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ORIGINAL SCIENTIFIC REPORT

The SIARI Score: A Novel Decision Support Tool Outperforms LRINEC Score in Necrotizing Fasciitis

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Abstract

Background The Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) scoring system was developed to aid the diagnosis of necrotizing fasciitis and guide management [1].

Aim To validate the LRINEC score and identify clinical predictors to develop a refined diagnostic scoring tool for the diagnosis of necrotizing fasciitis at Middlemore Hospital, New Zealand.

Methods This was a retrospective case–control study of patients admitted to Middlemore Hospital with necrotizing fasciitis and severe cellulitis between January 2000 and December 2010. The LRINEC scores at admission were evaluated for performance in discriminating between cases of necrotizing fasciitis and severe cellulitis. Cases and controls were randomized into developmental and validation cohorts. Univariate and multivariate logistic regression analysis of demographic, clinical, and laboratory variables for the diagnosis of necrotizing fasciitis was performed. The identified independent predictors were used to develop a new diagnostic scoring tool.

Results The area under the receiver operating characteristic curve (C-statistic) of a LRINEC score ≥ 6 for the diagnosis of necrotizing fasciitis was 0.679. The newly developed SIARI score [Site other than the lower limb, Immunosuppression, Age < 60 years, Renal impairment (creatinine > 141), and Inflammatory markers (CRP ≥ 150, WCC > 25] demonstrated superior diagnostic ability compared with the LRINEC score in both the developmental (C-statistic: 0.832 vs. 0.691, $p < 0.001$) and validation cohorts (C-statistic: 0.847 vs. 0.667, $p < 0.001$).

Conclusion The LRINEC score exhibited only modest discriminative performance in this cohort, while the SIARI score is a simplified tool that demonstrates superior diagnostic ability for detecting necrotizing fasciitis. Future external validation studies are required to confirm the trends observed in this study.

This study has not been presented to a society or meeting.

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Introduction

Necrotizing fasciitis is a rare and life-threatening soft tissue infection. Optimal management of this condition requires rapid diagnosis and timely surgical intervention. However, the diagnosis of necrotizing fasciitis is often challenging as it can be difficult to differentiate from severe cellulitis, which generally does not require surgical intervention. The lack of a widely accepted definition and simple gold standard diagnostic test also contribute to this clinical dilemma. This has led to various diagnostic adjuncts being described such as ultrasound, computed tomography, fascial biopsy, and decision support tools. In 2004, Wong et al. developed the "Laboratory Risk Indicator for Necrotizing Fasciitis" (LRINEC) scoring system, which uses six routine laboratory blood tests (C-reactive protein, total white cell count, hemoglobin, sodium, creatinine, and glucose) to assess risk and aid the diagnosis of necrotizing fasciitis [1]. This study set out to retrospectively validate the LRINEC score in Middlemore Hospital, New Zealand. Middlemore Hospital is a busy tertiary hospital with the population having relatively high deprivation and high rates of necrotizing fasciitis [2]. This study also set out to identify key demographic, clinical, and laboratory predictors for the diagnosis of necrotizing fasciitis with an aim of developing a refined decision support tool that has improved performance and is simple to use.

Methods

This retrospective case–control study received institutional ethics committee approval. All cases of necrotizing soft tissue infection admitted to Middlemore Hospital between January 2000 and December 2010 were identified from a computerized discharge record search. The medical charts of all patients were reviewed by two investigators to confirm the diagnosis of necrotizing fasciitis. The diagnosis was confirmed by both the intra-operative impression of necrotizing fasciitis by the operating surgeon and consistent operative findings (which included the presence of "dishwater fluid," necrotic or gray discolored fascia, and/or absence or lack of bleeding of the superficial tissues).

The control group consisted of patients admitted during the same time frame with severe cellulitis. To identify these patients, a computerized search of all patients admitted with cellulitis between January 2000 and December 2010 was conducted and the clinical records were reviewed to select controls that met criteria for severe cellulitis as defined by Marwick et al. (Box 1) [3].

Patients excluded from the study were those aged 15 years or younger and/or patients referred from other hospitals.

