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REVIEW

Infectious and Non-Infectious Diseases Causing the Air Crescent Sign: A State-of-the-Art Review

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Abstract Aspergilloma, also known as mycetoma or fungus ball, is characterized by a round or oval mass with soft-tissue attenuation within a preexisting lung cavity. The typical computed tomography (CT) aspect of an aspergilloma is a mass separated from the wall of the cavity by an airspace of variable size and shape, resulting in the air crescent sign, also known as the meniscus sign. This CT feature is non-specific and can be simulated by several other entities that result in intracavitary masses. This review describes the main clinical and imaging aspects of the infectious and non-infectious diseases that may present with fungus-ball appearance, including pulmonary hydatid cyst, Rasmussen aneurysm, pulmonary gangrene, intracavitary clot, textiloma, lung cancer, metastasis, and teratoma, focusing on the differential diagnosis.

Keywords Air crescent sign · Aspergillosis · Fungus ball · Computed tomography · Pulmonary diseases

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Introduction

The term "aspergilloma" is used to describe a nodular lesion that occupies cavitary lesions of the lung. Certain imaging characteristics, such as the air crescent, meniscus, and ball-in-hole signs, have been associated with the presence of a fungus ball, which results in the collection of air in a crescentic shape, separating the wall of a cavity from an inner mass [1–3].

Although *Aspergillus* colonization is the most frequent cause of the air crescent sign, this finding has been reported in association with a variety of other conditions, and the differential diagnosis may be difficult. Additional causes of a pulmonary intracavitary mass surrounded by a crescent of air include other fungi, pulmonary hydatid cyst, Rasmussen aneurysm, pulmonary gangrene, intracavitary clot, textiloma, lung cancer, metastasis, and teratoma [1, 3, 4].

A knowledge of diseases simulating aspergilloma will aid proper diagnosis in the appropriate clinical setting. The differential diagnosis between intracavitary aspergilloma and other conditions is important for the determination of the patient's outcome and for treatment planning. The aim of this review is to describe the main differential diagnosis of the air crescent sign, focusing on computed tomography (CT) and clinical findings.

Aspergilloma

Aspergillosis is a mycotic disease caused by *Aspergillus* species, usually *A. fumigatus*. *A. fumigatus* is one of the most ubiquitous of airborne saprophytic fungi and a medically important fungal opportunist. Its natural ecological niche is the soil, wherein it survives and grows on organic debris, dust, foods, spices, and rotted plants [1, 5, 6].

The spectrum of pulmonary aspergillosis can be divided into five forms: aspergilloma, allergic bronchopulmonary aspergillosis, semi-invasive aspergillosis, airway-invasive aspergillosis (acute tracheobronchitis, bronchiolitis, bronchopneumonia, obstructing bronchopulmonary aspergillosis), and angioinvasive aspergillosis [5, 7, 8]. Saprophytic aspergillosis (aspergilloma), commonly referred to as "fungus ball," is characterized by *Aspergillus* infection without tissue invasion. Aspergilloma occurs within a preexistent pulmonary cavity, usually in an upper lobe, or dilated bronchus and typically results from a conglomeration of fungal hyphae admixed with mucus, inflammatory cells, fibrin, and tissue debris to form a mass. Patients at risk of aspergilloma development have cavitary, bullous, or cystic lung disease, commonly encountered as a result of tuberculosis (TB), sarcoidosis, or emphysema. Other conditions that are occasionally associated with aspergilloma include bronchogenic cyst, pulmonary sequestration, and pneumatoceles secondary to *Pneumocystis jirovecii* pneumonia in patients with acquired immunodeficiency syndrome (AIDS) [5–7, 9].

In general, affected patients are asymptomatic, but they may present with chronic productive cough or hemoptysis due to the disruption of blood vessels in the wall of the cavity occupied by the fungus. Bleeding is most frequently mild, but hemoptysis may be massive and selective bronchial artery embolization or surgical resection may be indicated [5–7].

On CT, thickening of the walls of a preexisting cavity or cyst has been described as an early sign of *Aspergillus* colonization, antedating the detection of the fungus ball [10, 11]. Aspergilloma characteristically appears as a single rounded nodule or mass within a cavity. Typically, the intracavitary lesion is demarcated from the wall of the cavity by air, resulting in the air crescent sign. Changing the position of the patient (between supine and prone) usually demonstrates that the intracavitary lesion is mobile, which is a useful imaging criterion for the differential diagnosis (Fig. 1). Pleural reaction and thickening of the cavity wall may be present. Most affected cavities are in the upper lobes, reflecting associations with TB and sarcoidosis. Aspergillomas are usually single, although some are multiple [1, 5, 6, 12, 13].

