NON-THROMBOTIC PULMONARY EMBOLISM: SPECTRUM OF CT AND MR IMAGING FINDINGS

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Nothing to disclose
LEARNING OBJECTIVES

1. To review the spectrum of non-thrombotic pulmonary embolism

2. To provide a case-based review of thoracic CT and cardiothoracic MRI findings
NON-THROMBOTIC PULMONARY EMBOLISM

- Uncommon

- Non-specific clinical presentation (from acute respiratory distress syndrome to asymptomatic). Clinical history may be relevant

Complex, multi-pathway, multi-level pathogenesis

1. Direct Obstruction
2. Inflammatory reaction depending on the obstructive material
3. Neoplastic growth
4. Para-neoplastic processes
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SEPTIC EMBOLISM

Predisposing conditions

- Immunosuppression
- Drug abuse
- Infections
- Cardiac valve abnormalities
- Long-term catheterisation

Imaging features

- Peripheral irregular nodules of varying size
- Cavitation
- Peripheral enhancement
- Feeding vessel
- Lower zones
- Empyema
Generalized sepsis of unknown primary source. Contrast enhanced CT (lung window, A-B) shows bilateral ill-defined cavitating nodules, some of which are wedge-shaped. Soft tissue window (C-D) reveals a filling defect in the right lower branch and a right renal infarct.
SEPTIC EMBOLISM

Young male with known history of intravenous drug abuse. Echocardiogram, four chamber view (A) shows tricuspid valve vegetation. Chest X-rays (B, PA and C, lateral view) show bilateral nodules and left basal consolidation. CT views in three planes (D-H) show bilateral wedge-shaped opacities and cavitating nodules. Note the feeding vessel sign in soft tissue window (H, arrow). Vascular tree in bud pattern (I) in drug addicts who use oral tablet fillers in IV preparation would raise suspicion of cellulose/talc granulomatosis.
SEPTIC ENDOCARDITIS OF TRICUSPID VALVE

Spin-echo sequence, axial and coronal planes (A and B, respectively). Peripheral right upper node nodules, one of which is wedge-shaped.

Still images of cine SSFP sequence, four chamber (C), right ventricular inflow and outflow tract (D) and short axis (E) views. A single one-centimeter mobile structure appended to the anterior leaflet of the tricuspid valve is seen (arrows), in keeping with a vegetation.
Most commonly affected organs are the liver (75%) and lungs (15%)\(^1\)

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19 years old female with known history of hydatid disease. CT pulmonary angiography. Axial plane in soft tissue window (A-C): filling defects in the right main pulmonary artery and many of its branches; some of the intra-arterial masses show calcification (arrow). Lung window (D-E) shows multiple lobulated nodules with areas of parenchymal opacification, which could represent embolic infarctions.

There is a partly calcified cyst in the liver (*), in keeping with hepatic hydatid disease.
HYDATID PULMONARY EMBOLISM

19 years old female with known history of hydatid disease. Cardiothoracic MRI of. Axial T1-W (top panel) and T2-STIR (bottom panel) images show multiple heterogeneous lesions within the right pulmonary artery and its branches; the signal intensity is high on T2-W sequence after fat suppression. The MRI appearances are in keeping with cystic masses. Additionally, there are multiple right lung nodules and opacities.
NON-THROMBOTIC PULMONARY EMBOLISM: SPECTRUM OF CT AND MR IMAGING FINDINGS

TUMOUR EMBOLISM

- Rather common in autopsies

- Often non-specific
- Vessel calibre varies: centrilobular embolism shows tree-in-bud
- Associated parenchymal infarcts
- Differential diagnosis by MRI: tissue characterisation for large emboli

DIRECT EMBOLISM: FROM CENTRAL TO CENTRILOBULAR ARTERIES

- Rare
- Fibrocellular intimal hyperplasia of small arteries, triggered by microemboli
- Tree-in-bud pattern