Data collection

Clinical records, both written and electronic, were reviewed to extract data on baseline characteristics including demographic data, site of infection, comorbidities, medications, and smoking status. Blood tests conducted at admission were used to calculate the LRINEC score [1]. Outcome data collected for cases with necrotizing soft tissue infection included length of hospital admission, number of operations, and 30-day mortality.

Statistics

Statistical analysis was performed using MedCalc Statistical Software version 18.0 (Ostend, Belgium) and IBM SPSS Statistics version 22.0 (New York, USA). All tests were two-tailed, and $p < 0.05$ was considered statistically significant. Comparisons of continuous variables between groups were performed using independent t tests, where normal distribution had been confirmed by the Shapiro–Wilk test ($p > 0.05$). Non-normally distributed measurements were analyzed using the Mann–Whitney U test, and categorical data using Fisher's exact or Chi-squared tests. The multiple imputation method was used to account for missing data as per previous LRINEC score developmental and validation cohort studies [1, 4]. The area under the receiver operating characteristic curves (C-statistic) was used to evaluate the performance of the LRINEC score in discriminating between cases of necrotizing fasciitis and severe cellulitis, and predicting mortality, hospital admission time, and re-operation rates in patients with necrotizing fasciitis. Diagnostic accuracy values were calculated at the previously reported LRINEC cutoff value of ≥6 [1].

Box 1 Marwick et al. criteria for severe cellulitis requires both criteria 1 and 2 [3]

1. Cellulitis + SIRS (systemic inflammatory response syndrome)

   [SIRS defined as two or more of the following criteria: white blood cell count <4 or >12/mm^3 temperature <36 or >38 C, heart rate >90 beats/min, respiratory rate >20 breaths/min].

2. SEWS (standardized early warning score) ≥4

   The SEWS score components include respiratory rate, oxygen saturations, temperature, heart rate, blood pressure, and AVPU score

Cases and controls were randomized, respectively, by sequentially assigned computer-generated random number allocation conducted by a blinded investigator into split-half developmental and validation cohorts for the purposes of constructing and evaluating a modified diagnostic scoring system for discriminating between cases of necrotizing fasciitis and severe cellulitis. Univariate odds ratio analysis and Fisher's exact test were used to assess potential demographic, clinical, and laboratory predictors for the diagnosis of necrotizing fasciitis in the developmental cohort. Laboratory factors were entered as categorical variables using cutoff points described by the developers of the original LRINEC score [1]. Multivariate logistic regression was conducted, incorporating all variables with $p < 0.15$ in the univariate analysis. The modified decision support tool was then constructed by converting regression coefficients of independently predictive factors of the multivariate logistic model for diagnosing necrotizing fasciitis into integer scoring components [1, 5]. The C-statistic of the original LRINEC and newly constructed scoring systems was compared using the pairwise DeLong test, and Youden optimal diagnostic cutoff sensitivity and specificity values calculated in the developmental and validation cohorts.

Results

Between January 2000 and December 2010, 138 patients with necrotizing fasciitis were admitted, while 142 patients with severe cellulitis during the same time period served as controls. The mean ± SD age of the study population (173 males and 107 females) was 56 ± 13 years. Patients of European descent accounted for 41% of the study population, Pacific Island 30%, and Māori 25%. In almost three quarters (73%) of patients, the site of infection was in the lower limb. Common comorbidities included diabetes (36%), ischemic heart disease (29%), obesity (24%), and heart failure (23%).

Demographic characteristics, site of infection, medical history, and laboratory measurements of cases and controls of the entire cohort are presented in Table 1. Overall, cases with necrotizing fasciitis were significantly younger than controls with severe cellulitis ($p < 0.001$). The prevalence of lower limb sites of infection, peripheral vascular disease, heart failure, ischemic heart disease and chronic respiratory disease was higher among controls with severe cellulitis (all $p < 0.01$). A total of 68 cases and 73 controls were randomized to the developmental cohort, and 70 cases and 69 controls to the validation cohort. Clinical characteristics did not differ between developmental and validation cohorts (all $p > 0.05$).

