Prognostic Value of Neutrophil-to-Lymphocyte Ratio in Patients With Sepsis

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Abstract

Objective: We attempt to evaluate the role of neutrophil-to-lymphocyte ratio (NLR) in predicting 28-day mortality in patients with sepsis to investigate its prognostic value.

Method: Relevant clinical and laboratory data of 91 healthy controls, 87 non-septic patients admitted to intensive care unit (ICU) and 127 septic patients on admission were collected, and septic patients were divided into survival (n=79) and death groups (n=48) according to their prognoses. NLR levels among different groups were compared and analyzed for associations with C-reactive protein (CRP), procalcitonin (PCT) and SOFA score. Univariate logistic regression analysis was used to assess the prognostic value of the NLR in patients with sepsis.

Result: The NLR level was significantly higher in the septic patients compared to the case controls and healthy individuals ($P < 0.05$), and was much higher in septic patients who died ($P < 0.05$). ROC analysis indicated that the NLR had the best prognostic value for sepsis, with an AUC of 0.77 (95% CI: 0.69-0.84). Univariate logistic regression analysis suggested that NLR >8.25 was an independent risk factor for sepsis (odds ratio [OR] 6.39, $P = 0.001$). Correlation analysis suggested that the NLR was positively correlated with CRP, PCT and SOFA score.

Conclusion: Peripheral serum NLR appeares to have a predictive value for 28-day mortality in patients with sepsis.

Introduction

Sepsis is a systemic inflammatory response syndrome caused by infection that can lead to life-threatening multi-organ dysfunction and has a high mortality rate [1]. It is an important leading cause of death in most patients with infectious diseases, while early recognition may help improve adverse outcomes. The neutrophil-to-lymphocyte ratio (NLR) is a novel inflammatory biomarker that can be obtained through blood routine tests. It is cost-effective and widely available, and it is beneficial to the early recognition of poor prognosis in septic patients. A retrospective cohort study demonstrated that the NLR could serve as a predictor of the hospital mortality in septic patients with a sensitivity of 55.1% and a specificity of 70.7% [2]. In addition, a meta-analysis suggested that the NLR may be a prognostic biomarker in septic patients, and higher levels of NLR may indicate adverse prognosis [3]. However, relationship between the NLR and poor prognosis of septic patients still needs to be verified by a large number of studies. Here, we conducted a retrospective study to explore the predictive value of the NLR for 28-day mortality in septic patients.

Materials And Methods

Research Object

In all, 127 patients with sepsis visiting the First Affiliated Hospital of Kunming Medical University from December 2019 to December 2020 were selected, all of whom met the diagnostic criteria of sepsis 3.0 [4], including 85 males and 42 females, with an average age of (57.51 ± 14.81) years old. Besides, 87 non-septic patients admitted to the intensive care unit (ICU) were included as case controls, including 56 males and 31 females with an average age of (57.38 ± 11.65) years old, and 91 healthy individuals from our physical examination center, including 58 males and 33 females with an average age of (53.62 ± 11.25) years old, were enrolled as healthy controls. According to the outcomes, the septic patients were assigned into survival group (n = 79) and death group (n = 48), with the former including 53 males and 26 females aged (56.65 ± 15.25) years old, and the latter including 32 males and 16 females aged (58.17 ± 15.88) years old. Exclusion criteria: (1) patients younger than 18 years or older than 80 years; (2) patients with acute cardiovascular and cerebrovascular events, complicated by malignancies in multiple systems, and severe hemopathy; (3) pregnant and lactating women; (4) patients with unclear past medical history, which affects the accuracy of the Sequential Organ Failure Assessment (SOFA) scoring; (5) patients with other complications causing lymphopenia (such as malignancy, malnutrition, HIV infection and autoimmune diseases), and had took immunosuppressive drugs or cytotoxic drugs, etc.; (6) patients who refused to sign the informed consent. All participants were informed of the research and signed the informed consent, and the study was carried out with the approval of the hospital ethics committee.

Methods

Data Collection

Clinical medical records of the eligible subjects were searched from the Hospital Information System (HIS) based on the case-control study method, including general information such as age and gender, clinical manifestations like route of infection, comorbidities, days of hospitalization, vital signs (temperature, respiratory rate, heart rate, blood pressure), etc., and laboratory indexes that were measured via the peripheral blood samples collected within 24 h of admission, such as blood routine, liver and kidney function, C-reactive protein (CRP), procalcitonin (PCT), SOFA, etc. The automatic blood cell counter (XN-9000, Sysmex, Shanghai, China) was applied for blood routine test, Roche automatic electrochemiluminescence immunoassay (E602, Roche Diagnostics, Shanghai, China) for PCT analysis, and automatic blood biochemistry analyzer (Hitachi 7600 − 120, Hitachi, China) for biochemical test. Patients with sepsis were followed up by telephone interviews on day 28 after discharge.

Statistical Analysis

SPSS22.0 was used for data input and statistical analysis. The χ^2 test or Fisher's exact test was used for enumeration data. The measurement data were expressed as mean±standard deviation ($\bar{x} \pm s$). Group comparisons of measurement data were performed using one-way analysis of variance (ANOVA) if the homogeneity of variance is satisfied, or the *Mann-Whitney U* test if not. Sensitivity of the NLR to the diagnosis of sepsis was assessed by the receiver operator characteristic (ROC) curve, and the prognostic value of NLR, white blood cell (WBC), CRP, PCT, SOFA score and creatinine for sepsis was further evaluated by 95% confidence interval (CI) and area under the ROC curve (AUC). *Pearson* correlation

analysis was performed for the correlation of the NLR with CRP, PCT and SOFA score, and univariate logistic regression analysis was used to assess the prognostic value of each indicator for patients with sepsis. P<0. 05 indicated statistical significance.

