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Imaging of Pulmonary Embolus: Thrombotic, Nonthrombotic, and Mimickers

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Abstract

Pulmonary embolism is a common and potentially fatal pathological condition. Imaging plays a crucial role in the diagnosis and differentiation of the causes of pulmonary embolus. Here we present typical imaging findings associated with both thrombotic and nonthrombotic pulmonary emboli, as well as their potential mimickers.

Résumé

L'embolie pulmonaire est une pathologie courante et potentiellement mortelle. L'imagerie joue un rôle crucial dans le diagnostic et la différenciation des causes de l'embolie pulmonaire. Ici, nous présentons des manifestations typique d'imagerie associés à l'embolie pulmonaire thrombotique et non thrombotique, ainsi que des artefacts d'imagerie pouvant entraîner un diagnostic erroné d'embolie.

Key Words: Pulmonary embolus; Thrombotic pulmonary embolus; Nonthrombotic pulmonary embolus; Pulmonary embolus mimickers

Pulmonary embolism (PE) is an important cause of potentially fatal lung disease. Clinical pretest probability of PE can be assessed by the Modified Wells Scoring System [1], the Revised Geneva Scoring System [2], and the Pulmonary Embolism Rule-Out Criteria [3]. Its pathogenesis, clinical presentation, clinical course, and treatment options are dependent on the nature of the embolic material. Thus, differentiation of thrombotic and nonthrombotic PE is of critical importance. Although the nonthrombotic PEs are relatively uncommon, certain imaging and clinical features may help in their correct diagnosis.

Acute Pulmonary Thromboembolism

Pulmonary thromboembolism (PTE) is a common clinical entity that requires prompt and accurate diagnosis given its significant morbidity and mortality when untreated. Estimates for the prognosis of PE are variable; however, if left untreated, PE has been reported to have as high as 30% overall mortality [4], compared with 2%−11% if treated with anticoagulation [5]. The diagnosis of acute PTE has an important clinical component, which establishes the pre-imaging probability of PE based on specific signs and symptoms, and biomarkers, such as the D-dimer. However, confirmatory imaging is required for the definite diagnosis of PTE. Computed tomography pulmonary angiography (CTPA) is considered the modern gold standard imaging modality for the diagnosis of acute PTE. Classical imaging findings include a complete filling defect with obstruction of an entire vessel section or partial filling defect that is surrounded by a rim of contrast material (Figure 1) [6,7].

Chronic PTE

The imaging features of chronic PTE are similar to those of its acute form. Its classical imaging features include a complete or partial occlusion of the pulmonary arteries, with a notable persistent decrease in vessel diameter in comparison to its adjacent bronchi. This decrease in diameter is thought to be due to thrombus retraction [8]. When the lumen of the involved

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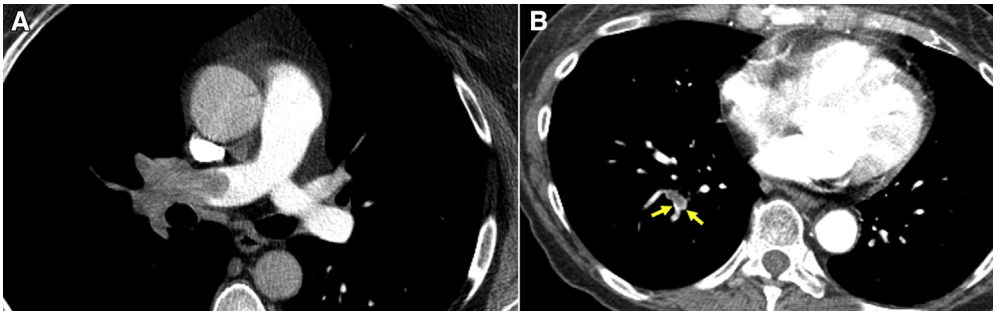

Figure 1. Axial computed tomography pulmonary angiography demonstrating classical pulmonary thromboembolism. (A) Massive central pulmonary embolism with complete filling defect and obstruction of the main right and lobar pulmonary arteries. (B) Segmental pulmonary embolism with partial central filling defect surrounded by a rim of contrast material (arrows) in the right lower lobe.

