

The Empty Azygos Fissure

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ABSTRACT

The azygos fissure is typically visible on chest radiography as a right paramediastinal supernumerary line in projection of the right lung apex. The azygos vein, located at the bottom of the fissure, is visible as a teardrop-shaped opacity. The empty azygos fissure is a rare finding. It is the consequence of the displacement of the azygos vein out of the fissure with a close paramediastinal position. This phenomenon, related to lung collapse, has been described in the literature as the migration of the azygos vein due to various etiologies such as increased intrathoracic pressure, spontaneous or iatrogenic pneumothorax, or even during sudden development of kyphosis. In our clinical case, the empty azygos fissure was developed after drainage of a large right pleural effusion. An empty azygos fissure must therefore suggest a history of pulmonary atelectasis related to pneumothorax or large drained effusion.

CASE REPORT

CASE REPORT

A 72 year-old man was admitted in the emergency for shortness of breath. The physical exam was compatible with large pleural effusions. Chest PA radiograph and CT performed at the emergency department before chest drainage show a massive pleural effusion surrounding the azygos vein while the underlying lung parenchyma is collapsed (Fig. 1). After drainage of the right pleural effusion is completed, chest CT shows that the azygos fissure is well visible (arrow), but the azygos vein is now displaced medially towards the upper mediastinum (Fig. 2). No history of pneumothorax was recorded in the prior or current patient's history. A chest PA radiograph performed 7 years before the acute episode showed azygos fissure (arrow) with azygos vein in its normal location in the lower part of the fissure (arrowhead) (Fig. 3).

DISCUSSION

During fetal development, the right posterior cardinal vein, precursor of the thoracic segment of the azygos vein, normally migrates over the apex of the right upper lung to occupy a medial mediastinal position. In some cases, a migration anomaly occurs and the vein penetrates into the right

upper lobe. The vein carries the parietal and visceral layers of pleura to form an accessory fissure comprising a total of four pleural layers, called mesoazygos [1; 2]. The lung parenchyma positioned medially to the accessory fissure is called azygos lobe or Adam's lobe [1]. It is important to distinguish the azygos fissure from other normal pulmonary fissures or accessories lung fissures. Indeed, these are typically formed with a double layer of visceral pleura, unlike the azygos fissure which includes two other layers of parietal pleura. It should be noted that the azygos lobe is not an independent segment composed of a bronchovascular tree unlike the other lung lobes. Indeed the azygos lobe is not strictly a lung lobe [3].

The azygos fissure is typically visible on chest radiography as a right para-mediastinal supernumerary line in projection of the right lung apex. The azygos vein, located at the bottom of the fissure, is visible as a teardrop-shaped opacity [2]. The incidence of this normal variant is estimated between 0.4% and 1.2% [2; 4]. Accessory pulmonary fissures, including the azygos fissure, are known to affect up to 50% of the population. The other most frequent fissures are the inferior accessory fissure (incidence of about 30-50%), the superior accessory fissure (5-14% in the left inferior lobe; 30% in the right inferior lobe; 12% in both side), the left minor fissure (8-18%) and other intersegmental fissures [4].

The presence of an azygos fissure, associated with collapse of the right upper lung lobe, may allow the displacement of the azygos vein outside the azygos fissure. With reexpansion of the right upper lobe, the azygos vein may be repositioned in a right paratracheal location, leaving an empty azygos fissure. In the case presented here, an empty azygos fissure was observed after appearance of a large right pleural effusion. The chest CT showed the collapse of the azygos lobe allowing the azygos vein to slip out from the mesoazygos and appears to float in the pleural effusion (fig.1). Various etiologies have been described in the literature for the migration of the azygos vein: increased intrathoracic pressure [2], spontaneous or iatrogenic pneumothorax [5; 6], or even during sudden development of kyphosis [1]. Less frequently, complete disappearance of the fissure has been described (named "vanishing azygos lobe"), after reexpansion and obliteration of the right upper lung [2; 3].

Scar, bubble wall, displaced or supernumerary fissure, pleural line made visible by pneumothorax or dilatation of the esophagus may mimic an azygos fissure. In these situations, identification of the azygos vein in its usual position at the bottom of the fissure, visible as a teardrop-shaped opacity, confirms the correct diagnosis of azygos lobe [2; 7]. However this classical sign may be absent in case of empty azygos fissure.