Results

Clinical Features

The clinical characteristics of 87 case controls, 91 healthy controls and 127 patients with sepsis are shown in Table 1. The WBC count, neutrophil (NEUT) count and NLR levels were significantly higher in the sepsis group than those in the case controls and healthy individuals, with statistically significant differences ($P < 0.05$) (Fig. 1). The diagnostic value of the NLR for sepsis is displayed in Fig. 2, with an AUC of 0.88 ($P < 0.001$, 95% CI: 0.84–0.92).

Table 1
Characteristics of septic patients, ICU controls and healthy controls

Parameter	health controls (n = 91)	ICU controls (n = 87)	Sepsis patients (n = 127)
Patient characteristics			
Age, years	53.62 ± 11.25	57.38 ± 11.65	57.51 ± 14.81
Male sex	58 (63.7%)	56 (64.4%)	85 (66.9%)
Constants			
Pulse rate, beats/min	NA	89.37 ± 19.12	98.56 ± 22.17
Breath rate, beats/min	NA	18.54 ± 3.25	19.37 ± 4.22
Systolic blood pressure, mmHg	NA	114.75 ± 16.23	109.23 ± 10.18
Diastolic blood pressure, mmHg	NA	67.83 ± 11.54	60.76 ± 13.25
Comorbidities			
Hypertension	NA	25 (28.7%)	48 (37.8%)
Diabetes	NA	16 (18.4%)	23 (18.1%)
COPD	NA	19 (23.0%)	30 (23.6%)
Laboratory values			
WBC (×10^9/L)	5.98 ± 1.48	7.92 ± 2.83	13.42 ± 9.23
N (×10^9/L)	3.59 ± 1.18	6.09 ± 2.42	10.61 ± 5.47
L (×10^9/L)	1.90 ± 0.42	0.97 ± 0.38	1.01 ± 0.76
NLR	1.93 ± 0.61	6.54 ± 2.38	13.81 ± 10.36
M (×10^9/L)	0.37 ± 0.18	0.67 ± 0.36	0.72 ± 0.53
HCT	38.46 ± 2.39	36.47 ± 5.23	35.43 ± 9.34
PLT(×10^9/L)	202.56 ± 46.57	175.54 ± 114.44	143.66 ± 105.01
TBI (μmol/L)	8.65 ± 1.64	18.29 ± 4.57	30.39 ± 35.09

Note: Continuous values as mean ± standard deviation, categorical values as absolute number and percentage. COPD, chronic obstructive pulmonary disease; WBC, white blood cell count; N, neutrophils; L, lymphocytes; NLR, neutrophil to lymphocyte ratio; M, monocytes; HCT, hematocrit value; PLT, platelets; TBI, total bilirubin; Crea, creatinine; BUN, blood urea nitrogen; PaO_2, pressure of oxygen; $PaCO_2$, partial pressure of carbon dioxide; CRP, C-reaction protein; PCT, procalcitonin; SOFA, sequential organ failure assessment; ICU, intensive care unit; NA, not applicable.

Parameter	health controls (n = 91)	ICU controls (n = 87)	Sepsis patients (n = 127)
Crea (μmol/L)	5.48 ± 2.08	65.77 ± 10.17	173.52 ± 178.87
BUN (mmol/L)	13.61 ± 3.28	17.45 ± 4.56	11.03 ± 7.92
PaO_2 (mmHg)	NA	86.78 ± 29.76	88.97 ± 60.39
$PaCO_2$ (mmHg)	NA	34.02 ± 10.13	33.44 ± 12.34
Lct (mmol/L)	NA	2.55 ± 1.08	2.79 ± 2.84
CRP (mg/L)	NA	91.37 ± 60.15	110.97 ± 78.67
PCT (ng/mL)	NA	8.57 ± 10.76	13.14 ± 25.59
SOFA score	NA	1.75 ± 0.74	5.86 ± 3.81
ICU stay, days	NA	12.78 ± 7.49	15.13 ± 14.80
Died/survived	NA	0/87	79/48

Note: Continuous values as mean ± standard deviation, categorical values as absolute number and percentage. COPD, chronic obstructive pulmonary disease; WBC, white blood cell count; N, neutrophils; L, lymphocytes; NLR, neutrophil to lymphocyte ratio; M, monocytes; HCT, hematocrit value; PLT, platelets; TBI, total bilirubin; Crea, creatinine; BUN, blood urea nitrogen; PaO_2, pressure of oxygen; $PaCO_2$, partial pressure of carbon dioxide; CRP, C-reaction protein; PCT, procalcitonin; SOFA, sequential organ failure assessment; ICU, intensive care unit; NA, not applicable.

Comparison of Survival and Death Groups

Age, gender, etiology (pulmonary infection, acute pancreatitis, postoperative infection, infection from other causes), comorbidities (hypertension, diabetes mellitus, chronic obstructive pulmonary disease), days of hospitalization, vital signs (temperature, pulse rate, respiratory rate, systolic and diastolic blood pressure), laboratory indexes (total bilirubin [TBI], PaO_2, $PaCO_2$, lactic acid), were not statistically different between the survival and death groups ($P > 0.05$). WBC, NEUT, NLR, CRP, PCT, SOFA score, creatinine and urea nitrogen levels were significantly higher in the death group than those in the survival group, but lymphocytes were lower, with statistically significant differences ($P < 0.05$) (see Table 2 and Fig. 3).