Overall, 83 (60%) patients with necrotizing fasciitis had LRINEC scores of ≥6, and of the 78 necrotizing fasciitis cases (57%) with complete LRINEC scores at admission, 64 (82%) had LRINEC scores of ≥6. A total of 51 (36%) patients with severe cellulitis had LRINEC scores of ≥6, and of the 74 severe cellulitis controls (52%) with complete LRINEC scores at admission, 36 (49%) had a LRINEC score of ≥6. A missing C-reactive protein measurement at admission was the reason for the incomplete scores in all instances, and this was more common earlier in the cohort. The LRINEC score was significantly greater in patients with necrotizing fasciitis ($p < 0.001$), and elevated laboratory measurements of C-reactive protein, white cell count, sodium, creatinine, and glucose were also observed (all $p < 0.05$). Hemoglobin measurements did not differ significantly between groups ($p = 0.32$).

Of the 138 cases with necrotizing fasciitis, 30-day mortality occurred in 30 (22%) patients. The median (IQR) hospital admission was 20 (8–35) days, and the median (IQR) number of operations was 3 (2–6).

Performance of LRINEC score

The discriminative ability of a LRINEC score ≥6 in diagnosing necrotizing fasciitis, and predicting 30-day mortality, hospital admission time, and re-operation is presented in Table 2. The C-statistic of the LRINEC score for the diagnosis of necrotizing fasciitis was 0.679 (95% CI 0.617–0.741, $p < 0.001$), with a sensitivity of 60% (95% CI 51–68%) and specificity of 64% (95% CI 56–72%). Although the discriminative ability of the LRINEC score in predicting prolonged hospital admission time was significantly greater than chance (C-statistic, 0.670; 95% CI 0.569–0.771; $p = 0.002$), its prognostic performance for mortality and re-operation rate was not (both $p > 0.05$).

Development of SIARI score

Due to the poor discrimination of the LRINEC score, we developed a novel decision support tool for our population. Univariate and multivariate logistic regression analyses of potential demographic, clinical and laboratory predictors for the diagnosis of necrotizing fasciitis in the developmental cohort are presented in Table 3. A total of six independent predictors were identified from the multivariate analysis, including age, site of infection, presence of immunosuppression, C-reactive protein, white cell count, and creatinine (all $p < 0.05$). The modified diagnostic scoring system (SIARI: Site other than lower limb, Immunosuppression, Age ≤ 60 years, Renal impairment, Inflammatory markers) derived by the conversion of the regression coefficients of the independent predictors into integer risk scores is presented in Table 4.

Table 1 Demographic, clinical, and laboratory characteristics of cases (necrotizing fasciitis) and controls (severe cellulitis)

Characteristic	Cases (n = 138)	Controls (n = 142)
Demographics		
Age, years	52 ± 14	61 ± 10
Male gender	88 (64%)	85 (60%)
Ethnicity		
European	49 (36%)	65 (46%)
Māori	35 (25%)	34 (24%)
Pacific	44 (32%)	39 (27%)
Indian	4 (3%)	2 (1%)
Other	6 (4%)	2 (1%)
Site of infection		
Lower limb	72 (52%)	133 (94%)
Upper limb	13 (9%)	5 (4%)
Perineum	27 (20%)	2 (1%)
Abdomen	23 (17%)	1 (1%)
Trunk	19 (14%)	0 (0%)
Abdomen	7 (5%)	2 (1%)
Head and/or neck	2 (1%)	0 (0%)
Medical history		
Diabetes mellitus	49 (36%)	52 (37%)
Nonsteroidal anti-inflammatory drug use	8 (6%)	6 (4%)
Smoking	22 (16%)	16 (11%)
Obesity	28 (20%)	40 (28%)
Obstructive sleep apnea	2 (1%)	7 (5%)
Immunosuppression (HIV, chemotherapy, or steroid use)	8 (6%)	2 (1%)
Intravenous drug use	0 (0%)	0 (0%)
End-stage renal failure	13 (9%)	17 (12%)
Peripheral vascular disease	8 (6%)	24 (17%)
Heart failure	15 (11%)	48 (34%)
Ischemic heart disease	24 (17%)	57 (40%)
Cerebrovascular disease	11 (8%)	17 (12%)
Gout	22 (16%)	29 (20%)
Chronic respiratory disease	11 (8%)	29 (20%)
Liver failure	2 (1%)	0 (0%)
Laboratory measurements		
C-reactive protein, mg/L	296 ± 141	173 ± 118
White cell count, per mm^3	20.9 ± 11.7	17.0 ± 7.2
Hemoglobin, g/L	127 ± 24	129 ± 20
Sodium, mmol/L	133 ± 6	135 ± 5
Creatinine, μmol/L	211 ± 157	157 ± 114
Glucose, mmol/L	10.2 ± 8.3	8.6 ± 3.7
LRINEC score	6.3 ± 3.0	4.4 ± 2.9

