die.[5]
Table 3 and figure 3 show that 5, 14, 25 male participants and 2, 3, 1 female participants have LRINEC scores of ≤5 [low risk], 6-7 [intermediate risk] & ≥8 [high risk] respectively. The male:female ratio was 7.3:1. The difference in LRINEC score according to gender was statistically not significant [p>0.05]. Present study found a higher incidence of NF among males but their association with LRINEC score was not statistically significant. Predominance of male gender is mainly attributed to the rising demand of labor-intensive jobs in this rapidly developing country which could have some potential to distort the gender balance.[6]
Table 4 and figure 4 show that 6, 15, 24 participants with extremities lesion, 1, 1, 2 with scrotum lesion and 0, 1, 0 with perineum lesion have LRINEC score of ≤5 [low risk], 6-7 [intermediate risk] & ≥8 [high risk] respectively. The difference in LRINEC scores according to the site of lesion was statistically not significant [p>0.05]. Present study observed that the most common site involved in NF was extremities. Only a few cases of NF were observed in sites other than extremities, but their association with LRINEC score was not statistically significant. These findings are comparable with the studies done by Sheikh N et al,[6] Roje Z et al,[7] El-menyar A et al,[8]
Table 5 and figure 5 show that 4, 12 and 15 participants with spontaneous onset of infection, and 3, 5 and 11 participants with a preceding injury, (snakebite/ trauma/ itching/ burns/ thorn pricks etc) have LRINEC scores of ≤5 [low risk], 6-7 [intermediate risk] & ≥8 [high risk] respectively. The difference in LRINEC score according to the type of injury was statistically not significant [p>0.05]. Present study found that 62.0% of NF have a spontaneous onset injury.
Table 6 and figure 6 show that 7, 17, 26 participants with signs of inflammation and 2, 3, 1 participants without signs of inflammation have LRINEC scores of ≤5 [low risk], 6-7 [intermediate risk] & ≥8 [high risk] respectively. Table 7 and figure 7 show that 5, 12, 8 participants with visible necrosis and 2, 5, 18 participants without any necrosis have LRINEC scores of ≤5 [low risk], 6-7 [intermediate risk] & ≥8 [high risk] respectively. The difference in LRINEC score based on the presence of necrosis was statistically significant [p<0.05]. Table 8 and figure 8 show that 0, 1, 2 participants with crepitus on palpation and 7, 16, 24 participants without crepitus have LRINEC scores of ≤5 [low risk], 6-7 [intermediate risk] & ≥8 [high risk] respectively. The difference in LRINEC score according to the presence of crepitus was statistically not significant [p>0.05]. Of the 3 patients who had crepitus in my study, Pus C/S sampled from one patient grew E. coli and 2 other patients showed growth of Klebsiella species, of which one patient was found to have pneumoscrotum on surgical debridement.
The disease is generally caused by microorganisms such as streptococci and staphylococci that are found on skin and mucosa on healthy individuals. The causative pathogens attack the subcutaneous tissues and produce toxins causing severe inflammation, ischemia, necrosis and septic shock that eventually lead to multi organ dysfunction.[9,10] Present study found that inflammation was observed in all cases and necrosis was found in almost half of the cases whereas crepitus was present in only few cases. The association of inflammation and necrosis with LRINEC score was statistically significant, but the association of crepitus was not statistically significant.
Table 9 and figure 9 show that Diabetes Mellitus (DM) was present in 37 participants, Hypertension (HTN) in 24, Chronic Renal Failure (CRF) in 3 and Peripheral Vascular Disease (PVD) in 3 participants. Table 10 and figure 10 show that, 7, 11 and 19 participants with DM and 0, 6 and 7 without DM have LRINEC scores of ≤5 [low risk], 6-7 [intermediate risk] & ≥8 [high risk] respectively. The difference in LRINEC score according to the status of DM was statistically not significant [p>0.05]. It also shows that 3, 8 and 13 participants having HTN and 4, 9 and 13 participants without HTN have LRINEC scores of ≤5 [low risk], 6-7 [intermediate risk] & ≥8 [high risk] respectively. The difference in LRINEC score according to the status of HTN was also statistically not significant [p>0.05]. Around 2, 1 and 0 participants with CRF and 5, 16 and 26 participants without CRF have
LRINEC scores of ≤5 [low risk], 6-7 [intermediate risk] & ≥8 [high risk] respectively. The difference in LRINEC score according to the status of CRF was statistically significant [p<0.05]. Around 3, 2 and 2 participants with PVD and 4, 15 and 24 without PVD have LRINEC scores of ≤5 [low risk], 6-7 [intermediate risk] & ≥8 [high risk] respectively. The difference in LRINEC score according to the status of PVD was statistically significant [p<0.05].
Table 11 and figure 11 show that DM was observed in 31 male and 6 female participants, HTN observed in 22 male and 2 female participants, CRF observed in 3 male and 0 female participants, PVD observed in 6 male and 1 female participants. The difference in gender according to the status of DM, HTN, CRF and PVD was statistically not significant [p>0.05]. Present study found statistically non-significant association between gender and incidence of DM, HTN, CRF and PVD.
Table 12 and figure 12 show that 2, 4, 5 participants with history of smoking and 5, 13, 21 participants with no history of smoking have LRINEC scores of ≤5 [low risk], 6-7 [intermediate risk] and ≥8 [high risk] respectively. The difference in LRINEC score according to history of smoking was statistically not significant [p>0.05]. Angoules AG et al,[11] and Goh T et al,[12] said that medical conditions associated with NF are DM [31-445], Obesity [28%], smoking (27 %), alcoholism (17 %), cirrhosis (8– 15 %),

