



# Neutrophil-to-lymphocyte ratio and lactate dehydrogenase for early diagnosis of AIDS patients with *Talaromyces marneffe* infection

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**Background:** This study aimed to explore the value of neutrophil-to-lymphocyte ratio (NLR) in combination with routine blood tests, lactate dehydrogenase (LDH), and T-lymphocyte subsets for the early diagnosis of acquired immunodeficiency syndrome (AIDS) combined with *Talaromyces marneffe* (TM) infection.

**Methods:** A total of 166 confirmed AIDS patients were enrolled in this study. The observation group included 80 AIDS patients with TM infection, and the control group consisted of 86 AIDS patients with other complications. Regression analysis was performed to evaluate the predictive value of each index and the combination of these indexes for AIDS combined with TM infection using receiver operating characteristic (ROC) curve analysis.

**Results:** NLR and LDH were significantly higher in patients in the observation group compared with those in the control group, and the differences were statistically significant ( $P < 0.05$ ). There was no statistical difference in platelets, infantile granulocytes (IGM), and nucleated red blood cells (NRBC) between the 2 groups ( $P > 0.05$ ). The area under the operating characteristic curve (AUC) of the observed indicators were: NLR, 0.628; hemoglobin (HGB), 0.704; LDH, 0.607; lymphocyte (LYM) count, 0.744; CD4<sup>+</sup> T lymphocyte count, 0.789; and CD8<sup>+</sup> T lymphocyte count, 0.701. The combined AUC of multiple indicators was 0.815, with a sensitivity and specificity of 76.2% and 76.1%, respectively.

**Conclusions:** NLR, HGB, LYM, LDH, and T lymphocyte subsets were diagnostic for early AIDS combined with TM infection, and CD4<sup>+</sup> T lymphocytes had the best diagnostic efficacy alone.

**Keywords:** Acquired immunodeficiency syndrome (AIDS); *Talaromyces marneffe* (TM); neutrophil-to-lymphocyte ratio; blood count; lactate dehydrogenase

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## Introduction

*Talaromyces marneffe* (TM), formerly known as *Penicillium marneffe* (FM), is a thermally dimorphic invasive fungus which can cause both limited and disseminated infections.

TM grows as mycelium at 25 °C and as yeast at 37 °C. Talaromycosis, the infection caused by TM, occurs in patients with cellular immune deficiency and is one of the most common opportunistic infections in end stage acquired immunodeficiency syndrome (AIDS), with an

incidence of 4–14% and an associated mortality rate of 10–30% (1). Due to the widespread clinical use of highly active antiretroviral therapy (HAART), amphotericin B combined with itraconazole antifungal, and combination prophylaxis, the morbidity and mortality rate of AIDS combined with *Talaromyces* has decreased (2). However, about 50,000 new patients are diagnosed each year, and the morbidity and mortality rate is still as high as 10% (3). The timing of etiologic diagnosis and potent antifungal treatment is relatively late, and early diagnosis and combined antiviral and appropriate antifungal therapy are key to improving prognosis (4).

Fungal culture is the gold standard for confirming the diagnosis of TM infection, but this method has the disadvantage of being time consuming (3–14 days) and can delay optimal treatment (5). A number of serological diagnostic methods have been developed with low specificity and high false negatives (3). Microscopic examination of bone marrow smears, although a rapid method, relies on personnel experience, is invasive, and the results need to be combined with fungal culture (6). Mass spectrometry, proteomics, broad-spectrum polymerase chain reaction (PCR) amplification, and metagenomic next-generation sequencing (mNGS) have improved sensitivity and specificity to some extent (7,8). The neutrophil-to-lymphocyte ratio (NLR) has been shown to be the most important factor in inflammatory, neoplastic, and tumorigenic diseases. NLR has a high value in the diagnosis and prognosis of inflammatory diseases, tumors, and coronary heart disease. Merriman *et al.* used the NLR as a diagnostics method for HIV-positive adult patients (9). Compared with Merriman's study, we used NLR for diagnosing the AIDS patients with TM infection. However, the predictive value of NLR in AIDS combined with TM infection is still unclear. In this study, we investigated the early diagnosis of AIDS-TM by analyzing differences in the expression of NLR, blood test results, lactate dehydrogenase (LDH), and T lymphocyte subsets in patients with AIDS-TM and other comorbidities, with the aim of providing a basis for early identification, early treatment, and improved prognosis. We present the following article in accordance with the STARD reporting checklist (available at <https://apm.amegroups.com/article/view/10.21037/apm-22-36/rc>).

