Original Research Article

The clinical efficacy of laboratory risk indicator for necrotizing fascitis score in early diagnosis of patients with necrotizing fascitis

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ABSTRACT

Background: Necrotizing fasciitis is a rare, rapidly progressive infection which causes extensive necrosis of the fascia and subcutaneous tissue. Early recognition and debridement are major prognostic determinants, and delay has been shown to increase mortality rate. We describe a novel, simple, and objective scoring system, the laboratory risk indicator for necrotizing fasciitis (LRINEC) score, based on routine laboratory investigations readily available at most centres, that can help to distinguish necrotizing fasciitis (nec fasc) from severe cellulitis or abscess.
Methods: We performed a single centre, retrospective, all patients treated at the RLJ Hospital for necrotizing fasciitis between January 2017 and December 2019 were included in this study. The outcome of the study was based on comparing LRINEC score and Wang and Wong staging, which is useful to detect necrotizing fasciitis severity.
Results: In our study, males were predominantly affected more common in lower limbs followed by perineum and abdominal wall in their fifties with diabetes mellitus and hypertension as dominant co-morbid diseases. In the study among subjects with high risk score, 83.3% required ICU stay, among subjects with moderate risk, 16.7% required ICU stay and among subjects with low risk, 12.5% required ICU stay.
Conclusions: All patients with higher LRINEC scores and who were classified as 'high risk' in Wang and Wong classification required ICU stay and significant association with mortality rate.

Keywords: Necrotising fasciitis, Laboratory risk indicator for necrotizing fasciitis, Morbidity

INTRODUCTION

Necrotizing fasciitis (NF), also known as flesh-eating disease, is an infection that results in the death of parts of the body's soft tissue. It is a rare, severe disease of sudden onset that spreads rapidly. Necrotizing fasciitis causes extensive necrosis of the fascia and subcutaneous tissue leading to severe systemic toxicity.

Symptoms usually include red or purple skin in the affected area, severe pain, fever, and vomiting. The most commonly affected areas are the limbs and perineum. It is perhaps the most severe form of soft tissue infection and is potentially limb and life threatening. Early recognition and aggressive debridement of all necrotic fascia and subcutaneous tissue are major prognostic determinants, and delay in operative debridement has been shown to increase mortality rate. It is usually treated with surgery to remove the infected tissue, and intravenous antibiotics. Delays in surgery are associated with a much higher risk of death.[1]

Despite high-quality treatment, the risk of death is between 25 and 35%. Its rarity and the paucity of early pathognomonic signs make NF a major diagnostic challenge. The differentiation of necrotizing fasciitis from other soft tissue infections is therefore critically important. However, early clinical recognition of necrotizing fasciitis

is difficult, as the disease is often indistinguishable from cellulites or abscesses early in its evolution. Delayed recognition is one of the main reasons for the high mortality rate. Although modalities such computed tomography, magnetic resonance imaging (MRI), and frozen section biopsy have been shown to be useful in the early recognition of necrotizing fasciitis, routine application of theses modalities in the evaluation of soft tissue infections has been limited by cost and availability. Various scoring systems are being developed to determine the likelihood of getting necrotizing fasciitis, but a scoring system developed by Wong and colleagues in 2004 is the most commonly used. It is the laboratory risk indicator for necrotizing fasciitis (LRINEC) score, which can be used to stratify by risk those people having signs of severe cellulitis or abscess to determine the likelihood of necrotizing fasciitis being present.

We describe a novel, simple, and objective scoring system, the LRINEC score, based on routine laboratory investigations readily available at most centres, that can help to distinguish necrotizing fasciitis (nec fasc) from severe cellulitis or abscess.[2]

Objective

The objective of this study was to perform systematic review to diagnose necrotizing fasciitis early based on laboratory tests routinely performed by using LRINEC score.

METHODS

This is an observational retrospective study, 28 patients who were diagnosed as necrotising fasciitis from 2017-2019, admitted in department of general surgery RLJH Hospital were included.[4] Relevant investigations were done in all. Initially clinical staging was done according to Wang and Wong stage as (a) stage 1 (early): tendernes to palpation (extending beyond the apparent area of skin involvement), erythema, swelling, warmth; (b) stage 2 (intermediate): blister and bullae formation; and (c) stage 3 (late): crepitus, skin anaesthesia, skin necrosis, discoloration

Informed consent will be taken and patients were scored according to LRINEC scoring system and were compared to clinical stage.