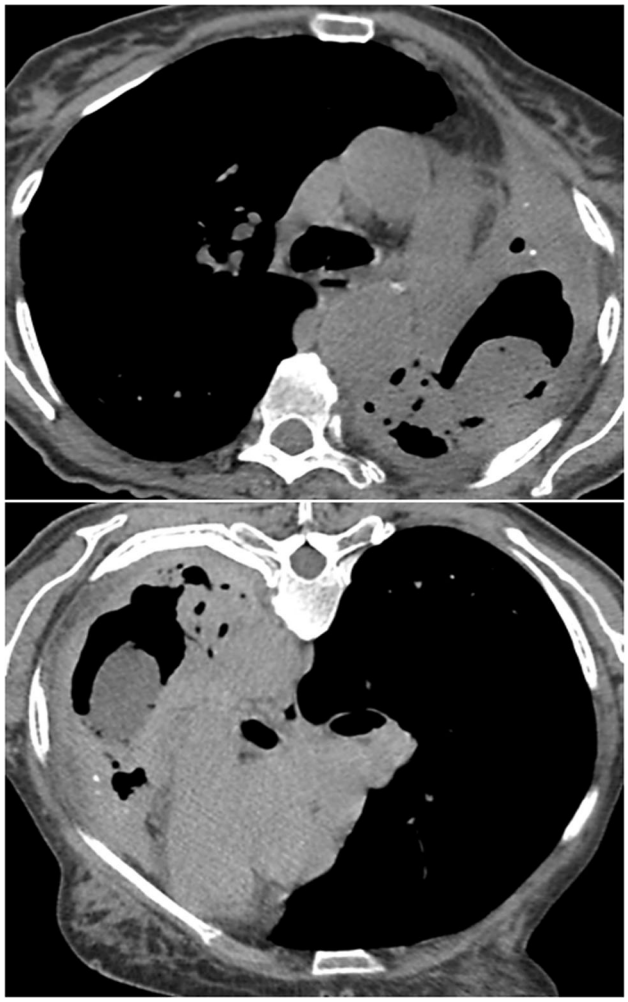

Fig. 1 Aspergilloma. A 62-year-old woman with a previous history of tuberculosis. Axial CT image obtained with mediastinal window settings. **a** Show a thick-walled cavity containing an ovoid mass in the left upper lobe of the lung. **b** An image obtained with the patient in the prone position demonstrates the change in the aspergilloma location

Angioinvasive Aspergillosis

Invasive aspergillosis is the most severe and aggressive form of pulmonary aspergillosis, distinguished by the ability to invade pulmonary arteries, resulting in pulmonary necrosis and hemorrhage. It is a potentially lethal opportunistic infection caused by *Aspergillus* species that occur primarily in immunosuppressed individuals [14].

Angioinvasive aspergillosis has become a leading cause of death, mainly among patients with hematological malignancy. The development of new intensive chemotherapeutic regimens for solid tumors, difficult-to-treat lymphoma, myeloma, and resistant leukemia, as well as an increase in the number of solid organ transplantations and increased use of immunosuppressive regimens for other autoimmune diseases, has increased the number of patients at risk of invasive aspergillosis development [5, 6].

On histological analysis, this form of aspergillosis is characterized by the invasion and occlusion of small to medium pulmonary arteries by the hyphal form of the fungus, resulting in pulmonary hemorrhage, arterial thrombosis, and, eventually, infarction. This process leads to the formation of necrotic hemorrhagic nodules or pleura-based, wedge-shaped hemorrhagic infarcts [5, 14]. In the

early stages of the infection, usually during the neutropenic period, CT may reveal the halo sign, defined by areas of ground-glass attenuation surrounding the nodular opacities, which is highly specific for invasive fungal disease in an adequate clinical context [5, 6, 14].

Subsequent development of the air crescent sign in an area of opacity, due to the separation of necrotic lung fragments from the adjacent parenchyma, is usually seen during convalescence (2–3 weeks after the initiation of treatment and concomitant with the resolution of neutropenia). This process depends on granulocyte function and, hence, occurs during bone marrow recovery; thus, the presence of the air crescent sign marks the recovery phase of the infection. The frequency with which it occurs is variable, but it is seen in about 50% of patients. The presence of a peripheral linear scar or thin-walled cyst marks the resolution of infection [5, 14].

Hydatid Cyst Disease

Hydatid disease is a zoonosis produced by the larval stage of the tapeworm *Echinococcus granulosus*. Most hydatid cysts in humans are hepatic, with the lungs being the second most frequent location in adults and probably the most common site in children. The disease involves the liver in approximately 75% of cases, the lung in 15% of cases, and other anatomic locations in 10% of cases [7, 15, 16].

Clinical symptoms include coughing attacks, hemoptysis, and chest pain. After cyst rupture, the expectoration of cyst fluid and scolices may occur. Rupture into the pleural cavity also may occur [7].

Imaging findings vary according to the growth of the parasite and its relationship to adjacent lung tissue. Hydatid cysts can become very large, due to the compressibility of the lungs. Initially, a cyst may be round or oval, appearing as a well-defined mass with a density ranging from 3 to 18 Hounsfield units. Neither the cyst nor the pericyst enhances on CT as these structures are avascular. Daughter cysts, such as calcifications in the cyst wall or internally, are rarely seen in the lung [7, 15–18].

