

Research Paper: Azygos Lobe: The Prevalence, Dimensions, and Estimated Volume of Thirteen Cases Investigated by Computed Tomography



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ABSTRACT

Introduction: Surgery and diagnostic radiology have emphasized the significance of the azygos lobe as a normal variant of lungs. Therefore, this study investigated the prevalence, dimensions, and estimated volume of thirteen azygos lobes.

Methods: The chest CT scans of 789 patients (490 men and 297 women) were retrospectively analyzed for one year (2020-2021), in an Iranian population. Then, the dimensions of the azygos lobe, including Maximum Width (MW), Maximum Length (ML), and Maximum Height (MH), and also Estimated Volume (EV) were reported in total, men, and women.

Results: The total prevalence of the azygos lobe was 1.65%; it was 1.83%, and 1.34% in men and women, respectively, showing a higher prevalence in men. Also, Mean±SD MW, ML, MH, and EV were 47.76±19.28 mm, 60.03±15.91 mm, 46.44±11.91mm, and 88.831±80.18ml, respectively. No significant difference was detected between mean MW, ML, and MH. Although the dimensions and estimated volume were higher in men than in women, the differences were insignificant.

Conclusion: The literature provides no reliable and sufficient data about the size of azygos lobes, especially among the Iranian population. Data reported in this study can be of importance in diagnosis and preventing surgical complications, regarding the presence of the azygos lobe.

1. Introduction

Considered as a normal variant of lungs' anatomy, the azygos lobe produced by azygos fissure containing azygos vein and four layers of pleura is of significant medical importance [1, 2]. Although it is called the right azygos lobe, the literature has also reported the left azygos lobe [3]. During the development when the precursor of azygos vein—right posterior car-

dinal vein—fails to normally arches over the root of the lung to join with the superior vena cava, it penetrates the apex of the right lung separating it from the rest [1].

According to the literature, the azygos lobe was first recognized in 1777 by Wrisberg who reported azygos lobes in both lungs of a 3-year-old boy cadaver [2]. Therefore, the azygos lobe was initially called the “lobe of Wrisberg”, but after the year 1944, Crawford described it as “azygos lobe” [4]. Azygos lobe had been in-

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investigated in cadavers, and imaging modalities reported its prevalence from 0.4% to 1.2% [5].

The significance of the azygos lobe has been emphasized in surgery and diagnostic radiology [1, 2, 5]. It is crucial to be aware of the manifestation of the azygos lobe in chest radiography and Computed Tomography (CT) to distinguish it from lung masses, the tuberculosis-related fistula between a lymph node and esophagus, lung abscess, etc [1, 5, 6]. Thus, the clinicians, surgeons, and anatomists should be aware of this pulmonary variant since the presence of the azygos lobe can complicate thoracic surgery or thoracoscopy by increasing the risk of vascular injury and bleeding [2, 7].

Regarding the significance of the azygos lobe, this study investigated its different shapes in thirteen patients and reported the dimensions and estimated volume of this curious lobe.

2. Materials and Methods

Patients and computed tomography

The chest CT scans of 789 patients (490 men and 297 women) were retrospectively analyzed for one year (2020-2021), in the Medical Imaging Center of Dr Shariati Hospital, Mahdasht City, Alborz, Iran.

The CT imaging device was Hitachi Supria 16/32 with the power of 51 kW, the gantry bore of 75 cm, the scan range of 180 cm, a 5 MHU X-ray tube, and the minimum slice thickness of 0.675 mm. While acquiring the CT scans, patients had to stay still and hold their breath in deep inspiration to avoid motion artifacts. The CT scans of the chest with 7.5 mm thickness and 7.5 mm interval were acquired, then, the images were reconstructed with

thickness and interval of 1.25 mm to analyze the azygos lobe more accurately.

