

Research Article

CT findings and differential diagnosis in adults with invasive pulmonary aspergillosis

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Received 7 December 2017; revised 18 January 2018; accepted 31 January 2018

Available online 7 February 2018

Abstract

Objective: To investigate the CT findings and differential diagnosis in adults with invasive pulmonary aspergillosis among the population group and compare it with other traditional techniques to explore whether it can serve as a better tool.

Methods: Medical records of the patients with invasive pulmonary aspergillosis from January 2006 to January 2016 selected retrospectively in Zhongnan Hospital of Wuhan University, China. All of the data, such as CT scan findings, pathological and sputum cultures from the patients were collected to analyze. Furthermore, the sensitivity and specificity of CT imaging were evaluated in the diagnosis and differentiation of adults with invasive pulmonary aspergillosis.

Results: A series of studies was analysed, and the results suggested that: invasive pulmonary aspergillosis as a series of radiological manifestations different from other types of pulmonary aspergillosis, which may help in its diagnosis and differential diagnosis. CT scans have similar or better value in early detection and differentiation of invasive pulmonary aspergillosis from other types of pulmonary aspergillosis. Three main CT findings were identified: small nodules (<1 cm) 38.7% (12/31), patchy or segmental consolidations 19.4% (6/31), large nodules (masses) 32.3% (10/31), and peribronchial infiltrates, associated or not with a tree in bud 9.7% (3/31). This study found a combination of two or more of these signs as follows: 6 patients presented with small nodules accompanied by reticulation, a tree in bud or peribronchial infiltrates, while two patients showed mainly large pulmonary masses. Crescent sign followed by cavitation was discovered in 9 patients (29.0%). Two patients succumbed to massive pulmonary bleeding caused by invasive pulmonary aspergillosis. Twenty-one patients deceased in this series, 12 of them succumbed to invasive pulmonary aspergillosis, one died from cerebral invasive aspergillosis, while in nine patients the causes of death were not mainly invasive pulmonary aspergillosis only. Manifest pulmonary haemorrhage occurred in 22.6% (7/31) of invasive pulmonary aspergillosis episodes. Further CT analysis of detecting invasive pulmonary aspergillosis obtained a high sensitivity of 90.3%(28/31) and a specificity of 89.5%(17/19).

Conclusions: The present study demonstrates that invasive pulmonary aspergillosis exhibit various features in the CT images, which are different from typical pneumonia and other kinds of lung diseases. These unique characteristics of invasive pulmonary aspergillosis shown in CT scan have comparable specificity and sensitivity to commonly used serum tests for invasive pulmonary aspergillosis. It indicates that CT analysis may help in detecting invasive pulmonary aspergillosis at the early stage, guide clinical intervention and reduce mortality and morbidity resulting from invasive pulmonary aspergillosis.

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Keywords: Invasive pulmonary aspergillosis; *Aspergillus* spp.; Halo sign

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Peer review under responsibility of Beijing You'an Hospital affiliated to Capital Medical University.

1. Introduction

Aspergillosis is a mycotic illness caused by *Aspergillus*, a filamentous fungus. The most common pathogenic species responsible for the lung disease is *Aspergillus fumigatus*. *Aspergillus fumigatus* is a saprophytic and omnipresent airborne fungus, whose natural ecological place is loam. Heat, wetness and biological stuff (carpet, autumn leaves) promote its growth. Human beings continue to inhale a large number of conidia (spores) of this fungus, which are habitually eliminated by mucosal ciliary body clearance and innate immune mechanisms in immunologically active hosts without potential lung disease. The progress of pulmonary aspergillosis requires susceptibility factors such as allergies (asthma), airway disease (bronchiectasis, cystic fibrosis), chronic lung disorders (tuberculosis, sarcoidosis) or immunodeficiency. Modification of mucociliary cells in bronchial dilatation or cystic fibrosis permits the colonisation of the airways by *Aspergillus* fungus. Immunosuppression caused by steroids, transplantation, or aplasia may be responsible for invasive forms depending on the level of immune deficiency. IPA is an aggressive illness caused due to the invasion of the bronchial wall and the accompanying arterioles by the hyphae. IPA occurs mainly in patients with severe immunodeficiency, and the incidence of invasive pulmonary aspergillosis has increased over the past two decades because of widespread use of chemotherapy and immune-suppressive agents. Of all analyses performed between 1980 and 2001, the rate of invasive mycoses increased from 0.4% to 3.1%. IPA increased from 18% to 65% of all mycoses found on analyses over the course of the study [1–3].

