Thoracic emergencies in oncologic patients.

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Learning objectives

To review the pathophysiology of the principal onco-thoracic emergencies in adults (eg central airway obstruction, esophagorespiratory fistula, pulmonary artery sarcoma vs pulmonary embolism, SVC syndrome, primary and metastic lung carcinoma, lymphangitic carcinomatosis and massive pleural effusion).

To discuss the importance of chest plain film as the initial radiologic examination for assessing intrathoracic emergencies.

To correlate chest plain film and CT scan imaging findings.

Background

Oncologic emergencies are known to be acute life-threatening conditions that develop either because of underlying malignancy or as a complication from treatment. Also many oncological diseases debut in the ER and need appropriate patient care.

In the appropriate clinical scenarios, chest plain film makes a fast approach on an accurate and timely diagnosis.

We shall look through "not to be missed" imaging findings and correlate different imaging techniques in onco-thoracic emergencies in adults.

Findings and procedure details

1. CENTRAL AIRWAY OBSTRUCTION (Fig. 1 on page 6)

• Malignancies may compress or invade into the central airway, resulting in substantial luminal narrowing.

• Most common cause: primary carcinoma of the lung.

• Clinical features: Obstruction of the central airway = Acute respiratory failure. Main stem and lobar bronchi obstruction = Postobstructive pneumonitis (atelectasis, dyspnea, fever, and cough).
• Chest plain film: radiopaque mass that obstructs the airway (lung collapse and/or pleural effusion).

• CT with coronal reformations: can help identify the cause, site, and severity of central airway obstruction and associated lung parenchymal changes.

2. ESOPHAGORESPIRATORY FISTULA (Fig. 2 on page 7)

• Fistula communication between the esophagus and the trachea (most common type), bronchi or lung parenchyma.

• Due to: tumor progression into airways (most common cause: esophageal adenocarcinoma) or iatrogenic effects (e.g. radiation therapy, esophageal stent placement).

• Clinical features: recurrent pulmonary infections, aspiration pneumonitis and coughing after liquid ingestion.

• Chest plain film (nonspecific): recurrent pulmonary consolidations, lung abscesses and pleural effusion.

• Esophagography with low-osmolar hydrosoluble contrast material and fluoroscopic observation: confirm the diagnosis and identify the site of fistulae. Orally ingested contrast material may be seen in the airway lumen and lung parenchyma.

• CT with axial and coronal reformations: identify a direct fistulous communication between the esophagus and the airway, lung parenchyma repercussion and assessing complications after stent placement (stent migration, stent fracture, and tracheal stenosis).

3. PULMONARY EMBOLISM (Fig. 3 on page 8)

3.1 Deep venous thrombosis and subsequent embolism: Secondary to the direct thrombogenic effects of the malignancy or hypercoagulability due to chemotherapy.

3.2 Tumor embolism: Obstruction of the centrilobular arteries with tumor cells, peripheral arterial dilatation and extensive intimal hyperplasia.

Coagulation system activation: development of local thrombus and irreversible obstruction. Pulmonary tumor emboli should not be considered as metastases because they do not proliferate or spread locally.
• 4% Unsuspected pulmonary embolism most common at patients with gynecologic malignancies and melanoma.

• Clinical features (similar regardless of the cause): acute dyspnea, chest pain and signs and symptoms of rightsided heart failure.

Chest plain film: normal most of the time. Cardiomegaly and prominent PAs (<50% of the cases). The absence of consolidation, dysnea and hypoxemia suggests pulmonary embolism.

Contrast-enhanced CT:

• Acute pulmonary emboli: central filling defect within the pulmonary arteries (PAs) with a thin rim of contrast = "Polo mint" sign.

• Chronic pulmonary emboli (Fig. 4 on page 9): Eccentric filling defect. Concave shape thrombus that points toward the vessel lumen.

• Subpleural lines, pulmonary infarction and hypertension signs.

• Signs of right ventricular dysfunction: right cardiomegaly, displacement of the interventricular septum, reflux of contrast material into the inferior vena cava and hepatic veins.

