Easy interpretation of radiologic signs – Pictorial essay

Jibu PS, Akhila Babu, Vishnusharma, Bibin Jose

Email: jibu.ps@gmail.com

Abstract

Comparison of many clinical signs to commonly encountered objects is useful as memory aid. Similarly, radiological sign in chest imaging can be compared to a particular object or pattern for easier recognition. In this article, we discuss 23 classic thoracic radiological roentgenographic signs commonly used in chest imaging and serves as an educational review for respiratory therapists and physicians for better assessment and rapid interpretation.

Keywords: Chest x-ray, radiological patterns, radiological signs.

Introduction

The introduction of the X-ray technology in early 21st century, gave health care professionals a way to *'see inside'* the human body without cutting it. The reliability, accuracy and the ease in identifying specific diseases allowed its everyday use. Many of these radiological signs in chest imaging can be easily remembered by likening them to a particular object or pattern. These recognisable, characteristic patterns on imaging modalities help us to shorten the differential diagnosis lists, group illness of similar characteristics and diagnosis of the disease.[1,2]

Localisation of intrathoracic lesions

Silhouette sign

Absence of border of an anatomical structure that is normally visualised in a chest x-ray (CXR) shows that the area nearby this margin is filled with tissue or material of the same density. Obliteration of the right heart border due to right middle lobe collapse is a classic example for silhouette sign. When a silhouette sign appears in the hilum, it is called as *hilum overlay sign*. This sign was first documented by Felson in 1950, that obliteration of the border of the heart, diaphragm and aorta happens when it touches an intrathoracic lesion *(Figure 1)*.

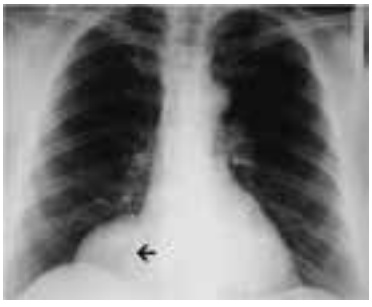

Figure 1: Silhouette sign: CXR of a patient without any complaints. The lesion obscures the right border of the heart (arrow) and demonstrates a cystic lesion

Hilum overlay sign

When the silhouette sign appears in the hilum, it is called *hilum overlay sign*. It is used to localise the hilar lesion in the CXR. If hilar vessels are not seen from the lesion, it indicates that the lesion is in the hilum. If the hilar vessels are seen through the lesion, it indicates that is either anterior or posterior to the hilum *(Figure 2)*.

Jibu PS, MS, BSc RT
Senior respiratory therapist, Al Adan hospital, Ministry of Health, Kuwait

Akhila Babu, MSc RT
Respiratory therapist, Al Adan hospital, Ministry of Health, Kuwait

Vishnusharma, MD
Head of Pulmonary Medicine, AJ Institute of Medical Sciences, Mangalore

Bibin Jose, MD
Department of Pulmonary Medicine, AJ Institute of Medical Sciences, Mangalore

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Figure 2: CXR of a patient demonstrating enlarged right hilum. Hilar vessels can be seen inside the lesion indicating the lesion is not in hilum.

Air bronchogram sign

The air bronchogram sign becomes visible as a result of the parenchymal opacification. Intrapulmonary airways are not seen in chest radiograph normally but are visualised in parenchymal consolidation as air within the lumen becomes visible as branching linear lucencies in contrast to the surrounding opaque lung. They are most frequently seen in pneumonia, pulmonary oedema and acute respiratory distress syndrome (ARDS) *(Figure 3)*.

Figure 3: Air bronchogram sign. Chest radiograph of a patient with pneumonia.

Signs of collapse

Collapse of the lungs results in complete or partial loss of lung volume. Collapse can be due to intrinsic (inside airway) and extrinsic (outside airway) aetiology. There are direct and indirect signs of collapse, the direct signs are displacement of the interlobar fissures, loss of aeration and vascular bronchial crowding. The indirect signs are elevation of the hemidiaphragm, mediastinal displacement, hilar displacement and compensatory hyperinflation.

Golden S sign

This sign is appreciated well both in PA or lateral chest radiograph, first described by Golden in 1925. It resembles a reverse S shape, also referred as *reverse S sign of Golden*. The Golden S sign is typically seen in the right upper lobe collapse with or without presence of a central mass. This sign can appear in central neoplasms (bronchial carcinoma, primary mediastinal tumor *etc*) because of the downward convexity of the medial or proximal portion of the minor fissure *(Figure 4)*.