The crescent sign is produced when an enlarging cyst eventually erodes the bronchioles. With coughing and straining, air may be introduced between the pericyst and the endocyst, producing a radiolucent air shadow in the form of a crescent or meniscus. With continued leakage, the two layers may separate. The cyst then shrinks and ruptures, allowing the passage of air into the endocyst. An air–fluid level in the endocyst with air between the endocyst and pericyst, producing an "onion peel" appearance, constitutes the "combo" sign. An air–fluid level with collapsed floating membranes inside the cyst produces the "water lily" sign. All of the liquid content may be expelled to the bronchial tree, or the remaining solid components may fall to the most dependent part of the cavity [7, 14, 18]. This is a sign of detachment and signifies impending rupture and death of the parasite (Fig. 2). The sign is highly reliable, but not pathognomonic of hydatid cyst [19, 20]. Balikian et al. [20] analyzed 50 cases of hydatid disease of the lungs and noted this sign in 8 (16%) patients.

Rasmussen Aneurysm

TB is caused by *Mycobacterium tuberculosis*, an acid-fast bacillus that is transmitted primarily via the respiratory route. Infection occurs in the lungs, but the organism can seed any organ via hematogenous spread. Up to an estimated one-third of the world's population is infected with *M. tuberculosis*. The infection is clinically latent in the majority of affected individuals, but reactivates and causes active TB in approximately 5–10% of patients [21]. The World Health Organization reports social inequality, population aging, large migration flows, and the advent of AIDS as the main causes of the recent worldwide resurgence of TB [22, 23].

Hemoptysis in TB may be due to bronchiectasis, aspergilloma, TB reactivation, scar carcinoma, chronic bronchitis, broncholithiasis, microbial colonization within a cavity, and vascular complications, such as pseudoaneurysms [24–26]. Pulmonary artery pseudoaneurysms secondary to pulmonary TB comprise a rare complication known as Rasmussen aneurysm [24–27]. Progressive weakening of the arterial wall occurs as granulation tissue replaces the adventitia and media, resulting in thinning of the arterial wall and pseudoaneurysm formation. Usually, the source of bleeding in pulmonary TB is the bronchial arteries. The surrounding chronic lung parenchymal inflammation results in hypervascularity and elevated pressure in the bronchial arteries, unlike Rasmussen aneurysm, which usually occurs in a peripheral pulmonary artery. Massive hemoptysis due to the rupture of a Rasmussen aneurysm through the cavity wall is potentially fatal, with mortality rate of $> 50\%$ [24, 27, 28].

Most intracavitary nodules associated with TB correspond to aspergillomas, but the diagnosis of Rasmussen aneurysm can be suspected on the basis of characteristic imaging findings, which include intracavitary protrusion, replacement of a cavity by a nodule, and presence of a rapidly growing mass. Rasmussen aneurysm can also be identified on pre- and post-contrast-enhanced CT images as markedly enhancing nodules located within the walls of tuberculous cavities (Fig. 3). Although Rasmussen aneurysm frequently presents as nodular lesions within or

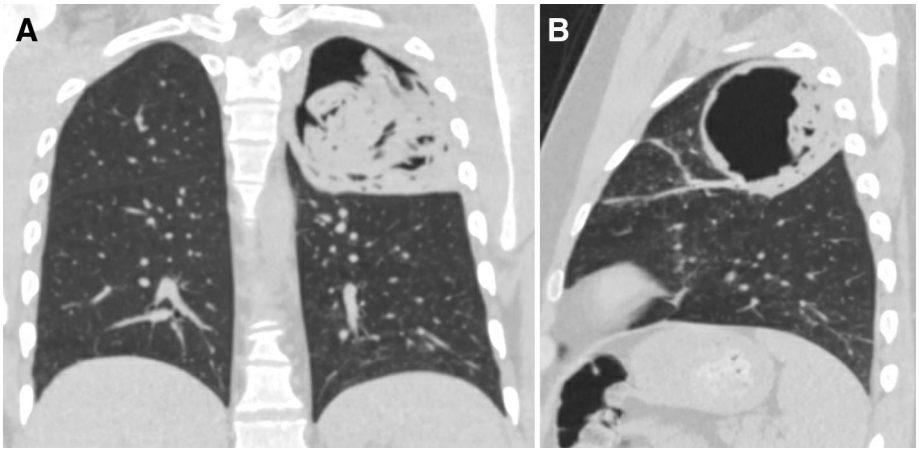

Fig. 2 Ruptured hydatid cyst. A 30-year-old man with cough and dyspnea. Coronal (**a**) and sagittal (**b**) CT images obtained with pulmonary window settings show a large cavitated lesion in the left upper lobe containing multiple curvilinear hyperattenuating membranes in the dependent part, representing the detached, crumpled endocyst

adjacent to a chronic TB cavity, it may also occur inside a consolidation, making its identification more difficult [24, 26, 28].