LRINEC score was calculated by considering six biological variables: C-reactive protein (CRP), white blood cell count, hemoglobin, creatine, glucose and sodium levels.[3]

Inclusion criteria

All patients treated at the RLJ Hospital for necrotizing fasciitis between January 2017 and December 2019 were included.

Exclusion criteria

All cases missing laboratory values were due to the absence of a CRP value were excluded. Since, the score for a negative or positive CRP value for the LRINEC score was 0 or 4 respectively, a LRINEC score of 0 or 1 without a CRP value would have placed the patient in the 'low risk' group and a LRINEC score of 8 or greater without CRP value would have placed the patient in the 'high risk' group.

Statistical analysis

Data was entered into Microsoft excel data sheet and was analyzed using SPSS 22 version software. Categorical data was represented in the form of Frequencies and proportions. Chi-square test was used as test of significance for qualitative data. Continuous data was represented as mean and standard deviation.

Graphical representation of data

MS excel and MS word was used to obtain various types of graphs such as bar diagram, pie diagram.

P value (probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests.

Statistical software

MS excel, SPSS version 22 (IBM SPSS statistics, Somers NY, USA) was used to analyze data.

RESULTS

In the study majority of subjects were in the age group 41 to 50 years (26.9%), 73.1% were males, 26.9% were females, most common location was right lower limb and left lower limb (30.8% respectively), 26.9% underwent fasciotomy and 38.5% underwent wound debridement alone, 50% of subjects had comorbidities, DM was the most common co-morbidity.

On tissue culture, 11.8% were positive for gram negative bacilli, 7.7% for Klebsiella and Enterococcus species respectively and 3.8% were positive for Proteus mirabilis and Enterobacter species. In the study 23.1% had high risk, 46.2% had moderate risk and 30.8% had low risk.

In the study among subjects with high risk score, 33.3% had clinical stage 2 and 66.7% had clinical stage 3, among subjects with moderate risk score, 8.3% had clinical stage 1, 41.7% had clinical stage 2 and 50% had clinical stage 3 and among subjects with low risk score, 62.5% had clinical stage 1, 37.5% had clinical stage 2 and 0% had clinical stage 3. There was significant association between clinical stage and LRINEC risk score.
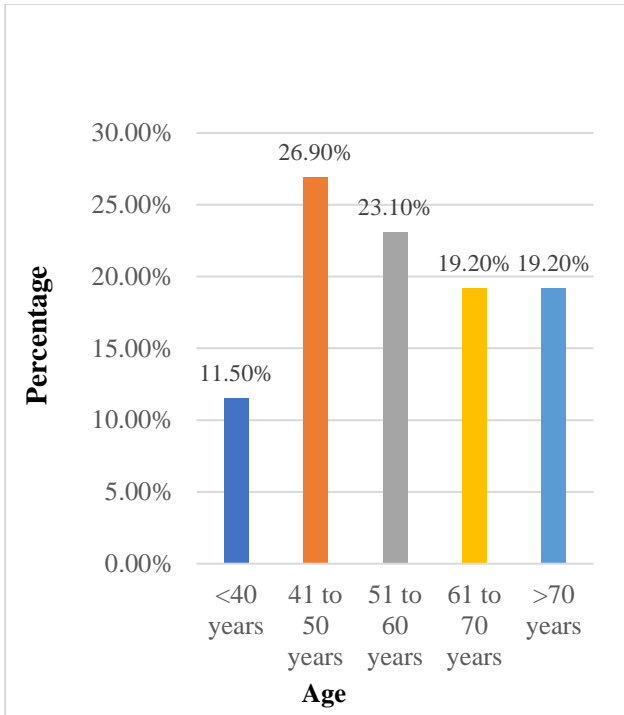
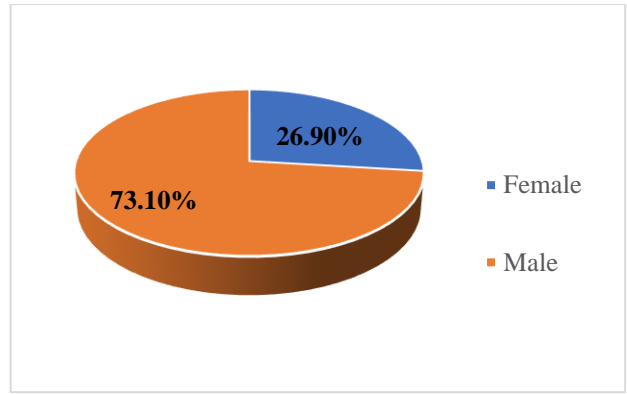**Figure 1: Bar diagram showing age distribution of subjects.**

