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Analysis on the imaging features of AIDS with pulmonary fungal infection

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Analysis on the imaging features of AIDS with pulmonary fungal infection

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【ABSTRACT】 Purpose: To investigate the imaging performance characteristics of AIDS patients with pulmonary fungal infection. **Methods:** Fifty-one cases of AIDS with pulmonary fungal infections patients and 56 cases of non-AIDS with pulmonary fungal infection patients were performed for CT scan and HRCT scan. The contrast enhanced scan was performed in patients with the mass or suspicious mediastinal lymph nodes. Results were compared between the two groups. **Results:** The most common fungal infection in two groups of patients was *Candida albicans*. The infection rates were 54.8%(28cases) and 58.3%(32cases) respectively. In two groups, the differences of diffuse distribution, the incidence rates of upper and lower lobes in the bilateral lung fields were statistically significant ($P<0.05$). The differences of patching or large consolidation shadow, cavitas, enlarged lymph nodes in mediastinum and pleural effusion were also significant in two groups ($P<0.05$). **Conclusions:** The lesion in most of AIDS patients with pulmonary fungal infection mostly showed diffuse distribution, patching or large consolidation shadow with more extensive region ($P=0.002$). The differences between AIDS with pulmonary fungal

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infection and non-AIDS pulmonary fungal infection were statistically significant in lesion location and complicated imaging features. The most common fungal infection in AIDS patients was candida albicans.

Key words: Acquired immunodeficiency syndrome; Fungal infection; Tomography, X-ray computed

Introduction

Acquired immune deficiency syndrome (AIDS) is the most severe immune suppression clinical syndrome after infected with the human immunodeficiency virus (HIV). Pulmonary fungal infection is one of the common opportunistic infections and underlying cause of death in patients with AIDS. Pulmonary fungal infections increased significantly, often accompanied by other pathogens of mixed infections because of low immune system in AIDS patients. The disease is hard to be diagnosed because of its complicated imaging features. The purpose of this study is to discuss the imaging features of AIDS patients with pulmonary fungal infection.

Materials and methods

Fifty-one AIDS patients with pulmonary fungal infection (31male and 20 female, aged 8 to 72 years old, mean age 39 ± 15 years) and 56 non-AIDS patients with pulmonary fungal infection (39male and 17 female, aged 14 to 83 years old, mean age 50 ± 17 years) which all were confirmed by etiology were selected from July 2006 to January 2009 in this study.

All of patients in two groups performed CT plain scan examination using the U.S. GE Hispeed Advantage RP22 spiral CT machines. In addition, the patients who combine with mass or suspicious mediastinal lymph nodes performed enhanced CT scan. The CT scan began at the end of the patient's deep breathing and the range was from apex to bottom of the lung. Scan parameters: 120kV, 160mAs, collimation 10mm, pitch 1. High-resolution CT (HRCT) scan was performed in region of interest using collimation 1mm, spacing 5mm ~ 10mm, bone calculation.

The diagnosis of AIDS adopted The People's Republic of China AIDS diagnostic criteria in 2003. The clinical diagnosis of pulmonary fungal infection adopted diagnostic criteria of invasive pulmonary fungal infection published by Chinese Medical Association in 2006, mainly include three aspects: host factors, clinical characteristics, microbiological or histopathological examination. Invasive pulmonary fungal infection can be diagnosed in clinic at least in line with a host factors, lung infection in a major or two minor clinical features and a evidence of microbiological examination.

Imaging data of all patients were read using blind analysis by two radiologist. Those of lesions characteristics (location, distribution, size, shape, density, cavity), intrathoracic enlarged lymph nodes and pleural effusion were compared and analyzed in two groups patients.

statistics

The statistical analysis was performed using SPSS version 11.0 for Windows. The Student's t-test or non-parametric test was used to examine significant differences in the measurement data. The chi-square test was used to examine significant differences for the sample rate of data packet. A p-value less than 0.05 (two-sided) was considered to indicate a significant difference.

Results

1. Etiological classification comparison

Table 1 etiological classification in two groups patients.

etiological classification	AIDS patients with pulmonary fungal infection		Non-AIDS patients with pulmonary fungal infection	
	cases	%	cases	%
Candida albicans	28	54.8	32	58.3
Candida glabrata	5	9.7	3	5.5
Aspergillus	6	12.9	9	16.7
Cryptococcus	5	9.7	6	11.1
mucor	3	6.5	2	2.8

penicillium marneffeii	2	3.2	2	2.8
histoplasma	2	3.2	2	2.8

The differences of etiological classification were no statistically significant between the two groups ($\chi^2 = 0.014, p > 0.5$).