Pulmonary Gangrene

Pulmonary gangrene is a rare complication of severe pulmonary infection in which a pulmonary segment or lobe is sloughed. It is part of a spectrum that includes necrotizing pneumonia and pulmonary abscess, associated with devitalized lung tissue. The majority of cases occur secondary to *Klebsiella pneumoniae*; other causative organisms include *Streptococcus pneumoniae, Haemophilus influenzae, Staphylococcus aureus*, and anaerobic bacteria. It has also been described in cases of mucormycosis and TB, secondary to radiation [29], and associated with septic embolism [30, 31].

The common pathological feature in most cases is vascular thromboses, with the loss or reduction of blood supply. Lung necrosis subsequently occurs, followed by the formation of a cavity and sloughing of devitalized lung tissue, which creates an intracavitary mass [29, 32].

The tomographic features are quite characteristic, with an initial homogeneous infiltrate in one or more lobes, which progresses to dense consolidation with bulging of adjacent fissures. Hypodense areas then appear and coalesce. The development of lung gangrene can be recognized with the appearance of an air crescent within the consolidation that evolves to a cavity with an intracavitary mass corresponding to the necrotic lung, which is free and mobile. The severity of the clinical picture and rapid radiological evolution can help differentiate pulmonary gangrene from other causes of intracavitary masses [33, 34].

Intracavitary Clot

Bleeding can occur in a preexisting cyst, bullous emphysema, bronchiectasis, or cavity [35]. Bleeding can also occur within a cavity due to active TB or secondary to infection with *Aspergillus* [1, 7]. Fresh bleeding into a cavity may result in the formation of a clot, which may be indistinguishable from mycetoma when it is outlined by a crescent of air. Typically, the clot is mobile on prone and supine CT images, as is mycetoma [1, 7].

Traumatic pneumatoceles with air fluid levels may also evolve to the true air crescent sign due to a disparity in the contraction rates of the fibrin ball of the hematoma and its surrounding capsule [35–37], simulating a fungus ball. The presence of an air meniscus should alert the clinician to a history of trauma, and other radiological signs of injury, such as pneumothorax and hemothorax, pneumomediastinum, tracheobronchial injury, cardiac contusion or laceration, and/or bone fracture, should be sought [35–37].

Imaging follow-up may suggest the final diagnosis. An air fluid level that subsequently evolves to an intracavitary mass and resolves within a short period of time suggests that the abnormality is the result of hemorrhage into a preexisting cavity. The fluid and the mass can present increased density, suggesting a clot [1, 7].

Textiloma

"Textiloma" and "gossypiboma" are terms used to describe a mass of cotton or woven material that is left behind in a body cavity during surgery. Because of legal and ethical concerns, few publications have addressed this topic [23, 38]. Retained sponges are most frequently observed in patients with obesity and after emergency operations and laparoscopic interventions. Textilomas may present at any time, from immediately postoperatively to several decades after initial surgery [23].