Figure 2: Pie diagram showing sex distribution of subjects.

In the study among subjects with high risk score, 83.3% required ICU stay, among subjects with moderate risk, 16.7% required ICU stay and among subjects with low risk, 12.5% required ICU stay. There was significant association between LRINEC risk score and ICU stay.

Among subjects with high risk score, 33.3% had mortality, among subjects with moderate and low risk score, 0% had mortality. There was significant association between LRINEC risk score and mortality.
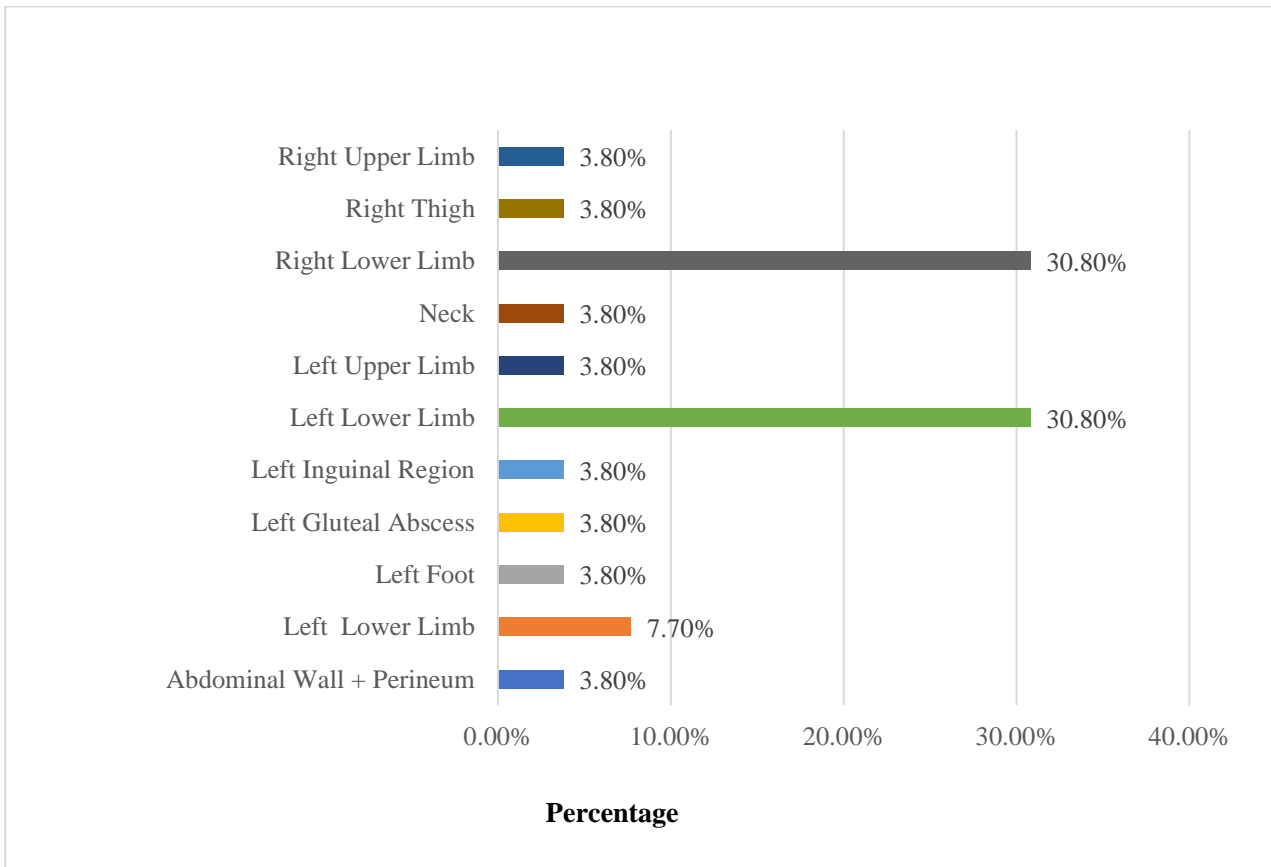

