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Review Article

The Azygos Lobe: A Comprehensive Review

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Abstract

The azygos lobe, an uncommon anatomical variation in the right lung that was initially described by Heinrich Wrisberg in 1877, presents a unique structural anomaly that challenges both radiological interpretation and surgical intervention. Unlike true accessory lobes, it lacks an independent bronchus and vascular supply, arising instead from an aberrant course of the azygos vein during embryogenesis. This deviation leads to the formation of the azygos fissure, a distinctive pleural separation composed of four layers. While typically asymptomatic, the azygos lobe holds significant clinical relevance, often mimicking pathological conditions such as pneumothorax or pulmonary bullae on imaging. High-resolution computed tomography (HRCT) enhances its visualization, distinguishing it from disease processes that may prompt unnecessary interventions. Surgically, its presence alters thoracic anatomy, complicating procedures such as video-assisted thoracic surgery (VATS) and lung resections. Despite these challenges, malignancies confined to the azygos lobe have been successfully managed with minimally invasive techniques. This comprehensive review delves into the embryology, anatomy, radiology, clinical implications and surgical considerations of the azygos lobe, underscoring its importance in both diagnostic accuracy and operative planning.

Keywords: Azygos lobe, Azygos Vein, Embryological development, Mesoazygos, Azygos fissure, Blood supply of Azygos lobe, Trigonum parietale, Surgical Considerations with Azygos lobe.

Introduction

Described by Heinrich Wrisberg in the year 1877,[1] "the azygos lobe" is an uncommon anatomical variation in the right lung. Although often mistaken for an accessory lobe, it does not qualify as one due to the absence of a dedicated bronchus and vascular supply. Instead, it represents part of the right upper lobe that is separated by the azygos fissure.[2] This fissure results from an abnormal course of the azygos vein during embryonic development and is composed of four pleural layers—two visceral and two parietal.

The incidence of an "azygos lobe" varies depending on the imaging modality used. It is found in approximately 1% of autopsy findings, 0.4% of routine chest skiagram, and 1.2% of high-resolution computed tomography (HRCT) scans.[3] Though it serves no distinct physiological purpose beyond normal gas exchange, its clinical significance arises from its potential to mimic pathological conditions such as pneumothorax, abscesses, or bullae on imaging.[2] This review provides a detailed analysis of the embryology, anatomy, radiology, clinical significance and surgical considerations of the azygos lobe.

Embryological Development

The formation of the azygos lobe begins between the 4th and 6th weeks of gestation. Typically, the azygos vein, which originates from the right posterior cardinal vein, migrates medially over the apex of the right lung on its way to the superior vena cava. However, when it develops, the vein deviates from this normal trajectory and instead passes through the upper lobe of the right lung. This deviation results in the invagination of the parietal pleura into the lung tissue, thereby forming the azygos fissure. This fissure encases the vein and effectively separates a portion of the upper lobe (Figure 1).[4]

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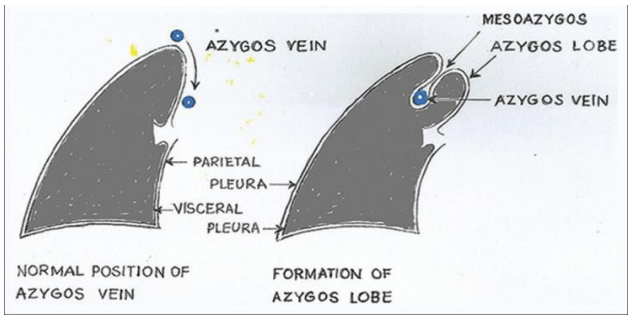

Figure 1: Formation of an azygos lobe (Source: Salve *et al.*[5])

The azygos fissure can have different orientations, classified into three types:[1]

- Type A: A transverse fissure that demarcates the apex from the lateral portion.
- Type B: A longitudinal fissure that bisects the lung apex into two lateral sections.
- Type C: A vertically oriented fissure that originates medially, isolating a small segment of the upper lobe.