Pulmonary scar is visible on chest radiographs as coarse linear opacity. A bubble appears as a rounded focal lucency of more than 1cm in size or as an area of decreased attenuation, surrounded by a thin wall (less than 1mm). Multiple bubbles are often present and are associated with other signs of pulmonary emphysema [8]. A pulmonary fissure appears as linear opacities, normally 1 mm or less in thickness, corresponding in position and extent to the anatomic fissural separation of pulmonary lobes or segments. These include minor, major, horizontal, oblique, accessories, anomalous, and azygos fissures [4]. In the case of pneumothorax, a visceral pleural edge is visible (unless the pneumothorax is very small or the pleural edge is not tangential to the x-ray beam) with no pulmonary parenchyma visible on the external side of this edge. Tension pneumothorax may be associated with considerable shift of the mediastinum and/or depression of the hemidiaphragm [8]. Esophageal dilatation could be visible on chest X-ray in severe disease as a retrocardiac clarity displacing paraesophageal line, with air fluid level at the aortic arch or above. On chest CT, the esophageal dilatation is visible as a dilated luminal structure with retained debris and narrowing at level where it enters the stomach.

It is of paramount importance to be aware of the patient's medical history (known previous thoracic surgery, pneumothorax, large pleural effusion) to correctly interpret an empty azygos fissure. If necessary, CT may help to rule out pathologies mimicking an empty azygos fissure. Theoretically, a large pleural effusion causes a significant decrease in left ventricular preload [9]. This may lead to right heart failure and increased systemic venous pressure. It has been shown that increased systemic venous pressure can show a distended shadow of the azygos vein on chest PA radiograph, well visible in the case of an aberrant position of the azygos vein

(azygos lobe). The venous distension disappears when the patient recovered from heart failure [10]. We can therefore hypothesise that after drainage of a large pleural effusion in a patient with an azygos lobe, the decreased caliber of the azygos vein might seem like disappeared azygos vein on the post treatment chest PA radiograph. A chest CT could also confirm any anatomical changes. The position of the azygos vein may be important in thoracic surgery, as an unknown migrant azygos vein can potentially be the source of bleeding complications [1].

In conclusion, in case of an azygos lobe, the azygos vein may displace out of its fissure, secondary to lung collapse. An empty azygos fissure must therefore suggest a history of pulmonary atelectasis related to pneumothorax or large effusion.

Preoperative awareness of a migrating azygos vein may also be useful before thoracic surgery.

TEACHING POINT

The empty azygos fissure is the consequence of the displacement of the azygos vein out of the fissure with a close paramediastinal position, related to lung collapse during pneumothorax or large effusion. Chest CT may help to rule out pathologies mimicking an empty azygos fissure, since differential diagnosis includes pulmonary scar, pulmonary bubble, displaced or supernumerary fissure, pneumothorax, and esophageal dilatation.