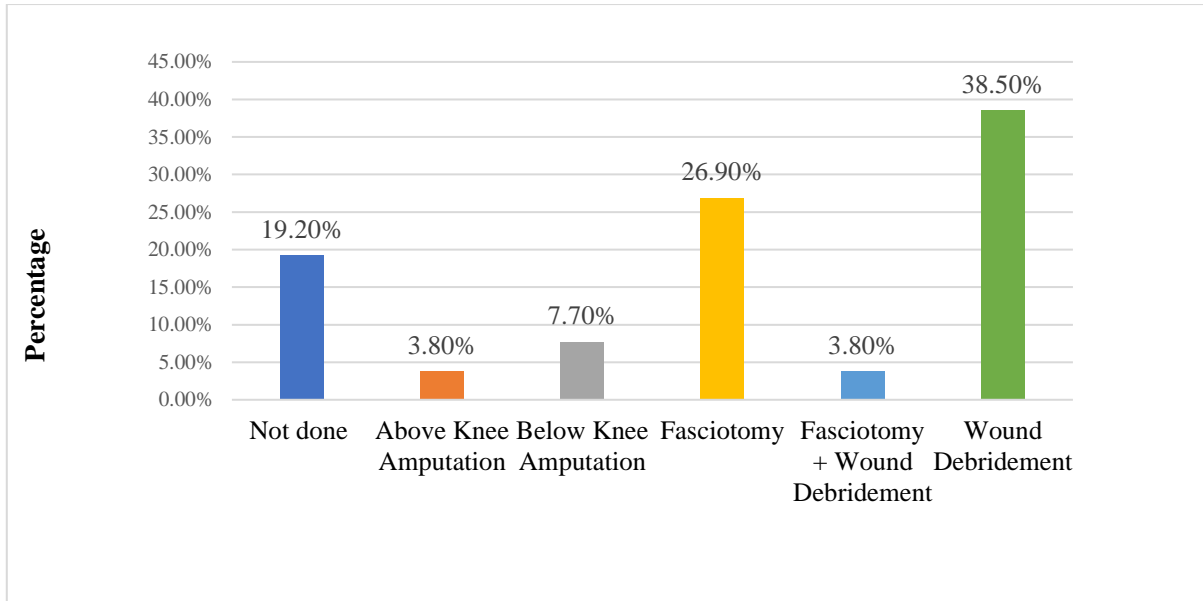**Figure 3: Bar diagram showing location distribution of subjects.**

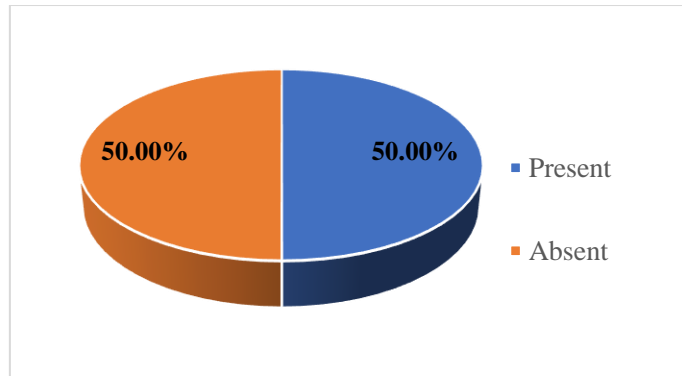**Figure 4: Bar diagram showing type of surgery of subjects.**

