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ORIGINAL RESEARCH

Comparison of Serum NLR, IL-10 and SAA Expression Levels in Patients with Intestinal Fistula Complicated by Abdominal Infection and Study on Risk Factors for Poor Prognosis

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Purpose: The purpose of this research is to investigate the expression levels of serum NLR, IL-10 and SAA, as well as risk factors for poor prognosis in patients with intestinal fistula complicated by abdominal infection.

Patients and Methods: From May 2018 to January 2025, 80 intestinal fistula patients admitted to our hospital and 36 healthy physical examinees during the same period were enrolled. Patients were divided into intestinal fistula group and intestinal fistula with abdominal infection group; the latter was further subdivided into good and poor prognosis subgroups based on hospitalization and follow-up outcomes. Serum NLR, IL-10 and SAA levels were detected before and after treatment. Logistic multiple regression was used to analyze poor prognosis-related factors, and ROC curves to evaluate the predictive value of single and combined indicators for poor prognosis in intestinal fistula patients with abdominal infection.

Results: NLR, IL-10 and SAA were significantly higher in intestinal fistula group than controls ($P<0.05$), and higher in co-infection group than fistula-only group (all $P<0.05$). Both groups showed post-treatment level reductions (all $P<0.05$), but co-infection group still had higher levels (all $P<0.05$). The three indicators were independent poor prognosis factors (all $P<0.05$). Combined detection had AUC 0.970, sensitivity 0.997 and specificity 0.929.

Conclusion: Serum NLR, IL-10 and SAA are significantly elevated in intestinal fistula with abdominal infection, serving as independent prognostic factors. Their combined detection has high predictive value for poor prognosis.

Keywords: intestinal fistula, abdominal infection, NLR, IL-10, SAA, prognosis

Introduction

Intestinal fistula is a common complication after general surgery, mainly manifested as a rupture of the digestive organs or intestinal wall, thereby forming an abnormal passage.[1] Intestinal contents, digestive juices, etc can leak into the abdominal cavity or other organs through this passage,[2] and thus are often accompanied by complications such as infection, internal environment disorder, and malnutrition.[3,4] As a serious complication of intestinal fistula, abdominal infection, if not treated in time, can develop into sepsis, abdominal abscess, multiple organ failure, etc. It is characterized by high incidence, rapid progression, and high mortality, and is one of the main causes of death in patients with intestinal fistula.[5] Therefore, it is particularly important to find serum markers that can early evaluate the condition of intestinal fistula complicated with abdominal infection and predict the prognosis.

Previous studies have shown that the neutrophil-to-lymphocyte ratio (NLR) is a diagnostic indicator for early-stage infections[6–8] and can also be used to predict the prognosis of various infectious diseases.[9–11] Serum amyloid A (SAA) is an acute-phase protein that not only reflects the degree of inflammatory response in the body but also is closely associated with inflammatory progression, helping to improve the diagnostic efficacy of infectious

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diseases.[12,13] These three indicators have certain diagnostic value in other infectious diseases, but their expression levels and diagnostic efficacy in patients with intestinal fistula complicated by abdominal infection remain unclear.[14] This study aims to analyze the changes in serum NLR, IL-10 and SAA levels before and after treatment in patients with intestinal fistula combined with abdominal infection, and to evaluate the risk factors affecting prognosis.

Materials and Methods

Research Subjects

A total of 80 patients with intestinal fistula admitted to our hospital from May 2018 to January 2025 were selected as the research subjects, and another 36 healthy people who underwent physical examination during the same period were selected as the normal control group. According to the presence or absence of complicated abdominal infection, the patients with intestinal fistula were divided into the intestinal fistula group (40 cases) and the intestinal fistula complicated with abdominal infection group (40 cases). According to whether the patients died of abdominal infection during hospitalization and follow-up, the patients in the intestinal fistula complicated with abdominal infection group were divided into the good prognosis group and the poor prognosis group, including 28 cases in the good prognosis group and 12 cases in the poor prognosis group. The inclusion criteria were as follows: ① History of surgery; ② Definitive diagnosis of intestinal fistula confirmed by imaging or gastrointestinal endoscopy; ③ Age ≥ 18 years; ④ Patients in the infection group met the diagnostic criteria for abdominal infection specified in the Chinese Guidelines for the Diagnosis and Treatment of Abdominal Infection (2019 Edition): physical examination, laboratory tests and imaging examinations suggesting abdominal infection; infectious ascites or infectious lesions confirmed by abdominal paracentesis or laparoscopic exploration.[15] The exclusion criteria were as follows: ① Preoperative comorbidities including malignant tumors, coagulation disorders, hepatic or renal insufficiency, and immune system diseases; ② Cognitive impairment or mental disorders present preoperatively or during follow-up; ③ Poor compliance of patients or their family members, resulting in inability to complete follow-up. This study has been approved by the Hospital Ethics Committee (approval number: cyfyll2024679). Due to the retrospective nature of the study, which involved anonymous data and no intervention, informed consent was waived by the Ethics Committee.

