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The Air Crescent Sign[1]

APPEARANCE

Although initially revealed on chest radiographs, the air crescent sign can be visualized both on radiographs and computed tomographic (CT) scans of the chest (Figs 1, 2). It is recognized as a crescent-shaped or circumferential area of radiolucency within a parenchymal consolidation or nodular opacity.

EXPLANATION

The air crescent sign can be visualized in a pulmonary cavitary process, which results in air surrounded by radiopaque material along both its inner and outer margins. Despite being described in a number of entities, the air crescent sign is characteristic of invasive pulmonary aspergillosis when seen in the appropriate clinical setting. In this case, the hyphal form of the fungus invades the pulmonary vasculature resulting in pulmonary hemorrhage, arterial thrombosis, and eventual infarction. Over time, with retraction of the infarcted center and peripheral reabsorption of necrotic tissue by leukocytes, a central area of devitalized tissue is formed. The air crescent sign results when air fills the space between the devitalized tissue and surrounding parenchyma. An opaque rim of hemorrhagic tissue peripheral to the radiolucency makes visualization of the air crescent possible (1–5).

DISCUSSION

Invasive aspergillosis is a potentially lethal opportunistic infection that primarily occurs in immunosuppressed individuals, who include patients with hematologic disorders such as leukemia and lymphoma and those who have undergone bone marrow or other organ transplantation. Specifically, invasive aspergillosis should be suspected in any patient with neutropenia who develops a fever that does not respond to antibiotics. Rarely, infection can develop despite a normal immune system following inhalation of a large inoculum of spores (6,7).

An early diagnosis is essential because a delayed or improperly treated infection has a 65%–90% mortality rate (8). The angioinvasive nature of the infection, with associated pulmonary infarction, results in clinical findings that may mimic thromboembolic disease. A tissue diagnosis may be difficult because sputum cultures are positive in only 10% of patients (9). Alternatively, more invasive diagnostic approaches, including bronchoscopy with transbronchial biopsy, percutaneous needle aspiration biopsy, or open lung biopsy, may be required. However, possible thrombocytopenia or compromised respiratory status may be a relative contraindication to these invasive procedures. For these reasons, imaging findings that suggest the diagnosis of invasive pulmonary aspergillosis are important.

Initially, chest radiographs may be normal, but as an infection progresses, single or multiple ill-defined peripheral opacities develop and can coalesce into larger consolidations. A miliary pattern of disease may also be seen (10). Subsequent development of the air crescent sign in an area of opacity appears approximately 2 weeks following appearance of the initial radiographic abnormality. The air crescent sign is dependent on granulocyte function and, hence, occurs during bone marrow recovery. The frequency with which it occurs is variable, but it may be seen in 50% of patients (3,11).

Patients with neutropenia do not develop cavitary lesions. Visualization of the air crescent sign is an indicator that marks the recovery phase of the infection. Gefter et al (11) reported that 67% of patients with acute leukemia and the air crescent sign had increased survival compared with 8% of those without the sign. Unfortunately, the diagnostic value is somewhat limited because of its late appearance. In reality, recognition of invasive aspergillosis at this stage implies that treatment has been delayed (8). In addition, it was reported (11) that identification of the air crescent sign led to appropriate treatment in around 33% of patients. Invasive aspergillosis had already been diagnosed and treatment initiated prior to its appearance (11).

Index terms:
Aspergillosis, 60.2056
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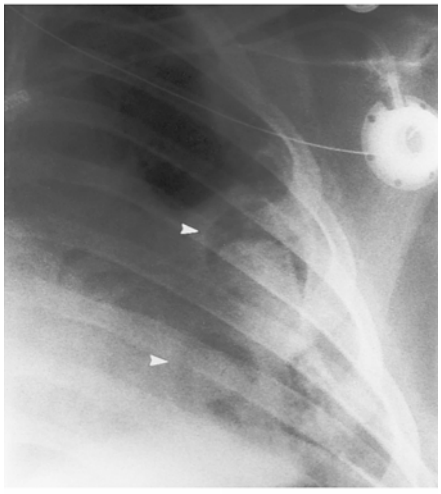
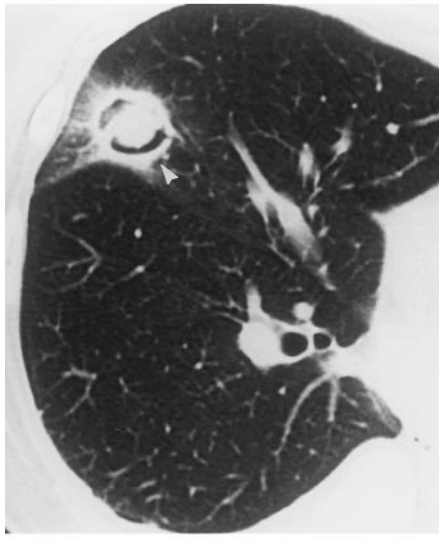
a.



b.

Figure 1. Invasive aspergillosis in a 6-year-old girl with neutropenia and acute lymphocytic leukemia. **(a)** Frontal chest radiograph shows a lingular infiltrate. **(b)** Frontal chest radiograph obtained 1 week later shows interval development of at least two air crescent signs (arrowheads), which coincided with recovery of the patient's white blood cell count.

a.



b.

Figure 2. Invasive aspergillosis in a 58-year-old woman with acute myelocytic leukemia. **(a)** Transverse CT image depicts the CT halo sign, represented by ground-glass attenuation (arrowhead), surrounding the nodular opacity. **(b)** Transverse CT image obtained approximately 4 days later shows the air crescent sign (arrowhead), which marks the recovery phase of infection and which coincided with white blood cell count recovery.

A peripheral linear scar or thin-walled cyst marks the resolution of infection (12).

In the early stages of infection, CT is more sensitive and specific than radiography (13). For example, during the neutropenic period, CT may demonstrate areas of ground-glass attenuation surrounding these nodular opacities (Fig 2). Termed the "CT halo sign," this represents pulmonary hemorrhage, and in the correct clinical setting, it is highly specific for invasive aspergillosis (3,12,13). Recognition of this finding may lead to prompt institution of empiric antifungal therapy.

The pathologic basis for an air crescent sign in invasive aspergillosis may be shared with other angioinvasive fungal infections or bland thromboembolism. A cavitating neoplasm, infections such as tuberculosis, nocardiosis, or a bacterial lung abscess may also give rise to an air crescent sign (1,11). Caution is advised not to mistake the Monad sign of aspergilloma with the air crescent sign of invasive aspergillosis. The former develops in immunologically competent patients with structural lung disease. The radiographic appearance is that of a gravity-dependent mass within a preexisting cavity (7).

In conclusion, the air crescent sign is highly suggestive of invasive pulmonary aspergillosis when seen in the appropriate clinical setting. However, the diagnostic utility of the sign is limited by its relatively late appearance. On the other hand, visualization of the CT halo sign may lead to an early diagnosis of invasive aspergillosis and prompt institution of lifesaving therapy. Subsequent appearance of an air crescent sign on a

chest radiograph or on a CT scan marks the recovery phase of the infection and is associated with a favorable prognosis.

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