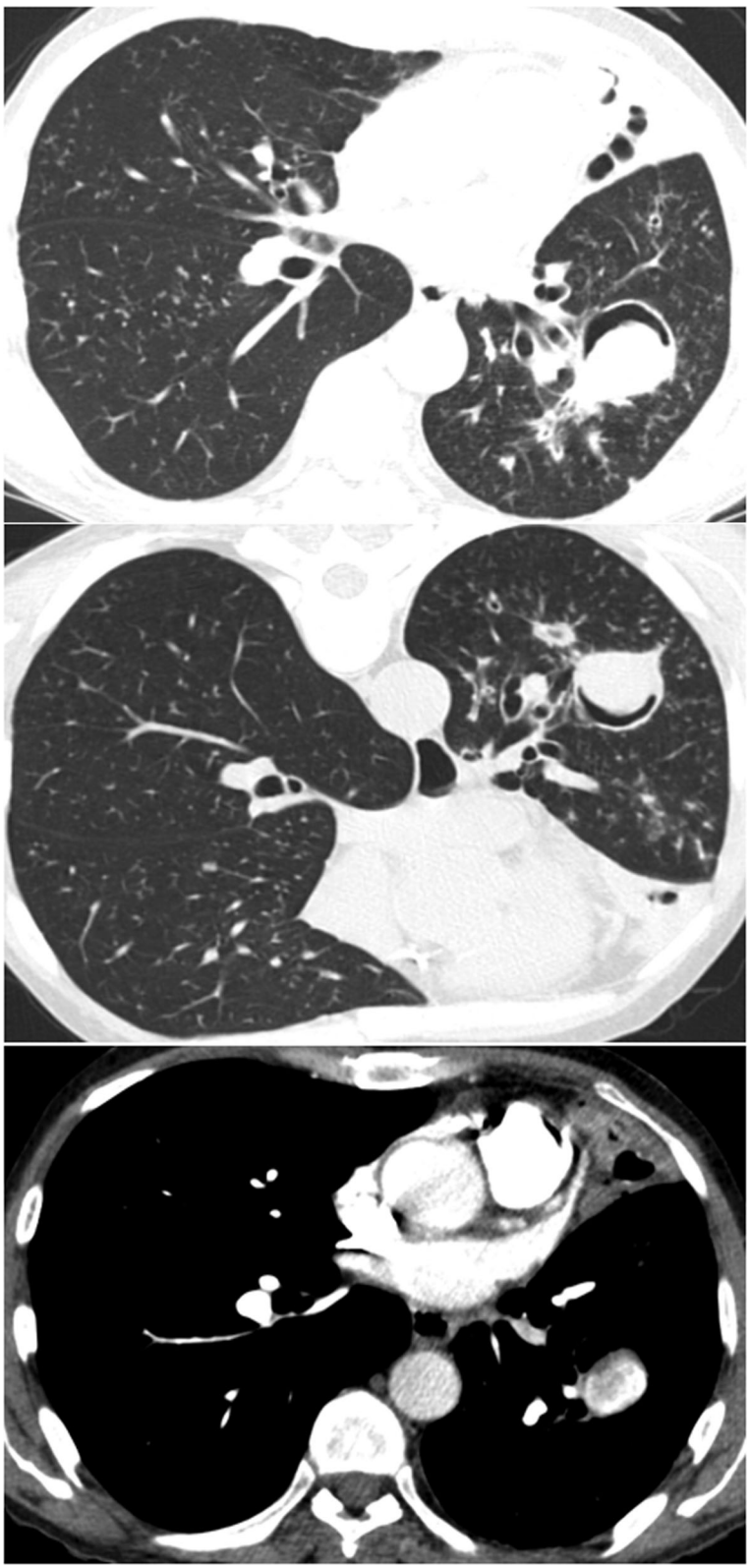

Fig. 3 Rasmussen aneurysm. A 40-year-old man presented with a 3-month history of cough, fever, and weight loss. He also presented sudden hemoptysis. Axial CT images obtained with lung window settings in the supine (**a**) and prone (**b**) positions show a nodule with no mobility inside a cavity, and air interposed between the nodule and the cavity wall (the air crescent sign), located in the left lower lobe. An axial contrast-enhanced CT image (**c**) shows intense enhancement of the intracavitary nodule. Note also small nodules in both lungs, and a lingular cavitated consolidation

Symptoms of textiloma are usually non-specific and may appear years after surgery. A broad spectrum of clinical symptoms may occur, ranging from none (incidental finding on a postoperative radiograph) to fatal, depending on the site and type of complication resulting from the retained foreign body. Some textilomas cause

infection or abscess formation in the early stage, whereas others remain clinically silent for many years and may cause an asymptomatic condition for a long time. Two common sites of intrathoracic textiloma are the pleural and pericardial cavities [23, 39].

When these materials are mistakenly left behind during surgery and cause foreign body reactions, two types of response are found: exudative and aseptic fibrous. The latter can involve adhesion, encapsulation, and, eventually, granuloma formation. The former usually occurs early in the postoperative period and may involve secondary bacterial contamination, with infection or abscess formation, which can result in the formation of various fistulas, including bronchial fistula with drainage of exudative effusion. The risk of fistulization increases with the retention time [23, 39].

Many characteristic radiological findings are used to diagnose textiloma. Radiographs are the most commonly used method for the detection of retained sponges. When the sponge contains a radiopaque marker, the diagnosis can be made easily by conventional radiography; radiographs can also suggest the diagnosis when a characteristic whorl-like pattern is present. Intrathoracic textilomas may also produce chest masses that radiologically resemble intrapulmonary abscesses, aspergillomas, echinococcal cyst disease, or malignant tumors [23, 38]. CT is the technique of choice for the detection of textilomas and possible complications. Textiloma can be specifically indicated by the CT finding of a low-density heterogeneous mass with an external high-density wall that is further highlighted on contrast-enhanced imaging and has a spongiform pattern containing air bubbles. The radiopaque marker strip is seen as a thin metallic density in the mass, and calcification of the mass wall may be observed on CT. The spongiform pattern with gas bubbles is the most characteristic CT sign of textiloma [23, 39–41]. However, this aspect needs to be differentiated from hydatid cysts. Both conditions can present as encapsulated cysts containing a high-density undulated structure that corresponds to the sponge of a textiloma or to the detached inner membrane of a hydatid cyst [42].

Textilomas showing the aspect of the air crescent sign mimicking a fungus ball are, in most cases, associated with bronchial fistula. The probable mechanisms are (1) an aseptic response to the retained surgical sponge that created encapsulation, resulting in a foreign body granuloma, (2) inflammation due to compression of the lung by the granuloma, and (3) creation of a bronchial fistula that drained the exudative effusion, due to inflammation, resulting in a volumetric reduction of the lesion and appearance of the air crescent sign [39]. The ball that corresponds to the textiloma can be mobile inside the cavity [38].

Lung Cancer

At the end of the 20th century, lung cancer had become one of the world's leading causes of preventable death. Because of the high case-fatality rate of lung cancer, the incidence and mortality rates are nearly equivalent, and, consequently, routinely collected vital statistics provide a long record of the disease's occurrence [43].

