Talaromyces Marneffe Mp1p Antigen Detection May Play an Important Role in the Early Diagnosis of Talaromycosis in Patients with Acquired Immunodeficiency Syndrome

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Abstract

Talaromycosis is a life-threatening fungal disease commonly seen in patients with acquired immunodeficiency syndrome (AIDS), which is endemic in Southern China and Southeast countries. The diagnostic methods available for talaromycosis are relatively time-consuming and yield a high mortality. Therefore, early diagnosis of talaromycosis is extremely important. We aimed to determine a potential method for assisting in its early diagnosis. A total of 283 patients with AIDS admitted to our hospital because of opportunistic infections were prospectively included in this case-control study and divided into those with (TSM, $n = 93$) and without talaromycosis (non-TSM, $n = 198$). The diagnostic accuracy of the Mp1p assay with enzyme immunoassay, galactomannan (GM) assay, and blood culture performed within 3 days of hospitalisation was evaluated. Most patients were men ($n = 243$ [85.9%]), mainly young (52.3%), and middle-aged adults (33.9%). The positivity rates in the Mp1p assay, GM assay, and blood culture were 72%, 64.5%, and 81.7%, respectively, in the TSM group. The sensitivity, specificity, and positive and negative predictive values of the Mp1p assay were 72.0% (67/93), 96.8% (184/190), 91.8% (67/73), and 87.6% (184/210), respectively. The Mp1p assay showed a substantial agreement with the gold standard (κ : 0.729) and superiority to the GM assay (κ : 0.603); it also showed a superior diagnostic efficacy in the patients with CD4 + T cell counts of $< 50 \text{ Nr}/\mu\text{L}$ compared to those with CD4 + T cell counts of $\geq 50 \text{ Nr}/\mu\text{L}$. The Mp1p assay possesses a superior advantage in assisting in the early diagnosis of talaromycosis in patients with AIDS, especially those with low CD4 + T cell counts.

Introduction

Talaromycosis is an invasive fungal disease caused by *Talaromyces marneffe*, which is common in immunocompromised individuals, especially in patients with acquired immunodeficiency syndrome (AIDS). It is mainly prevalent in Southern China and Southeast countries, including Thailand, Vietnam, India, and Malaysia [1–5]. In Southern China, the prevalence of talaromycosis in hospitalized patients with AIDS has increased by 65% within 5 years [6]. Talaromycosis is a life-threatening disease with a high mortality rate of up to 50.6% without timely antifungal treatment [4, 7, 8]. Delayed diagnosis of talaromycosis is an important reason for its high mortality rate [8, 9]. For every day of delay in the diagnosis of talaromycosis, the risk of death increases by 2% [9]. Therefore, early diagnosis of talaromycosis is extremely important.

However, its early diagnosis is difficult. At present, the definite diagnosis of talaromycosis relies on histopathology or culture evidence of *T. marneffe* infection [10, 11], which has significant limitations. It is relatively time-consuming, with culture of pathogens requiring approximately 1 to 2 weeks [2, 8, 10]. In addition, such diagnostic methods usually require invasive examinations to improve the positivity rate. Therefore, new methods are urgently needed for the early diagnosis of talaromycosis.

Previous studies have developed a range of new technologies; however, none of them have been proven for clinical use [9, 12–19]. A meta-analysis showed that the total sensitivity and specificity for the early diagnosis of talaromycosis were 82% (95% confidence interval [CI]: 68–90%) and 99% (95% CI: 98–

100%), respectively [19]. Serological testing is an adjunct to a rapid diagnosis. The galactomannan (GM) assay is widely used in clinical practice to assist with the diagnosis of aspergillosis. A few studies have found that it could also be used to assist in the diagnosis of talaromycosis [9, 20]. However, the GM assay has a strong cross-reaction with *Aspergillus*, which limits its clinical application. Preliminary studies found that Mp1p antigen detection had a sensitivity of 75–86.3% and a specificity of 98–99% for the diagnosis of talaromycosis [14, 16]; it is expected to be a rapid diagnostic method in patients with AIDS [21]. However, the early diagnostic accuracy of Mp1p antigen detection in actual clinical settings remains unclear. Therefore, the aim of our real-world study was to assess the diagnostic efficacy of Mp1p antigen detection for talaromycosis in patients with AIDS within 3 days of admission, thus determining a potential method for assisting in the early diagnosis of talaromycosis in these patients.