Table 2
Index comparison between the survival and non-survival groups of sepsis patients

Parameter	Survival (n = 79)	Non-survival (n = 48)	*P-value*
Patient characteristics			
Age, years	56.65 ± 15.25	58.17 ± 15.88	0.509
Male sex	53 (67.1%)	32 (66.7%)	0.961
Etiology			
Pulmonary infection	12 (15.2%)	8 (16.7%)	0.825
Acute pancreatitis	6 (7.6%)	3 (6.3%)	0.999
Postoperative infection	22 (27.8%)	12 (25.0%)	0.725
Others	39 (49.4%)	25 (53.1%)	0.767
Comorbidities			
Hypertension	27 (34.2%)	21 (43.8%)	0.281
Diabetes	11 (13.9%)	12 (25.0%)	0.116
COPD	14 (17.7%)	14 (29.2%)	0.131
Constants			
Temperature, ℃	36.72 ± 0.60	36.61 ± 0.43	0.993
Pulse rate, beats/min	20.60 ± 4.33	20.58 ± 4.60	0.817
Breath rate, beats/min	92.35 ± 18.50	100.98 ± 20.54	0.033
Systolic blood pressure, mmHg	120.45 ± 18.74	121.98 ± 21.44	0.505
Diastolic blood pressure, mmHg	74.13 ± 14.64	72.02 ± 13.50	0.729
Laboratory values			
WBC (×10^9/L)	11.64 ± 6.04	16.35 ± 12.40	0.007
N (×10^9/L)	9.56 ± 5.51	12.34 ± 4.98	0.003
L(×10^9/L)	1.15 ± 0.88	0.78 ± 0.39	0.001
NLR	10.18 ± 6.09	19.79 ± 12.94	< 0.001

Note: Continuous values as mean ± standard deviation, categorical values as absolute number and percentage. COPD, chronic obstructive pulmonary disease; WBC, white blood cell count; N, neutrophils; L, lymphocytes; NLR, neutrophil to lymphocyte ratio; CRP, C-reaction protein; PCT, procalcitonin; SOFA, sequential organ failure assessment; TBI, total bilirubin; Crea, creatinine; BUN, blood urea nitrogen; PaO_2, pressure of oxygen; $PaCO_2$, partial pressure of carbon dioxide; ICU, intensive care unit.

Parameter	Survival (n = 79)	Non-survival (n = 48)	*P-value*
CRP (mg/L)	96.82 ± 70.14	134.66 ± 86.92	0.016
PCT (ng/ml)	8.72 ± 20.40	20.37 ± 31.25	0.001
SOFA (score)	4.76 ± 3.11	7.67 ± 4.17	< 0.001
TBI (μmol/L)	36.49 ± 9.63	32.86 ± 11.05	0.090
Crea (mmol/L)	149.94 ± 171.63	211.35 ± 185.47	0.004
BUN (mmol/L)	10.00 ± 8.60	13.61 ± 8.77	0.005
PaO2 (mmHg)	102.36 ± 78.65	79.04 ± 33.92	0.305
PaCO2 (mmHg)	34.36 ± 6.62	40.13 ± 15.31	0.173
Lct (mmol/L)	2.51 ± 3.00	3.02 ± 2.72	0.080
ICU stay, days	16.0 ± 12.05	15.90 ± 16.78	0.156

Note: Continuous values as mean ± standard deviation, categorical values as absolute number and percentage. COPD, chronic obstructive pulmonary disease; WBC, white blood cell count; N, neutrophils; L, lymphocytes; NLR, neutrophil to lymphocyte ratio; CRP, C-reaction protein; PCT, procalcitonin; SOFA, sequential organ failure assessment; TBI, total bilirubin; Crea, creatinine; BUN, blood urea nitrogen; PaO_2, pressure of oxygen; $PaCO_2$, partial pressure of carbon dioxide; ICU, intensive care unit.

Prognostic Value of Laboratory Indexes for Sepsis

The AUC of the ROC curve, sensitivity and specificity of WBC, NLR, CRP, PCT, creatinine and SOFA score for predicting the prognosis of sepsis are shown in Table 3 and Fig. 4. NLR had the best prognostic value for sepsis among these indexes, with the largest AUC of 0.77 (95% CI: 0.69–0.84, P < 0.001), diagnostic sensitivity of 95.8% and specificity of 48.1%, followed by the SOFA score with an AUC of 0.72 (95% CI: 0.63–0.79, P < 0.001), diagnostic sensitivity of 77.1% and specificity of 62.0%.

Table 3
ROC analysis for laboratory indexes on sepsis prognosis

Parameter	AUC (95%CI)	Cut-off value	*z*-Value	Youden index J	*P*-value	Sensitivity	Specificity
WBC ($\times 10^9$/L)	0.64 (0.55–0.72)	9.02	2.92	0.29	0.004	89.6%	39.2%
PCT (ng/ml)	0.67 (0.58–0.76)	3.85	3.44	0.36	0.001	64.6%	71.4%
CRP (mg/L)	0.65 (0.56–0.73)	109.99	2.85	0.25	0.004	58.3%	67.1%
SOFA (score)	0.72 (0.63–0.79)	4.00	4.60	0.39	< 0.001	77.1%	62.0%
Crea (mmol/L)	0.65 (0.56–0.74)	99.00	2.98	0.28	0.003	68.8%	59.7%
NLR	0.77 (0.69–0.84)	8.25	6.62	0.44	< 0.001	95.8%	48.1%

Note: AUC, area under curve; CI, confidence interval; WBC, white blood cell count; PCT, procalcitonin; CRP, C-reaction protein; SOFA, sequential organ failure assessment; Crea, creatinine; NLR, neutrophil to lymphocyte ratio.