Figure 5: Bar diagram showing comorbidities distribution of subjects.
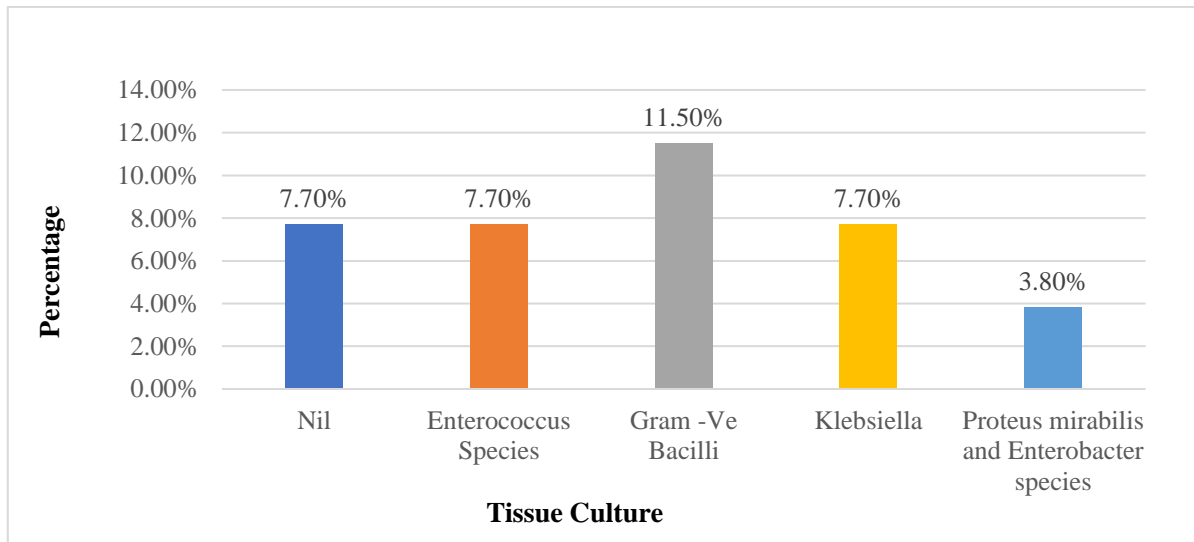

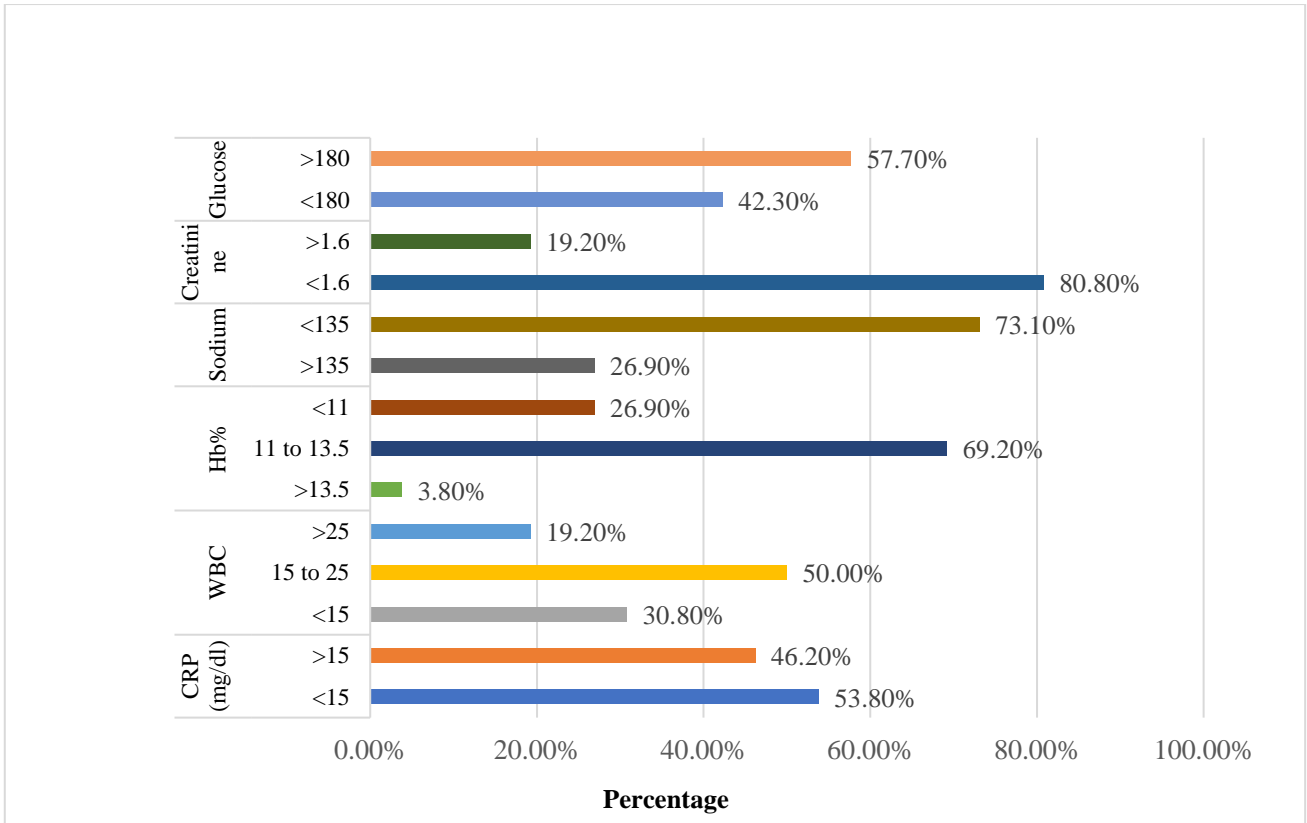**Figure 6: Bar diagram showing tissue culture findings distribution.**