Parameters of the azygos lobe

The azygos lobe parameters are reported in mm (Figure 1) and include the Maximum Width (MW, medial to lateral), Maximum Length (ML, anterior to posterior), and Maximum Height (MH, superior to inferior) of the azygos lobe. These parameters were measured by the internal measuring software of the CT imaging machine. Moreover, the estimated volume was calculated by the following formula and reported in mm³.

$$\text{Estimated Volume} = \frac{MW \times ML \times MH}{2} \times 10^{-3}$$

Statistics analysis

To check the differences in the dimensions and estimated volume of the azygos lobes between males and females, normally distributed data (checked by the Kolmogorov-Smirnov test) were analyzed by independent t test using the SPSS v. 16. Data were reported as Mean±SD, and P≤0.05 was considered significant.

3. Results

Prevalence and demographic data

The chest CT scans of 787 Iranian patients with the age range of 17 to 94 years (Mean±SD: 39.92±19.05 years) were investigated in one year (2019-2021). A total number of 13 cases (1.65%) of the azygos lobe were found. The population included 490 men and 297 women, in which nine cases (1.83%) and four cases (1.34%) of azygos lobe were observed, respectively, showing a higher prevalence in men than in women.

Table 1. Dimensions and estimated volume

Parameters	Min	Max	Mean±SD		
			Men	Women	Total
MW (mm)	18.4	80.7	49±21.17	39.25±14.1	47.76±19.28
ML (mm)	36.6	90.3	63.65±16.91	51.9±11.04	60.03±15.91
MH (mm)	30	63.75	46.66±12.16	45.93±13.12	46.44±11.91
EV (mm ³)	10.10	27.12	104.23±91.29	54.18±34.35	88.83±80.18

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There is no significant difference between the dimensions and estimated volume of azygos lobe in male and female or in total (tested by t-test for two independent samples). Data is reported as Mean±SD; MW: Maximum width (mm), ML: Maximum length (mm), MH: Maximum height (mm), EV: Estimated volume (ml).