## Methods

### *Clinical data*

A total of 166 patients with AIDS admitted to the People's

Hospital of Baise between April 2020 and September 2021 were included in this study. The inclusion criterion was patients who met the diagnostic criteria of the China AIDS Treatment Guidelines (2018 version) (10). Eighty cases of AIDS with TM bloodstream infection were selected as the observation group, including 64 males and 16 females (aged 20–74 years, 44.60±10.76 years). Eighty-six AIDS patients with other complications such as bacteria, viruses, and other fungi without TM infection were selected as the control group, including 65 males and 21 females (aged 28–81 years, 53.15±13.23 years). The exclusion criteria included other opportunistic complications of non-human immunodeficiency virus (HIV) infection.

### *TM culture*

The venous blood of AIDS patients was cultured using the Autobio BC120 automated blood culture system, a control group was set up, and the system alarm was set to within 7 days for initial determination of TM positive. The positive colonies in the alarmed culture bottles were extracted and cultured in *Stachybotrys*, blood agar, Chinese-blue lactose agar, and chocolate agar for secondary confirmation of TM and other strains of bacteria.

### *Routine blood analysis*

The Japanese Hysenmecom XN-9000 automatic hematocrit analyzer and supporting reagents were used, and the experimental method was operated according to the instrument manual.

### *T lymphocyte subpopulation assay*

The Navios flow cytometry (Beckman Coulter, Brea, CA, USA) and the manufacturer's supporting monoclonal antibodies CD4-fluorescein isothiocyanate (FITC) and CD8-alginate (PE)/CD3-PC5 were used to detect helper/inducible T lymphocyte (CD3<sup>+</sup>CD4<sup>+</sup>) counts and suppressor/killer T lymphocyte (CD3<sup>+</sup>CD8<sup>+</sup>) cell counts.

### *Serum LDH*

LDH level was measured by the colorimetric method using Roche Cobas 6000 automatic biochemical analyzer, reagents, and standards from the manufacturer.

**Table 1** Comparative analysis of routine blood results between the 2 groups

Laboratory	AIDS with TM infection (n=80)	AIDS with other complications (n=86)	Z value	P value
WBC ( $10^9/L$ )	4.25±0.25	6.28±0.61	-3.095	0.002
NEU ( $10^9/L$ )	3.09±0.23	3.90±0.31	-2.115	0.036
LYM ( $10^9/L$ )	0.65±0.05	1.16±0.08	-5.355	<0.001
NLR (%)	7.08±0.80	4.84±0.756	2.411	0.017
HGB (g/L)	86.34±2.75	104.57±5.32	-4.764	0.000
MON ( $10^9/L$ )	0.35±0.03	0.500±0.03	-4.128	0.000
PLT ( $10^9/L$ )	183.31±14.91	215.59±11.74	-1.703	0.091
IGM ( $10^9/L$ )	0.16±0.26	0.11±0.29	1.251	0.213
NRBC ( $10^9/L$ )	0.56±0.003	0.01±0.003	1.170	0.245

AIDS, acquired immunodeficiency syndrome; TM, *Talaromyces marneffe*; WBC, white blood cells; NEU, neutrophils; LYM, lymphocytes; NLR, neutrophil-to-lymphocyte ratio; HGB, hemoglobin; MON, monocytes; PLT, platelets; IGM, infantile granulocytes; NRBC, nucleated red blood cells.

### Observation indexes

Routine blood parameters, including white blood cells (WBC), neutrophils (NEU), lymphocytes (LYM), monocytes (MON), hemoglobin (HGB), infantile granulocytes (IGM), and nucleated red blood cells (NRBC), were observed in both groups, and NLR values, LDH levels, and T lymphocyte subsets ( $CD4^+$  and  $CD8^+$  lymphocyte counts) were calculated.

### Ethical statement

All procedures performed in this study involving human participants were in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the ethics committee of the People's Hospital of Baise (No. LLSC-2022-01) and informed consent was taken from all the patients.