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FIGURES

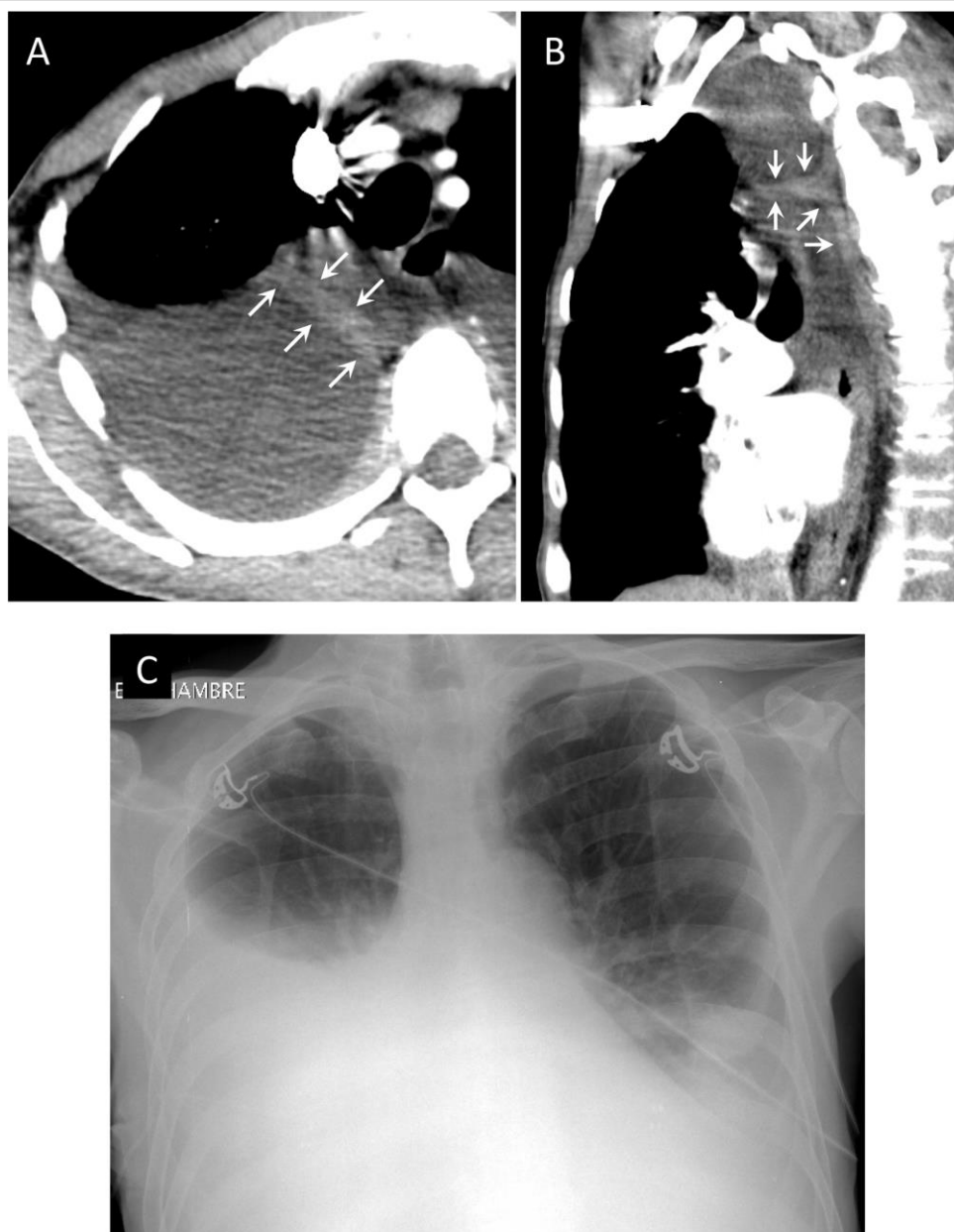


Figure 1: Axial (A) and sagittal reformatted chest CT (B), reconstructed in mediastinal window, and chest PA radiograph (C), of a 72 year-old man, performed at the emergency department before treatment of a pleural effusion. Chest PA radiograph shows a large right pleural effusion (C). The azygos vein is slightly visible in the right massive pleural effusion on CT scan reconstructions (A and B arrows), which was acquired on a GE Discovery 750 HD scanner, using 270 mA and 120 kVp after injection of 60 ml of iohexol. Slice thickness was 1.25 mm. The azygos vein is outside of the lung parenchyma, which is collapsed due to pleural effusion. No history of pneumothorax was recorded before or during imaging exam.