Figure 4: Golden S sign: Patient with right upper lobe collapse. Frontal chest radiograph shows an abnormal convexity in the right perihilar region creating a rounded inferior border with the displaced minor fissure and the' reverse S' of right upper lobe collapse.

Luftsichel sign

'Luftsichel' is a German word for sickle of air (luft:air, sichel:crescent). This sign occurs commonly in left upper lobe collapse because of the absence of minor fissure in the left lung. In left upper lobe collapse, the major fissure moves in an anterior and superior direction and finally lies parallel to the anterior chest wall so that the posterior empty space is filled by the apex of the left lower lobe, give rise to a paramediastinal lucency resembles a sickle of air.

Figure 5: Luftsichel sign. Left upper lobe collapse causing a crescent shaped periaortic lucency representing the expanded superior segment of the left lower lobe

Flat waist sign

This was described by Kattan and Wlat in 1976. It indicates left lower lobe collapse and is seen in frontal views in CXR. It appears in extensive collapse of the left lower lobe due to flattening of the aortic knuckle and main pulmonary artery, occurring due to cardiac rotation and displacement to the left. Hilar structures shift downward and rotation of the heart produces flattening of the cardiac waist *(Figure 6)*.

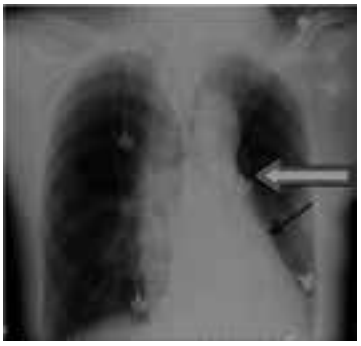

Figure 6: Flat waist sign. This is seen in extensive collapse of the left lower lobe due to flattening of aortic knuckle and main pulmonary artery, occurring due to cardiac rotation.

Air crescent sign

Appearance of circumferential air area surrounding a dense or nodular opacity in chest is called as air crescent sign. It is most characteristic of pulmonary aspergillosis, tumour, haematoma, Wegener's granulomatosis, hydatid cyst, tuberculosis and bacterial abscess.

Figure 7: Air crescent sign. Frontal radiograph of the chest shows cavitating lesion.

Signs of pneumothorax and pneumomediastinum

Deep sulcus sign

The deep sulcus sign describes the radiolucency in a deep costophrenic sulcus, suggestive of pneumothorax. This increased radiolucency can extend from the lateral costophrenic angle to the hypochondrium. It is an important sign indicating possible pneumothorax in chest X- rays obtained in supine position *(Figure 8)*.

Continuous diaphragm sign

This sign occurs when the mediastinal air accumulated at the lower border of the heart continues with both hemidiaphragms. It is a useful sign in differentiating pneumothorax from pneumomediastinum *(Figure 8)*.

Figure 8: Deep sulcus sign and continuous diaphragm sign. Pleural free air accumulating at the right costodiaphragmatic sinus and extending up to the hypochondrium is depicted (arrow head). Mediastinal air neighbouring the lower border of the heart causes the continuous diaphragm sign by combining hemidiaphragms (arrow).

Ring around artery sign

This sign appears when there is lucency along or surrounding the right pulmonary artery, characteristic of pneumomediastinum. *'Ring around the artery'* sign can be visualised on lateral chest radiographs and will be accompanied by other signs of pneumomediastinum *(Figure 9)*.

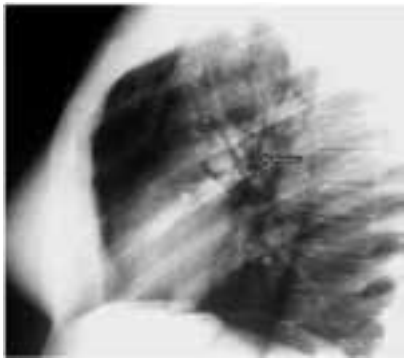

Figure 9: A patient with asthma with spontaneous pneumomediastinum shows a well-defined lucency (arrows) along the pulmonary artery due to mediastinal air

Spinnaker sail sign

Spinnaker sail sign is also called Angel wing sign. The causes of sail sign appearance are respiratory distress, birth trauma, rib fracture, hiatus hernia,

oesophageal diverticulum, surgery and spontaneous. Spinnaker sail sign is an abnormal elevation of lobes of thymus seen with neonatal pneumomediastinum. It is a wedge shaped opacity from the right hemidiaphragm to the superior mediastinum indicating displaced thymic tissue by air which is accumulated under pressure in mediastinum *(Figure 10)*.

