Research Article

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Evaluation of tracheobronchial angles on computed tomography in patients with pneumomediastinum

Pnömomediastinumlu hastalarda bilgisayarlı tomografide trakeobronşiyal açıların değerlendirilmesi

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Abstract

Purpose: To investigate tracheobronchial diameters and tracheobronchial bifurcation angles on computed tomography (CT) in patients with pneumomediastinum.

Materials and methods: CT scans of 63 patients with pneumomediastinum (PP) and 63 patients with normal CT findings (PN) were retrospectively evaluated in the Radiology Archives of our hospital. In PP, the extent of mediastinal air on CT images was visually classified into three grades. Thoracic anteroposterior distance (TAPD) and transverse thoracic distance (TTD), anteroposterior (AP) diameters of the trachea and bronchi, tracheal length (TL), right main bronchus angle (RMBA), left main bronchus angle (LMBA), subcarinal angle (SCA), and interbronchial angle (IBA) were measured on CT images in all patients. All measurements were compared between patients with and without pneumomediastinum.

Results: A significant sex-related difference was observed in thoracic AP diameter and left main bronchus diameter in the PN group. Among PP, 22.2% (n=14) were grade 1, 30.2% (n=19) were grade 2, and 47.6% (n=30) were grade 3.

Tracheal length and left main bronchus diameter were higher in PN patients compared to PP patients. The mean SCA was 75.06±23.40° in the PP group and was significantly greater than in the PN group (p=0.001). LMBA was significantly higher in the PN group compared with the PP group (p=0.003).

Conclusion: Individuals with a narrower LMBA, shorter tracheal length, larger thoracic AP diameter, and wider SCA may be at greater risk of developing pneumomediastinum in the setting of barotrauma.

Keywords: Pneumomediastinum, subcarinal angle, trachea, bronchi, computed tomography.

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Öz

Amaç: Pnömomediastinumlu hastalarda bilgisayarlı tomografide (BT) trakeobronşiyal çapları ve trakeobronşiyal bifurkasyon açılarını araştırmak.

Gereç ve yöntem: Hastanemizin Radyoloji Arşivinde, pnömomediastinumlu (PP) 63 hasta ve normal BT bulguları olan (PN) 63 hastanın BT taramaları retrospektif olarak değerlendirildi. Pnömomediastinumlu hastalarda, BT görüntülerindeki mediastinal hava miktarı görsel olarak üç dereceye ayrıldı. Tüm hastalarda BT görüntülerinde torasik anteroposterior mesafe (TAPD) ve transvers torasik mesafe (TTD), trakea ve bronşların anteroposterior (AP) çapları, trakea uzunluğu (TL), sağ ana bronş açısı (RMBA), sol ana bronş açısı (LMBA), subkarinal açı (SCA) ve interbronşiyal açı (IBA) ölçüldü. Tüm ölçümler pnömomediastinumlu ve pnömomediastinumsuz hastalar arasında karşılaştırıldı.

Bulgular: PN grubunda torasik AP çapı ve sol ana bronş çapında cinsiyete bağlı anlamlı bir fark gözlendi. Pnömomediastinumlu hastalar arasında %22,2'si (n=14) 1. derece, %30,2'si (n=19) 2. derece ve %47,6'sı (n=30) 3. dereceydi. PN hastalarında trakea uzunluğu ve sol ana bronş çapı, PP hastalarına göre daha yüksekti. PP grubunda ortalama SCA 75,06±23,40° idi ve PN grubuna göre anlamlı derecede daha büyüktü (p=0,001). LMBA, PN grubunda PP grubuna göre anlamlı derecede daha yüksekti (p=0,003).

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Sonuç: Daha dar LMBA, daha kısa trakea uzunluğu, daha büyük torasik AP çapı ve daha geniş SCA'ya sahip bireyler, barotravma durumunda pnömomediastinum gelişme riski daha yüksek olabilir.

Anahtar kelimeler: Pnömomediastinum, subkarinal açı, trakea, bronşlar, bilgisayarlı tomografi.