Table 4
Univariate logistic regression analysis for sepsis-related factors

	Crude[a]			Adjustment[b]		
	OR	95%CI	*P*-value	OR	95%CI	*P*-value
Age	1.01	0.98–1.03	0.589	1.03	1.00-1.06	0.074
Gender	0.98	0.46–2.10	0.961	0.64	0.22–1.86	0.417
WBC	1.08	1.02–1.15	0.008	1.05	1.00-1.11	0.038
PCT	1.02	1.00-1.04	0.012	1.02	0.99–1.04	0.183
CRP	1.01	1.00-1.01	0.009	1.01	1.00-1.01	0.149
SOFA	1.24	1.11–1.39	< 0.001	1.21	1.05–1.39	0.007
Crea	1.00	1.00–1.00	0.062	1.00	1.00–1.00	0.549
NLR > 8.25[c]	7.32	4.84–15.23	< 0.001	6.39	3.72–14.18	0.001

Note: OR, odds ratio; CI, confidence interval; WBC, white blood cell count; PCT, procalcitonin; CRP, C-reaction protein; SOFA, sequential organ failure assessment; Crea, creatinine; NLR, neutrophil to lymphocyte ratio. [a] Univariate logistic regression analyses before adjustments for age and gender; [b] Univariate logistic regression analyses after adjustments for age and gender; [c] Optimal cut-off value to predict prognosis using receiver operating characteristic (ROC) curves.

Correlation Analysis of NLR and Studied Indexes

The correlation analysis between NLR and each index is shown in Fig. 5. NLR levels were found to be positively correlated with the classical biomarkers CRP (r = 0.132, P < 0.001), PCT (r = 0.408, P < 0.001) and SOFA score (r = 0.164, P < 0.001).

Univariate Logistic Regression Analysis for Prognostic Risk Factors of Sepsis

Univariate logistic regression analysis was performed for relevant indexes to identify potential prognostic risk factors for sepsis. Before adjustments for age and gender, WBC, PCT, CRP, SOFA score, and NLR > 8.25 were independent risk factors of 28-day mortality in sepsis and were significantly correlated with sepsis (P < 0.05). The NLR > 8.25 was with an OR of 7.32 (95% CI: 4.84–15.23). After adjustments, WBC, SOFA score, and NLR > 8.25 were also found to be independent risk factors of sepsis (P < 0. 05), and OR of the NLR > 8.25 was 6.39 (95% CI: 3.72–14.81) (see Table 5).

Discussion

With the number of patients increasing with years, sepsis has become a major focus and difficulty in the clinical management of patients with severe infections. Therefore, accurate and effective biomarkers of sepsis are of great significance to the treatment and prognosis. The mechanisms of the onset and progression of sepsis remain unclear, while the immune response is known a vital part that helps reduce the severity of inflammation. Immune-related biomarkers such as NLR, CRP, PCT, interleukins and chemokines have been widely applied to the early recognition and prognosis of sepsis [5–6]. Although the correlation between NLR and the prognosis of sepsis is currently controversial, there is a study which confirmed that elevation of NLR levels is independently correlated with poor clinical prognosis in patients with sepsis [7].

In this study, the ROC curve for assessing diagnostic value of the NLR was plotted with an AUC of 0.88, which demonstrated that the NLR could effectively distinguish healthy subjects from non-septic patients admitted to ICU, suggesting the diagnostic value of the NLR for sepsis. Beyond that, the NLR level was significantly higher in the sepsis death group compared to the survival group, which reflected that NLR is a potential predictor for the prognosis of sepsis. The cut-off value of NLR was 8.25 in the study, which was consistent with the cut-off value of 9.11 as reported by Ni[2] et al. We further observed NLR as an independent risk factor for 28-day mortality in patients with sepsis by univariate logistic regression analysis, which is consistent with the results demonstrated by Liu[8] et al., who found a positive correlation between NLR levels and the severity of disease in septic patients.

Currently, the diagnosis of sepsis relies on the SOFA scoring, which however fails in early diagnosis due to its tedious and time-consuming calculation mode, and is seldom applied in clinic as it is not well known by departments except the ICU. In this study, we found that the NLR had a great predictive value for the prognosis of sepsis, with the AUC of ROC curve of 0.77 and a sensitivity of 95.8%, which significantly outweighed the SOFA scoring. In addition, the NLR is easier to obtain and can be monitored in real-time, making it easier to carry out in clinical practice. The correlation analysis here also confirmed a positive correlation between the NLR level and SOFA scores.

CRP has been shown to facilitate the diagnosis of sepsis in relevant research [9]. As an indicator of inflammation, CRP has been used for many years to help monitor the condition of patients with chronic disease. Nevertheless, CRP lacks the specificity for the diagnosis of sepsis. In the study, adjusted univariate logistic regression analysis revealed that CRP could not be used as an independent risk factor for the prognosis of sepsis, with an AUC for prognostic efficiency of 0.65, which was significantly lower than that of the NLR and SOFA scoring.

PCT has been regarded as an indicator included in the diagnostic criteria for sepsis in the guidelines of Surviving Sepsis Campaign (SSC). A meta-analysis showed that the PCT test is more expensive compared to CRP test, but highly accurate for sepsis diagnosis. Another meta-analysis suggested that the sensitivity and specificity of PCT for distinguishing sepsis from non-infectious disease is 77% and 79%, respectively [5]. However, PCT levels can also elevate in non-infectious conditions, so clinical symptoms

should be taken into consideration. This study also revealed a significant positive correlation between the NLR and PCT levels.