Currently, IPA is a common pulmonary complication of severely immunocompromised hosts such as patients with haematologic malignancies, especially acute and chronic myelogenous leukaemia, patients who have undergone haematopoietic stem cell transplantation, patients treated with immunosuppressive agents such as high-dose corticosteroids, as well as patients with AIDS. A major predisposing factor in these patients is severe neutropenia (absolute neutrophil count of <500 cells/L). Other risk factors affecting the course of IPA include host variables (age, underlying disease), immunosuppression associated with acute or chronic graft versus host disease and concomitant viral infection. The primary clinicopathologic manifestations of IPA include acute bronchial pneumonia, vascular invasion aspergillosis, acute bronchial bronchitis and chronic necrotizing aspergillosis. The rare forms of IPA include bronchiolitis, bronchiolitis obliterans and mutual diseases. Although CT findings suggest each type of aspergillosis, a histological examination is needed to differentiate these forms. For IPA patients with poor prognosis, the mortality rate is in between 30% and 85%. Therefore, an early recognition of this disease and differentiation of lung complications caused by other pathogens is mandatory to improve survival. In the case of unknown causes, the establishment of an empirical treatment of antifungal, antibiotic and sometimes additional antiviral therapy should follow. The outcome of IPA has been considered weak in immunocompromised patients,

especially in allogeneic bone marrow recipients. In addition to the risk mentioned above factors for IPA, early CT findings might help in assessing risk and prognosis in patients with IPA [4–7].

HRCT imaging of the “halo sign” along with pulmonary nodule-revealing an early sign of IPA with high sensitivity and specificity. Nevertheless, differential diagnosis of the halo sign is quite intricate, as it may observe as a result of contagion with other microorganisms. Pathologic examination of nodules with the halo sign exposed that the halo around a central fungal lesion paralleled to a nodule encircled by a rim of congealing necrosis due to the vascular annexation that causes thrombotic occlusion and ischaemic necrosis [4,6,8]. Due to the limitations of the radiological findings, a few recent studies have evaluated the role of multidetector computed tomographic accuracy in the early diagnosis of IPA. The purpose of this research study is to demonstrate the risk factors, current diagnosis and management of IPA. This study performed a retrospective study, to examine the CT images of different invasive pulmonary aspergillosis patients, aiming to explore the diagnostic value of CT in IPA at the early stage. The primary aim of this study is to investigate various CT features of IPA in different patients and its underlying cause. And also, comparing the diagnostic value of CT with the gold standard of IPA such as pathological and sputum cultures. Hope that this study may guide practitioners to take appropriate diagnosis for IPA infected hosts at an early stage and follow-up therapy to reduce its morbidity and mortality.

2. Materials and methods

2.1. Study design and population

A retrospective study conducted at Zhongnan Hospital of Wuhan University. Moreover, the selection of patients was made by inclusion and exclusion criteria mentioned below. Ten years data of the patients with pulmonary aspergillosis were collected from 2006 to 2016. At last, a total of 31 patients were included for analysis, from that 19 patients are males and 12 patients are female. Information regarding previous research has derived from a systematic review of the literature related to IPA. Moreover, medical records of the patients with invasive pulmonary aspergillosis were selected retrospectively in the Zhongnan Hospital of Wuhan University, China. All the data, such as CT scan findings, GM detection, cytology and histopathology were collected for analysis. All images were viewed at picture archiving and communication system workstation. Furthermore, evaluate the sensitivity and specificity of CT imaging in the diagnosis and differentiation of adults with IPA. Data tabulation was carried out using Microsoft Excel (Microsoft Corp, 2007). Statistical analysis was conducted using SPSS 20.0 (SPSS, Inc. 1989–1995, Chicago, IL). This study protocol conformed to the ethical guidelines of the 1975 Declaration of Helsinki by the Ethics Committee of Zhongnan Hospital of Wuhan University, and written informed consent was obtained from every study participants.

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