Intraluminal Arterial Filling Defects Misdiagnosed as Pulmonary Emboli: What Else Could They Be?

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KEYWORDS

• Nonthrombotic pulmonary embolism • Amniotic fluid embolism • Tumor embolism
• Pulmonary artery sarcoma • Computed tomography angiography • Stenosis or obstruction
• Cement embolism • Pulmonary hypertension

KEY POINTS

- Pulmonary artery filling defects can be observed in pathologic conditions other than pulmonary embolism.
- Nonthrombotic pulmonary embolism with biological and nonbiological materials and intrinsic pulmonary artery lesions have been described among these conditions.
- Fibrosing mediastinitis and congenital absence or stenosis of pulmonary artery, pulmonary parenchymal and airway malignancies are some other rare causes of misdiagnosis.
- Correct diagnosis is based on the appropriate clinical suspicion with full scope of clinical, laboratory and radiologic data.

INTRODUCTION

The incidence of pulmonary embolism (PE) is estimated to be 112 cases per 100,000 US population. Since 1998, the incidence of PE has nearly doubled, but mortality from PE has significantly decreased in the same period.[1,2] This trend is attributed to early diagnosis and intervention. Computed tomography pulmonary angiography (CTPA) has become the investigation of choice for the imaging of pulmonary arteries in patients with suspected PE and has largely replaced the gold standard pulmonary angiography.[3] The PIOPED II trial reported a sensitivity of 83% and specificity of 96% for CTPA to detect PE.[4]

CTPA has a high diagnostic accuracy, demonstrating partial or complete intraluminal filling defects in pulmonary arteries. The filling defects characteristically show signs, such as the doughnut sign, railroad sign, or abrupt cutoff of the vessels. However, the positive predictive value of a positive CTPA is much lower (58%) in patients with a low probability of PE.[5] Therefore, caution must be used before diagnosing all filling defects as pulmonary thromboembolic disease, particularly with atypical presenting symptoms. In clinical practice, PE is more common; however, other causes of filling defects, although rare, can lead to inappropriate diagnosis and a delayed intervention. Certain filling defect patterns, such as the involvement of entire main pulmonary arteries

Disclosure Statement: No disclosures.
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Clin Chest Med 39 (2018) 505–513
https://doi.org/10.1016/j.ccm.2018.04.004

and one of its branches, delayed and heterogenous contrast enhancement of the lesion, and globular filling defects, are more suggestive of an etiology other than PE. Hence, an accurate timely diagnosis is often challenging.[6]

The primary purpose of this article is to describe other etiopathologic processes causing intraluminal filling defects of the pulmonary arteries, which radiographically mimic PE and often misdiagnosed as PE. The filling defect can arise from embolization into the pulmonary vasculature, referred to as nonthrombotic PE (NTPE), or de novo pulmonary vascular lesions.

NONTHROMBOTIC PULMONARY EMBOLISM

NTPE refers to the obstruction of pulmonary circulation by embolization of different biologic and nonbiologic materials. NTPE is less common than thrombotic PE, which explains the low clinical suspicion and frequent misdiagnosis.[7–9]

The mechanism of NTPE is multifactorial. It involves both mechanical obstruction of the pulmonary vasculature and activation of the inflammatory and coagulation cascades as in the pulmonary tumor thrombotic microangiopathy. These events lead to stenosis or occlusion of the vessel, with development of pulmonary hypertension (PH), right heart failure, and sudden death.[8]

NTPE frequently presents with atypical signs and symptoms, making clinical diagnosis an arduous task. Symptomatology of NTPE is largely similar to thrombotic PE, for example, dyspnea, pleuritic chest pain, cough, hemoptysis, and syncope. The clinical appearance may range from being asymptomatic to sudden death. Patients may present with hemodynamic instability and acute respiratory distress syndrome (ARDS). Embolism owing to fat, amniotic fluid, and septic embolism usually have a more dramatic presentation. Patients can present with subacute to chronic dyspnea owing to development of chronic thromboembolic PH and congestive heart failure. This finding is more common with talc, cement, and tumor embolism.[10] The clinical signs are variable, and include tachycardia, tachypnea, cyanosis, low oxygen saturation, and hypotension.

A laboratory diagnosis of NTPE is nonspecific. The D-dimer test does not have diagnostic value in NTPE, unlike in PE.[11] Many patients show elevated troponin as an expression of right ventricular strain.[12] The diagnosis of NTPE is largely based on radiologic imaging. The CTPA in NTPE can follow 2 distinct patterns, macroembolic and microembolic, all based on the nature and location of the emboli. The macroembolism usually presents with visible pulmonary artery obstruction (**Table 1**). Owing to the hyperdense nature of some of the nonbiological materials, they can be obscured by the bright contrast material, and thus remain undetected.[13] The imaging characteristics secondary to pulmonary artery occlusion include enlargement of central pulmonary artery (Fleischner sign), pleural-based wedge-shaped opacity (Hampton sign), peripheral radiolucency owing to decreased vascularity (Westermark sign), and hemidiaphragm elevation. However, these signs are nonspecific, are often seen in any type of pulmonary occlusion.[10]

Conversely, microembolism owing to fat, talcum, amniotic fluid, septic material, and many tumors may not cause filling defects in CTPA (**Fig. 1**; see **Table 1**). They present with signs of PH, parenchymal infarction from pulmonary arterial obstruction, and pulmonary edema owing to venous obstruction.[13] The radiologic manifestation of microembolic event also depends on the site of occlusion. An occluded subsegmental pulmonary artery at centrilobular region can cause a tree-in-bud appearance like mucoid impaction or peribronchiolar inflammation.[10] The spectrum of radiographic manifestations owing to microembolism also include bilateral infiltrates consistent with ARDS, multiple pulmonary cavities seen in septic emboli, ground glass opacities, and parenchymal consolidation as a result of chemical pneumonitis.[13]

The pulmonary-specific management measures are supportive, and include adequate oxygenation, ventilatory support, hemodynamic resuscitation with fluid, and vasopressors.

Table 1
Most common causes of NTPE

Macroembolic NTPE	Microembolic NTPE
Hydatid embolism	Fat embolism
Glue embolism	Amniotic fluid embolism
Gas embolism	Septic embolism
Catheter embolism	Bone and tissue embolism
Pacemaker lead embolism	Talcum embolism
Cement embolism	Radioactive seed embolism
Embolism with angiographic and intraoperative material	Mercury embolism
Bullet embolism	Silicone embolism
Ventriculoperitoneal shunt embolism	Trophoblastic embolism
Tumor embolism	

Some types of nonthrombotic pulmonary embolism may have both microembolic and macroembolic presentation; the table reflects the most common presentation.

Abbreviation: NTPE, nonthrombotic pulmonary embolism.