Figure 10: Spinnaker sail sign. A paediatric chest radiograph showing pneumomediastinum. Thymus is outlined by air with each lobe displaced laterally like spinnaker sails.

Naclerio's V sign

It is V shaped air lucency outlining the medial portion of the left hemidiaphragm and the lower lateral mediastinal border. It occurs in the settings of pneumomediastinum and in oesophageal perforation *(Figure 11)*.

Figure 11: Naclerio's V sign. V-shaped air lucency outlining the medial portion of the left hemidiaphragm and the lower lateral mediastinal border.

Signs of pulmonary embolism

Hampton's hump sign

The Hampton's hump sign is a wedge shaped peripheral consolidation with a rounded convex apex directed towards the hilus signifying a pulmonary infarction distal to the pulmonary emboli which cause alveolar necrosis and haemorrhage *(Figure 12)*. This sign was first documented in 1920 by Aubrey Otis Hampton.

Figure 12: Hampton Hump sign. Chest X ray of a patient with pulmonary embolism showing a peripherally located, wedge shaped homogenous opacity consistent with the infarct (arrow). Hump of a camel (right)

Westernmark sign

Focal or regional pulmonary oligaemia due to occlusion of a larger pulmonary lobar artery or a widespread small vessel, results in increased radiolucency in chest radiographs. This sign was first described by *Neils Westernmark (Figure 13)*.

Figure 13: Westernmark sign. Frontal radiograph of a patient with pulmonary embolism showing increased radiolucency in the upper and middle zone of the left lung due to decreased vascularisation.

Fleischner sign

Fleishcner sign was first described by the German born radiologist Felix Fleischn. This sign refers to enlargement of the proximal pulmonary arteries in plain radiography. It is seen most commonly in massive pulmonary embolism and relatively low sensitivity in the diagnosis of small emboli *(Figure 14)*.

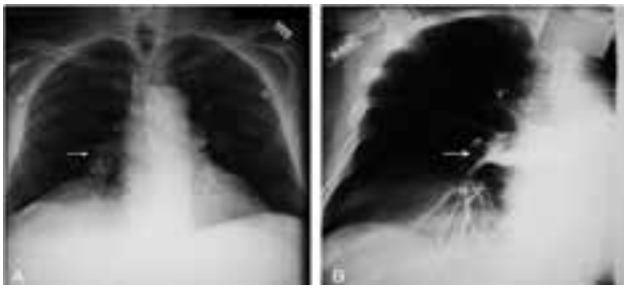

Figure 14: Fleischner sign. Frontal chest radiograph of a patient (A) shows enlargement of the right interlobar artery (arrow). The follow up angiogram (B) confirm the presence of multiple thrombi and dilatation of interlobar artery.

Signs of left atrial enlargement

Third Mogul sign

'Skiing the moguls of the heart' - the term refers to the left mediastinal outline starting at the aortic knob. A prominent knob indicates ectasia, aneurysm or hypertension. The second mogul is the main pulmonary artery segment. Excessive convexity is due to post-stenotic dilatation, chronic obstructive pulmonary disease, pulmonary artery hypertension and left to right shunt. Severe concavity is seen in right to left shunt. The third mogul is the left atrial appendage that indicates prior rheumatic carditis *(Figure 15)*.

Figure 15: Third mogul sign. Frontal chest radiograph of a patient (above) demonstrating 'the moguls of the heart'. First mogul - aortic knob, second mogul - pulmonary artery, and third mogul- left atrium.' Skiing the moguls' (below)

Double density sign

This sign appears as a curvilinear density projecting over the right retrocardiac region and the curvilinear line represent the inferolateral margin of the left atrium. This occurs in left atrial enlargement *(Figure 16)*.

Figure 16: Double density sign. Frontal chest radiograph demonstrates overlapping of an enlarged left atrium and a normal right atrium.

Walking man sign

Walking man sign appears as a result of posterior displacement of the left mainstem bronchus by the enlarged left atrium. It mimics inverted V or a walking man and is visualised well in lateral CXR *(Figure 17)*.