• Suggestive findings of tumor emboli: contrast-enhanced filling defects within the PAs, dilated and beaded peripheral branches of the PAs. Adenopathies and lymphangitic carcinomatosis.

**4. PULMONARY ARTERY SARCOMA** (Fig. 5 on page 10)

• Rare mesenchymal vascular tumor that involves the pulmonary arteries.

• Potentially lethal tumor, usually diagnosed during surgery or autopsy.

• Frequent clinical misdiagnose as pulmonary embolism.

• Clinical features: non-specific symptoms (similar to pulmonary embolism) that often occur at the end-stage of the disease. Chronic clinic without dyspnea suggests the diagnosis.

• Chest plain film: unilateral hiliar mass that simulates a prominent pulmonary artery or a lung malignancy.

• Contrast-enhanced CT: Low attenuation filling defect with heterogeneous appearance (with areas of necrosis and haemorrhage) that occupies and expands at the pulmonary artery with extravascular invasion, pulmonary
consolidation or subpleural nodules, pleural effusion or cardiomegaly. It occurs frequently unilaterally, in contrast with the often bilateral involvement of pulmonary arteries in the thromboembolic disease.

• PET/CT: Pulmonary artery sarcoma shows FDG uptake.

5. MALIGNANT-RELATED PNEUMOTHORAX (Fig. 6 on page 11)

• 4% of lung metastases tend to cavitation.
• Cavitatory pulmonary metastases complications: pneumothorax or haemopneumothorax.
• Pneumothorax clinical features: pleuritic chest pain often absent, dyspnoea usually severe. If tension pneumothorax: distended neck veins and tracheal deviation, cardiac arrest and in the most severe cases, death.
• Chest plain film: gas in the pleural space, visible visceral pleural edge, peripheral space is radiolucent compared to adjacent lung, lung collapse. Subcutaneous emphysema and pneumomediastinum.
• The mediastinum should not shift away from the pneumothorax unless a tension pneumothorax is present.
• Ultrasound: no movement of lung within the rib-interspace. Small pneumothoraces are best appreciated anteriorly in the supine position (gas rises) whereas large pneumothoraces are appreciated laterally in the mid-axillary line.
• CT: Easily identified at lung windows. When bullous disease is present, a loculated pneumothorax may appear similar.

6. PERICARDIAL TAMPONADE in oncologic patients (Fig. 7 on page 12)

• Secondary to: underlying malignancy, as a complication of irradiation or from an opportunistic infection.
• It can occur either rapidly or gradually over time, with impair cardiac function and hemodynamic compromise (as little as 200 mL of fluid can cause tamponade if the fluid accumulates rapidly).
• Clinical features: Tachicardia and pulsus paradoxus (nonspecific), dyspnea, acute circulatory collapse, and chest pain. Beck triad (in only a minority of patients): muffled heart sounds, hypotension, and jugular venous distention.
• Chest plain film: cardiomegaly with "water bottle" cardiac silhouette, mediastinal widening, fat pad sign (a stripe of water density separates two fat layers on the outer surface of the parietal pericardium and beneath the visceral pericardium).

• Echocardiography: gold standard. However, in equivocal cases or when echocardiography is not feasible, additional imaging studies including computed tomography or magnetic resonance are necessary.

• CT: compression and narrowing of the cardiac chambers, either by pericardial effusion or by a mass.

• Malignant pericardial effusion: high-attenuation pericardial effusions, hemorrhage or debris and of irregular nodular pericardial thickening with enhancing soft-tissue nodules.

7. SUPERIOR VENA CAVA SYNDROME (Fig. 8 on page 13)

• Due to extrinsic compression or local invasion.

• Most frequently caused by lung carcinoma or lymphoma.

• Narrowing or complete SVC obstruction that subsequently impairs venous drainage from the head, neck, and upper extremities.

• Clinical features: symptoms develop gradually and may be asymptomatic. The most common symptom: dyspnea. The severity depends on the development of collateral vessels and thrombus.