### Statistical methods

Statistical software in R language was used for analysis. Normally distributed data were described by mean ± standard error, and nonnormally distributed data were described by median (2.5–97.5% percentiles). Student's *t*-test was applied to compare normally distributed data between groups, and Mann-Whitney U test was applied to nonnormally distributed data.  $P < 0.05$  was considered statistically significant. For multiparameter linear regression analysis, the receiver operating characteristic (ROC) curve was used to evaluate the predictive value of NLR, HGB, LYM, serum

LDH,  $CD4^+$  lymphocyte count, and  $CD8^+$  lymphocyte count singly and jointly for AIDS combined with TM infection. The optimal threshold value for diagnosis was determined when the Youden index was maximum, and the diagnostic efficacy was evaluated by the area under the curve (AUC).  $P < 0.05$  was considered statistically significant.

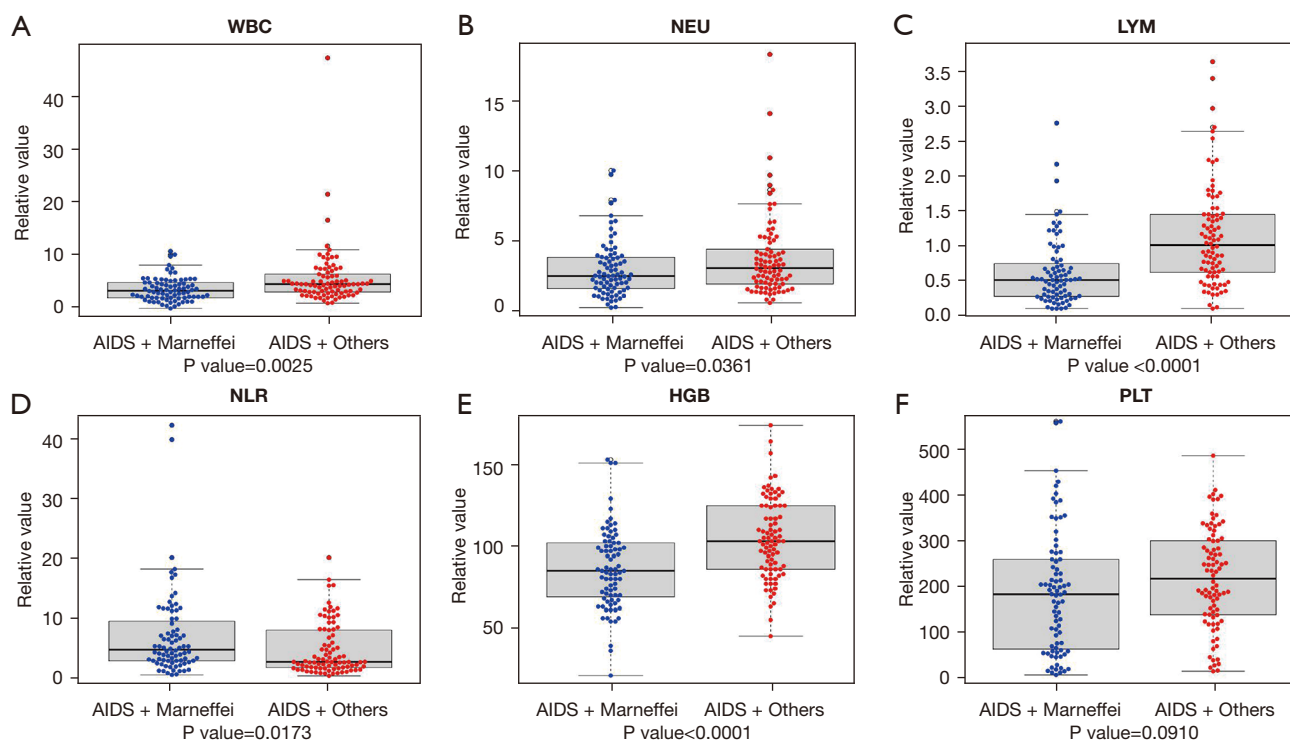
## Results

### Comparative analysis of routine blood results between the 2 groups

There was no significant difference in the routine blood results between the 2 groups (all  $P > 0.05$ ; Table 1, Figure 1). The routine blood results of the 2 groups were: WBC, 4.25±0.25 (AIDS-TM group, n=80), 6.28±0.61 (AIDS-other complications, n=86) ( $Z = -3.095$ ,  $P = 0.002$ ); NEU, 3.09±0.23, 3.90±0.31 ( $Z = -2.115$ ,  $P = 0.036$ ); LYM, 0.65±0.05, 1.16±0.08 ( $Z = -5.355$ ,  $P < 0.001$ ); NLR, 7.08±0.80, 4.84±0.756 ( $Z = 2.411$ ,  $P = 0.017$ ); HGB, 86.34±2.75, 104.57±5.32 g/L ( $Z = -4.764$ ,  $P = 0.000$ ); MON, 0.35±0.03, 0.500±0.03 ( $Z = -4.128$ ,  $P = 0.000$ ); platelets (PLT), 183.31±14.91, 215.59±11.74 ( $Z = -1.703$ ,  $P = 0.091$ ); IGM, 0.16±0.26, 0.11±0.29 ( $Z = 1.251$ ,  $P = 0.213$ ); and NRBC, 0.56±0.003, 0.01±0.003 ( $Z = 1.170$ ,  $P = 0.245$ ) (Table 1, Figure 1).

### Comparison of serum LDH levels and T lymphocyte subpopulation

LDH was higher in the observation group than in the