Materials And Methods

Study population

This case-control study prospectively enrolled patients with AIDS hospitalised in the Guangzhou Eighth People's Hospital (GEPH) between March and September 2018. The inclusion criteria were as follows: 1) confirmed HIV infection on HIV antibody or HIV nucleic acid testing; 2) age of 18 years or over; 3) CD4 + T cell count of ≤ 200 Nr/ μ L; 4) antiretroviral therapy-naïvety; 5) history of blood culture, Mp1p antigen detection, and GM tests within 3 days of admission; and 6) admission to the hospital because of opportunistic infections (OIs). The exclusion criteria were as follows: 1) pregnancy or lactation; 2) incomplete clinical data; and 3) hospital stay duration of less than 3 days. Ethical approval was provided by the Medical Ethics Committee of the GEPH (Approval No. 202034167). All patients signed an informed consent form.

The case group (TSM group) included all patients with AIDS with culture- and/or pathology-proven talaromycosis. The control group (non-TSM group) included patients with AIDS who were diagnosed with infectious diseases other than talaromycosis. The flow diagram of the study design is shown in Fig. 1.

Data collection and definitions

Data were collected from the patients' electronic medical records. The demographic data included age and sex. The clinical data included signs and symptoms on admission, laboratory test results within 3 days of admission, and all diagnostic information on OIs. All data were double-checked by two trained research assistants before analysis.

The laboratory test indicators included the red blood cell count, white blood cell (WBC) count, platelet (PLT) count, and aspartate aminotransferase (AST), alanine aminotransferase (ALT), albumin, blood urea nitrogen, and creatinine levels. Leukopaenia was defined as a WBC count of $< 3.5 \times 10^9$ cells/L; thrombocytopenia, PLT count of $< 125 \times 10^9$ cells/L; and anaemia, haemoglobin (Hb) level of < 120 g/L.

for men and < 110 g/L for women. A FACSCanto™ II flow cytometer was used to analyse CD4 + lymphocytes in the blood samples.

OIs were defined as infections caused by conditional pathogens not harmful to healthy populations but to immunodeficient populations. The presence of *T. marneffei* infection was based on cultures of clinical specimens, including blood, bone marrow, bronchoalveolar lavage fluid (BALF), or other body fluid samples, and/or histopathological identification.

Diagnosis of talaromycosis

All patients underwent blood culture using the standard automated aerobic BACTEC bottles, GM test using the Platelia Aspergillus enzyme immunoassay kit (Bio-Rad, Marnes-la-Coquette, France), and Mp1p assay within 3 days of hospitalisation. Meanwhile, some patients received cultures of bone marrow, BALF, or other body fluid samples, and histopathological examination with hexamine silver staining.

T. marneffei was isolated using standard culture techniques. In standard Sabouraud dextrose agar, *T. marneffei* grew more readily than did other endemic dimorphic fungi. *T. marneffei* was cultured as a mould at 25°C to 30°C and made a transition from mycelium to yeast at 32°C to 37°C. Identification was based on the morphological and microscopic observation of the colonies, demonstration of mould-to-yeast conversion, and presence of a red diffusible pigment production at 25°C. Histopathological diagnosis was based on the identification of characteristic yeast cells with a midline septum in the tissue sections [6, 10].

Mp1p antigen test in the serum samples

Serum samples were obtained from the enrolled patients within 3 days of admission. In the double-antibody sandwich enzyme-linked immunosorbent assay (ELISA), the plasma samples were restored at 25°C. Twenty microlitres of biotin reagent and fifty microlitres of serum specimen were added to the microplate (pre-coated *T. marneffei* antibody) and incubated at 37°C for 30 min. The plates were washed for five times and dried, and 100 µL of the enzyme labelling reagents was added and incubated at 37°C for 30 min. The plates were washed for five times and dried; chromogenic agent A (50 µL) and chromogenic agent B (50 µL) were added to each well; and the plates were incubated at 37°C for 15 min and protected from light. After the addition of 50 µL of stopping solution to each well, the absorbance (A) at 450 nm was read using a microplate reader.

GM antigen detection

The GM antigen was detected using double-antibody sandwich enzyme-linked immunoassay following the manufacturer's instructions (Bio-Rad). An absorbent index of ≥ 0.5 was considered to indicate positivity for the GM antigen.

Statistical analysis

All statistical analyses were performed using SPSS version 25.5. The continuous variables were expressed as medians and interquartile ranges and the categorical variables as numbers and

percentages. The Wilcoxon rank-sum test was used for the continuous variables and the chi-squared test for the categorical variables. The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and kappa value were calculated to evaluate the diagnostic efficacy of Mp1p antigen detection and other diagnostic methods. The statistical significance level was set at a two-tailed *P* value of < 0.05.