NLR is a research hotspot in recent years. It can be obtained by blood routine tests and is capable of reflecting the inflammation condition in the body. Current studies have shown that the NLR has clinical application value in cardiovascular, renal diseases and tumor [10–11]. In sepsis, lymphocytes decrease owing to the apoptosis mediated by innate immune response [12]. Reversely, the number of neutrophils dramatically increases in severe infectious diseases, especially in sepsis, reflecting the degree of inflammation. This might be mediated by the overexpression of the anti-apoptotic protein Mcl (myeloid cell leukemia) -1, which further suppresses the apoptosis of neutrophils [13], or due to the upregulation of granulocyte colony-stimulating factor (G-CSF) and the excessive release of chemokines, resulting in increased neutrophils [14]. In the present study, the NLR level elevated more significantly in the death group with severer inflammation, and the risk of death was significantly increased at NLR > 8.25 (OR = 6.39, P = 0.001), which also provided a theoretical foundation for our results.

There are some limitations in this study. Firstly, the study is a retrospective single-center study and the effect of selection bias cannot be excluded. Secondly, we only recorded NLR within 24 hours of admission while dynamic detection might be more preferable. Thirdly, the sample size is limited and inclusion of more samples or a multicenter study would be more convincing. Finally, this study focused on 28-day mortality without dynamic follow-up of patients, which could not obtain specific survival time for survival analysis, and further COX regression analysis with time variables. The classification of survival and death groups was simply based on the outcome, requiring additional supplement in our follow-up study.

Conclusions

In summary, this study demonstrated that NLR was more significantly elevated in the death group of septic patients, and could be an independent risk factor of 28-day mortality. Besides, the NLR was positively correlated with SOFA score, CRP, and PCT. In all, the study indicated the prognostic value of the NLR in sepsis, and patients are more likely to die when NLR > 8.25, which will provide a reference for the diagnosis, treatment and prognosis of septic patients.

Declarations

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Authors' contributions

Xinyu Liao and Fuxing Li conceived and designed the experiments. Fuke Wang and Guoliang Wang reviewed drafts of the paper. Yaxing Zheng and Ruiying Zhong approved the final draft. Xinyu Liao and

Lu He conceived and designed the experiments, performed the experiments, analyzed the data, contributed reagents/materials/analysis tools, prepared figures and/or tables, authored or reviewed drafts of the paper, approved the final draft.

Authors' information

Xinyu Liao is doing PhD study time in Kunming Medical University.

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Availability of data and materials

All data generated or analyzed during this study are provided within this article

Ethics approval

All experiments were performed in accordance with the ethical standards of Kunming Medical University First Affiliated Hospital. Institutional review board approval for this study was obtained from the ethical Committee for our hospital. This study was classified as an exempt study because no individually identifiable information was collected.

Competing interests

All authors have no conflicts of interest in this article

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Table

Table 5 is not available with this version.