Four cell types account for more than 95% of all primary lung neoplasms: adenocarcinoma, squamous cell carcinoma, large cell carcinoma, and small cell carcinoma. Mixtures of these cell types may occur within the same primary neoplasm, and some tumors are too poorly differentiated to be further classified. Rapid growth, early metastatic spread, and responsiveness to chemotherapy and radiation therapy distinguish small cell carcinoma from the other types, which has led to the dichotomous classification of small cell and non-small cell carcinomas. Adenocarcinoma is the most common cell type seen in women and non-smokers [7].

The typical imaging manifestation of lung cancer is a solitary pulmonary nodule or mass with well-marginated, lobulated, irregular, or spiculated margins. Peripheral adenocarcinoma is the most common pathological type of lung cancer and is detected with increasing frequency; it may grow circumferentially around the lung and invade the pleura. Air bronchograms are common. Adenocarcinoma can have a lepidic pattern of growth, with cuboidal or columnar cells lining the walls of distal airspaces. A well-circumscribed peripheral solitary nodule or mass, frequently with a halo of ground-glass opacity, is the most common radiological finding in adenocarcinomas [7]. Another common pattern is cavitation. The vascular supply of lung cancer is richest at the margins. A growing bulky tumor outstrips its blood supply and central ischemia leads to necrosis. When communication with an adjacent bronchus permits expectoration of the material, a cavity results [7, 44–46].

CT features suggestive of cavitating lung cancer include wall thickness > 4 mm, spiculated or irregular inner and outer margins, enlarged lymph nodes, and a soft-tissue mass associated with infiltration of the adjacent thoracic wall. Part of the wall may project into the cavity, forming a so-called mural nodule, which has the tendency to increase in size. As a part of a tumor lump, a nodule can occur anywhere within a cavitary lesion, and should not be mobile with a change in the patient's position (Fig. 4). Although it is very rare, the development of a fungus ball in cavitary pulmonary carcinoma has been reported [44, 45, 47–49].

A growing malignant nodule requires its own blood supply from adjacent tissue. This process may be

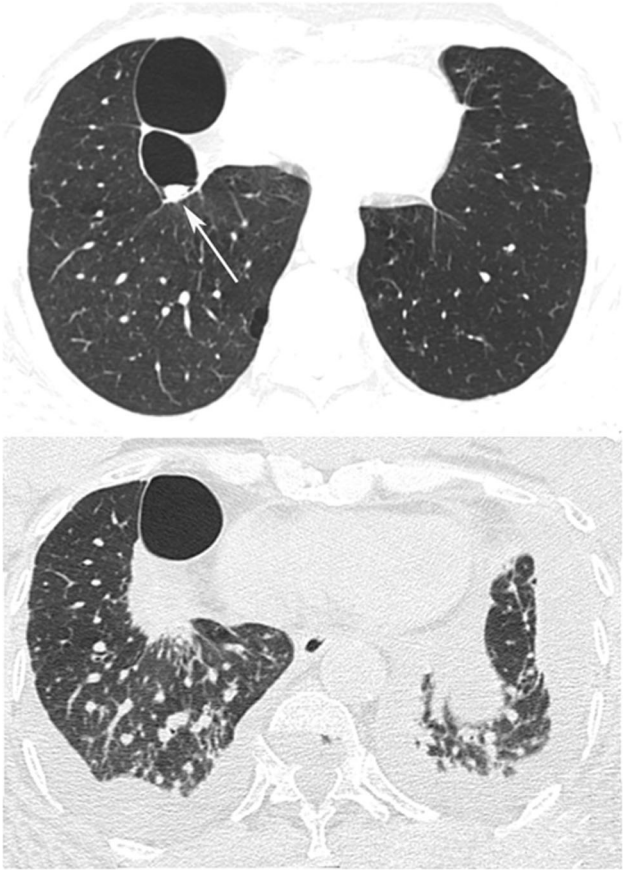

Fig. 4 Lung cancer. A 74-year-old man with a history of pulmonary TB 50 years previously. An axial CT image (**a**) shows two bullae in the right lower lobe, with a small nodule inside the smaller bulla (arrow). A follow-up image obtained 2 years later (**b**) demonstrates a mass with spiculated borders in the posterior aspect of the largest bulla, corresponding to the growth of the small nodule seen previously inside the smaller bulla. Also note the parenchymal interstitial thickening, suggestive of carcinomatous lymphangitis, and bilateral pleural effusion

associated with strong enhancement of a malignant nodule on CT. It is one of the most important features that should be assessed when making the differential diagnosis. Nevertheless, in the case of complete necrosis of the lesion, the cancer will not show significant contrast enhancement [2, 44].

