PREDICTION OF LOWER LIMB AMPUTATION IN DIABETIC GANGRENE AND NON DIABETIC GANGRENE WITH HELP OF LRINEC SCORE

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Abstract

Background and Objectives- Diabetes-related foot ulcers are complicated, multifaceted clinical problems that can manifest as anything from minor soft tissue abnormalities to severe tissue necrosis and excessive inflammation. It was aimed to analyze the effectiveness of the Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) score in predicting amputation in diabetic foot infection (DFI). **Methods-** It was a retrospective comparative study conducted in Patients with foot gangrene admitted in department of general surgery in VMKVMCH between January 2023 - February 2024.The total of 50 patients divided into two groups of 25 each. GROUP A: subjects were patients with Diabetic foot gangrene and underwent Lower extremity amputation during the time of hospitalisation. GROUP B: subjects were patients with Non-Diabetic foot gangrene who underwent Lower extremity amputation during the time of hospitalisation. **Results-**Mean age of group a patients was 59.6± 10.2 years and for group B was 59.8±10.8. 62% of them were males. The median duration of diabetes was 13 years (interquartile range [IQR], 4−30 years) in group A. Among the included patients, 66% of them were treated with oral antidiabetic drugs and 30% of them were treated with insulin. Group A patients had significantly higher levels of white blood cell, neutrophil, monocyte, platelet, CRP, ESR, procalcitonin, and LRINEC score, while they had significantly lower levels of hemoglobin, lymphocyte and sodium. However, among these parameters hemoglobin, lymphocyte, sodium and ESR levels were not significant parameters in deceased patients. **Conclusion-** LRINEC score may be a promising scoring system in predicting both amputation and mortality in DFI.

Keywords: Diabetes, Diabetic Foot, LRINEC, Ulceration, Clinical Parameters

INTRODUCTION

Diabetes-related foot ulcers are complicated, multifaceted clinical problems that can manifest as anything from minor soft tissue abnormalities to severe tissue necrosis and excessive inflammation. Nearly half of diabetic foot ulcers are considered infectious due to the appearance of redness, discomfort, swelling, and heat. Diagnosis of diabetic foot infection (DFI) is closely correlated with higher likelihood of lower limb amputation and mortality. Over half of diabetic foot ulcers become infected.[1,2]

To forecast foot problems and clinical care, several diabetic foot risk classification systems have been established. The current agreement states that gangrene is recognized as a criterion for DFI severity; nevertheless, these severity evaluation tools

do not examine the necrotizing process. On the other hand, the infectious process disrupts local blood flow, which results in many layers' secondary necrosis. Consequently, DFIs are dangerous soft tissue infections that are accompanied by the process of necrotizing.[3,4]

For the purpose of forecasting necrotizing tissue infections, the Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC)[2] score was created. The 13-point LRINEC score is determined using standard laboratory indicators such as hemoglobin, glucose, creatinine, salt, white blood cell count, and C-reactive protein (CRP). Furthermore, research has demonstrated its prognostic significance in necrotizing infections. According to earlier research, an LRINEC score of less than six indicates a higher risk of necrotizing fasciitis, whereas an LRINEC score of more than eight indicates a substantial likelihood of necrotizing infections.[5,6]

To the best of our knowledge, there are no published findings on the significance of the LRINEC score in DFI patients. Our study's objective was to evaluate how well the LRINEC score predicted lower limb amputation in DFI patients.

MATERIALS AND METHODS

It was a retrospective comparative study conducted in Patients with foot gangrene admitted in department of general surgery in VMKVMCH between January 2023 - February 2024. A total of 50 patients were studied during the study period. Patients who were hospitalized, diabetic patients, patients with foot infection and patients over the age of 18 were enrolled in the study. Patients without diabetes, patients under the age of 18, pregnant patients, patients with other cause of skin inflammation (trauma, gout, venous stasis, thrombosis and fracture), patients with other focus of infection, patients without any signs of foot infection and patients who received antibiotics in the last two weeks were excluded from the study.

The total of 50 patients divided into two groups of 25 each. GROUP A: subjects were patients with Diabetic foot gangrene and underwent Lower extremity amputation during the time of hospitalisation. GROUP B: subjects were patients with Non-Diabetic foot gangrene who underwent Lower extremity amputation during the time of hospitalisation.

Demographic data (age, sex), clinical findings (duration of diabetes, type of diabetes, diabetes medications, complications of diabetes, history of debridement or amputation, time from onset of symptoms to hospital admission, wound characteristics), laboratory findings (white blood cell, neutrophil, lymphocyte, monocyte, platelet, hemoglobin, glycated hemoglobin A1c, glucose, blood urea nitrogen, serum creatinine, aspartate aminotransferase, alanine aminotransferase, sodium, CRP, ESR, procalcitonin), treatment types (medical treatment without surgery, debridement/drainage, amputation) and in-hospital outcome data (need for amputation, in-hospital mortality) were recorded from the medical charts.