Treatment Plan

Data such as age, gender, BMI index, and length of hospital stay were collected for each group. All patients had their vital signs monitored after admission and received treatments such as irrigation, drainage, anti-infection therapy, and nutritional support in accordance with the principles for the treatment of intestinal fistula.[15] Supportive treatments such as abscess puncture and spasmolysis with pain relief were administered when necessary.

Detection of Serum NLR, IL-10 Levels and SAA Levels

3 mL of venous blood samples were collected from patients upon admission and before discharge, respectively. After centrifugation at 4°C, the upper serum was aspirated. The neutrophil-to-lymphocyte ratio (NLR) was detected using a full blood cell analyzer (SYSMEXXN-10(B2)). For interleukin-10 (IL-10) and serum amyloid A (SAA), enzyme-linked immunosorbent assay (ELISA) kits and supporting reagents were used (IL-10: Sharay4000, batch number: 20241014; SAA: GenruiPA300, batch number: 3325010601). According to the instructions, the samples were placed into an automatic microplate reader (Thermo MULTISKAN MK3) for quantitative detection.

Post-Treatment Follow-Up

Patients were followed up in the outpatient clinic every 3 months after discharge, and their prognosis was recorded. Death during the follow-up period was defined as poor prognosis, while survival was defined as good prognosis. The follow-up duration ranged from 5 to 18 months, with a median follow-up time of 11 months, and the follow-up period ended in June 2025.

Statistical Analysis

Statistical analysis was performed using SPSS 27.0 and GraphPad Prism 7.0 software. Measurement data that conformed to normality and homogeneity of variance were expressed as mean ± standard deviation ($\bar{x} \pm s$). Independent samples *t*-test was used for comparison between two groups, paired *t*-test was used for comparison before and after treatment in the same group, and one-way analysis of variance was used for comparison among three groups. For data that did not conform to normality and homogeneity of variance, they were expressed as median (QL, QU), and corresponding non-parametric test methods were used for comparison. Count data were expressed as numbers (cases) and percentages, with intergroup comparisons performed using the chi-square test or Fisher's exact test. Multivariate regression analysis was performed using the Logistic method, and the diagnostic efficacy of each indicator for infection was evaluated by drawing ROC curves. A P value < 0.05 was considered statistically significant.

Results

Comparison of Clinical Data and Levels of NLR, IL-10, and SAA in Three Groups

There were no statistically significant differences in age, gender ratio, or BMI levels among the three groups (all P > 0.05). Compared with the healthy control group, the levels of NLR, IL-10, and SAA in both the intestinal fistula group and the intestinal fistula complicated with abdominal infection group were significantly increased, with statistically significant differences (all P < 0.05). Compared with the intestinal fistula group, the levels of NLR, IL-10, and SAA in the intestinal fistula complicated with abdominal infection group were significantly higher, and the differences were statistically significant (all P < 0.05). In addition, there were significant differences in the levels of NLR, IL-10, and SAA among the three groups (all P < 0.001)(Table 1).

Comparison of NLR, IL-10 and SAA Levels Before and After Treatment in the Intestinal Fistula Group and the Intestinal Fistula Combined with Abdominal Infection Group

Compared with those before treatment, the levels of NLR, IL-10, and SAA in both groups significantly decreased after treatment, with statistically significant differences (all P < 0.05). Compared with the intestinal fistula group, the levels of NLR, IL-10, and SAA in the intestinal fistula complicated with abdominal infection group were significantly higher after treatment, and the differences were statistically significant (all P < 0.05)(Table 2).

Comparison of clinical data and levels of NLR, IL-10, and SAA in patients with different prognoses in the group of intestinal fistula combined with abdominal cavity infection.