Metastases

Typical radiological findings of pulmonary metastasis include multiple, peripherally located, round, variably sized nodules (hematogenous metastasis) and diffuse thickening of the interstitium (lymphangitic carcinomatosis). A majority (73%) of cases of multiple nodules detected with CT have been reported to be pulmonary metastases. In daily practice, however, unusual radiological features of metastases are frequently encountered and make distinction from other non-malignant pulmonary diseases difficult. These features are cavitation, calcification, hemorrhage around the metastatic nodules, pneumothorax, the air-space pattern, tumor embolism, endobronchial or endovascular metastasis, a solitary mass, and sterilized metastasis [50–52].

The frequency of pulmonary cavitation in metastatic lung cancer is approximately 4%, in contrast to the 9% frequency of cavitation in primary bronchogenic carcinoma [50, 51]. The frequency of cavitation does not differ significantly between squamous cell carcinoma and adenocarcinoma types [50, 51]. The exact mechanism of cavitation is usually difficult to determine, but the cause is presumed to be tumor necrosis, air trapping by a check-valve mechanism that develops by means of tumor infiltration into the bronchial structure, or local extension by the elastic traction and bullae [50, 51]. Chemotherapy is also known to induce cavitation [52].

Metastatic lung cancer that creates an aspergilloma-like structure inside a cavity is quite rare (Fig. 5). As aspergilloma in an immunocompetent patient is not associated with clinical symptoms and signs, the differential diagnosis of cancer and a surgical approach are always crucial [51]. Watanebe et al. [51] described a patient with lung metastasis of transitional cell cancer of the urothelium involving aspergilloma-like structures in an isolated cavity with an air crescent sign. Histopathological analysis confirmed that the tissue extended to the internal cavity wall and the inner cavity. The central part of the aspergilloma-like structure was stromal tumor tissue, and the surrounding tissue was a transitional cell carcinoma. The metastasized cell cancer may have grown along the internal cavity wall, covered the later-growing stromal tumor tissue, and formed the fungus ball-like structures in the cavity.

Teratoma

Teratomas are encapsulated germ cell tumors that contain tissue from one or more of the three germinal layers: the endoderm, mesoderm, and ectoderm. They occur most commonly in the gonads, but around 3% are known to be extragonadal, primarily intrathoracic. Teratoma is a common tumor of the mediastinum; primary malignant teratoma of the lung is exceptionally rare. To substantiate the diagnosis, one must exclude the most likely alternative of lung metastasis or direct extension from a teratoma arisen in mediastinum [53–55].

Intrathoracic teratomas typically present between the first and second decades of life, and unlike malignant mediastinal germ cell tumors, which have male predominance, pulmonary teratomas are distributed equally among

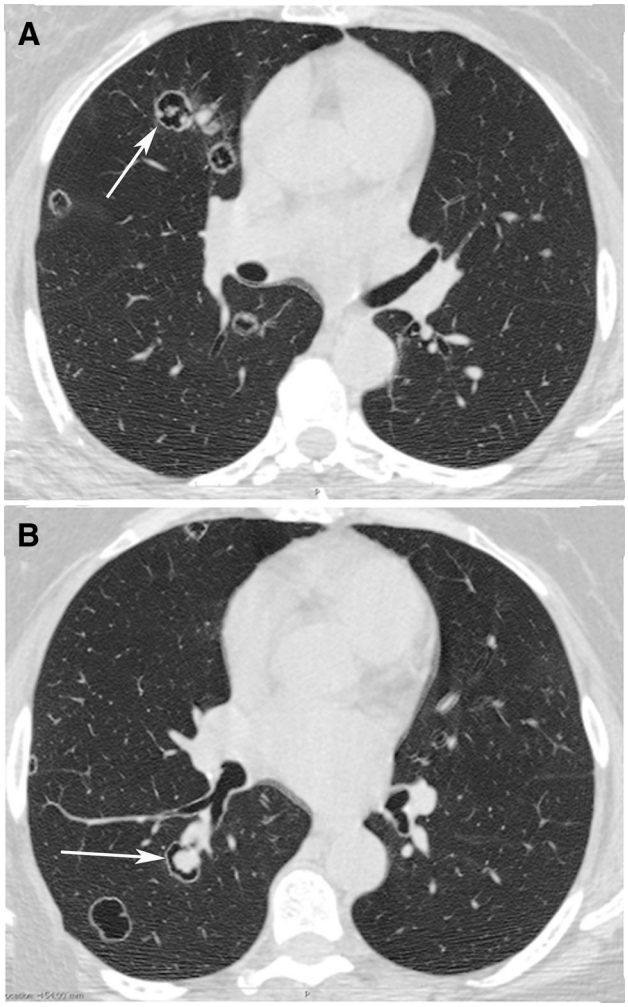

Fig. 5 Metastases. A 37-year-old woman with uterine metastases. Axial CT images obtained with lung window settings (**a**, **b**) show several cavitated nodules, some with intracavitary nodules (arrows), in both lungs