We defined diabetic foot as infected if at least two clinical findings of infection were present including erythema, local tenderness/pain, local increased warmth, purulent discharge and local swelling/induration. The treatment schedules were decided by multidisciplinary team in line with current guideline recommendations

Table 1: Calculation of LRINEC score[2]

Variable	Value	points
C-Reactive Protein (mg/dL)	< 15	0
	≥ 15	4
White blood cell count (per mm3)	< 15	0
	15-25	1
	> 25	2
Hemoglobin (g/dL)	> 13.5	0
	11-13.5	1
	< 11	2
Sodium (mmol/L)	≥ 135	0
	< 135	2
Creatinine (mg/dL)	≤ 1.6	0
	> 1.6	2
Glucose (mg/dL)	≤ 180	0
	> 180	1

Interpretation

Score < 5 - low   < 50% of probable necrotising fasciitis
Score 6-7 - moderate   50- 75 % of probable necrotising fasciitis
Score >8 - high risk   > 75 % of probable necrotising fasciitis

Venous blood samples were obtained at the time of hospital admission as a routine procedure. Infection markers including white blood cell, erythrocyte sedimentation rate (ESR) and CRP levels were examined. Our laboratory department analyzed all laboratory studies according to the standard procedures. LRINEC scoring system consists of laboratory parameters which are presented in Table 1. LRINEC score of each patient was calculated according to the laboratory results recorded on the first day of hospital admission.

Statistical Analysis

The study population's clinical and demographic features were compiled using descriptive statistics. The chi-square test and other suitable statistical tests were used in association analysis to investigate the associations between the variables. The statistical analysis was performed using SPSS for Windows version 22.0 software. The critical value of P indicating the probability of significant difference was taken as <0.05 for comparison.

RESULTS

Table 2: Demographic details and clinical features among both groups

Variables	Group A	Group B
Mean age (years)	59.6±10.2	59.8±10.8
Gender Males	17	14
Females	8	11
Mean duration of diabetes (years)	13 (4-30)	14 (3-29)
Treatment OHA	11	22
Insulin	12	3
Both	2	0
Mean duration of chronic ulceration	3months	4 months
Rt foot	17	16
Lt foot	8	9
H/o debridement	20	11
h/o LL amputation	3	1

As per table 1 the study population consists of 50 patients with foot infection. Mean age of group A patients was 59.6± 10.2 years and for group B was 59.8±10.8. 62% of them were males. The median duration of diabetes was 13 years (interquartile range [IQR], 4−30 years) in group A. Among the included patients, 66% of them were treated with oral antidiabetic drugs and 30% of them were treated with insulin. Right foot infection was detected in 33 (66%) patients, left foot infection was detected in 17 (34%) patients. The median duration of the chronic ulceration was 3 months (IQR, 1.7−9 months). 62% had a history of debridement and (8%) patients had a history of lower limb amputation.

Table 3: Comparison of Laboratory values among patients

Parameters	Group A	Group B	*P*
Hemoglobin (g/dL)*	10.6 ± 1.9	11.3 ±1.9	**0.01**
White blood cell (K/uL)	14,500 (5080 −58,380)	11,730 (4170 −43,810)	**0.01**
Neutrophil (K/uL)	11,680 (1000 −52,290)	8430 (1250−41,970)	**0.01**
Lymphocyte (K/uL)	1440 (230−8400)	1680 (380−5680)	**0.01**
Monocyte (K/uL)	870 (0−2240)	720 (150−3340)	**0.01**
Platelet (K/uL)	378,000 (148,000 −963,000)	335,000 (110,000 −872,000)	**0.01**
HbA1c (%)	9 (4.3−15.5)	8.7 (5.3−16.5)	0.57
Glucose (mg/dL)	230 (59−695)	215 (41−623)	0.34
BUN (mg/dL)	22 (6−109)	20 (6−107)	0.09
Serum creatinine (mg/dL)	1.1 (0.3−9)	1 (0.6−8.9)	0.59
AST (U/L)	18 (6−467)	16 (6−140)	0.29
ALT (U/L)	16 (5−296)	16 (3−118)	0.78
Sodium (mmol/L)	132 (118−152)	135 (120−145)	**0.01**
CRP (mg/dL)	15 (0.1−50.2)	9.8 (0.1−43.4)	**0.01**
ESR (mm/h)	89.5 (9−140)	84 (5−134)	**0.01**
PCT (ng/mL)	0.3 (0.03−32.5)	0.1 (0.01−11)	**0.01**
LRINEC score (points)	6 (0−13)	4 (0−13)	**0.01**

As per table 3 Group A patients had significantly higher levels of white blood cell, neutrophil, monocyte, platelet, CRP, ESR, procalcitonin, and LRINEC score, while they had significantly lower levels of hemoglobin, lymphocyte and sodium. However, among these parameters hemoglobin, lymphocyte, sodium and ESR levels were not significant parameters in deceased patients.