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Introduction

Pneumomediastinum develops when air enters the mediastinum due to disruption of the anatomical structures within or adjacent to this compartment. It is classified as either primary (spontaneous) or secondary, depending on etiological factors such as iatrogenic injury or trauma [1, 2]. In the etiopathogenesis of spontaneous pneumomediastinum, a sudden increase in intrathoracic pressure leads to disruption of the mucosal barrier in the tracheobronchial tree or esophagus, allowing gas to escape into the mediastinum. Increased intra-alveolar pressure may subsequently cause alveolar rupture, enabling air to dissect along the bronchovascular sheath toward the pulmonary hilum and mediastinum—a mechanism known as the Macklin effect [3, 4]. The incidence of pneumomediastinum has been reported as approximately 2 per 10,000 individuals, and patients frequently present with dyspnea and chest pain, particularly in traumatic cases [5]. Chest radiography and thoracic computed tomography (CT) are the primary modalities used for diagnosis.

The anatomical characteristics of the tracheobronchial tree vary according to race and age [6, 7]. Although distance-measurement methodologies differ among studies, angle measurements have generally been performed using similar techniques. The subcarinal angle (SCA) is defined as the angle formed between the right and left main bronchi at the level of the tracheal bifurcation, whereas the interbronchial angle (IBA) refers to the angle between the longitudinal axes of both main bronchi. Knowledge of tracheobronchial anatomy is clinically important during procedures such as bronchoscopy, endotracheal intubation, and surgeries involving the tracheobronchial tree. Moreover, tracheobronchial angles may be altered in cardiac pathology, postoperative states, and other conditions that affect the mediastinum [8-10].

The aim of this study is to evaluate tracheobronchial diameters and bifurcation angles on computed tomography in patients with spontaneous pneumomediastinum.

Materials and methods

Our study started after the approval of the Non-Interventional Clinical Research Ethics Committee of Pamukkale University Faculty of Medicine (approval date: 02.22.2024, approval number: E-60116787-020-494146).

Study group

Between January 2021 and January 2023, patients with pneumomediastinum (PP) were identified in the Emergency Radiology Archive of Pamukkale University Faculty of Medicine Hospital by screening CT reports in the hospital information management system. The clinical histories and CT images of these patients were retrospectively reviewed. CT examinations of patients with a history of sternal or thoracic surgery, thoracic or costosternal anomalies, interstitial lung disease, oncological, lymphoproliferative, or hematological disorders, infectious parenchymal diseases (e.g., viral or bacterial pneumonia), tracheobronchial anomalies or variations; or trauma-related indications for CT were excluded from the study. A total of 63 patients with spontaneous pneumomediastinum (40 males, 23 females; age range: 18-76 years; mean age: 42.92±22.48 years) and 63 individuals with normal CT findings (49 males, 14 females; age range: 18-74 years; mean age: 30.57±13.8 years) were included. All CT scans were retrospectively evaluated by two radiologists who were blinded to each other’s assessments.

Computed tomography

CT examinations were performed using a 128-detector multidetector CT scanner (Ingenuity 128; Philips Healthcare, Cleveland, OH, USA) and a 64-detector multidetector CT scanner (LightSpeed VCT 64; GE Healthcare, Milwaukee, WI, USA). The imaging parameters for the CT scanner with 128 detectors were as follows: tube voltage 100 kV; tube current 150-200 mAs; slice thickness 1.5 mm; collimation 3x1.5 mm; matrix 512x512; rotation time 0.4 seconds; and field of view (FOV) 500 mm. For patients without contraindications for iodinated contrast media in their CT scans, 50-100 ml nonionic contrast material (300 mg/ml I) was administered via the antecubital vein at a rate of 3.5-4 ml/s. All CT scans were evaluated in the mediastinal (WW: 350, WL: 60) and lung (WW: -600, WL: 1600) window axial and coronal planes.