Data are presented as mean ± SD, or the number of patients (% of patients). The sum of the proportions of the sites of infection exceeds 100% because some patients had more than one infected site

Table 2 Discriminative ability of the LRINEC score for diagnosing necrotizing fasciitis, and predicting 30-day mortality, hospital admission time ≥1 month, and ≥2 re-operations in patients with necrotizing fasciitis

	Necrotising fasciitis diagnosis	Mortality prediction	Hospital admission time prediction	Re-operation prediction
C-statistic (95% CI)	0.679 (0.617–0.741)	0.519 (0.407–0.631)	0.670 (0.569–0.771)	0.578 (0.479–0.676)
Discriminative significance (p value)	<0.001*	0.75	0.002*	0.12
Sensitivity (95% CI)	60% (51–68%)	58% (39–75%)	66% (53–78%)	66% (55–76%)
Specificity (95% CI)	64% (56–72%)	39% (30–49%)	45% (32–60%)	48% (35–62%)
Positive predictive value (95% CI)	62% (56–68%)	22% (16–30%)	57% (50–65%)	65% (58–71%)
Negative predictive value (95% CI)	62% (57–68%)	22% (17–28%)	55% (43–66%)	49% (39–59%)
Positive likelihood ratio (95% CI)	1.67 (1.29–2.17)	0.96 (0.68–1.34)	1.21 (0.89–1.64)	1.27 (0.94–1.71)
Negative likelihood ratio (95% CI)	0.62 (0.49–0.79)	1.07 (0.66–1.72)	0.74 (0.46–1.19)	0.71 (0.47–1.06)

The diagnostic or prognostic accuracy values are calculated at the previously reported cutoff of LRINEC score ≥6. Asterisks denote statistically significant values ($p < 0.05$)

Table 3 Univariate and multivariate logistic regression analysis of potential demographic, clinical and laboratory predictors of the diagnosis of necrotizing fasciitis in the developmental cohort

Predictor	Univariate analysis		Multivariate analysis		
	Odds ratio (95% CI)	p	Odds ratio (95% CI)	β	p
Age < 60 years	4.64 (2.26–9.54)	<0.001*	6.78 (3.02–15.2)	1.91	<0.001*
Male gender	1.19 (0.61–2.34)	0.73	–	–	–
Māori ethnicity versus European ethnicity	1.70 (0.73–3.99)	0.28	–	–	–
Pacific ethnicity versus European ethnicity	1.57 (0.71–3.48)	0.31	–	–	–
Non-lower limb versus lower limb site of infection	13.6 (4.88–37.9)	<0.001*	15.4 (5.92–39.9)	2.73	<0.001
Diabetes	0.93 (0.47–1.85)	0.86	–	–	–
Nonsteroidal anti-inflammatory drug use	1.08 (0.26–4.49)	> 0.99	–	–	–
Smoking	2.02 (0.74–5.48)	0.22	–	–	–
Obesity	0.74 (0.34–1.62)	0.55	–	–	–
Obstructive sleep apnea	0.35 (0.04–3.43)	0.62	–	–	–
Immunosuppression (HIV, chemotherapy, or steroid use)	5.71 (0.65–50.2)	0.11	12.5 (1.29–121.2)	2.52	0.03*
End–stage renal failure	1.08 (0.38–3.07)	>0.99	–	–	–
Peripheral vascular disease	0.21 (0.06–0.78)	0.02*	0.93 (0.26–3.33)	–0.08	0.91
Heart failure	0.24 (0.10–0.58)	0.001*	0.46 (0.16–1.32)	–0.78	0.15
Ischemic heart disease	0.28 (0.12–0.61)	0.001*	0.47 (0.18–1.26)	–0.75	0.13
Cerebrovascular disease	0.44 (0.13–1.52)	0.24	–	–	–
Gout	0.74 (0.30–1.77)	0.51	–	–	–
Chronic respiratory disease	0.34 (0.13–0.94)	0.04*	0.36(0.10–1.26)	–1.01	0.11
C-reactive protein ≥ 150 mg/L	3.83 (2.31–6.35)	<0.001*	3.71 (1.32–10.4)	1.31	0.01*
Hemoglobin 110–135 versus > 135 g/L	0.82 (0.39–1.70)	0.71	–	–	–
Hemoglobin < 110 versus > 135 g/L	1.29 (0.51–3.27)	0.64	–	–	–
White cell count 15–25 versus < 15 per mm^3	0.89 (0.42–1.89)	0.85	–	–	–
White cell count > 25 versus < 15 per mm^3	4.33 (1.47–12.8)	0.007*	3.03 (1.16–7.95)	1.11	0.03*
Sodium < 135 mmol/L	2.20 (1.12–4.33)	0.03*	1.51 (0.76–3.03)	0.41	0.24
Creatinine > 141 μmol/L	1.81 (0.92–3.53)	0.09	2.68 (1.02–7.15)	0.98	0.04*
Glucose > 10.0 mmol/L	1.58 (0.75–3.31)	0.26	–	–	–