This developmental anomaly leads to the formation of the azygos lobe, a distinct anatomical entity suspended by a parietal pleural fold known as the mesoazygos.[4]

Anatomy and Blood Supply

As an extension of the right upper lobe, the azygos lobe does not have an independent bronchus or vascular supply, setting it apart from true accessory lobes. Its ventilation is maintained by subsegmental branches of the apical bronchus (B1a and B1b), while its blood supply comes from the corresponding pulmonary arteries (A1a and A1b). Venous drainage is predominantly *via* the V1a and V2 veins, and lymphatic drainage mirrors that of other lung segments, following the bronchial tree to the hilum [6]

Notably, autopsy studies have confirmed this vascular arrangement. For example, one report detailed that the "azygos lobe" was supplied by apical sub-subsegmental branches (B1ai and B1bi) and corresponding pulmonary arteries (A1ai and A1bi). These findings emphasize its dependence on adjacent bronchovascular structures.[1]

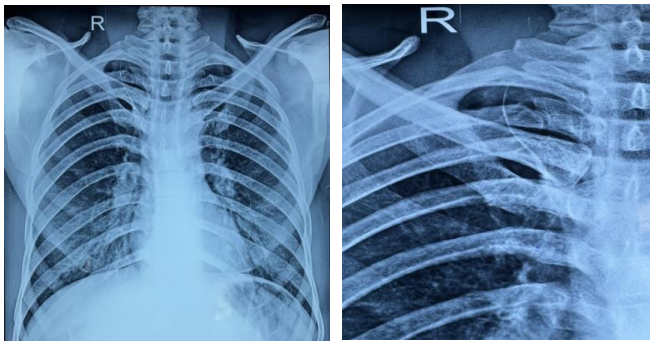

Figure 2: Chest X-ray showing a convex opacity representing an azygos fissure seen in the right upper lobe with a tear drop-like opacity seen in the bottom of the fissure representing an azygos vein. (Tear Drop Sign)

Radiological Features

Radiological identification of an azygos lobe is critical to prevent misdiagnosis. On chest radiographic imaging, the azygos fissure looks like a delicate, arching line extending across the apex of the right lung. (Figure 2) The azygos vein is seen curving along the inferior margin of the fissure, and extrapleural areolar tissue may create a triangular shadow (trigonum parietale) at the fissure's apex.[7]

High-resolution computed tomography (HRCT) provides superior detail, showing the fissure extending from the lateral portion of vertebrae to the superior vena cava. The azygos fissure uniquely contains four pleural layers, unlike the two layers of pleura in normal fissures. The azygos vein represents itself as a prominent structure curving superiorly within the fissure, which may be straight or convex depending on the lobe's size.[7]

Radiological findings include:[7]

- A triangular soft-tissue density at the superior portion of the fissure (trigonum parietale).
- A curved fissure extends across the apex of the right lung.
- Azygos vein is displaced from its usual mediastinal position to the inferior margin of the fissure.

Differentiating an azygos lobe from pathological conditions is crucial to avoid unnecessary interventions.

Clinical Significance

Although the azygos lobe is asymptomatic in most cases, its presence holds diagnostic and surgical importance:

Imaging Mimics

The azygos fissure may resemble pathological entities such as bullae, abscesses, or pneumothorax on plain films. Consolidation can appear as a lung mass.[2]

Protection from Disease Spread

The mesoazygos sometimes works as a barrier, isolating the "azygos lobe" from infections or neoplastic processes in the adjacent lung. For example, cases of pulmonary tuberculosis rarely involve the azygos lobe. [8]

Oncological Considerations

Primary lung cancers in the azygos lobe are uncommon but have been reported. Notably, these cancers often present without regional lymph node involvement, simplifying treatment and improving prognosis.[9] For example, Fukuhara *et al.*[10] documented a case of adenocarcinoma localized within the azygos lobe, which was successfully managed using robotic-assisted thoracic surgery.

Surgical Implications

Azygos lobe complicates thoracic surgeries by altering the anatomy of the upper lobe. Its presence increases the risk of bleeding and prolongs operative times, particularly during video-assisted thoracic surgery (VATS) and sympathectomies.

Surgical Considerations

The atypical trajectory of the azygos vein and the distinct structure of the azygos fissure create complexities in thoracic surgical procedures. VATS techniques often require careful dissection to avoid injury to the vein and associated pleural layers. Successful resection of lesions within the azygos lobe has been reported using advanced techniques such as caudal traction, which provides circumferential exposure of the bronchovascular pedicle without extensive azygos vein dissection.[11]

Surgeons must be aware of this variant to adapt their approach and minimize complications. As an illustration, Darlong *et al.*[12] documented the effective removal of squamous cell carcinoma from the azygos lobe, achieving favorable results. However, preoperative imaging and planning remain critical to avoid intraoperative surprises.

Conclusion

The azygos lobe, though rare, holds significant clinical and surgical relevance. Understanding its embryology, anatomy, and radiological features is essential for accurate diagnosis and management. Awareness among clinicians, particularly radiologists and thoracic surgeons, can prevent misdiagnosis and improve treatment outcomes. Continued research and case documentation will further elucidate its implications in clinical practice.

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