Image analysis

CT images of the patients included in the study were evaluated to measure the anteroposterior (AP) diameter of the trachea 2 cm above the carina, tracheal length, and the AP diameter of the main bronchi 2 cm distal to the carina. On axial CT images, the thoracic anteroposterior distance (TAPD) and transverse thoracic distance (TTD) were measured at the level of the carina (Figure 1).

In this study, the subcarinal angle (SCA) was defined as the angle between the right and left main bronchi on coronal reformatted CT images. The right main bronchus angle (RMBA) and left main bronchus angle (LMBA) were obtained by measuring the angle between the longitudinal axis of the trachea and the longitudinal axis of each main bronchus on coronal reformatted images. In addition, the interbronchial angle (IBA) was defined as the angle formed between the longitudinal axes of the right and left main bronchi (Figure 2).

In PP, the extent of mediastinal air was visually graded into three categories. Air predominantly localized in the superior paratracheal region was classified as grade 1; air extending inferiorly to the level of the carina was classified as grade 2; and diffuse mediastinal air was classified as grade 3 (Figure 3).

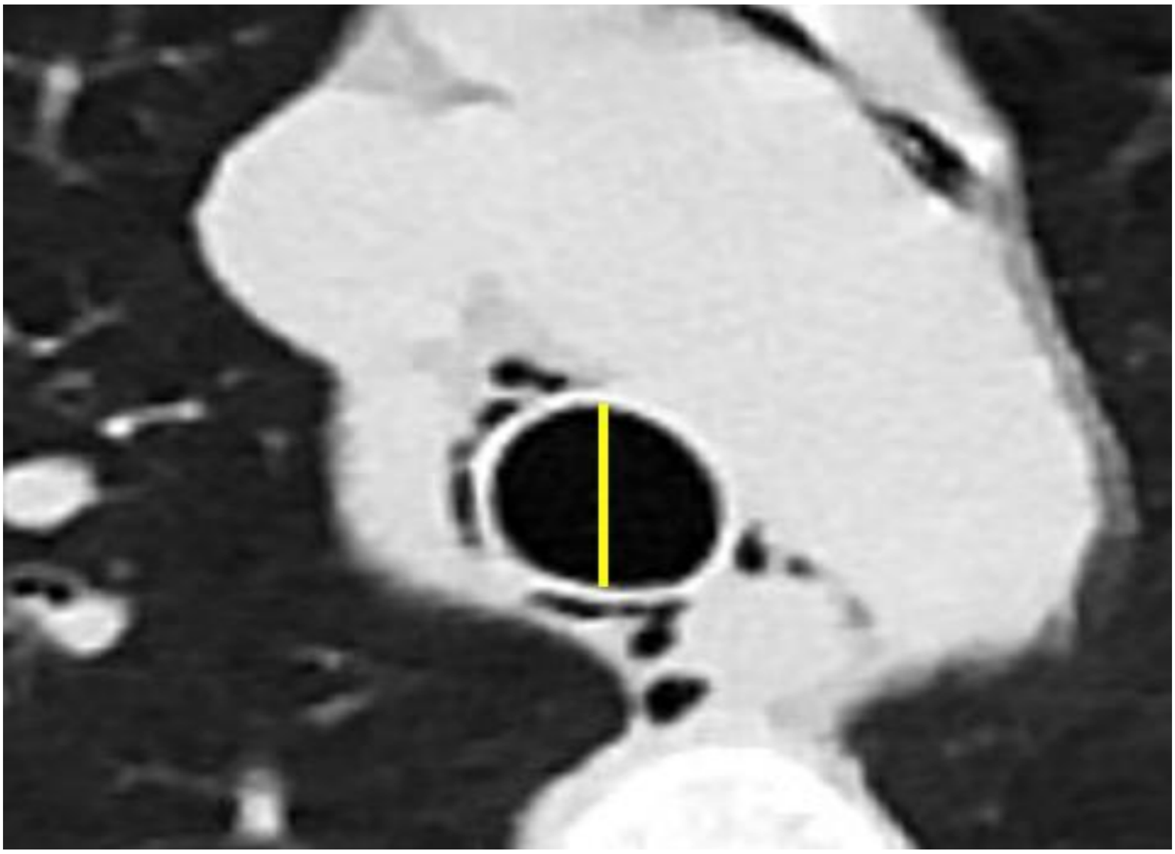

Figure 1a. Measurement of the anteroposterior (AP) diameter of the trachea on an axial CT image, 2 cm proximal to the carina