There were no statistically significant differences in age, gender ratio, or BMI levels between the two groups (all P > 0.05). Compared with the good prognosis group, the length of hospital stay in the poor prognosis group was significantly longer, with a statistically significant difference (P < 0.05). Additionally, the levels of NLR, IL-10, and SAA in the poor prognosis group were also significantly higher, with statistically significant differences (all P < 0.05)(Table 3).

Table 1 Comparison of Clinical Data and Levels of NLR, IL-10 and SAA in Three Groups

Parameter	Healthy Control Group (n=36)	Intestinal Fistula Group (n=40)	Intestinal Fistula with Abdominal Infection Group (n=40)	F	P
Age (year)	51.92±3.92	52.18±2.97	52.75±2.66	0.684	0.507
Sex				1.118	0.572
Male (n/%)	22 (61.11%)	29 (72.50%)	27 (67.50%)		
Female (n/%)	14 (38.89%)	11(27.50%)	13 (32.50%)		
BMI (kg/m^2)	22.84±1.27	23.09±1.33	22.69±1.29	0.978	0.379
NLR	1.72±0.49	3.63±0.4[a]	5.01±1.35[ab]	134.756	<0.001
IL-10 (ng/L)	3.09±0.67	12.64±5.7[a]	16.56±5.29[ab]	85.572	<0.001
SAA (mg/L)	4.82±1.15	30.7±7.66[a]	33.34±11.2[ab]	144.829	<0.001

Note: [a]*P* <0.05 compared with healthy control group, [b]*P* <0.05 compared with intestinal fistula group.

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Table 2 Levels of NLR, IL-10 and SAA in Intestinal Fistula Group and Intestinal Fistula with Abdominal Infection Group Before and After Treatment

Group	Time	NLR	IL-10 (ng/L)	SAA (mg/L)
Intestinal fistula (n=40)	Before treatment	3.63±0.4	12.64±5.7	30.7±7.66
	After treatment	2.18±0.39 [a]	5.44±1.22 [a]	10.9±5.7 [a]
Intestinal fistula with abdominal infection (n=40)	Before treatment	5.01±1.35	16.56±5.29	33.34±11.2
	After treatment	2.45±0.5 [ab]	7.08±2.27 [ab]	17.73±5.87 [ab]

Note: [a]*P* <0.05 compared with before treatment, [b]*P* <0.05 compared with intestinal fistula group after treatment.

Table 3 Comparison of Clinical Data and NLR, IL-10 and SAA Levels in Patients with Different Prognoses

Parameter	Well Prognosis Group (n=28)	Poor Prognosis Group (n=12)	χ^2/t	P
Age (year)	52.93±2.52	52.33±3.03	0.644	0.523
Sex			0.005	0.941
Male (n/%)	19(67.86%)	8(66.67%)		
Female (n/%)	9(32.14%)	4(33.33%)		
BMI (kg/m^2)	22.79±1.36	22.45±1.15	0.757	0.454
Hospitalization time (days)	10.21±2.02	13.08±2.43	−3.868	<0.001
NLR	4.18±0.47	6.94±0.38	−17.982	<0.001
IL-10 (ng/L)	14.74±4.86	20.82±3.64	−3.884	<0.001
SAA (mg/L)	28.28±8.9	45.16±5.68	−6.038	<0.001

Logistic Regression Analysis of Influencing Factors for Poor Prognosis in Intestinal Fistula Complicated with Abdominal Infection

Based on the results of univariate analysis, four factors including length of hospital stay, NLR, IL-10, and SAA levels were selected for Logistic regression analysis. The analysis results showed that NLR, IL-10, and SAA levels were independent factors affecting the poor prognosis of patients with intestinal fistula complicated with abdominal infection (all $P < 0.05$)(Table 4).

Analysis of the Predictive Value of NLR, IL-10, and SAA Levels for Poor Prognosis in Intestinal Fistula Complicated with Abdominal Infection

The levels of NLR, IL-10, and SAA have high efficacy in predicting poor prognosis, while the combined detection of the three has the highest predictive efficacy, with an AUC of 0.970, and the sensitivity and specificity are 0.997 and 0.929, respectively (Table 5 and Figure 1).