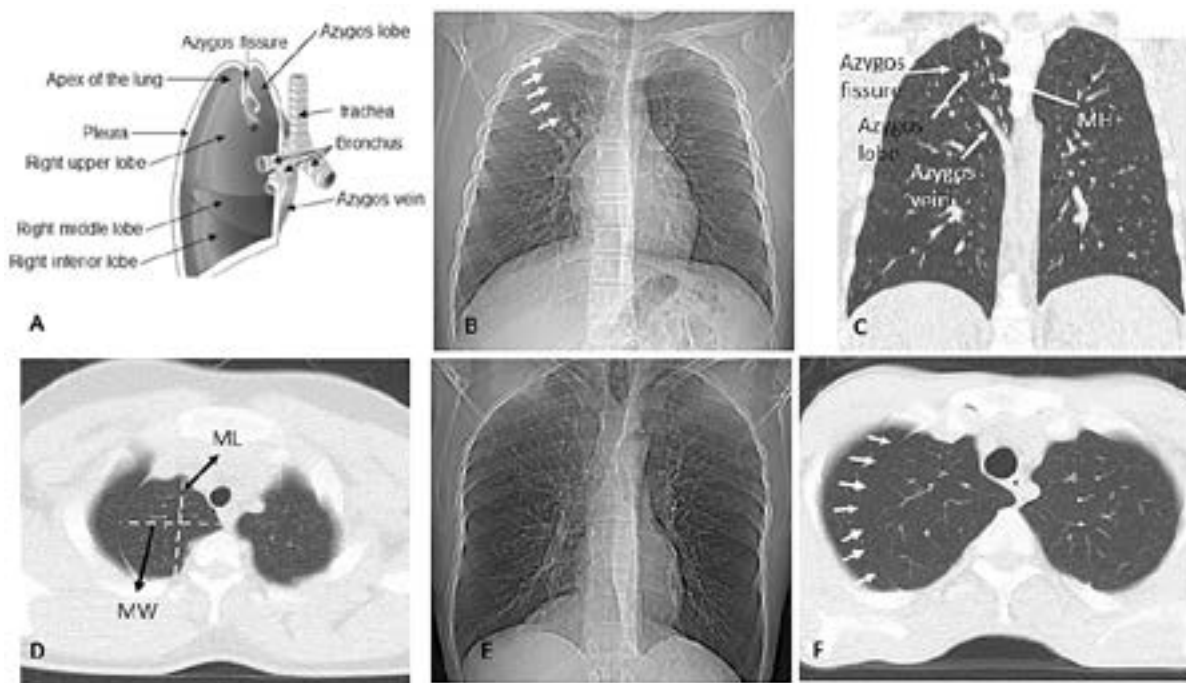


Figure 1. Azygos lobe

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A: Schematic figure showing azygos vein, azygos fissure, and azygos lobe [11]. B: Plain chest radiograph showing the location of azygos fissure. C: Reconstructed coronal computed tomography scan of the same patient in B, showing azygos vein, azygos lobe, and azygos fissure, and also the MH of azygos lobe. D: Axial computed tomography scan of lungs of the same patient in B showing the ML and MW of azygos lobe. E: Plain chest radiograph that shows no azygos fissure. F: Axial computed tomography scan of lungs of the same patient in E showing a very thin azygos fissure, which is not detectable in plain chest radiograph – this azygos lobe is the biggest of the thirteen cases.

Dimensions and estimated volume

Table 1 and Figure 2 represent the MW, ML, and MH of these thirteen cases. The Mean±SD MW, ML, and MH were 47.76±19.28 mm, 60.03±15.91 mm, and 46.44±11.91 mm, respectively. However, no significant difference was detected between mean MW, ML, and

MH. Also, these factors were separately investigated in men and women; in men, MW, ML, and MH were 49±21.17 mm, 63.65±16.91 mm, and 46.66±12.16 mm respectively, and in women, were 39.25±14.1 mm, 51.9±11.04 mm, and 45.93±13.12mm, respectively. Although the azygos lobe dimensions were higher in men

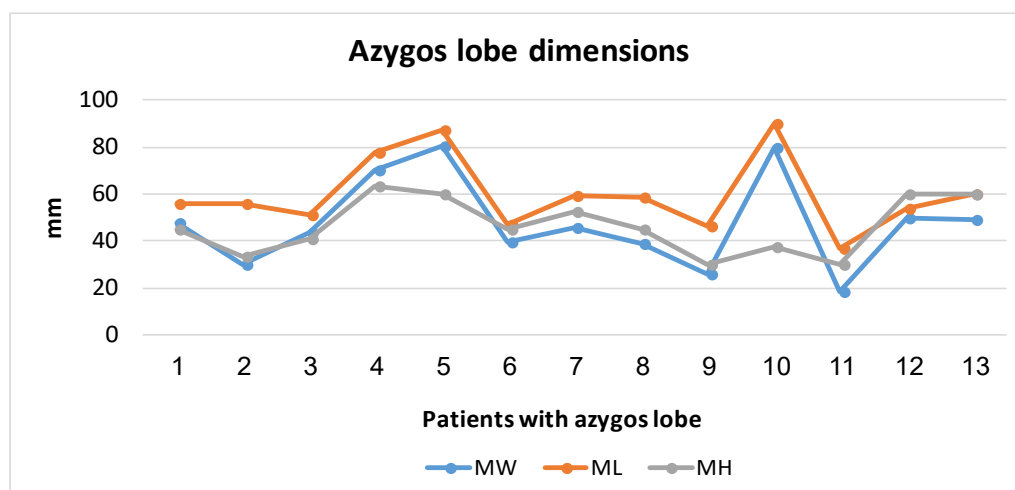
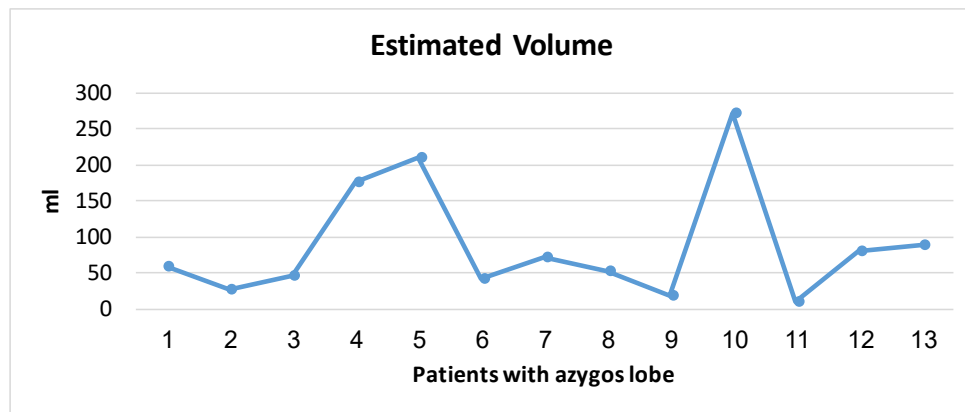