Results

Baseline characteristics

A total of 283 patients with AIDS were enrolled in this study, including 93 patients with talaromycosis and 190 patients without talaromycosis. Most of the patients were men ($n = 243$ [85.9%]), young, and middle-aged. The median CD4 + T cell count was 25 (9–64) Nr/ μ L, and 194 (68.6%) patients had a CD4 + T cell count of < 50 Nr/ μ L. The TSM group had a higher proportion of young adults (65.6% vs 45.8%, $P = 0.002$) and a higher incidence of fever, cough, sputum, rash, hepatomegaly, splenomegaly, and lymphadenectasis than the non-TSM group (all $P < 0.05$). The TSM group also had a higher incidence of abnormal laboratory test results, including lower CD4 + T cell count (12 [6–27] vs 40 (16–87) Nr/ μ L, $P < 0.001$) and higher CD4 + T cell count (< 50 Nr/ μ L; 91.4% vs 57.4%, $P < 0.001$), WBC count, PLT count, Hb level, ALT level, and AST level (all $P < 0.05$) (Table 1), than the non-TSM group. The incidence of most OIs was similar between the two groups (Table S1).

Table 1
Basic characteristics between the TSM and non-TSM groups among the patients with AIDS

	Total (n = 283)	Non-TSM (n = 190)	TSM (n = 93)	P-value
Age Groups (Y)	44(33–53)	39(31–48)	46(35–55)	0.005
Young Adults (n [%])	148[52.3]	87[45.8]	61[65.6]	0.002
Middle-age Adults (n [%])	96[33.9]	71[37.4]	25[26.9]	-
Old Adults (n [%])	39[13.8]	32[16.8]	7[7.5]	-
Male (n [%])	243 [85.9]	162 [85.3]	81 [87.1]	0.677
Fever (n [%])	189 [66.8]	111 [58.4]	78 [83.9]	< 0.001
Cough and Sputum (n [%])	170 [60.1]	104 [54.7]	66[71.0]	0.009
Rash (n [%])	63 [22.3]	26 [13.7]	37 [39.8]	< 0.001
Lymphadenectasis (n [%])	162 [57.2]	87 [45.8]	75 [80.7]	< 0.001
Hepatomegaly (n [%])	61 [21.6]	26 [13.7]	35 [37.6]	< 0.001
Splenomegaly (n [%])	82 [29.0]	41 [21.6]	41 [44.1]	< 0.001
Leukopenia (n [%])	87 [30.74]	47 [24.74]	40 [43.01]	0.002
Thrombocytopenia (n [%])	78 [27.56]	36 [18.95]	42 [45.16]	< 0.001
Anemia (n [%])	212 [74.9]	129[67.9]	83[89.2]	< 0.001
Elevated ALT (n [%])	68 [24.03]	33 [17.37]	35 [37.63]	< 0.001
Elevated AST (n [%])	137 [48.41]	70 [36.84]	67 [72.04]	< 0.001
Hypoproteinemia (n [%])	278 [98.23]	185 [97.37]	93 [100]	0.272
Elevated BUN (n [%])	20 [7.07]	14 [7.37]	6 [6.45]	0.777
Elevated Cr (n [%])	14 [4.95]	11 [5.79]	3 [3.23]	0.521
CD4 + T-cell (Nr /uL)	25 (9–64)	40 (16–87)	12 (6–27)	< 0.001
CD4 + T-cell < 50 Nr /μL (n [%])	194[68.6]	109 [57.4]	85 [91.4]	< 0.001
CD4: CD8 Ratio	0.08 (0.04–0.15)	0.10 (0.05–0.17)	0.06 (0.03–0.10)	< 0.001
Blood culture (+) time (day)	-	-	7(5–9)	-

	Total (n = 283)	Non-TSM (n = 190)	TSM (n = 93)	<i>P</i> -value
Notes: All data are expressed as medians (interquartile range), or n [%], as appropriate. TSM, talaromycosis; young adults, age 18–44 years; middle-age adults, age 45–59 years; old adults, age ≥ 60 years; leukopenia, white blood cell count < 3.5 × 10 ⁹ cells/L; thrombocytopenia, platelet count < 125 × 10 ⁹ cells/L; anemia, hemoglobin < 120 g/L for males and < 110 g/L for females; ALT, alanine aminotransferase; AST, aspartate aminotransferase; BUN, blood urea nitrogen; Cr, creatinine.				