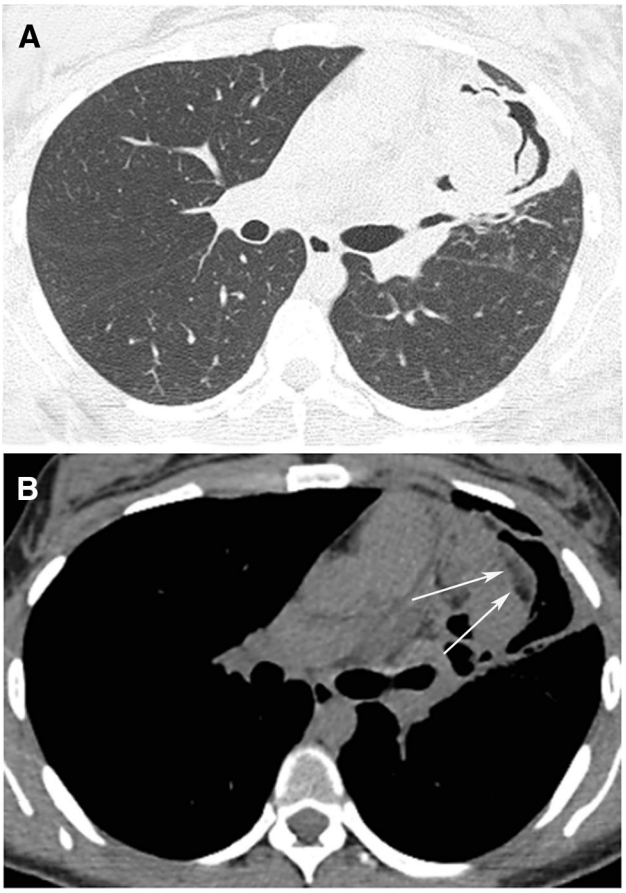

Fig. 6 Teratoma. A 22-year-old woman presented with a history of cough and hemoptysis. Axial chest CT images obtained with the lung (**a**) and mediastinal (**b**) window settings reveal a thick-walled cavity in the left upper lobe, adjacent to the mediastinum, with an intracavitary mass (asterisk) and the air crescent sign. Note that the solid content presents focal areas of fat density (arrows in **b**)

males and females [55]. The presenting symptoms are variable and usually not specific. A highly suggestive symptom of an intrapulmonary teratoma is the expectoration of hair (trichoptysis), which occurs in 13% of cases and signifies direct communication between the teratoma and the tracheobronchial tree [53, 55, 56]. Although the typical CT aspect of a teratoma is a heterogeneous, lobulated mass containing soft tissue, fat, fluid, and/or calcium, this entity may appear as a cavitary lesion or consolidation. Air within a cavity is also a feature distinguishing intrapulmonary from mediastinal teratomas (Fig. 6). In teratomas presenting with cavitated lesions, the aspect may simulate an aspergilloma. Barreto et al. [53] reported the case of a 22-year-old woman who presented with cough and hemoptysis. CT revealed a heterogeneous thick-walled cavitated mass in the left upper lobe, with an air crescent sign and intracavitary content, mimicking a fungus ball.

Criteria for Differential Diagnosis

Some CT characteristics may be very useful in the differential diagnosis of lesions presenting with the air crescent sign. Aspergillus colonization of preexisting cavities is the most frequent cause of the air crescent sign, but it is not specific. To confirm this diagnosis, the most valuable radiologic sign is to demonstrate that the mass moves when the patient changes position. When the cavity is large enough and the nodule is attached to the wall, aspergillus colonization is less probable, and other conditions, particularly neoplastic lesions (lung cancer and metastases) and Rasmussen aneurysm, should be considered in the differential diagnosis. Clots are also mobile within the cavity.

CT contrast enhancement of the intracavitary mass is another criterion for diagnosis: aspergillomas do not enhance, whereas Rasmussen aneurysm presents as a highly enhancing nodule. Lung cancer and metastasis may also show contrast enhancement, but this enhancement is

not as marked as in Rasmussen aneurysm. The Rasmussen aneurysm is frequently associated with findings of pulmonary tuberculosis, hydatid cysts may present with typical serpiginous membranes twisted inside the cavity, and metastatic nodules are frequently multiple. Patients' clinical histories, such as previous surgery in cases of textiloma, immunosuppression in cases of invasive aspergillosis, and previous neoplasm in cases of pulmonary metastasis, may also offer important diagnostic clues.

Conclusion

The most common cause of the CT finding of intracavitary nodules and the air crescent sign is a fungus ball or aspergilloma, usually due to fungal colonization of preexisting lung cavities. Although fungus balls develop most commonly in TB cavities, they also occur in cysts, bullae, and bronchiectasis. However, this CT aspect has been reported in association with a variety of pulmonary conditions, including infectious and non-infectious diseases. Radiologists and physicians should be aware of this commonality, and a detailed clinical history including immunosuppression, previous diseases, and residence in endemic areas is essential for the diagnosis. The differential diagnosis should also be based on characteristic imaging (especially CT) findings, such as cavity thickness, contrast enhancement, nodule mobility, and intracavitary content density. Precise diagnosis is crucial and may have implications for disease management and prognosis.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval This article does not contain any studies with human participants or animals performed by any of the authors.

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