Discussion

The early symptoms of intestinal fistula are insidious, with a low diagnosis rate. Delayed detection can lead to various complications such as abdominal infection and hypernatremia.[2,3] According to previous literature reports, the mortality rate of intestinal fistula complicated with abdominal infection can reach 10%-30%.[16] At present, there is no serum

Table 4 Logistic Analysis of Risk Factors for Poor Prognosis of Intestinal Fistula with Abdominal Infection

Parameter	β	SE	Wald χ^2	OR	95% *CI*	P
Hospitalization time (days)	0.645	0.235	7.562	1.906	0.963–2.288	0.056
Level of NLR	1.778	0.711	6.249	5.918	5.327–7.102	0.012
Level of IL-10	0.106	0.094	1.292	1.112	1.001–1.335	0.015
Level of SAA	0.028	0.052	0.291	1.028	1.008–1.234	0.042

Table 5 The Predictive Value of Combination Detection of NLR, IL-10 and SAA for Poor Prognosis of Intestinal Fistula with Abdominal Infection

Parameter	AUC	Cut-off Value	Sensitivity	Specificity	AUC (95% CI)	*P*
Level of NLR	0.829	4.98	0.833	0.679	0.700–0.958	0.001
Level of IL-10	0.850	17.40	0.917	0.714	0.713–0.987	0.001
Level of SAA	0.958	37.06	0.917	0.893	0.902–0.998	<0.001
Combination	0.970		0.997	0.929	0.924–0.999	<0.001

marker with high specificity and sensitivity that can timely and effectively predict the severity and prognosis of intestinal fistula complicated with abdominal infection. Based on this, this study evaluates the clinical significance of the combined detection of serum NLR, IL-10 and SAA in patients with intestinal fistula complicated by abdominal infection, and assesses the risk factors affecting prognosis, aiming to provide a reference for the early diagnosis and treatment of such patients.

NLR reflects relative changes in neutrophil and lymphocyte levels and is commonly used to assess systemic inflammatory responses. Xu Tong et al reported that the AUC of NLR for diagnosing appendicitis complicated by abdominal infection reached 0.812.[8] Li Jun et al also found that NLR levels increased significantly in intestinal fistula patients with postoperative infection, with a prognostic predictive efficacy of 63.2%.[6] Additionally, elevated NLR levels are associated with poor prognosis in patients undergoing peritoneal dialysis with peritonitis.[7] These findings collectively confirm the diagnostic and predictive value of NLR as an inflammatory factor in abdominal infection. IL-10 is a multifunctional cytokine mainly produced by macrophages and regulatory T cells, and its levels are significantly elevated in infections, autoimmune diseases, and tumors.[17,18] Luo Zijin et al demonstrated that IL-10 is highly expressed in patients with ureteral calculi complicated by infection and correlates with disease severity.[10] It also exhibits diagnostic value in cirrhotic patients with abdominal infection, with an AUC of 0.868.[9] SAA is an apolipoprotein primarily synthesized by the liver. Its levels rise sharply during infection, making it a sensitive early inflammatory marker.[12,19,20] Liu Jing et al noted that SAA expression is closely associated with disease progression in patients with pulmonary tuberculosis complicated by lung infection and can predict their prognosis.[14] Moreover, significantly elevated