**Figure 1** Differences in blood cells of patients with TM infection and without TM infection. AIDS, acquired immunodeficiency syndrome; WBC, white blood cells; NEU, neutrophils; LYM, lymphocytes; NLR, neutrophil-to-lymphocyte ratio; HGB, hemoglobin; PLT, platelets; TM, *Talaromyces marneffei*.

control group, and the difference was statistically significant ( $P<0.05$ ).  $CD4^+$  lymphocyte count,  $CD8^+$  T lymphocyte count, and  $CD4^+/CD8^+$  ratio were significantly lower in the observation group than in the control group, and the differences were statistically significant (all  $P<0.01$ ; Table 2, Figure 2). The results were: LDH,  $458.40\pm 49.03$  U/L (AIDS-TM group,  $n=80$ ),  $318.04\pm 20.93$  U/L (AIDS-other complications,  $n=86$ ) ( $Z=2.633$ ,  $P=0.010$ );  $CD4^+$ ,  $40.25\pm 6.53$ ,  $183.66\pm 37.04$  pcs/ $\mu$ L ( $Z=-6.021$ ,  $P=0.000$ );  $CD8^+$ ,  $259.78\pm 27.21$ ,  $428.73\pm 42.53$  pcs/ $\mu$ L ( $Z=-4.026$ ,  $P=0.000$ ); and  $CD4^+/CD8^+$  ratio,  $0.163\pm 0.02$ ,  $0.447\pm 0.05$ , ( $Z=-5.213$ ,  $P=0.000$ ). LDH reference range, 109 to 245 U/L;  $CD4^+$  reference range, 404 to 1,612 cells/ $\mu$ L;  $CD8^+$  reference range, 220 to 1,129 cells/ $\mu$ L; and  $CD4^+/CD8^+$  ratio reference range, 0.71 to 2.78 (Table 2, Figure 2).

#### Comparison of the distribution of $CD4^+$ cell counts between the 2 groups

As shown in Table 3, almost all (97.5%) cases in the observation group had fewer than 200  $CD4^+$  cells/ $\mu$ L, with

77.5% having fewer than 50  $CD4^+$  cells/ $\mu$ L. Most (65.1%) cases in the control group had fewer than 200  $CD4^+$  cells/ $\mu$ L, with a more dispersed distribution. Distribution of the cell counts (pcs/ $\mu$ L) in the 2 groups were:  $\leq 50$ , 61 (77.5%) (control group), 30 (34.9%) (AIDS-TM group); 50–100, 9 (11.3%), 9 (10.5%); 100–200, 6 (7.5%), 17 (19.8%); and  $\geq 200$ , 3 (2.5%), 30 (34.9%) (Table 3).