malignancy (3 %), corticosteroid therapy (3 %) and chronic renal failure (3 %).

Table 13 and figure 13 show that 0, 0 and 3 participants without the requirement of debridement have LRINEC scores of ≤5 [low risk], 6-7 [intermediate risk] & ≥8 [high risk] respectively and 3, 13, 18 participants debrided only once have LRINEC score of ≤5 [low risk], 6-7 [intermediate risk] & ≥8 [high risk] respectively. 4, 3 and 5 participants scoring ≤5 [low risk], 6-7 [intermediate risk] & ≥8 [high risk] respectively and 0, 1 and 0 participants scoring ≤5 [low risk], 6-7 [intermediate risk] & ≥8 [high risk] respectively had to undergo three debridements. The difference in LRINEC score according to the requirement and the number of surgical debridements was statistically not significant [p>0.05] in this study.

However, the present study observed that cases with low LRINEC score required either no or one debridement, but this association was not statistically significant. Colak et al,[13] also found that high LRINEC scoring might predict the requirement of debridement and mortality in NF patients (n = 25).

Table 14 and figure 14 show that 32 participants had organisms grown in pus culture and 18 participants had no growth in their pus culture reports respectively.

Table 15 and figure 15 show that 4, 10 and 5 participants with LRINEC scores of ≤5 [low risk], 6-7 [intermediate risk] & ≥8 [high risk] respectively had tissue biopsy report findings consistent with necrotizing fasciitis and 3, 7 and 21 participants with LRINEC scores of ≤5 [low risk], 6-7 [intermediate risk] & ≥8 [high risk] respectively, had biopsy reports inconsistent with necrotizing fasciitis. The difference in LRINEC score according to the status of tissue biopsy report was statistically significant [p<0.05].

Table 16 and figure 16 show that disease progression was noted in 4, 3 and 4 participants who have LRINEC score was ≤5 [low risk], 6-7 [intermediate risk] & ≥8 [high risk] respectively. Amputation was required in 3, 3 and 4 participants scoring ≤5 [low risk], 6-7 [intermediate risk] & ≥8 [high risk] respectively. Death was noted only in 1 patient in the entire study and that patient belonged to the intermediate risk group according to the LRINEC Score. The difference in LRINEC score according to outcome of treatment was statistically not significant [p>0.05].