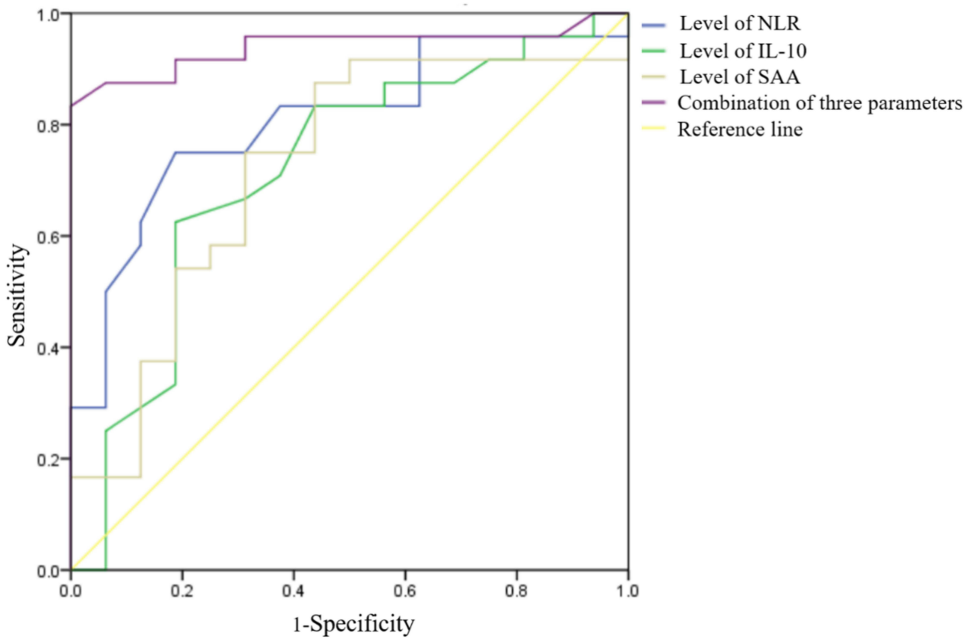

Figure 1 ROC curves for predicting the prognosis of intestinal fistula with abdominal infection by different parameters.

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serum SAA levels in patients with septic shock are an independent risk factor for poor prognosis.[13] The results of this study demonstrated that serum NLR, IL-10, and SAA levels were significantly higher in patients with intestinal fistula complicated by abdominal infection compared with the normal control group and simple intestinal fistula group, while all three levels decreased remarkably after treatment. This indicates that these indicators exhibit predictive stability and consistency for intestinal fistula combined with abdominal infection, which is consistent with previous research.[8,9] Further analysis revealed that NLR, IL-10, and SAA levels were significantly elevated in the poor prognosis group relative to the good prognosis group. This may reflect a systemic persistent inflammatory state in such patients, underscoring the prognostic sensitivity of these three indicators. Regression analysis identified serum NLR, IL-10, and SAA levels as independent risk factors for poor prognosis in patients with intestinal fistula complicated by abdominal infection. The combined detection of the three indicators yielded the highest predictive efficacy (AUC = 0.970), further confirming that their combination could serve as a sensitive and reliable prognostic marker.

This study still has several limitations. First, it adopted a retrospective design with a limited number of enrolled cases and a small number of adverse prognostic events, which may easily lead to bias in regression coefficient estimation. Second, when using ROC curves to evaluate model performance, the model's effectiveness might be overestimated as the predicted probability values were not fully considered, and there is a risk of selection bias. Third, the relevant variables in this study were not comprehensive enough: only three indicators (NLR, IL-10, and SAA) were detected, while other clinically common indicators related to abdominal infection (such as procalcitonin [PCT], C-reactive protein [CRP], and interleukin-6 [IL-6]) were not measured simultaneously. This prevents comparisons of the predictive efficacy between these indicators and those used in this study, as well as the construction of a combined predictive model incorporating more indicators to further improve the value of prognostic assessment. Fourth, the conclusions of this study were drawn based on retrospective samples from a single time period, which is prone to selection bias. Additionally, the study has not been replicated and validated in prospective samples, so its stability and reliability require further confirmation. Fifth, this was a single-center retrospective study, and data collection relied on the hospital's past medical record system. Some patients had missing or incompletely recorded clinical data, which may result in insufficient control of confounding factors. Future studies should verify and update the model by expanding the sample size while ensuring an adequate number of cases with adverse outcomes, extending similar inflammatory indicators, adopting multi-center joint enrollment, using a prospective design with a validation cohort, and strengthening the control of confounding factors. This will better guide the clinical diagnosis and treatment of patients with intestinal fistula complicated by abdominal infection.

Conclusion

In conclusion, the serum levels of NLR, IL-10, and SAA are relatively high in patients with intestinal fistula complicated with abdominal infection, and they are independent influencing factors for prognosis. The combined detection of the three has high value in predicting the prognosis of such patients.

Abbreviations

AUC, area under the curve; ROC, receiver operating characteristic; NLR, neutrophil-to-lymphocyte ratio; IL-10, Interleukin-10; SAA, Serum amyloid A.

Ethical Statement

This study complies with the Declaration of Helsinki. This retrospective study was approved by the Ethics Committee of Affiliated Hospital of Chengde Medical University (Approval No.:cyfyll2024679). Due to the retrospective nature of the study, which involved anonymous data and no intervention, informed consent was waived by the Ethics Committee.

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Disclosure

The authors report no conflicts of interest in this work.

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