Figures

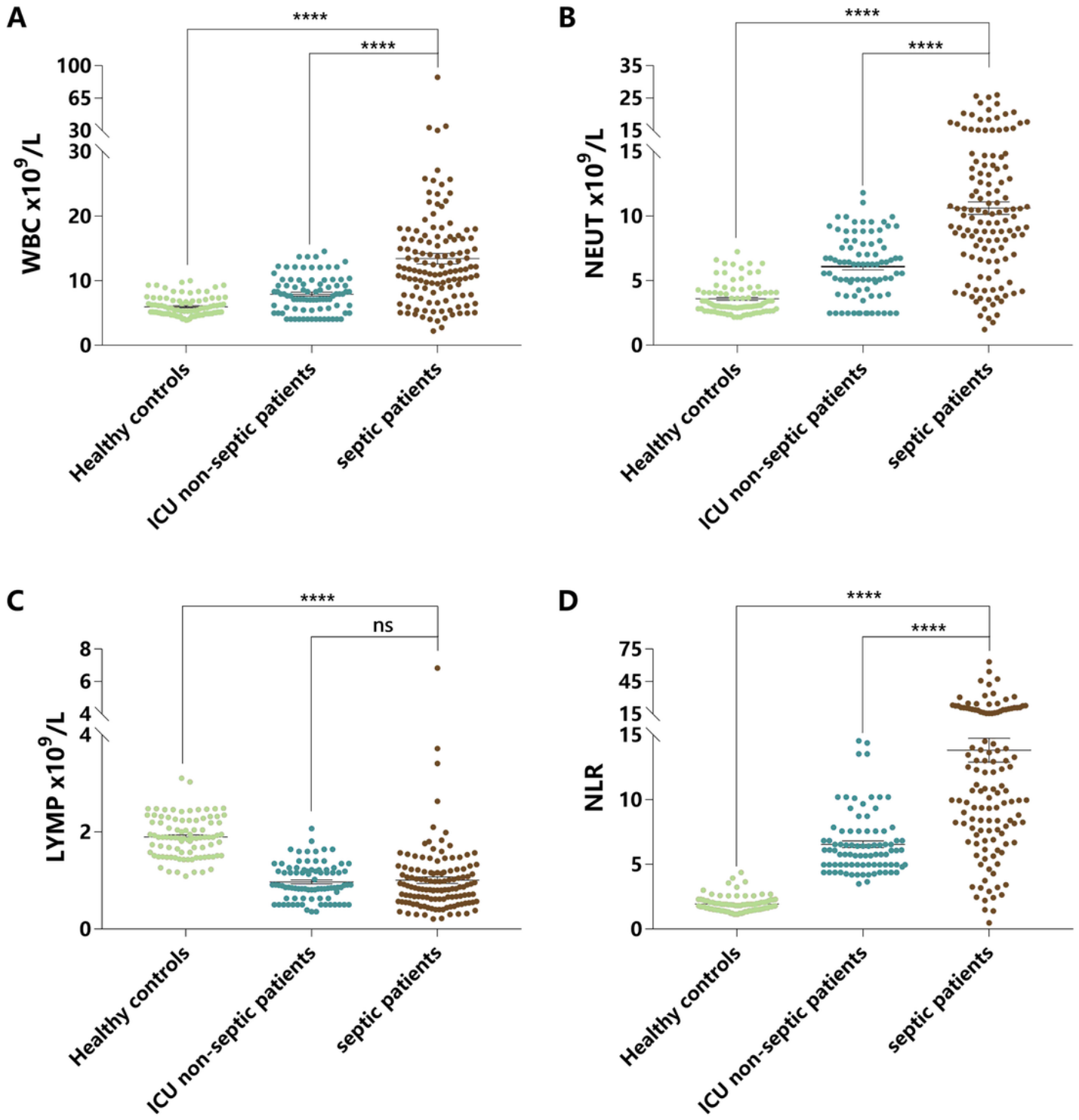

Figure 1

Comparison for WBC (A), NEUT (B), LYMP (C), and NLR (D) between healthy controls, ICU controls and sepsis patients WBC: white blood cell count, NEUT: neutrophils, LYMP, lymphocytes; NLR, neutrophil to lymphocyte ratio; Nonparametric Mann-Whitney U test was used to compare results between groups, ns: no statistical significance, * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$, **** $P < 0.0001$.

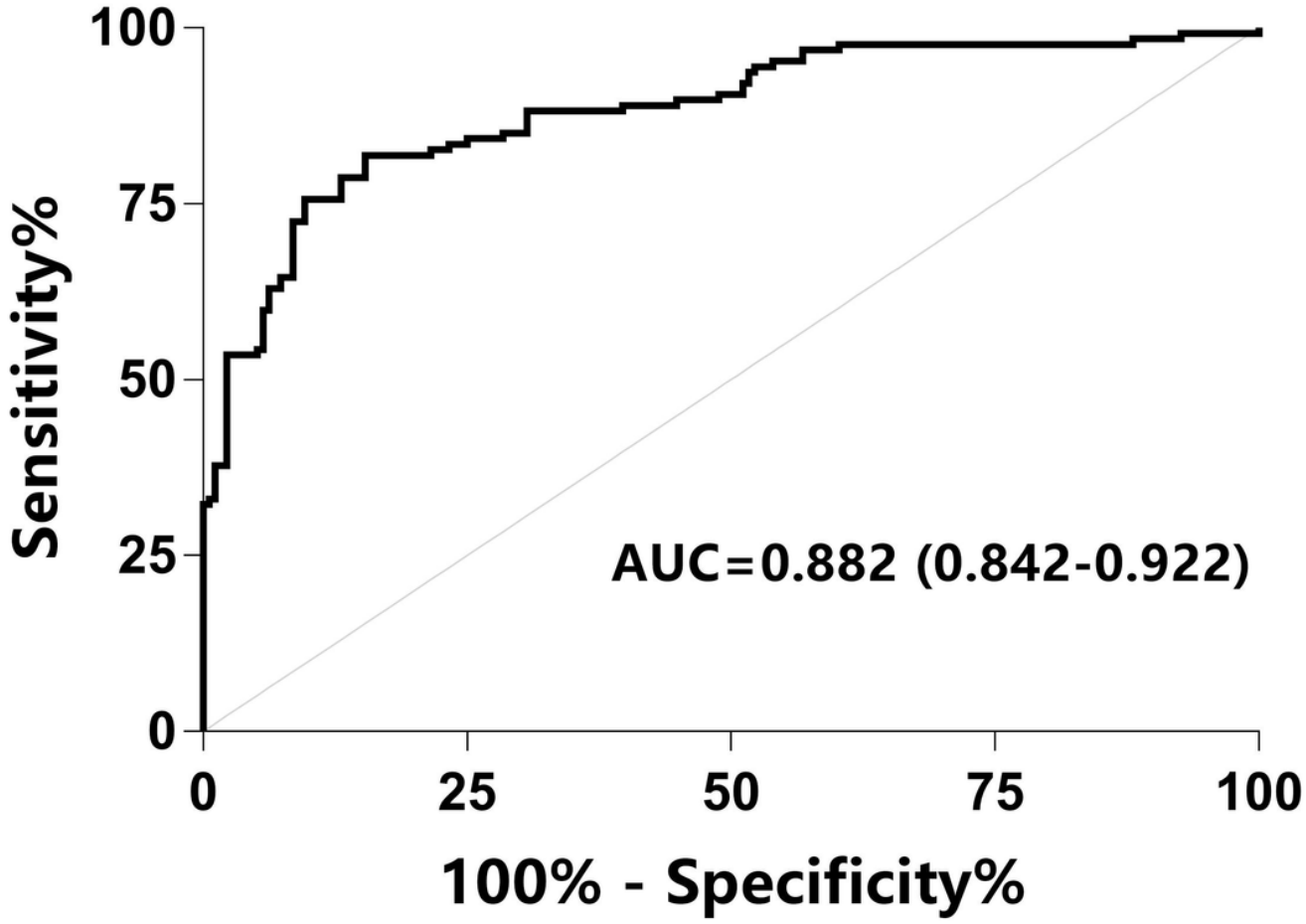

Figure 2

Receiver operating characteristic curve (ROC) of NLR for diagnosis of sepsis. Areas under the ROC curve for NLR had 81.9% sensitivity and 84.7% specificity (AUC 0.882, P < 0.001, 95% confidence interval [CI]:0.842–0.922). The X-axis refers to 1-specificity (false positive rate), and the Y-axis refers to sensitivity (true negative rate). AUC means the area under curve, and when AUC approaches to 1 the diagnosis performance on sepsis turns out to be excellent. NLR, neutrophil to lymphocyte ratio.