Asterisks denote statistically significant values ($p < 0.05$)

Table 4 SIARI score—novel decision support tool to differentiate necrotizing fasciitis from severe cellulitis

Variable	Score
Site of infection outside of lower limb	3
History of immunosuppression	3
Age $\leq$ 60 years	2
Creatinine > 141 μmol/L	1
White cell count > 25 per mm^3	1
C-reactive protein $\geq$ 150 mg/L	1

Site other than lower limb, Immunosuppression, Age $\leq$ 60 years, Renal impairment, Inflammatory markers

Performance of SIARI score

The discriminative ability of the SIARI and LRINEC scores in diagnosing necrotizing fasciitis in the developmental and validation cohorts is presented in Table 5, and receiver operating characteristic curves for the two scores in the validation cohort are illustrated in Fig. 1. The SIARI score demonstrated superior discriminative ability compared with the LRINEC score in both the developmental (C-statistic: 0.832 vs. 0.691, $p < 0.001$) and validation cohorts (C-statistic: 0.847 vs. 0.667, $p < 0.001$). In the validation cohort, the Youden optimal diagnostic cutoff for the SIARI score was $\geq$3, with a sensitivity of 84% (95% CI 74–92%) and specificity of 70% (95% CI 57–80%).

Discussion

In this New Zealand cohort, the LRINEC score exhibited only modest discriminative ability for differentiating between cases of necrotizing fasciitis from controls with severe cellulitis, with a C-statistic of less than 0.7. At the previously reported cutoff of $\geq$6 points [1], the LRINEC score demonstrated a sensitivity of 60%, specificity of 64%, positive predictive value (PPV) of 62%, and negative predictive value (NPV) of 62%. The suboptimal discriminative performance of the LRINEC score would appear to limit its clinical utility, especially given the significant implications of a missed or delayed diagnosis. This contrasts considerably to the original Singaporean study by Wong et al., which reported C-statistics in excess of 0.97 in both their developmental and validation cohorts, with a PPV of 92% and NPV of 96% at the optimal diagnostic cutoff LRINEC score of $\geq$6 [1].

Nevertheless, it is acknowledged that significant variation in the diagnostic performance of the LRINEC score has been previously reported in the literature. Studies from Australia include Narasimhan et al., which examined 98 patients with necrotizing fasciitis from Darwin and reported that a LRINEC score of $\geq$5 exhibited a PPV of 95.5% and NPV of 88.1% [6]. Holland analyzed data from 28 patients in Townsville with necrotizing fasciitis and reported that a LRINEC score of $\geq$6 demonstrated a PPV of 57% and NPV of 86% [7]. A Taiwanese study by Liao et al. validated the LRINEC score in 233 patients with necrotizing fasciitis and reported that a LRINEC score $\geq$6 had a sensitivity of 59.2%, specificity of 83.8%, PPV of 37.9%, and NPV of 92.5% [4]. Syed et al. assessed 27 patients with necrotizing fasciitis from a Malaysian population and reported that a LRINEC score $\geq$6 demonstrated a PPV of 65% and NPV of 41.7% [8]. In the USA, California, Burner et al. reported that a LRINEC score of $\geq$6 had a sensitivity of 77% in 80 patients with necrotizing fasciitis [9]. Misiakos et al. assessed 62 Greek patients with necrotizing fasciitis from Greece and reported that 41.9% of these patients had a LRINEC score of $\geq$6 [10]. In