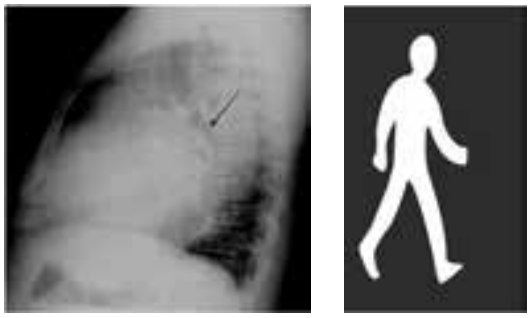

Figure 17: Walking man sign. Lateral chest X-ray demonstrates posterior displacement of the left mainstem bronchus, mimics inverted V or a Walking man.

Doughnut sign

The doughnut sign occurs in mediastinal lymphadenopathy. It occurs behind the bronchus situated in the subcarinal region. It can be visualised on a lateral chest radiograph and is formed by the normal right and left main pulmonary arteries and the posterior aspect of the aortic arch anteriorly, superiorly by hilar and subcarinal lymphadenopathy, inferiorly with the central radiolucent centre formed by the trachea and upper lobe bronchi *(Figure 18)*.

Figure 18: Doughnut sign. Lateral radiograph of the chest demonstrates enlarged lymph nodes. The doughnut pattern is formed by the radiolucent area at the central portion and the surrounding opacities due to lymph nodes.

Water bottle sign

The heart resembles a water bottle due to its globular shape from a large pericardial effusion *(Figure 19)*.

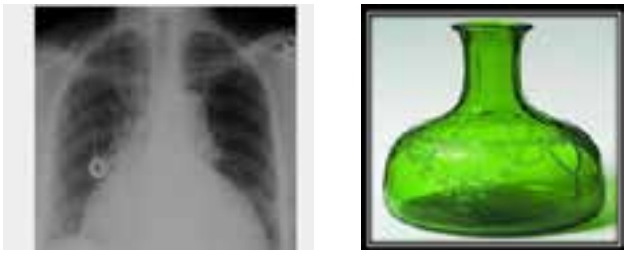

Figure 19: Water bottle sign. Frontal chest radiograph demonstrates a large pericardial effusion. The globular shape of the heart resembles a water bottle.

Fallen Lung sign

The term *'fallen lung sign'* refers to the collapsed lung in a dependent position, hanging on the hilum only by its vascular attachments. This is usually the result of the complete rupture of a bronchus and pneumothorax. The collapsed lung displaces peripherally rather than centrally, which occurs in pneumothorax without bronchial rupture *(Figure 20)*.

Figure 20: Fallen lung sign. A frontal chest radiograph demonstrates right sided pneumothorax with the 'fallen lung' just below the hilum.

Finger in glove sign

The dilated bronchi filled with mucous impaction appear as tubular or branching opacities that resembles fingers - so called 'finger in glove' sign, as seen in allergic bronchopulmonary aspergillosis and bronchiectasis. Similar appearance can rarely be seen in bronchial atresia *(Figure 20)*.

Figure 21: Chest radiograph demonstrates tubular opacities (arrow) due to dilated, mucous impacted bronchi.

Thymic wave sign and Thymic sail sign

The normal thymus has a soft texture resulting in undulation of its contour by the ribs. Therefore, in many radiographs, it presents a wavy margin known as *Thymic wave sign*. *Thymic sail sign* represents the triangular extension of thymus in chest radiographs. It is a frequently encountered radiographic finding in paediatrics. The shape of the thymus gland is convex and inferior border is straight, giving it a sail like appearance *(Figure 22)*.

Figure 22: Paediatric chest radiograph shows thymus. Thymic wave sign (arrow) and thymic sail sign (arrow and arrow head).

Bulging fissure sign

Classically, this sign appears in Klebsiella pneumonia infection, especially with the consolidation of the right upper lobe. Klebsiella has a tendency to produce large volumes of inflammatory exudate, so that the involved lobe expands and exerts mass effect on the adjacent interlobar fissure. Previously reported studies on patients with Klebsiella pneumonia showed that around 30% of this patients presented with bulging fissures on their chest radiograph. The bulging fissure sign is less commonly identified today, may be due to prophylactic antibiotic usage.

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