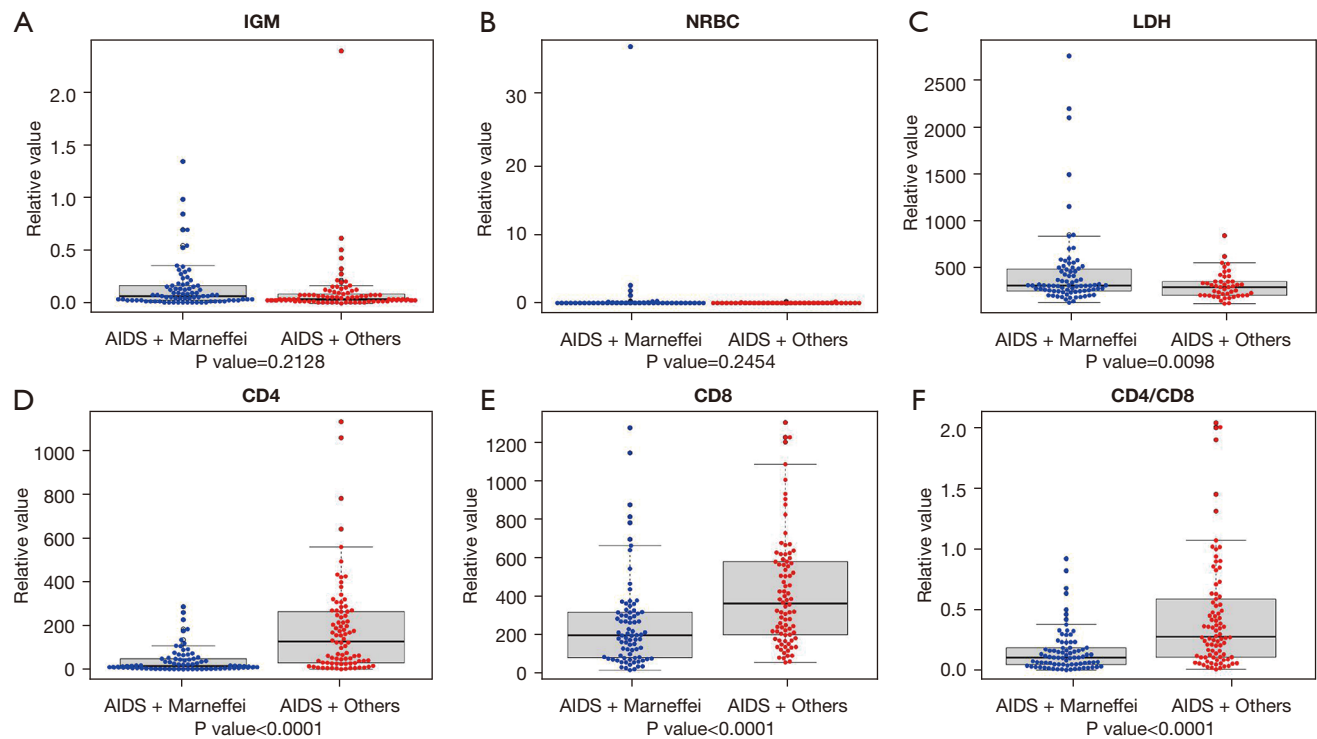
#### Predictive value of NLR, HGB, LDH, and T lymphocyte subsets for combined AIDS-TM

The results of ROC curve analysis showed that NLR, HGB, LYM, LDH,  $CD4^+$  lymphocyte count, and  $CD8^+$  lymphocyte count all had some predictive value for AIDS-TM, with AUCs of 0.628, 0.704, 0.744, 0.607, 0.789, and 0.701, respectively (Table 4, Figure 2). The predictive values were: NLR, AUC = 0.628 [standard error (SE) = 0.044,  $P=0.004$ , 95% confidence interval (CI): 0.544–0.713], best cutoff value (BCV) = 2.882, sensitivity of 0.775, and specificity of 0.535; HGB, AUC = 0.704 (SE = 0.040,  $P<0.001$ , 95% CI: 0.627–0.782), BCV = 85.50, sensitivity

**Table 2** Comparison of the results of serum LDH levels and T lymphocyte subsets between the 2 groups

Laboratory	AIDS With TM infection group (n=80)	AIDS with other complications group (n=86)	Z value	P value
LDH (U/L)	458.40±49.03	318.04±20.93	2.633	0.010
CD4 <sup>+</sup> (μL)	40.25±6.53	183.66±37.04	-6.021	0.000
CD8 <sup>+</sup> (μL)	259.78±27.21	428.73±42.53	-4.026	0.000
CD4 <sup>+</sup> /CD8 <sup>+</sup>	0.163±0.02	0.447±0.05	-5.213	0.000

LDH, lactate dehydrogenase; TM, *Talaromyces marneffe*.



**Figure 2** The difference in lymphocyte subpopulation with TM infection and without TM infection. AIDS, acquired immunodeficiency syndrome; TM, *Talaromyces marneffe*; IGM, infantile granulocytes; NRBC, nucleated red blood cells; LDH, lactate dehydrogenase.