Detection results of the different methods

In the total population, the positivity rates in the Mp1p and GM assays (25.8% and 26.1%, respectively) were similar to that in the blood culture (26.9%) and were slightly lower than that in the bone marrow culture (32.5%). More than a third of the patients were positive for “Mp1p + GM” (Fig. 2a). In the TSM group, the positivity rate for “Mp1p + GM” was 82.8%. The positivity rate in the Mp1p assay was similar to that in the blood culture (72% vs 81.7%, *P* = 0.122), while the positivity rate in the GM assay was lower than that in the blood culture (64.5% vs 81.7%, *P* = 0.002) (Table S2 and Fig. 2b).

The positivity rates for Mp1p, GM, and “Mp1p + GM” in those with CD4 + T cell counts of < 50 Nr/μL were higher than the positivity rates in those with higher CD4 + T cell counts. The positivity rates in the Mp1p assay increased with decreased CD4 + T cell counts (Fig. 3a). The number of patients with talaromycosis increased with decreases in the CD4 + T cell counts, and none of the patients were diagnosed with talaromycosis with a CD4 + T cell count of > 100 Nr/μL (Table S3). In the TSM group, the positivity rates for Mp1p, GM, and “Mp1p + GM” in those with CD4 + T cell counts of < 50 Nr/μL were 74.1%, 65.9%, and 84.7%, respectively, superior to the positivity rates in those with higher CD4 + T cell counts (Fig. 3b).

Diagnostic efficacy of the Mp1p assay for talaromycosis

For the diagnosis of talaromycosis in the patients with AIDS, the Mp1p assay showed a trend advantage over the GM assay. The sensitivity, specificity, PPV, NPV, and accuracy of the Mp1p assay were 72.0% (67/93), 96.8% (184/190), 91.8% (67/73), 87.6% (184/210), and 88.69%, respectively (Table 2). The combined approach “Mp1p + GM” assay showed a trend advantage in terms of the sensitivity and NPV for the diagnosis of talaromycosis over the Mp1p assay (sensitivity: 82.8% vs 72.0%; NPV: 91.4% vs 87.6%) but had slightly decreased specificity and PPV (specificity: 89.5% vs 96.8%; PPV: 79.4% vs 91.8%) (Table 2). The best agreement was observed in the blood culture (kappa: 0.857), followed by the Mp1p assay (kappa: 0.729) and “Mp1p + GM” assay (kappa: 0.715), and the worst agreement in the GM assay (kappa: 0.603) (Fig. 4).

Table 2
Diagnostic efficacy of Mp1p and other indicators

	Sensitivity	Specificity	PPV	NPV	Kappa
Mp1p	72.0%	96.8%	91.8%	87.6%	0.729
GM	64.5%	92.6%	81.1%	84.2%	0.603
Mp1p + GM	82.8%	89.5%	79.4%	91.4%	0.715
Blood Culture	81.7%	100.0%	100.0%	91.8%	0.857
Abbreviation: PPV, positive predicted value; NPV, negative predicted value. Mp1p + GM, Mp1p antigen detection positive or GM antigen detection positive.					

In the total population, the diagnostic efficacy of the Mp1p assay, GM assay, and “Mp1p + GM” assay in those with CD4 + T cell counts of < 50 Nr/μL was superior to that in those with higher CD4 + T cell counts (Fig. 5). In the patients with AIDS with CD4 + T cell counts of < 50 Nr/μL, the Mp1p assay showed a trend advantage over the GM assay for the diagnosis of talaromycosis, with a sensitivity of 74.1%, a specificity of 97.2%, a PPV of 95.5%, and an NPV of 82.8% (Table 3). In the patients with CD4 + T cell counts of < 50 Nr/μL, the best agreement was observed in the “Mp1p + GM” assay (kappa: 0.748), followed by the Mp1p assay (kappa: 0.732) and GM assay (kappa: 0.602). The sensitivity, PPV, and kappa value were quite low in those with CD4 + T cell counts of ≥ 50 Nr/μL (Table 3).

