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Review article

Common radiological findings in fungal infections in hematological patients – Review

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ABSTRACT

Introduction: Invasive fungal infections are correlated with an increase in mortality rate among hematological patients. A correct diagnosis based on clinical manifestations may be very time consuming, while a delay in an appropriate treatment can have a negative impact on the further course of the disease.

Aim: The aim of this study is to present the most common radiological findings seen in CT or MRI which may help in making an accurate diagnosis.

Material and methods: A thorough literature search concerning the nature of invasive fungal infections, their clinical manifestations and methods of their radiological imaging were reviewed.

Results: An early diagnosis based on radiological imaging is crucial since radiological modalities are able to reveal lesions that can suggest ongoing fungal processes.

Discussion: There is a relationship between an early diagnosis of fungal lesions in CT imaging (i.e. the halo sign or micro- and macro-nodules) and an increase in the survival rate of hematological patients. Moreover, radiological methods of imaging can determine the degree of severity, especially the invasion of the infection into soft tissues, orbital cavities, brain and vasculature.

Conclusions: Early and systematic radiological assessment of hematological patients with increased risk of fungal infection result in an accurate diagnosis and have a positive impact on the decrease of mortality rate of immunocompromised patients.

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1. Introduction

Fungal infections are significant cause of mortality among immunocompromised patients. They mainly have an opportunistic character, therefore, rarely affect individuals with normal immunological system. The major factor predisposing progression of a fungal infection is a severe and long-lasting neutropenia, caused both by advanced stage of the disease and the treatment itself. Paradoxically, the new methods of treatment such as bone marrow and other organs transplants, application of invasive diagnostic methods and a broad spectrum antibiotic therapy caused an increase in invasive fungal infection incidence. This may be due to prolongation of the immunocompromised patients' life. Although *Candida* and *Aspergillus* remain the most common causes of infection, in recent years the increased frequency of infections caused by other species of fungi were reported, particularly *Mucor* and/or *Fusarium*.¹⁻⁶ The symptoms of fungal infections are not specific and often difficult to distinguish from bacterial ones. Furthermore, an incorrect diagnosis and inappropriate treatment have a negative impact on the further course of the disease which can even lead to a fatal outcome. Radiological modalities are able to reveal lesions that can suggest ongoing fungal process such as: micro- and macro-nodules with the halo sign, reversed halo sign, tree in bud sign, air crescent sign, ground glass opacity, crazy-paving sign, microabscesses, bull's eye sign or black turbinate sign. Therefore, an early diagnosis based on radiological imaging, especially computed tomography (CT) and magnetic resonance imaging (MRI), is crucial.

2. Aim

The aim of this study is to introduce the most common radiological symptoms which may be helpful in an accurate diagnosis.

3. Material and methods

In this study a wide range of medical literature concerning the nature of invasive fungal infections, their clinical manifestations and methods of their radiological imaging were reviewed.

4. Results

An early diagnosis based on radiological imaging is crucial because radiological modalities are able to reveal lesions that can suggest ongoing fungal processes.

5. Discussion

5.1. Halo sign

The best radiological diagnostic method in case of invasive mycosis that is able to suggest infection at the early stage of

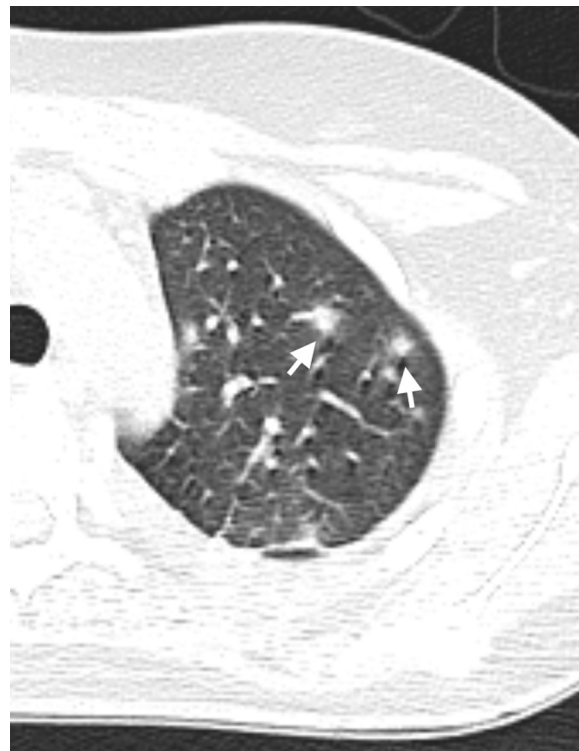


Fig. 1 – Pulmonary fungal infection in 16-year-old female patient with acute lymphoblastic leukemia. Nodules with halo sign visible on chest CT scan (arrows).

the disease is high-resolution CT (HRCT). Micro- and macro-nodules with the halo sign can be the earliest lesions seen in HRCT as far as lungs are concerned (Figs. 1 and 2). The halo sign was initially described by Kuhlman et al. in patients with severe leukemia who suffered from advanced invasive pulmonary aspergillosis (IPA) while its definition was formulated in 1996.⁷ The halo sign denotes a ground glass opacity surrounding the circumference of the nodule or consolidated area.⁸ Histopathologically, it is a focus of pulmonary infarction



Fig. 2 – 28-Year-old hematological female patient with pulmonary fungal infection. Chest CT scan with multiple, confluent nodules with halo sign (arrows).

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