Table 4: Predictive value of LRINEC score in predicting amputation

Variables *Amputation*	AUC	*P*	Sensitivity (%)	Specificity (%)	+LR	—LR	+PV (%)	—PV(%)
LRINEC ≥5	0.638 (0.590−0.684)	0.01	70.06	62.34	1.45	0.59	13.9	93.8

As per table 4 in our study, optimal cut-off value for LRINEC score was calculated as ≥5 points in predicting amputation. The area under the ROC curve (AUC) value for LRINEC score was 0.638 (95% confidence interval [CI]: 0.590−0.684) with the cut-off point of ≥5 in predicting amputation in DFI. LRINEC score yielded 70% sensitivity and 62.3% specificity for the cut-off point of ≥5.

DISCUSSION

Our results show that our score system, which can be computed using readily available laboratory values and doesn't need extra funding, can offer pertinent data regarding the outcomes of DFI patients. It was discovered that the LRINEC score had a rather low diagnostic accuracy, with a cut-off value of ≥5 for amputation prediction and ≥7 for DFI mortality prediction. Among the most common infections are skin and soft tissue infections (SSTIs), which are particularly common in people with diabetes. DFIs are thought to be the main factor contributing to hospitalizations linked to diabetes and to the rise in morbidity and death.

Different levels of microbial invasion in skin layers, including the dermis, epidermis, fat layers, fascia, and muscle, are present in these infections. SSTIs are categorized using several techniques. The Infectious Diseases Society of America's practice guidelines divide infections into five categories: necrotizing infections, surgical site infections, infections linked to animal contact and bites, superficial infections, uncomplicated infections, and infections in patients with compromised immune systems.[7,8] We showed in our study that the LRINEC score may be a useful indicator of limb loss in DFI patients. This outcome could be explained by how well the LRINEC score detects the necrotic process connected to the current peripheral circulatory disease, which is marked by a higher risk of amputation in individuals with diabetes. However, our analysis revealed that the LRINEC score had a comparatively low diagnostic accuracy.

According to the authors, a score of ≥6 indicated a moderate risk of necrotizing soft tissue infection, but a score of ≥8 indicated a higher risk. They added that the positive and negative predictive values of the LRINEC score were strong. The LRINEC score's ability to identify necrotizing infections was validated through a number of investigations. However, because of the relatively frequent false positive or false negative outcomes, lesser predictive values were found in these investigations, and the general consensus is that the LRINEC score may be more helpful in identifying high-risk patients than in the diagnostic process.

We looked into the impact of the LRINEC score on amputation in DFI patients in our study.[9,10,11] As per our hypothesis, the LRINEC score exhibited a moderate yet noteworthy diagnostic efficacy in forecasting amputation in DFI. We determined the significant cut-off value as ≥5 in our cohort, in contrast to the cut-off values established for necrotizing soft tissue infections. Greater predictive power can be obtained from different cut-off values in DFI homogenous subgroups that are more precisely characterized. As such, our findings need to be confirmed by prospective, in-depth research in the future.

Notwithstanding recent improvements in treatment choices, necrotizing soft tissue infections remain a highly fatal condition. Patients with an LRINEC score of ≥6 had a considerably greater death rate, according to a study that was conducted.[12] We also looked into the predictive significance of the LRINEC score in patients with DFI, based on the theory that it would be helpful in predicting mortality. The LRINEC score's predictive effect was likewise moderate but significant in our investigation. Nevertheless, the LRINEC score's computed cut-off value for predicting mortality was greater than the cut-off value for predicting amputation.[13,14] Our study has few limitations like small sample size so results cannot be generalized, retrospective design of the study and single- centre study.

CONCLUSIONS

The LRINEC score is a scoring system made up of uniform laboratory measures that may be useful in predicting DFI mortality and limb loss. Adding clinical parameters (like peripheral artery disease, which is a significant predictor of the necrotizing process) and other potentially correlated laboratory parameters (like laboratory tests that significantly differ among those who have been amputated) to the LRINEC score may improve the sensitivity and specificity rates in subsequent studies. The predictive value of a separate scoring system based on these extra laboratory tests might be higher than that of the LRINEC score.

Conflict of Interest- None declared

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