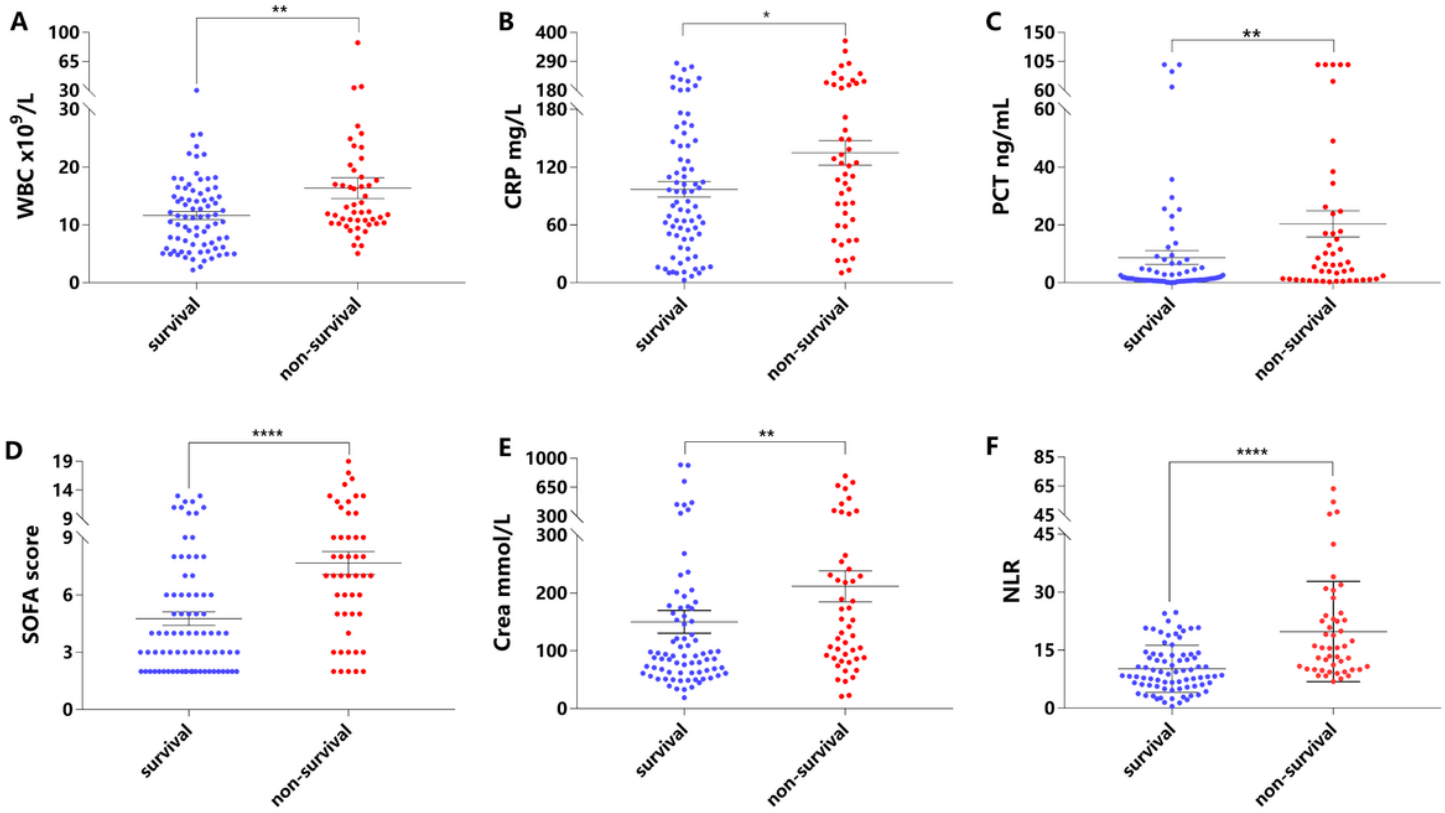

Figure 3

Comparison for WBC (A), CRP (B), PCT (C), SOFA (D), Crea (E), and NLR (F) between the Survival and Non-survival groups of sepsis patients WBC, white blood cell count; PCT, procalcitonin; CRP, C-reaction protein; SOFA, sequential organ failure assessment; Crea, creatinine; NLR, neutrophil to lymphocyte ratio. Nonparametric Mann-Whitney U test was used to compare results between groups, * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$, **** $P < 0.0001$.