Table 5 Discriminative ability of the SIARI and LRINEC scores in diagnosing necrotizing fasciitis in the developmental and validation cohorts

	Developmental cohort		Validation cohort	
	SIARI score	LRINEC score	SIARI score	LRINEC score
C-statistic (95% CI)	0.832 (0.764-0.899)	0.691 (0.616-0.765)	0.847 (0.785-0.908)	0.667 (0.589-0.723)
Discriminative significance (p value)	<0.001*	<0.001*	<0.001*	<0.001*
Youden's optimal diagnostic cutoff	$\geq$3	–	$\geq$3	–
Sensitivity (95% CI)	81% (70–89%)	59% (46–71%)	84% (74–92%)	61% (49–73%)
Specificity (95% CI)	73% (61–82%)	63% (51–74%)	70% (57–80%)	65% (53–76%)
Positive predictive value (95% CI)	73% (65–80%)	60% (51–68%)	74% (66–80%)	64% (55–72%)
Negative predictive value (95% CI)	80% (71–87%)	62% (54–70%)	81% (71–88%)	63% (54–70%)
Positive likelihood ratio (95% CI)	2.95 (2.00–4.36)	1.59 (1.11–2.28)	2.77 (1.91–4.01)	1.77 (1.22–2.56)
Negative likelihood ratio (95% CI)	0.26 (0.16–0.44)	0.65 (0.47–0.91)	0.23 (0.13–0.40)	0.59 (0.42–0.83)

The diagnostic accuracy values are calculated at the previously reported cutoff of LRINEC score of $\geq$6 and a cutoff of $\geq$3 for the modified score. Asterisks denote statistically significant values ($p < 0.05$)

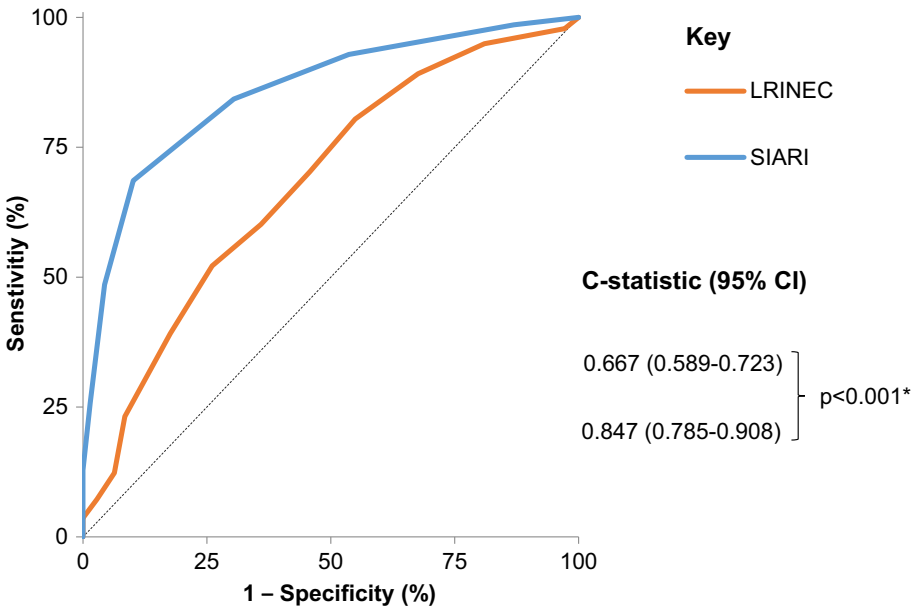

Fig. 1 Receiver operating characteristic (ROC) curve for the SIARI and LRINEC scores for the diagnosis of necrotizing fasciitis in the validation cohort

addition, it is noted that there have been no prospective diagnostic accuracy studies examining the performance of the LRINEC score. This is likely a reflection of the rarity of necrotizing fasciitis; however, it precludes reliable validation of the scoring tool. Overall, the variable discriminative performance of the LRINEC score for differentiating necrotizing fasciitis from other non-necrotizing soft tissue infections has raised concern for its utility in the clinical setting.