2. Lesion location contrast

Table 2 lesion location in two groups patients

lesion location and extension	AIDS patients with pulmonary fungal infection		Non-AIDS patients with pulmonary fungal infection		χ^2	P
	cases	%	cases	%		
diffuse distribution	20	38.7	9	16.7	4.119	0.042
interspersal distribution	20	38.7	20	36.1	0.048	0.826
superior lobe of right lung	39	77.4	30	52.8	4.339	0.036
middle lobe of right lung	30	58.1	23	41.6	0.001	0.982
inferior lobe of right lung	39	77.4	28	50.0	5.354	0.021
superior lobe of left lung	41	80.6	31	55.6	4.754	0.029
inferior lobe of left lung	33	64.5	22	38.9	4.377	0.036

The difference of lesions diffuse distribution in bilateral lungs between the two groups was statistically significant. The difference of the incidence of lesions occurred at superior and inferior lobes of bilateral lungs between the two groups was statistically significance.

3. lesion imaging characteristics contrast

Table 3 lesion imaging characteristics in two groups patients

lesion imaging characteristics	AIDS patients with pulmonary fungal infection		Non-AIDS patients with pulmonary fungal infection		χ^2	P
	Cases	%	cases	%		
patching or large consolidation shadow	23	45.2	6	11.1	9.829	0.002
nodular shadow	18	35.5	27	47.9	0.943	0.331
round-glass shadow	8	16.1	3	5.6	1.990	0.158
mass shadow	5	9.7	3	5.5	0.410	0.522
cavity shadow	15	29.0	5	8.3	4.854	0.028
pleural effusion	10	19.4	2	2.8	4.892	0.027
mediastinal enlarged lymph nodes	11	22.2	3	5.5	3.903	0.048
pneumothorax	2	3.2	0	—		

The differences of lesion imaging characteristics of patching or large consolidation shadow, an empty shadow, pleural effusion, mediastinal enlarged lymph nodes in the two groups were statistically significant.

Discussion

Being lower defense function because of immune function injury, inhibit or defect, AIDS patients often occur opportunistic infections. Opportunistic infections caused by pathogens that can be summarized as viruses, bacteria, fungi and parasites in four categories [1]. Analysis of the U.S. Centers for Disease Control show the 90% of AIDS patients suffered from symptoms of fungal infection. AIDS patients with fungal infection become more and more important and become focus of the study in opportunistic infection in AIDS patients. About 50% of all kinds of opportunistic infections occur in the lung which usually caused by two or more kinds of pathogens. In recent years, the incidence and fatality rate of pulmonary fungal infection were increased obviously.

1. Etiological classification

AIDS patients can occur a variety of fungal infections which usually caused by candida albicans, cryptococcus neoformans, aspergillus, mucor, histoplasma and coccidioides bacteria. The most common

pathogens caused the fungal infection was candida albicans in this study, which was in concordance with others reports [2]. The differences of etiological classification in pulmonary fungal infection were no significant difference between AIDS and non-AIDS patients, which the reason was that fungal infections often occur in patients with immune damage or defects. In AIDS group, CD₄+T cell count and immune function of patients decreased and even missed because of infecting with HIV. In non-AIDS group, immune impairment of patients were mostly due to spectrum antibiotics, corticosteroids, immunosuppressive agents and anti-tumor chemotherapy drugs were used for long-term. Although the pathogenesis of patients were different in two groups, the result was that all of them took the fungal infection because of the immune dysfunction or miss. It should be explained that the *Pneumocystis carinii*, was classified as a parasite class in traditional classification, was confirmed by the later studies that it was also a fungal spore bacteria. *Pneumocystis pneumonia* was often listed for special study because it accounted for 50%-60% lung infection in patients with AIDS.

2. Lesion distribution and imaging characteristics

There was no clear predilection sites of lesions location that two or more lobes in the bilateral lungs mostly were involved in AIDS patients with pulmonary fungal infection. Imaging features of patients were different and mainly included several types in the following: pneumonia type, tumor type, aspergillus ball, pleurisy and miliary type. They were also divided into four types in some reports, such as aspergilloma type, consolidation type, diffuse type and nodular type.