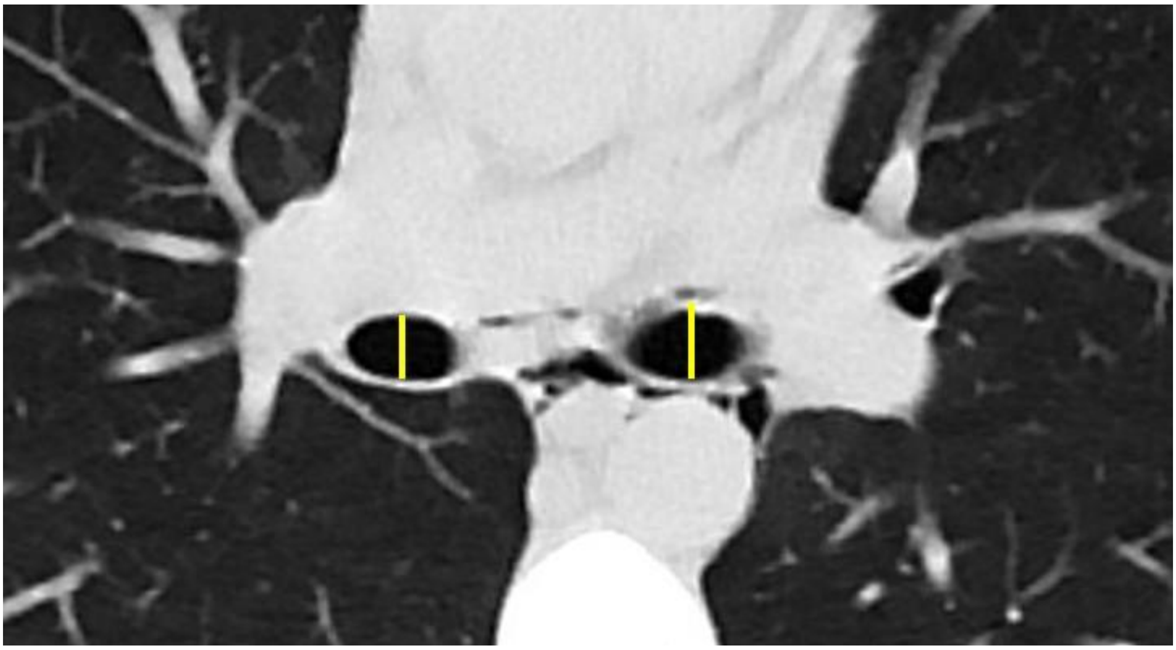

Figure 1b. Measurement of AP diameters of the main bronchi on an axial CT image, 2 cm distal to the carina