• Chest plain film: superior mediastinal widening. Right hilar prominence = presence of a mediastinal mass. Pleural effusion.

• Contrast-enhanced CT: identify the location and extension of the obstruction, superimposed thrombosis, a mediastinal/lung mass or lymphadenopathy. Collateral vessels highly suggest SVCS.

• Mutiplanar reconstructions: Detection of focal stenosis and the relationship with great vessels as well as the extension to collateral vessels.

Images for this section:
Central airway obstruction

(A) Chest plain film: Complete white-out of the right hemithorax. Trachea slightly displaced to the right (due to total lung collapse and pleural effusion seen on CT). Occupation of right main bronchus and carina (arrowheads).

(B and C) Contrast-enhanced CT: Total lung collapse (*) due to invasive lung cancer that extends into the right main bronchus and carina (arrowheads). Massive pleural effusion (arrow on B and C).

Fig. 1
Fig. 2

(B) Chest plain film show outflow of low osmolar hydrosoluble contrast at bilateral bronchioloalveolar bases (*). Esophageal stent preformed on a esophageal cancer stenosis (A).
(C) Axial CT demonstrate a fistulous communication between the esophagus and the trachea (arrow) that developed after radiation therapy.
(D-E) Diffuse soft-tissue thickening (arrowheads) suggestive of inflammatory changes due to RT (although it does not discharge remaining esophageal cancer).
(A) Spiculated nodule on the right breast, studied with mammography and biopsy (not shown) in a patient with partial mastectomy: Breast cancer recurrence (arrowhead). Nodal enlargement (arrow).
(B) Lymphangitic carcinomatosis: nodular and irregular interlobular septal thickening (square).
(C) Subsegmental pulmonary artery defect at the IRL suggestive of pulmonary embolism (arrowheads).
(D - F) Signs of right ventricular dysfunction: displacement of the interventricular septum (arrowhead), right cardiomegaly (*) with reflux of contrast material into the inferior vena cava and suprahepatic veins (arrow).
Lung cancer and chronic pulmonary embolism

(A) Spiculated and ill-defined mass at IRL that displaces adjacent broncovascular components.
(B) Right main pulmonary artery and superior left lobar artery eccentric defects that suggest chronic pulmonary embolism.
(C) Pulmonary hypertension (AP >29 mm)
(D) Signs of right ventricular dysfunction: displacement of the interventricular septum (arrowhead), right cardiomegaly (*) with reflux of contrast material into the inferior vena cava (arrow).

Fig. 4
(A) Axial contrast-enhanced CT shows an enhanced lesion (arrow) that expands and deforms the contour of the pulmonary main artery.

(B) PET-CT shows FDG contrast uptake suggestive of tumor: pulmonary artery sarcoma.

Fig. 5
Fig. 1 Pulmonary metastasis from an endometrial sarcoma:
(A) Chest plain film: diffuse and bilateral nodules (arrows).
(B) CT: Metastatic nodules and masses, some of them with cavitation (square). (C) Pulmonary bullae (*)

Fig. 2 Same patient with pneumothorax:
(A) Chest plain film: Nodules and masses increased in number and size.
(B and C) CT: Increased metastatic nodules and masses, right pneumothorax (arrowhead) that causes mediastinal shift towards the opposite side. Pulmonary bullae (*)
(A) Chest plain film (PA and LAT). Global cardiomegaly ("water bottle" cardiac silhouette) and "fat pad" sign.

(B) Contrast-enhanced CT: large pericardial effusion that compresses the cardiac chambers.

Fig. 7
(A) Axial contrast-enhanced TC shows a large tumoral adenopathy that compresses and invades the SVC (arrow).

(B) Three-dimensional volume-rendered image of the chest shows collateral vessels in the chest wall (arrowheads).

Fig. 8
Conclusion

Radiologists should be aware of these select, "not to be missed" imaging findings to make an accurate, timely diagnosis and provide appropriate patient care.

We all play a pivotal role in the timely diagnosis, thus assisting in appropriate management.

Personal information

References