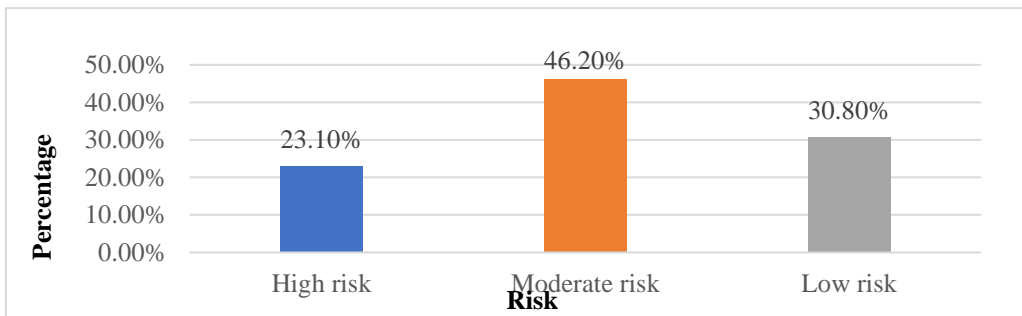**Figure 7: Bar diagram showing LRINEC score factors distribution.**

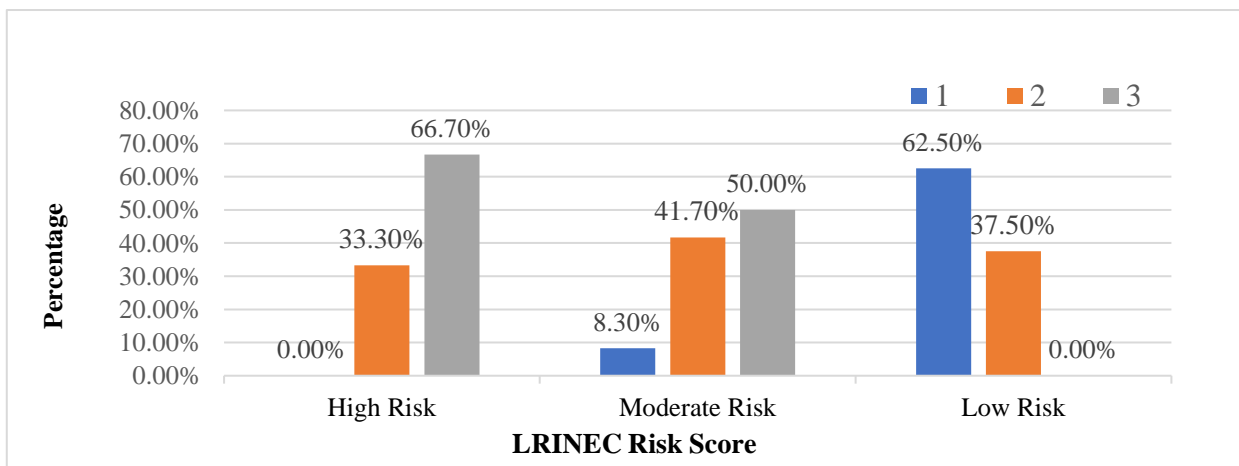**Figure 8: Bar diagram showing LRINEC score grading.**