Table 3
Diagnostic efficacy in the different CD4 + T cell count subgroupings

	CD4 + T-cell	Sensitivity	Specificity	PPV	NPV	Kappa
Mp1p	< 50 Nr/μL	74.1%	97.2%	95.5%	82.8%	0.732
	≥ 50 Nr/μL	50.0%	96.3%	57.1%	95.1%	0.491
GM	< 50 Nr/μL	65.9%	92.7%	87.5%	77.7%	0.602
	≥ 50 Nr/μL	50.0%	92.6%	40.0%	94.9%	0.383
mp1p + GM	< 50 Nr/μL	84.7%	89.9%	86.7%	88.3%	0.748
	≥ 51 Nr/μL	62.5%	88.0%	35.7%	96.0%	0.384
Abbreviation: PPV, positive predicted value; NPV, negative predicted value.						
Mp1p + GM, Mp1p antigen detection positive or GM antigen detection positive.						

Discussion

In this study, we found that Mp1p antigen detection possesses a superior advantage in assisting in talaromycosis diagnosis in patients with AIDS within 3 days of admission, especially those with low CD4 + T cell counts (< 50 Nr/ μ L).

Culture and histopathology are recognised as the gold standard methods for talaromycosis diagnosis but are time-consuming and have insufficient sensitivity. The median time for identifying *T. marneffei* from blood cultures was 7 (5–9) days in our study, which is similar to the study finding by Le et al. [2]. The time delay of culture and the difficulty of pathological detection make its rapid clinical diagnosis particularly difficult. PCR testing can help in the early diagnosis of talaromycosis, with a high specificity of 100%; however, it is expensive, with a low sensitivity of 70.4% before treatment [12]. *T. marneffei* specific antibody detection showed a sensitivity of 25–95% and was strongly cross-reactive to other pathogens, which limited its clinical application [13]. In recent years, an increasing number of studies have focused on the detection of *T. marneffei* specific antigens, including CYA, GM, and Mp1p. The sensitivity of these methods was 75–95%, and the specificity was 90–100%, indicating their potential for clinical application [9, 14, 16–18]. Mp1p is a type of mannoprotein on the *T. marneffei* cell wall and can be secreted into the blood after *T. marneffei* infection [22]. It is a key virulence factor in *T. marneffei* and has been shown to be highly immunogenic [22, 23].

As shown in our study, the incidence of talaromycosis was higher in the young adult patients with AIDS (65.6% vs 45.8%, $P = 0.002$), and the incidence of symptoms, such as fever, cough, sputum, and rash, and abnormal laboratory test results was higher in the patients with talaromycosis than in those without. However, these markers do not have sufficient specificity for identifying talaromycosis in clinical practice. In our study, the positivity rate for rash, a specific indicator of talaromycosis, was < 40% in the patients with talaromycosis, which was insufficient to be used as a diagnostic indicator.

The positivity rate in the Mp1p assay in the patients with talaromycosis was similar to that in the blood culture (72% vs 81.7%, $P = 0.122$) in our study. It had a substantial agreement with the gold standard (kappa: 0.729), and the sensitivity, specificity, PPV, and NPV of Mp1p antigen detection were 72.0%, 96.8%, 91.8%, and 87.6%, respectively, which were generally superior to those of the GM assay. Several studies have been conducted to validate the efficiency of different serum diagnostic methods [9, 12, 14–17, 19]. Wang et al. [14] detected the Mp1p antigen and antibody in 20 serum specimens of patients with talaromycosis and 525 negative control specimens. They found that the sensitivity of Mp1p antigen ELISA was 75%, which was superior to that of the Mp1p antibody test (30%). Another similar study conducted in Vietnam reported that the Mp1p antigen test had an excellent sensitivity of 86.3% and a specificity of 98.1% for talaromycosis diagnosis in patients with HIV infection [16]. These previous study findings, together with our findings, indicate that Mp1p antigen detection is a good tool for the early diagnosis of talaromycosis. Moreover, this technique is simple to perform and is commercially available; therefore, it is potentially generalizable to routine clinical practice. The sensitivity of the Mp1p assay in our study was lower than that in the study conducted in Vietnam (72.0% vs 86.3%) possibly because of the difference in the control group. Our control group was limited to patients with AIDS without talaromycosis, while the control group in the study conducted in Vietnam included healthy volunteers and

patients with non-HIV-related infections. In addition, some of our patients had received antifungal treatment before admission, which could also affect the results. The GM assay is also an available diagnostic tool in talaromycosis diagnosis but was found to be inferior to Mp1p antigen detection. It had a substantial agreement with the gold standard (kappa: 0.603) in our study; however, the sensitivity was only 64.5%, indicating a greater risk of misdiagnosis. A study conducted in Wuhan found that the GM assay had a sensitivity of 95.8% (23/24) and a specificity of 90.9% (30/33) in talaromycosis diagnosis [9]. The sensitivity of the GM assay in that study seemed to be much higher than that in our study; however, their sample size was small, which may increase the risk of sampling errors. In addition, the selection of the cut-off values and the different inclusion criteria could have affected the results.