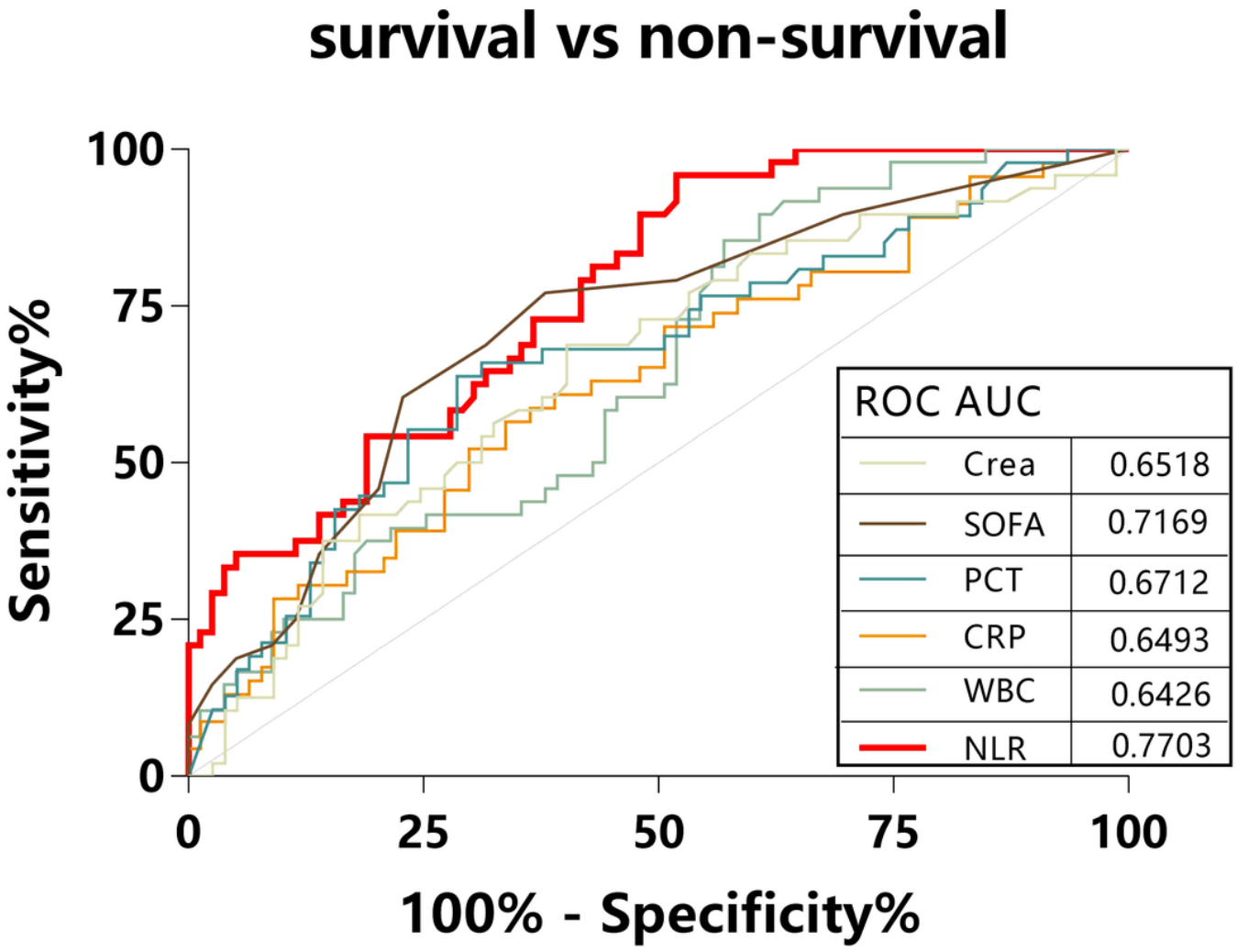

Figure 4

ROC curves for diverse laboratory indexes on sepsis prognosis The X-axis refers to 1-specificity (false positive rate), and the Y-axis refers to sensitivity (true negative rate). Curves in different colors stand for diverse laboratory indexes. AUC means the area under curve, and when AUC approaches to 1 the prognostic performance on sepsis turns out to be excellent. WBC, white blood cell count; PCT, procalcitonin; CRP, C-reaction protein; SOFA, sequential organ failure assessment; Crea, creatinine; NLR, neutrophil to lymphocyte ratio.

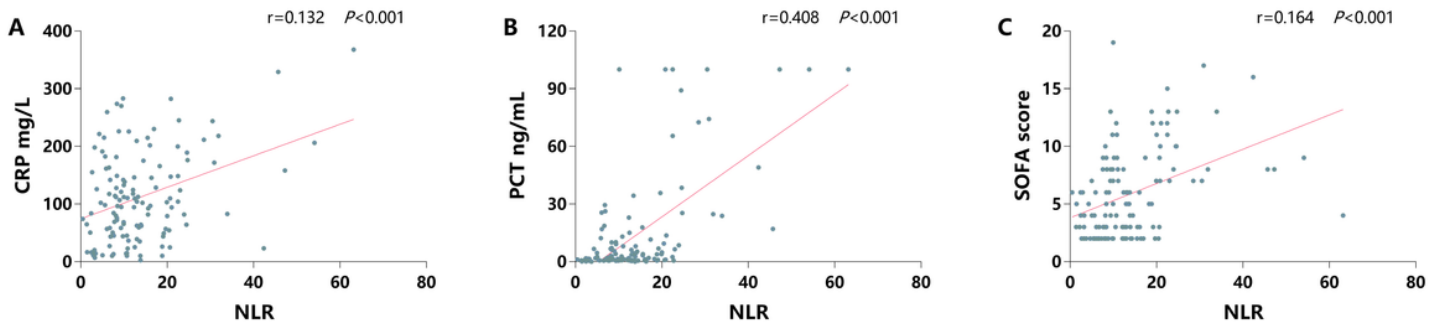

Figure 5

Pearson correlation analysis for NLR with CRP(A), PCT (B), SOFA (C) PCT, procalcitonin; CRP, C-reaction protein; SOFA, sequential organ failure assessment; NLR, neutrophil to lymphocyte ratio.