Table 17 and figure 17 show that of all the 11 participants in whom the disease progressed, 10 are diabetics and 1 is a non-doabetic. Among the 10 diabetic patients in whom disease progressed, 9 patients landed up in amputation and 1 patient succumbed to death. The difference in outcome of treatment according to status of DM was statistically not significant [p>0.05].

This condition involves necrosis of the superficial fascia and subcutaneous tissue, and progresses rapidly, leading to a severe systemic toxicity and even mortality. A high index of suspicion, early diagnosis and aggressive surgical debridement of necrotic tissues, or amputation if necessary, are essential for successful treatment. Nevertheless, according to the literature reports, NF is still associated with a high rate of mortality of 10.9–76% and an amputation rate of 15.0–30.0%.56–58.

Present study observed the non-significant association between outcome of treatment with LRINEC score. Of all the 50 participants, only one death was noted and this participant belonged to the intermediate risk category of the LRINEC score. Amputation was required to be done for 20.0% cases of necrotizing fasciitis. Espandar R et al,[14] said that the rates of gangrene and amputation in patients with diabetes mellitus were significantly higher than other comorbidities.

Table 18 and figure 18 show that only 2 participants required less than 5 days of hospital stay and he belonged to the high risk category. Among the patients requiring 5-10 days of hospital stay, 3, 12 and 19 patients have LRINEC scores of ≤5 [low risk], 6-7 [intermediate risk] & ≥8 [high risk] respectively. Among the participants requiring 10-20 days of hospital stay, 3, 3 and 4 participants have LRINEC scores of ≤5 [low risk], 6-7 [intermediate risk] & ≥8 [high risk] respectively. More than 20 days of hospital stay was required in 1, 2 and 1 cases whose LRINEC scores were ≤5 [low risk], 6-7 [intermediate risk] & ≥8 [high risk] respectively. The difference in LRINEC score according to duration of hospital stay was statistically not significant [p>0.05]. Present study found statistically non-significant association between duration of hospital stay with LRINEC score. This could most probably be due to certain patients getting discharged against medical advice due to financial constraints or other reasons. Out of 50 participants in the study, 13 participants got discharged against medical advice.

Table 19 compares the LRINEC score efficacy with histopathological findings. Table shows that sensitivity, specificity, PPV, NPV and accuracy noted for LRINEC score for diagnosis of necrotizing fasciitis was 73.7%, 71.0%, 60.9%, 81.5% & 72.0% respectively. It is very likely that the great variation in validation results for LRINEC is related to differences in race, region or area, demographics (age, sex, body mass index), morbid medical conditions (diabetes, immunosuppressant status) or study design.

CONCLUSION

Necrotizing soft tissue infections are often fatal, characterized by extensive necrosis of the fascia and subcutaneous tissues. It is perhaps the most severe form of soft tissue infection potentially limb and life threatening. Early diagnosis of necrotizing fasciitis is essential to advocate timely management for the better well being of the patient. LRINEC - Laboratory Risk Indicator for Necrotizing Fasciitis score is based on routine laboratory investigations that are readily available, at most centres that can help distinguish

Necrotizing Fasciitis from other soft tissue infections. LRINEC scoring system has a better positive predictive value in identifying the onset of necrotizing fasciitis and risk strategizing of the patients with severe soft tissue infections. The most common comorbidity associated with soft tissue infections in the study is Diabetes mellitus, whereas statistically significant association was found between Chronic Renal Failure and Peripheral Vascular disease and the severity of risk. The significance of LRINEC score in predicting the clinical outcome of the disease could not be outlined because of the limited population included in this study. Further studies are needed to determine whether additional interventions targeted to the high mortality risk group can lead to improved outcomes. Finally, Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) score can be used as an adjunct in the management of soft tissue infections especially in secondary care hospitals and may prevent delayed referral to tertiary centres where experienced surgeons, infectious disease and hyperbaric specialists may guide immediate operative and ancillary management, thereby improving the clinical outcome of the patient.

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