In this study, imaging features of AIDS patients with pulmonary fungal infection mainly showed as the following: ① spot or a large consolidation shadow, which corresponded to the pneumonia-type or consolidation type as said in former, usually can be seen in those patients who infected with candida albicans and aspergillus. Imaging features of this type disease mainly showed small pieces or large flake shadows with poor-defined margin and non-homogeneous density in both sides of the lung, can affected multiple lung segments or lobes. In large areas of consolidation we can saw "air bronchi sign" and cavity shadow in the film. The difference of incidence of widespread large consolidation shadow in the lungs was statistically significant ($\chi^2 = 4.119, P = 0.042$) between AIDS and non-AIDS patients with pulmonary fungal infection. The cause was that CD₄+T cells of AIDS patients were reduced because of infecting with HIV, then led to function of many cells reduced, such as macrophages, cytotoxic T cells, natural killer cells and B lymphocyte, thereby limited the spread of lesions and showed non-typical diffuse large consolidation or spot shadow in the film. On the other hand, AIDS patients with pulmonary fungal infection had a high incidence of tuberculosis which can also showed as diffuse large consolidation shadow. ② nodular shadow, which mainly occurred following pulmonary infection with histoplasmosis, cryptococcal and candida infections, mainly showed different size, single or multiple, most of distribution in lower lung fields and well-defined margin. Lobulation and spur sign can be watched in some cases. Around some nodules known as hemorrhagic nodules, we can saw ground-glass-like shadow as we called "halo wheel sign" which was considered as one of the characteristic signs of pulmonary fungal disease. In high-density central area of nodules was coagulation necrosis and halo wheel sign consisted of the peri-infarction edema and hemorrhage in histology^[3,4]. Multiple nodules were sometimes difficult to identify with lung metastases, all of them showed diffuse distribution of multiple round nodules at this time should be closely combined with the clinical and laboratory tests. Sometimes samples also presented as miliary nodules should be identified with the bloody miliary tuberculosis. ③ ground-glass shadow, the pathological basis was the alveolar interstitial tissue infected by fungi in patients, then caused interstitial pneumonia infiltrated by lymphocytes, plasma cells accompanied with macrophages and eosinophil, showed weak density, poor-defined margin, visible blood vessels within the shadow, scattered or diffuse distribution. Most of patients in this study showed ground-glass-like mainly were those of pneumocystis pneumonia. According to those typical imaging findings of lungs in patients of pneumocystis pneumonia, while accompanied with hypoxemia, can helped us to identify with other fungal infections. ④ mass or cavity shadow, mainly present as single or multiple mass, thin-walled cavity, more common occurred in patients infected by cryptococcus and histoplasma bacteria. Mass mostly showed lobulation, homogeneous density, slightly enhanced and infiltration changes. Cavity, caused by necrosis in the centre of fungal tissue, should identified with the abscess, tuberculosis or cancer cavity^[5]. This finding was most common in pulmonary cryptococcal infection. Five cases of cryptococcal infection in this study presented as isolated or multiple masses or

nodules. ⑤ aspergilloma, which was mostly no enhanced, presented those imaging findings as follow, the thin-walled cavity company with sphere lesions, change with the position movement of patients, "air crescent sign" which was considered as reliable evidence to diagnose the aspergilloma infection can be seen between the sphere lesion and the thin-walled cavity. ⑥ pleural effusion, pneumothorax and mediastinal enlarged lymph nodes. When the lesions occurred in the outer zone of lungs, especially close to the pleura, the patient got the pleural disease easily, such as pleural effusion, pleural thickening and so on. All of patients with pleural disease in this study showed a little pleural effusion and mild pleural thickening, the reason maybe related to not only the pleura of patients less infiltrated but the compositive ratio of cases in this study. It depended on the further study. Mediastinal enlarged lymph nodes of patients in this study mostly companied with pulmonary tuberculosis and showed ring enhancement in enhanced examination. There were two cases in this study of pneumothorax related with the emphysema.

In short, the lesions in most of AIDS patients with pulmonary fungal infection mostly showed diffuse distribution, patching or large consolidation shadow with more extensive region ($P=0.002$). The differences between AIDS with pulmonary fungal infection and non-AIDS pulmonary fungal infection were statistically significant in lesion location and complicated imaging features. The most common fungal infection in AIDS patients was candida albicans, which often companied with other pulmonary diseases such as tuberculosis, pneumocystis pneumonia and other pulmonary bacterial infections. We should take into account the possibility of fungal infections and combine with clinical symptoms and laboratory tests to make the final diagnosis when AIDS patients show non-typical spot or large consolidation shadow or multiple nodules in films.

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Note:

Figure 1. female, 33 years old. *Candida albicans* infection. spot and consolidation shadow in the lower lobes of bilateral lungs.

Figure 2. Female, 46 years old. Cryptococcal infection. mass can be seen in right lower lung, well defined margin.

Figure 3. Male, 26 years old. *Penicillium marneffeii* infection. HRCT film. scattered nodules in the bilateral lungs.

Figure 4. male, 53 years old. aspergillus infection. an cavity and patchy shadow in the left lung within the cavity we can see the "air crescent sign."

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