**Table 3** Comparison of the CD4<sup>+</sup> cell counts between the 2 groups

Numbers of CD4 <sup>+</sup> (μL)	AIDS With TM infection group, n (%)	AIDS with other complications group, n (%)
≤50	62 (77.5)	30 (34.9)
50–100	9 (11.3)	9 (10.5)
100–200	6 (7.5)	17 (19.8)
≥200	3 (2.5)	30 (34.9)

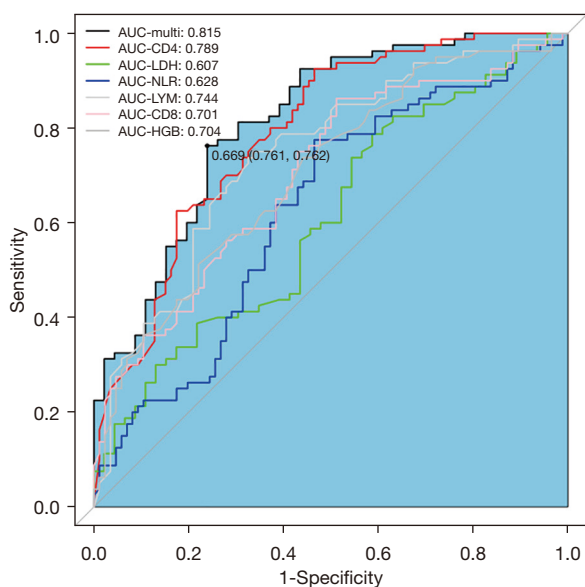
TM, *Talaromyces marneffe*; AIDS, acquired immunodeficiency syndrome.



**Table 4** The predictive value of NLR, HGB, LDH, and T lymphocyte subsets for AIDS with TM infection

Laboratory	AUC	Standard error	P value	95% CI	Best cutoff value	Sensitivity	Specificity
NLR	0.628	0.044	0.004	0.544–0.713	2.882	0.775	0.535
HGB	0.704	0.040	<0.001	0.627–0.782	85.50	0.513	0.779
LYM	0.744	0.380	<0.001	0.664–0.817	0.765	0.750	0.663
LDH	0.607	0.052	0.046	0.502–0.709	254.500	0.787	0.413
CD4 <sup>+</sup>	0.789	0.035	<0.001	0.720–0.854	121.50	0.925	0.535
CD8 <sup>+</sup>	0.701	0.040	<0.001	0.617–0.782	380.00	0.863	0.488

NLR, neutrophil-to-lymphocyte ratio; HGB, hemoglobin; LDH, lactate dehydrogenase; AIDS, acquired immunodeficiency syndrome; TM, *Talaromyces marneffeii*; AUC, area under curve; LYM, lymphocyte.



**Figure 3** The diagnostic value of different markers for AIDS patients with TM infection. AIDS, acquired immunodeficiency syndrome; TM, *Talaromyces marneffeii*; LDH, lactate dehydrogenase; NLR, neutrophil-to-lymphocyte ratio; HGB, hemoglobin; LYM, lymphocyte.

of 0.513, and specificity of 0.779; LYM, AUC =0.744 (SE =0.380,  $P<0.001$ , 95% CI: 0.664–0.817), BCV =0.765, sensitivity of 0.750, and specificity of 0.663; LDH, AUC =0.607 (SE =0.052,  $P=0.046$ , 95% CI: 0.502–0.709), BCV =254.500, sensitivity of 0.787, and specificity of 0.413; CD4<sup>+</sup>, AUC =0.789 (SE =0.035,  $P<0.001$ , 95% CI: 0.720–0.854), BCV =121.50, sensitivity of 0.925, and specificity of 0.535; and CD8<sup>+</sup>, AUC =0.701 (SE =0.040,  $P<0.001$ , 95% CI: 0.617–0.782), BCV =380.00, sensitivity of 0.863, and specificity of 0.488 (Table 4, Figure 2).

### NLR combined HGB, LDH and T lymphocyte subsets on the predictive value of combined AIDS-TM

The results showed that the combination of NLR, HGB, LDH, LYM, CD4<sup>+</sup> lymphocyte count, and CD8<sup>+</sup> lymphocyte count had a high predictive value for AIDS-TM, with an AUC of 0.815 (SE =0.014,  $P<0.001$ , 95% CI: 0.728–0.886), sensitivity of 0.762, and specificity of 0.761 (Figure 3).