THROMBOTIC MICROANGIOPATHY
TUMOUR EMBOLISM

Spindle cell sarcoma

Worsening breathlessness, haemoptysis and right arm pain. Cardiothoracic MRI. Axial T1-W (A), T2-STIR (B), coronal angiogram (C), early gadolinium phase (D), T1-W after contrast (E) images show a heterogeneous, hyperintense on T2, enhancing mass in the right pulmonary artery, significantly narrowing the lumen. Additionally, there are wedge-shaped right lung nodules (arrows). On CT, performed months later (F-G) there was a large wedge-shaped consolidation. There was also vascular tree-in-bud pattern in the right upper lobe (G).
TUMOUR EMBOLISM

CT study, arterial phase. Left lower lobe lesion with satellite nodules, and interstitial change and bronchial wall thickening suggestive of lymphangitis (lung window, A). Filling defects in segmental left lower lobe arteries (soft tissue window, B-C) in keeping with pulmonary emboli.
Lesions arising from abnormal proliferation of the trophoblastic epithelium of the placenta

**Aberrant fertilisation** (hydatiform mole)
1. Complete
2. Partial

**Malignant**
1. Invasive mole
2. Choriocarcinoma
3. Placental site trophoblastic tumours

**Findings**
- Nodules
- Miliary pattern
- Pleural effusion

- Trophoblastic material from gestational trophoblastic disease
- Filling defects
- Parenchymal infarcts
AIR EMBOLISM

- Small amount of air is common on CT angiograms (arrow)
- Other iatrogenic causes: transthoracic FNA/biopsy, central catheterization and positive pressure ventilation.
- >50ml of quickly injected air causes PE symptoms
- 300-500ml and 100ml/s would be lethal

Scuba diver’s barotrauma: clinical manifestation of Boyle’s law: alveoli are distended by expanding gases during ascent.

- A change in pressure of 70 mmHg (a full inspiration with compressed air at 1 m under water) can result in barotrauma
AMNIOTIC FLUID EMBOLISM

- 1 / 6000-120000 pregnancies
- Death-to-case rate: 0.2 /100,000 abortions
- Maternal mortality rate: 26.4% (population-based study)
- Amniotic fluid contains maternal extracellular fluid, fetal urine, squamous cells, lanugo hairs, vernix caseosa, mucin and meconium
- Amniotic fluid often enters maternal circulation through open veins of the placenta during delivery without consequences
- Pre-DIC pathological reaction is similar to septic or anaphylactic shock has been suggested, therefore some authors call it *anaphylactoid syndrome of pregnancy*
AMNIOTIC FLUID EMBOLISM

- Diffuse bilateral homogeneous opacities on chest X-Ray (non-specific pulmonary oedema)
- Obstruction of pulmonary branches of the PA is rarely seen\(^1\)
- Right heart strain
- Left ventricular failure
FAT EMBOLISM

- Long bone fracture
- Haemoglobin disorders
- Pancreatitis
- Major burns
- Blood transfusion
- Liposuction

DIRECT OBSTRUCTION

vessel wall damage
formation of free fatty acids

inflammation (neutrophils &co)
toxic reaction of the endothelium
FAT EMBOLISM

CT findings are non-specific

- Consolidation
- Ground-glass opacification
- Small irregular centrilobular/subpleural nodules in dependent distribution
- Vascular tree in bud (rare)
- Distal arterial branch calcifications (rare)

Clinical history is of key importance for correct diagnosis
CEMENT EMBOLISM

Minimally invasive percutaneous vertebroplasty can result in:

- Cement leaks into the external vertebral venous plexuses
- Cement migration into the inferior vena cava
- Pulmonary embolism (rare)\(^{13}\)

Leaks are more frequent with highly vascular lesions
64 years old male patient treated by percutaneous vertebroplasty. Lateral X-ray of thoracic spine (A) shows cement material within the vertebral body. Bilateral dense opacities are seen in anteroposterior chest X ray (B). CT images (C-F) in bone window confirm the X ray findings: cement material is seen in the distal segmental and subsegmental pulmonary arteries.
REFERENCES


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