There have been no reports related to combined approaches for talaromycosis diagnosis. Combined approaches seemed to have a diagnostic advantage over Mp1p antigen detection alone in our study. In addition, the sensitivity of combined approaches was superior to that of blood culture, although the PPV was not high enough. This suggests that combined approaches have the potential for application and are worth further in-depth studies to establish a better diagnostic model.

In our study, more than 90% of the patients with AIDS with talaromycosis had a CD4 + T cell count of < 50 Nr/ μ L. We found that the number of patients with talaromycosis and the positivity rates in the Mp1p assay increased with decreases in the CD4 + T cell counts. In addition, the Mp1p assay showed a superior diagnostic efficacy in the patients with CD4 + T cell counts of < 50 Nr/ μ L. It is known that lower CD4 + T cell counts are associated with more severe OIs and generally indicate more severe disseminated infections in patients with AIDS. We speculated that in patients with lower CD4 + T cell counts, the increased growth of *T. marneffei* strains may cause them to secrete more Mp1p antigens into the blood, which makes them easier to detect.

This study identified the clinical value of Mp1p antigen detection, which could assist in the early diagnosis of talaromycosis. Although a small number of studies have explored the diagnostic value of Mp1p antigen detection, these were only preliminary explorations [14–16]. The relatively large sample size is a strength of our study. Furthermore, in contrast to the study conducted in Vietnam [16], we selected hospitalised patients with AIDS as the control group, which more closely matched the clinical needs. We also compared between the different assays simultaneously, especially the Mp1p and GM assays. Few studies have compared the diagnostic efficacy of Mp1p and GM antigen detections simultaneously. Only Wang et al. [15] used both approaches to investigate Mp1p antigenaemia in patients with HIV infection. However, in their study, the GM assay was used only as a gold standard method for talaromycosis diagnosis.

This study had some limitations. Our study population included hospitalised patients with AIDS, and the PPV and NPV were not based on the general population. Therefore, our results are only applicable to the identification of talaromycosis in patients with AIDS but not in the general population. Another limitation of our study is that some of our patients lacked records of antifungal treatment before admission; thus, we cannot exclude such confounding factors. Nevertheless, our study offers application value. We believe

that Mp1p antigen detection can be used for the diagnosis of talaromycosis in clinical settings to promote its early diagnosis and treatment and reduce mortality. To further optimise the clinical application of Mp1p antigen detection, we will further detect and quantify Mp1p levels, determine the best cut-off value, and build a diagnostic model for early diagnosis in a larger prospective group.

In summary, it is difficult to achieve an early diagnosis of talaromycosis relying on the diagnostic gold standard of culture or histopathology. Mp1p antigen detection has a superior advantage in assisting in the early diagnosis of talaromycosis in patients with AIDS, especially those with low CD4 + T cell counts of 50 Nr/ μ L.

Declarations

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Data availability: The data used to support the findings of this study have not been made available because no patient approval was obtained.

Materials availability: All the materials of the current study are described in the text.

Code availability: Not applicable.

Authors' contributions: Weiping Cai, Xiaoping Tang, and Linghua Li designed and supervised the study. Material preparation, experimental operation, and data collection were carried out by Xu Ou, Haodi Wang, Liya Li, Pengle Guo, and Xiejie Chen. Data collation and result analysis were performed by Xiaoman Chen and Xu Ou. The first draft of the manuscript was written by Xiaoman Chen and Xu Ou. Linghua Li reviewed and revised the draft. All authors read and approved the final manuscript.

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Figures

Figure 1

Flow chart of the study

Figure 2

Positivity rates in the different diagnostic methods among the patients with AIDS and talaromycosis (a) Total patients with AIDS, (b) Patients with talaromycosis. Mp1p+GM, Mp1p antigen-positive or GM antigen-positive, BAL, bronchoalveolar lavage, AIDS, acquired immunodeficiency syndrome, GM, galactomannan

A

B

Figure 3

Positivity rates in the Mp1p and GM assays in the different CD4+T cell count subgroupings (a) Total patients with AIDS, (b) Patients with talaromycosis. AIDS, acquired immunodeficiency syndrome, GM, galactomannan

Figure 4

Diagnostic efficacy of the different diagnostic methods

Figure 5

Diagnostic efficacy in the different CD4+T cell count subgroupings

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