Figure 9: Bar diagram showing association between LRINEC score risk and clinical stage.
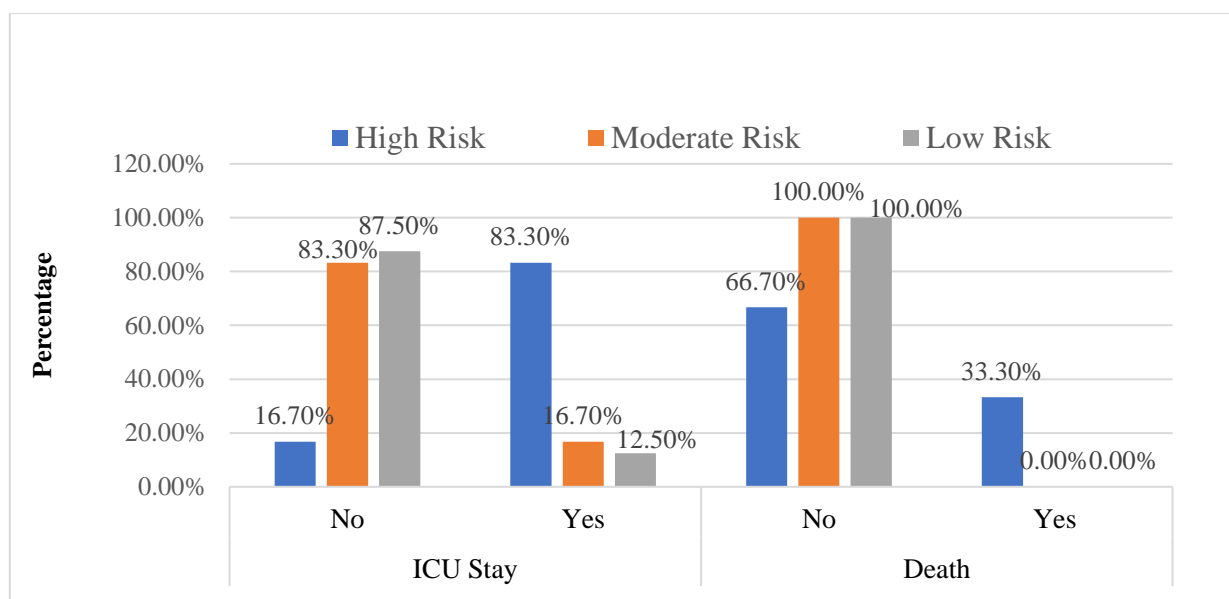
Figure 10: Bar diagram showing association between LRINEC score risk and ICU stay and mortality.

DISCUSSION

Athough, large series report necrotizing fasciitis as being more common in males, a few studies reported that females were more commonly affected. In our study, males were predominantly affected.[6] NF was more common in lower limbs in our study followed by perineum and abdominal wall. Patients with NF are usually in their fifties. In our study, median age was 57.5 years (20-81), which is consistent with previous studies. In some studies advanced age was considered as an independent predictor of mortality. Henry at al showed that older patients had significantly higher mortality rates in their series. Our findings were consistent with previous studies. The dominant co-morbid diseases in NF are diabetes mellitus and hypertension. Diabetes mellitus was the most common co-morbid disease in our study.[7]

The LRINEC score was first described in 2005 to distinguish NF from other soft tissue infections. A score 6 or more has 92% positive predictive value and 96% negative predictive value for the diagnosis of NF. It is useful to stratify patients as low (score 5 or less, probability of NF <50%), medium (6-7, probability of NF 50-75%) and high risk (8 or more, probability of NF >75%) risk of NF, in order to achieve a timely diagnosis and plan appropriate therapy.