## Discussion

Southeast Asia, northeast India and South China are the main epidemic areas of TM infection (11–13). With the AIDS epidemic, the number of Talaromyces cases increases rapidly, with Guangxi and Guangdong reporting the most cases in Mainland China (14).

The Chinese bamboo rat, silver star bamboo rat, small bamboo rat, and large bamboo rat are the natural hosts of TM, although the transmission route is still unclear. It is thought that the main modes of transmission are airborne inhalation and direct contact with conidia (15), which mainly invade the monocyte-macrophage system, causing granulomas and metabolic reactions in monocyte-rich tissues and organs such as the lung, liver, spleen, lymph nodes, skin, and bone marrow via interleukin 8 (IL-8) and other cytokines, causing an inflammatory response. The insidious and mild onset of the disease and the lack of specificity of the clinical manifestations make it easy to miss or misdiagnose the disease. In this paper, we first explored the use of NLR for the rapid diagnosis of AIDS-TM, showing that there was a significant difference in NLR, HGB, LYM, LDH, and T lymphocyte subsets between the observation and control groups and all had some predictive value for AIDS combined with TM infection. NLR combined with the above parameters had a higher

diagnostic efficacy (AUC =0.815). In this study, CD4<sup>+</sup> cell count, CD8<sup>+</sup> cell count, and lymphocyte count were found to be significantly lower in the observation group than in the control group, and CD4<sup>+</sup> cell count and CD8<sup>+</sup> cell count were below the lower limit of the reference range in both groups. Under normal cellular immunity, cytokines produced by CD4<sup>+</sup> cells activate reactive oxygen species (ROS), reactive nitrogen species, and enzyme systems within macrophages, which in turn kill the phagocytosed TM spores. CD4<sup>+</sup> T lymphocytes are the main target cells of HIV, and thus when HIV infects the body, it causes a decrease in CD4<sup>+</sup> cells and cellular immune deficiency through direct damage, fusion of infected cells with noninfected cells, immune damage, invasion of thymus and stem cells, and failure of macrophages to kill TM spores, resulting in their rapid multiplication in the body. A previous study (16) found that AIDS patients with CD4<sup>+</sup> cell counts less than 200 cells/ $\mu$ L had a higher risk of TM infection, while most AIDS patients with TM infection had CD4<sup>+</sup> cell counts less than 100 cells/ $\mu$ L. In the present study, the mean CD4<sup>+</sup> cell count in AIDS-TM patients was  $40.25 \pm 6.53$  cells/ $\mu$ L, a lower distribution than CD8<sup>+</sup> T lymphocytes, which are mainly responsible for the killing of target cells and inhibiting viral replication and transmission. The CD4<sup>+</sup>/CD8<sup>+</sup> ratio inversion can be used as an indicator of disease assessment in AIDS as it may be elevated in the early stages of HIV infection in the presence of virus-infected cells and cells expressing tumor-specific antigens. As the disease progresses, CD8<sup>+</sup> cells decrease and become dysfunctional (17). In addition, HIV infection can cause functional impairment of humoral immunity and a decrease in B cells, particularly memory B cells, under immune regulation by multiple molecules (18), leading to a decrease in total lymphocyte counts.

AIDS patients are prone to pathological hematopoiesis and varying degrees of hemocytopenia during disease progression, which can eventually progress to myelopoiesis dysfunction and lymphoma (19,20). Neutrophils, monocytes, and hemoglobin were lower in the AIDS-TM group than in the control group in this study, with statistically significant differences (all  $P < 0.05$ ). The incidence of hemocytopenia was higher in the AIDS-TM group than in the control group, with 13 (16.3%) and 6 (7.0%) cases, respectively, indicating that TM infection was more likely to appear at the end stage of AIDS and the condition was more severe. Yu *et al.* (21) concluded that HIV not only directly damaged or suppressed cells in the blood of patients, but also had the same effect

on bone marrow, causing a decrease in blood cells. In addition, concomitant chronic inflammation, nutritional hypoproteinemia, and certain adverse drug reactions can affect erythropoiesis, while hemoglobin, a major component of red blood cells, is also reduced. Splenomegaly and hyperfunction, which cause increased withholding and destruction of blood cells, are important causes of hemocytopenia. In addition, granulocytes and monocytes from phagocytosed TM are removed by the spleen, exacerbating the decrease in granulocytes and monocytes. At this time, smear microscopy of peripheral blood reveals neutrophils and monocytes engulfed or free outside the cells with a round, oval, or salami-shaped appearance, with 1 to 2 small purple-red nuclei distributed at the ends, and often with lightly stained pathogens in the central part, which can be an important tool for rapid diagnosis of TM infection. In both groups, almost all cases showed IGM, with 80 (100%) cases in the observation group and 85 (98.8%) cases in the control group, and NRBCs were more likely to be seen in the observation group (47 cases, 58.8%) than in the control group (17 cases, 19.8%). However, there was no statistically significant difference in IGM and NRBC between the 2 groups (both  $P > 0.05$ ), and thus these cannot be used as predictors of AIDS-TM.