pulmonary artery is only partially occluded, the thrombus can be eccentrically located and be associated with irregular contours of the intimal surface and obtuse angles with the vascular wall. Poststenotic dilation of the involved vessels can often be seen distally. Intraluminal pulmonary artery bands can also occur, defined as linear structures anchored at both ends to the vessel wall with an unattached midportion. Bands generally range from 0.3–2 cm with a width from 0.1–0.3 cm, and are usually oriented in the same direction as blood flow in the long axis of the vessel [9]. Additionally, classical signs of pulmonary arterial hypertension may also be present, such as increased tortuosity and diameter of the pulmonary arteries. Occasionally chronic pulmonary thrombi can calcify, which may be difficult to appreciate on contrast-enhanced CTA in mediastinal windows setting. Maximal intensity projections may assist in the identification of these calcifications, which are typically located at the site of arterial branching and are tubular in shape (Figure 2). However, they may still be difficult to differentiate from calcified pulmonary nodules. Pulmonary parenchymal findings of chronic PTE include signs of pulmonary infarction appearing as multiple peripheral linear opacities and subpleural wedge-shaped areas of consolidation, which do not show contrast enhancement. A mosaic parenchymal attenuation pattern can also be seen due to irregular perfusion-hypoperfused areas having decreased attenuation distal to occluded vessels, and regions of increased attenuation thought to be due to redistribution of blood flow to the patent vascular bed [8].

Pulmonary Artery Angiosarcoma

Pulmonary arterial angiosarcomas (PAAs) are rare, representing only about 3.6% of pulmonary sarcomas [10]. However, they can be occasionally misdiagnosed as PEs. They have an insidious onset and usually have a long asymptomatic course. On CTA, PAAs usually appear as a filling defect occupying the entire lumen with extraluminal extension [11]. Imaging findings that aid in differentiating the PAA from thrombotic PE include a low-attenuation filling defect occupying the entire lumen of the main pulmonary artery, heterogeneous enhancement of mass occupying the entire luminal diameter of the main or proximal pulmonary artery, and extravascular spread of the lesion (Figure 3).

Thrombosis of the Pulmonary Artery Stump Postlobectomy

Postlobectomy in situ pulmonary artery stump thrombosis is a rare entity that can occur as a complication of pulmonary resection (Figure 4) [12]. Unlike a pulmonary embolus, in situ vascular stump thrombosis is considered benign, but its clinical significance remains unclear. In theory, proximal thrombus extension can occur, however, the role of anticoagulation therapy remains uncertain.

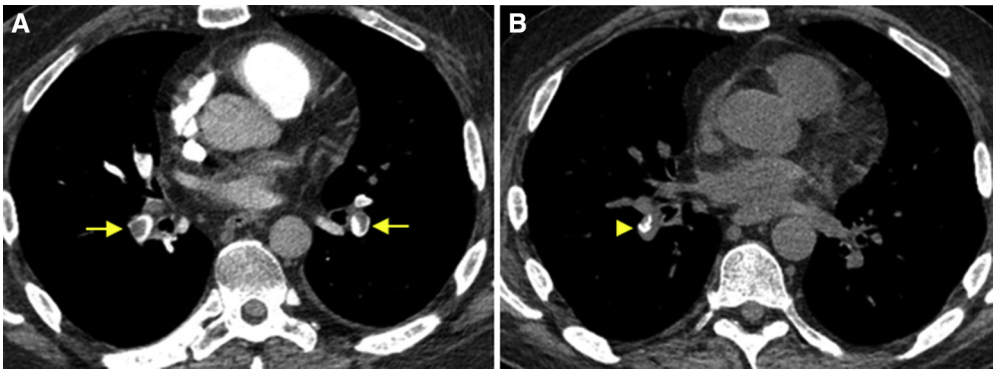

Figure 2. A 47-year-old man with recent diagnosis of acute lymphocytic leukaemia. (A) Initial computed tomography pulmonary angiography demonstrates acute pulmonary emboli (arrows). (B) Follow-up nonenhanced chest computed tomography performed 9 months later demonstrates eccentric intraluminal calcification in the right interlobar pulmonary artery (arrowhead), consistent with chronic pulmonary embolus.