In its essence, the LRINEC score is a laboratory-based surrogate marker for septic shock, which is almost invariably a feature of necrotizing soft tissue infections. However, in contrast to the SIARI score, the LRINEC score makes no allowance for clinical variables that may affect laboratory measurements in patients with necrotizing fasciitis. Also, the difficulty with differentiating necrotizing fasciitis from severe cellulitis is that septic shock can be present in both conditions. Both necrotizing fasciitis and cellulitis exist within a continuum of severity, and although the overwhelming majority of patients with necrotizing fasciitis have septic shock and a disease course that is rapidly lethal, there are variants that do not exhibit these same phenomena. It is this feature of necrotizing fasciitis combined with the often non-specific or subtle skin changes that can make the clinical diagnosis of necrotizing fasciitis exceedingly difficult. In clear cases of necrotizing fasciitis, clinical judgment remains the most important diagnostic tool. However, decision support tools may serve as useful adjuncts in cases of diagnostic uncertainty.

In the current study, the newly developed SIARI score demonstrated superior diagnostic performance compared with the LRINEC score, with C-statistics exceeding 0.8 in both the developmental and validation cohorts. The SIARI score offers several advantages, including being easier to use than the LRINEC score, requiring fewer laboratory variables, and considers key clinical predictors. The SIARI score is also a simple acronym comprising the clinical and laboratory factors listed in order of descending weighting. This facilitates easy recall within the clinical setting. The three laboratory variables in the SIARI score (creatinine > 141 μmol/L, C-reactive protein ≥ 150, and white cell count > 25) are assigned a weighting of 1 point. Therefore, to achieve the optimal diagnostic cutoff score of 3, all three laboratory criteria must be met in the absence of the clinical risk factors. The clinical risk factors in the SIARI score serve as a reminder to clinicians to retain a high index of suspicion in patients with soft tissue infections in sites outside the lower limbs, immunosuppressed patients (AIDS, steroid use, and other immunosuppressive medications such as chemotherapy), and in patients younger than 60 years. In these patients, laboratory values usually seen in profound sepsis may not necessarily be present.

The design of the current study was similar to the original LRINEC developmental study by Wong et al. [1]. However, the current study examines clinical and demographic factors, in addition to laboratory measurements. The criteria for the diagnosis of necrotizing fasciitis are variable in the published literature. In the current study, necrotizing fasciitis was a clinical diagnosis based on operative findings consistent with necrotizing fasciitis and the operating surgeon's clinical impression. In the study by Wong et al., the criteria for identifying controls with severe cellulitis included a clinical impression of severe cellulitis,

the use of parenteral antibiotics for ≥48 h, and abscesses (when present) needing surgical debridement [1]. However, due to concerns surrounding reproducibility, more robust diagnostic criterion for severe cellulitis described by Marwick et al. was adopted in the current study [3].

There are methodological limitations that need to be considered when interpreting the findings of the current study. The retrospective design within the setting of a single center, and the presence of missing C-reactive protein measurements accounted for by multiple imputation, has the potential to introduce selection bias. Nevertheless, the same limitations are acknowledged to exist in previous studies with similar designs. Furthermore, cases and controls from the same setting were randomized to developmental and validation cohorts, and the internal validation process might limit generalizability. Although multivariate logistic regression modeling incorporated all clinically relevant variables, with deliberate avoidance of R^2 or C-statistic maximization techniques, the potential for statistical over-fitting cannot be completely excluded. Future external validation studies are therefore required to confirm the trends observed in the current hypothesis-generating preliminary study.

Conclusion

In patients with suspected necrotizing fasciitis, the SIARI score may serve as a valuable diagnostic adjunct. The LRINEC score demonstrated suboptimal discriminative ability for the diagnosis of necrotizing fasciitis in this population.

Compliance with ethical standards

Conflict of interest The authors have no conflicts of interest to declare.

Ethical approval This retrospective study was conducted following institutional ethics committee approval.

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