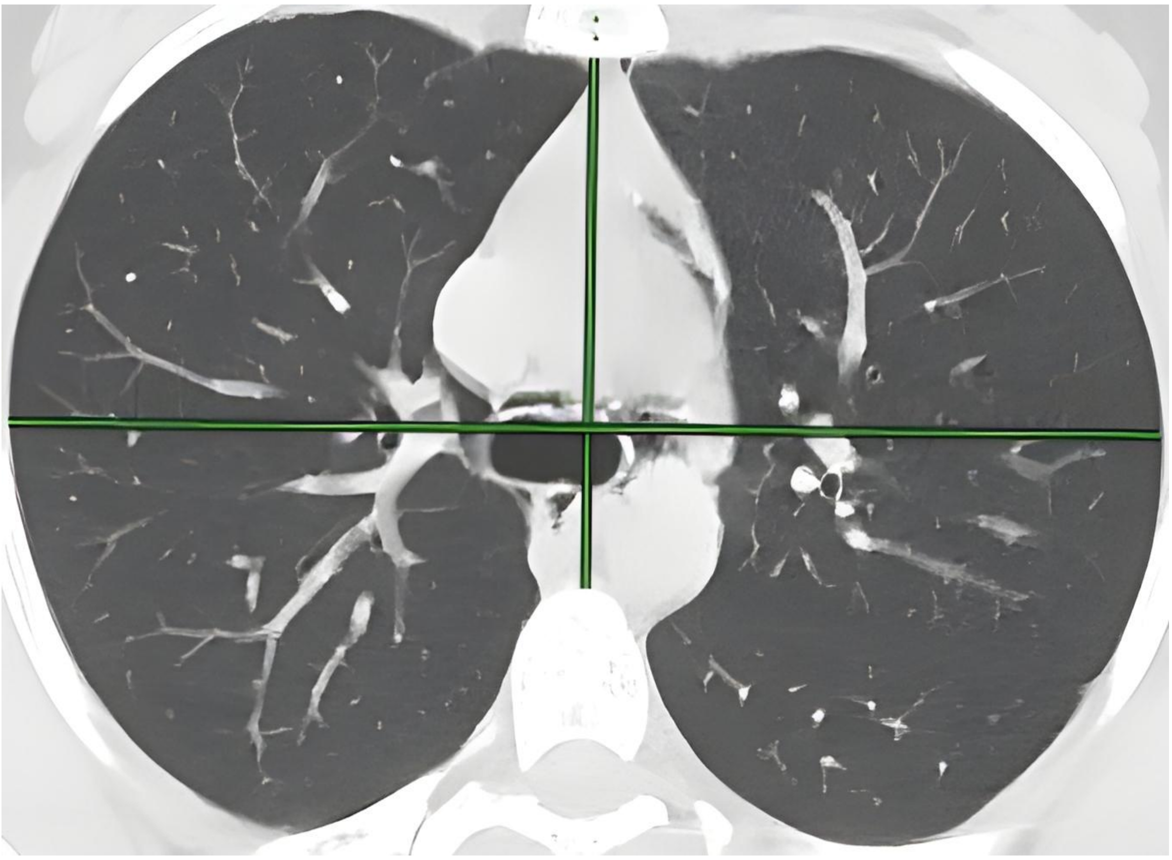

Figure 1c. Thoracic anteroposterior and transverse distances measured at the carinal level on an axial CT image

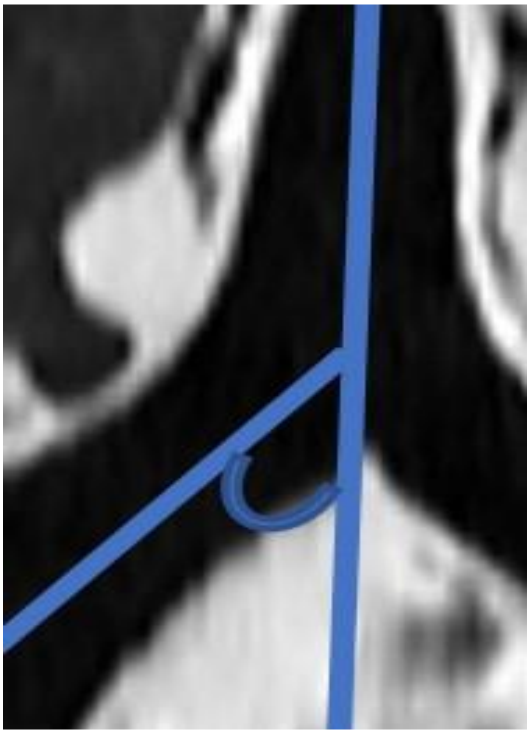

Figure 2a. Right main bronchus angle (RMBA): The angle between a vertical line passing through the center of the trachea and a line passing through the center of the right main bronchus on a coronal reformatted CT image