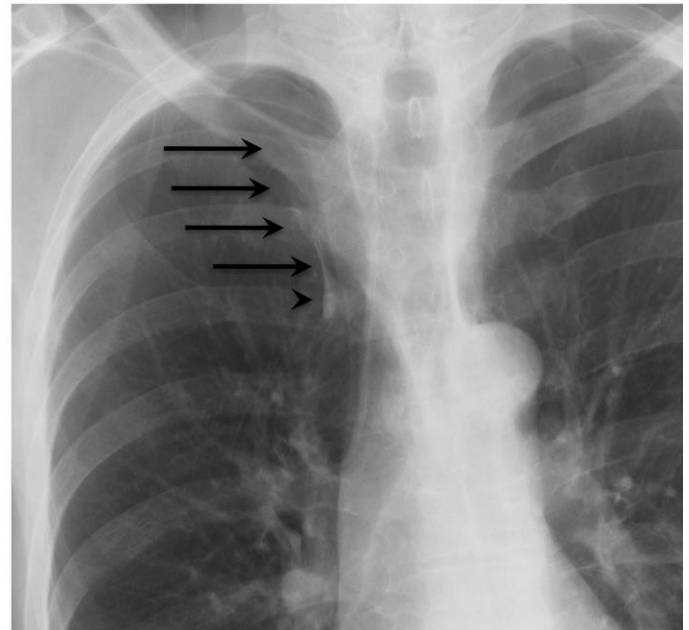
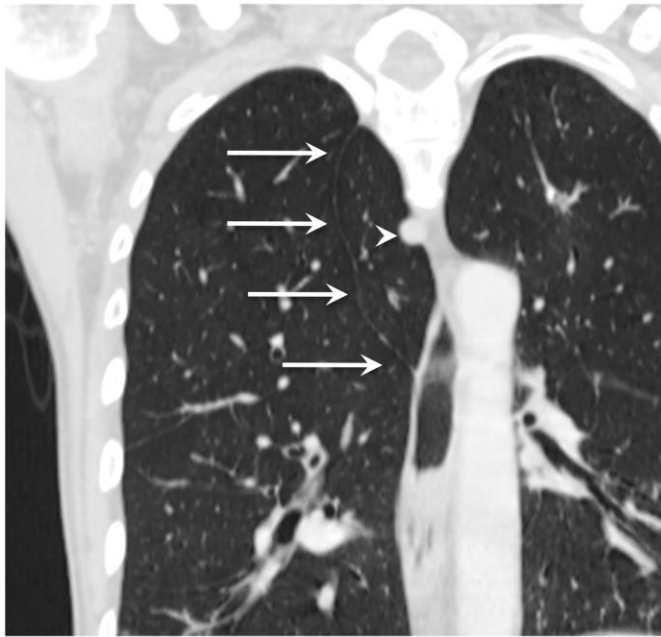
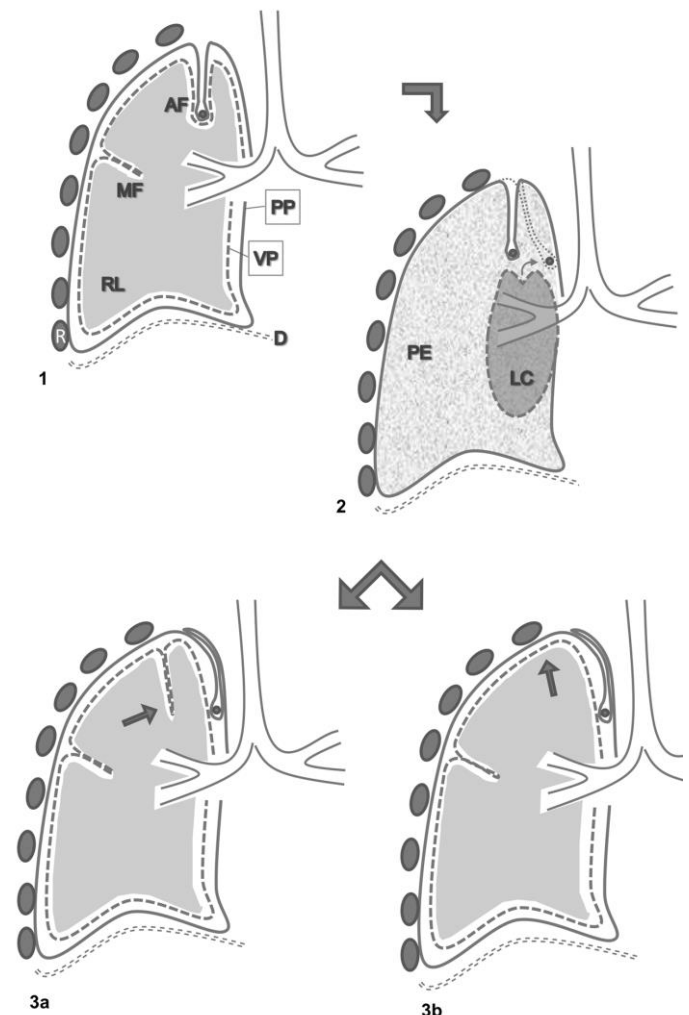


Figure 2: Coronal CT reconstruction of a 72 year-old male patient (same patient as figure 1) in lung parenchyma window of the CT performed after drainage of right pleural effusion. The CT was also realized on a GE Discovery 750 HD scanner, using 270 mA and 120 kVp after injection of 100 ml of iohexol. Slice thickness was 1.25 mm. (The azygos fissure is well visible (arrow). The azygos vein (arrow head) is displaced medially towards the upper mediastinum and lays outside of the azygos fissure.

Figure 3: Chest PA radiograph of the same 72 year-old male patient performed 7 years before acute episode shows azygos fissure (arrow) with azygos vein in its normal location in the lower part of the fissure (arrowhead).