In a study by Colak at al which investigated 25 patients with NF, mean LRINEC score was 4.6±2.7. Another large cohort by Menyar et al with 294 NF patients, mean LRINEC score was 6.28±2.9 and 45% of patients had LRINEC score <6.

In the study 23.1% had high risk, 46.2% had moderate risk and 30.8% had low risk. In the study 53.8% had CRP >15, 30.8% had WBC count <15, 19.2% had >25, 69.2% had Hb% 11 to 13.5 g% and 26.9% had Hb% <11 g%, 73.1% had sodium <135 mg/dl, 19.2% had creatinine >1.6 mg/dl, 57.7% had glucose >180 mg/dl.

Wang and Wong staging reflects chronological skin changes during the course of NF.[8] Since underlying fascia is the source of infection in NF, skin manifestations are secondary changes due to progressive ischemia. In stage 1 disease, skin manifestatios like swelling and calor are indistinguishable from other soft tissue infections. In stage 2, due to progressive infection of deep fascia, perforator vessels supplying the skin become progressively thrombosed, which leads to consecutive blisters and bulla formation. In stage 3, progressive ischemia results in hemorrhagic bullae, skin anesthesia, and skin gangrene. In the study among subjects with high risk score, 33.3% had clinical stage 2 and 66.7% had clinical stage 3, among subjects with moderate risk score, 8.3% had clinical stage 1, 41.7% had clinical stage 2 and 50% had clinical stage 3 and among subjects with low risk score, 62.5% had clinical stage 1, 37.5% had clinical stage 2 and 0% had clinical stage 3. There was significant association between wang and wong clinical stage and LRINEC risk score.

The mortality of NF is reported as approximately 25%. Although DM is a well-known predisposing factor for NF, its effect on mortality is less clear. Yılmazlar at al could not detect DM as a prognostic factor in their study. In our study, as with previous ones, neither DM nor other co-morbid factor was associated with mortality. Gender could be another factor related to mortality. A study authored by Misiakos at al showed that female gender was found to have significant association with mortality. In contrast with that study, Yanar didn't detect a relationship between gender and mortality in their series. Besides its diagnostic use, LRINEC score was also determined as a predictor of mortality in some studies.

In the study among subjects with high risk score, 83.3% required ICU stay, among subjects with moderate risk, 16.7% required ICU stay and among subjects with low risk, 12.5% required ICU stay. There was significant association between LRINEC risk score and ICU stay.

Among subjects with high risk score, 33.3% had mortality, among subjects with moderate and low risk score, 0% had mortality. There was significant association between LRINEC risk score and mortality.

Limitations

There were some limitations in our study. First, we lacked gold standard test to define all cases of the soft tissue infection. The diagnosis of NF can be confirmed by the final operative and pathologic findings of NF. However, the diagnosis of severe cellulitis can only be confirmed by clinical course. We did not design all enrolled cases to undergo CT or MRI imaging, or percutaneous biopsy because none of these diagnostic tests can be the gold standard test of NF and used for the comparison of accuracy. Second, only patients with NF involving the limbs were included in our study. Future prospective validation studies are warranted to determine whether the LRINEC score is a useful tool for discriminating NF from severe cellulitis in other parts of the body. Finally, this was a single-hospital study, and the patient characteristics of the study cohort may be different from other institutions.

Thus, our findings may not be applicable to other institutions with different patient characteristics, hospital features, and levels of care. In order to further test the validity of the LRINEC score, a multi-center study from different countries and with a larger sample should be conducted in the future.

CONCLUSION

Results of our study is LRINEC score comparing with Wang and Wong staging are useful to detect necrotizing fasciitis severity. While all patients with higher LRINEC scores and who were classified as 'high risk' in Wang and Wong classification required ICU stay and significant association with mortality rate.

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