Figure 2. Dimensions of thirteen Azygos lobe cases

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MW: Maximum Width; ML: Maximum Length; MH: Maximum Height.



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Figure 3. Estimated volume diagram
Estimated volume of thirteen azygos lobe cases.

than in women, no significant difference was detected between mean MW, ML, and MH.

According to Table 1 and Figure 3, the mean total estimated volume was $88.831.82 \pm 80.182.03$. The estimated volume in men and women was $104.230.7 \pm 91.291.04$ and $54.184.33 \pm 34.358.66$, respectively. Although the estimated volume of the azygos lobe in men was higher than in women, no significant difference was detected.

4. Discussion

Investigation of the azygos lobe in the Iranian population was previously reported neither in cadaveric studies nor imaging studies. The total incidence of the azygos lobe in the present CT imaging study was 1.65%. In men and women, it was 1.83% and 1.34%, respectively. The prevalence of the azygos lobe has been reported as 1%, 0.4%, and 1.2% in the cadaveric investigations, chest radiographs, and CT scans, respectively [1, 5, 8]. Compared with CT scans, the lower detection rate of the azygos lobe in chest radiographs can be attributed to the higher accuracy and multiplanar imaging in CT scans, which makes the detection of very thin azygos fissures possible. Also, a prevalence rate of 2.6% had been reported in imaging investigation [9].

This study reported the dimensions of azygos lobes, including MW, ML, and MH as well as the estimated volume of azygos lobe. Scarce studies in the literature regarded the dimensions of the azygos lobe. One study investigated the azygos lobe in the South African cadaveric population and reported only four azygos lobes with an average MW of 4.5 ± 0.44 cm and an average MH of 6.7 ± 1.46 cm [2]. In our study, we reported the average MW as 4.77 ± 1.92 cm, average ML as 6 ± 1.59 cm, and average MH as 4.64 ± 1.19 cm. Although the measure-

ments of MW are close to what is reported by Rauf [2], the measurements of MH are less than what is reported in his study. Since we reported 13 cases of azygos lobe, our data can be regarded as more reliable.

Studies report the significance of the azygos lobe since it can be considered a misdiagnosis in plain chest radiographs as a right paratracheal opacity [5], make thoracic surgeries difficult or even dangerous [5], and accompany other abnormalities, such as intrapulmonary right cephalic vein [10], esophageal atresia [11], etc.

5. Conclusion

Regarding the azygos lobe as an important variant of lungs, this study reports the dimensions, and estimated volume of thirteen azygos lobe investigated by CT in the Iranian population. As far as the authors are concerned, no reliable and sufficient data are available about the size of azygos lobes in the literature. Data reported in this study can be of significance in diagnosis and surgical procedures.

Ethical Considerations

Compliance with ethical guidelines

All ethical principles are considered in this article. The participants were informed about the purpose of the research and its implementation stages. They were also assured about the confidentiality of their information. They were free to leave the study whenever they wished, and if desired, the research results would be available to them.

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Authors' contributions

Conceptualization, methodology, software, validation, investigation: Mehrdad Ghorbanlou; Resources, data curation, writing – original draft preparation, writing – review & editing, visualization, supervision, project administration, and funding acquisition: Mehrdad Ghorbanlou and Fatemeh Moradi.

Conflict of interest

The authors declared no conflict of interest.

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