Previous studies have found that elevated NLR was associated with psoriasis and its severity, disease activity in systemic lupus erythematosus, Crohn's disease, sepsis in burn patients, and postoperative acute kidney injury, as well as with the prognosis of advanced malignancy, metastatic disease, and chronic obstructive pulmonary disease (COPD) (22-26), and it is considered to be an efficient marker of systemic inflammation. Bastard *et al.* (27) found an increase in systemic markers of inflammation and immune activation in HIV-infected individuals compared with healthy controls, suggesting that this is due to systemic inflammation caused by HIV infection and antiretroviral therapy (ART).

Merriman *et al.* (28), in a study of 259 unselected adult HIV-infected patients, found that NLR was elevated in both primary well-controlled and poorly-controlled HIV-infected patients. Most were accompanied by elevated C-reactive protein (CRP), with a minority of patients having normal CRP at the time of NLR elevation, and this was mainly seen in patients with other coinfections. This potentially implies that clinicians may be able to use NLR for suspected infection/inflammation in HIV-positive patients when inflammatory markers such as CRP are normal. In a study of inflammation-based systemic scores

and all mortality in HIV-infected patients, elevated NLR in HIV-infected patients was found to be associated with total mortality but not with CD4 cell counts (29). Notably, to the knowledge of our team, there are no reports on the use of NLR for predicting AIDS coinfection with TM. In the present study, NLR in both groups was higher than that of the normal population (0.78–3.53) (30). NLR was higher in the AIDS-TM group than in the other comorbidities group, and with a statistically significant difference, it has some diagnostic value for predicting AIDS-TM.

LDH is widely present in the cytoplasm and mitochondria of various tissues and is a key enzyme in the process of glycolysis, which can lead to tissue cell damage. Many conditions, including infection, hepatic sclerosis, acute myocardial infarction, and malignant tumors can cause LDH levels and activity to increase (31). The possible mechanism for this is that during inflammation, macrophages rely on adenosine triphosphate (ATP) produced by glycolysis to provide the energy needed to release large amounts of inflammatory mediators in a hypoxic state of the tissue cells (32). Lu *et al.* (33) found that LDH was positively associated with the inflammatory factors IL-1 $\beta$ , creatinine, and lactate accumulation and was an independent risk factor for death in patients with sepsis. In this study, serum LDH was significantly higher in both groups, and the LDH level in patients with AIDS-TM was significantly higher than that in patients with other complications, which could be used to predict TM infection.

In conclusion, the combination of NLR, HGB, LYM, LDH, CD4<sup>+</sup> lymphocyte count, and CD8<sup>+</sup> lymphocyte count had certain predictive value in AIDS-TM. The combination of the such as NLR, LDH, and so on parameters had good diagnostic efficacy for AIDS-TM and could be used as an indicator for early diagnosis of HIV-TM. These diagnostics methods can save the time and release the economy burden of patients. However, this study involved a small number of cases, we did not set up a healthy control group and a group with HIV infection alone for comparison, and we did not analyze the dynamic changes of the above parameters and their prognostic value before and after antiretroviral therapy (ART) and antifungal therapy, and thus further research is needed in the future.

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## Footnote

*Reporting Checklist:* The authors have completed the STARD reporting checklist. Available at <https://apm.amegroups.com/article/view/10.21037/apm-22-36/rc>

*Data Sharing Statement:* Available at <https://apm.amegroups.com/article/view/10.21037/apm-22-36/dss>

*Conflicts of Interest:* All authors have completed the ICMJE uniform disclosure form (available at <https://apm.amegroups.com/article/view/10.21037/apm-22-36/coif>). The authors have no conflicts of interest to declare.

*Ethical Statement:* The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All procedures performed in this study involving human participants were in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the ethics committee of the People's Hospital of Baise (No. LLSC-2022-01) and informed consent was taken from all the patients.

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