Figure 4 (right): Explanation of the escape of the azygos vein, the "empty azygos fissure" and the "vanishing azygos lobe". (1) The azygos vein is visible in an accessory fissure comprising a total of four pleural layers (parietal layers in continuous line; visceral layers in small dotted line), called mesoazygos. (2) In presence of massive pleural effusion, the pulmonary collapse allows the displacement of the azygos vein outside the azygos fissure. (3a) After treatment, pulmonary expansion pushes the azygos vein to an immediate medial mediastinal position. The residual azygos fissure looks "empty". (3b) Less frequently, complete disappearance of the fissure after reexpansion and obliteration of the right upper lung has been observed, named "vanishing azygos lobe".

R, ribs; D, diaphragm; RL, right lung; MF, minor fissure; AF, azygos fissure; PP, parietal pleura; VP, visceral pleura; PE, pleural effusion; LC, lung collapse



Etiology	Migration of the azygos vein outside an azygos fissure related to lung collapse.	
Incidence	Rare finding (incidence unknown).	
Gender ratio	No gender ratio.	
Age predilection	No age predilection.	
Risk factors	Various factors leading to lung collapse in presence of an azygos fissure (such as increased intrathoracic pressure, spontaneous or iatrogenic pneumothorax, right pleural effusion).	
Treatment	No treatment is required (Preoperative awareness of a migrating azygos vein is useful for a safe eventual surgery).	
Prognosis	No clinical impact.	
Findings on imaging	<i>X-ray</i>	<i>CT</i>
	Right para-mediastinal supernumerary line in projection of the right lung apex, without the classical sign of a teardrop-shaped opacity visible at the bottom of the line due to the azygos vein opacity.	Presence of an azygos fissure in classical right upper para-mediastinal position. The azygos vein is visible medially towards the upper mediastinum, outside the azygos fissure.

Table 1: Summary table for the empty azygos fissure

	<i>X-ray</i>	<i>CT</i>
Empty azygos fissure	Right para-mediastinal supernumerary line in projection of the right lung apex, without the classical sign of a teardrop-shaped opacity visible at the bottom of the line due to the azygos vein opacity.	Presence of an azygos fissure in classical right upper para-mediastinal position. The azygos vein is visible medially towards the upper mediastinum, outside the azygos fissure.
Pulmonary scar	Coarse linear parenchymal opacity.	Coarse linear parenchymal opacity.
Pulmonary bubble wall	A bubble appears as a rounded focal lucency of more than 1cm in size or as an area of decreased attenuation, surrounded by a thin wall (less than 1mm). Multiple bubbles are often present and are associated with other signs of pulmonary emphysema.	A bubble appears as a rounded focal lucency of more than 1cm in size or as an area of decreased attenuation, surrounded by a thin wall (less than 1mm). Multiple bubbles are often present and are associated with other signs of pulmonary emphysema.
Displaced or supernumerary fissure	Linear opacities, normally 1 mm or less in thickness, corresponding in position and extent to the anatomic fissural separation of pulmonary lobes or segments. These include minor, major, horizontal, oblique, accessories, anomalous, and azygos fissures.	Linear opacities, normally 1 mm or less in thickness, corresponding in position and extent to the anatomic fissural separation of pulmonary lobes or segments. These include minor, major, horizontal, oblique, accessories, anomalous, and azygos fissures.
Pneumothorax	A visceral pleural edge is visible (unless the pneumothorax is very small or the pleural edge is not tangential to the x-ray beam) with no pulmonary parenchyma visible on the external side of this edge. Tension pneumothorax may be associated with considerable shift of the mediastinum and/or depression of the hemidiaphragm.	A visceral pleural edge is visible with no pulmonary parenchyma visible on the external side of this edge. Tension pneumothorax may be associated with considerable shift of the mediastinum and/or depression of the hemidiaphragm.
Esophageal dilatation	In severe disease, the large, dilated esophagus could be visible as a retrocardiac clarity displacing paraesophageal line, with air fluid level at the aortic arch or above.	Seen as dilated luminal structure with retained debris and narrowing at level where it enters the stomach.

Table 2: Differential diagnosis table for the empty azygos fissure

ABBREVIATIONS

CT = computed tomography
PA = postero-anterior

KEYWORDS

Empty azygos fissure; azygos fissure; vanishing; CT; pleural effusion

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