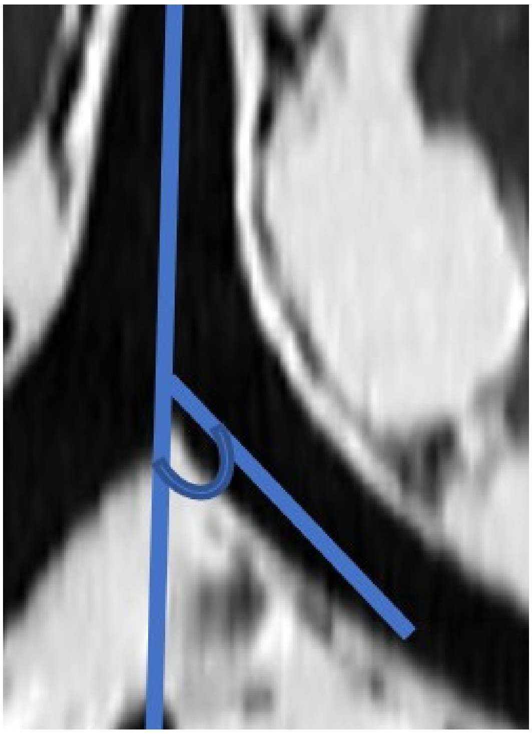

Figure 2b. Left main bronchus angle (LMBA): The angle between a vertical line passing through the center of the trachea and a line passing through the center of the left main bronchus on a coronal reformatted CT image

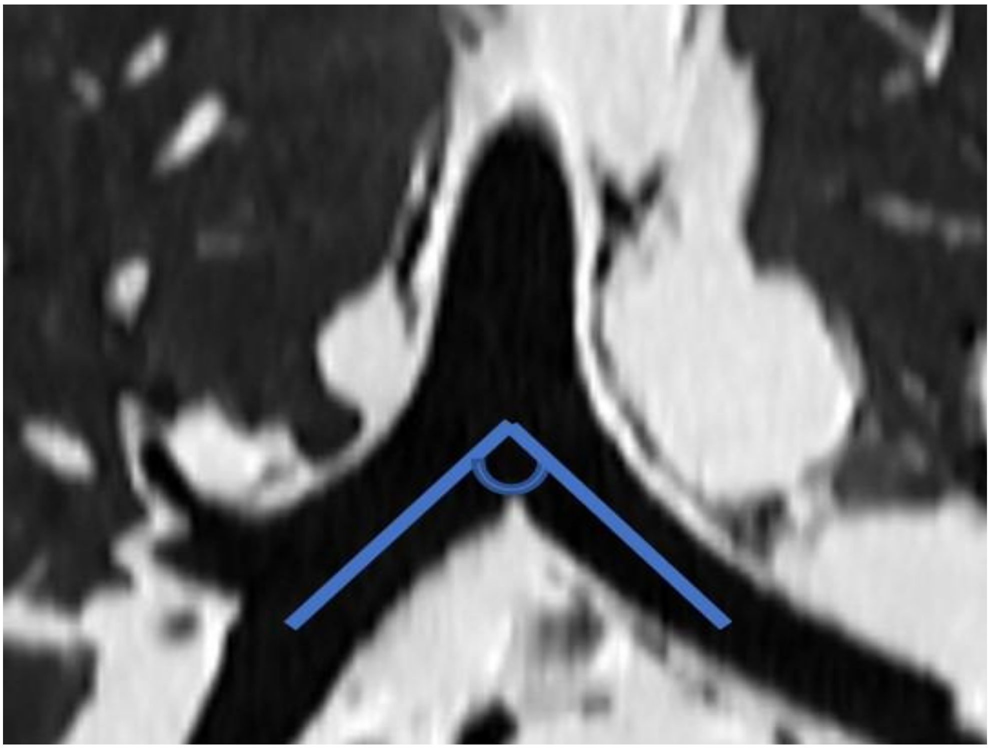

Figure 2c. Interbronchial angle (IBA): The angle formed between the longitudinal axes of the right and left main bronchi on a coronal reformatted CT image

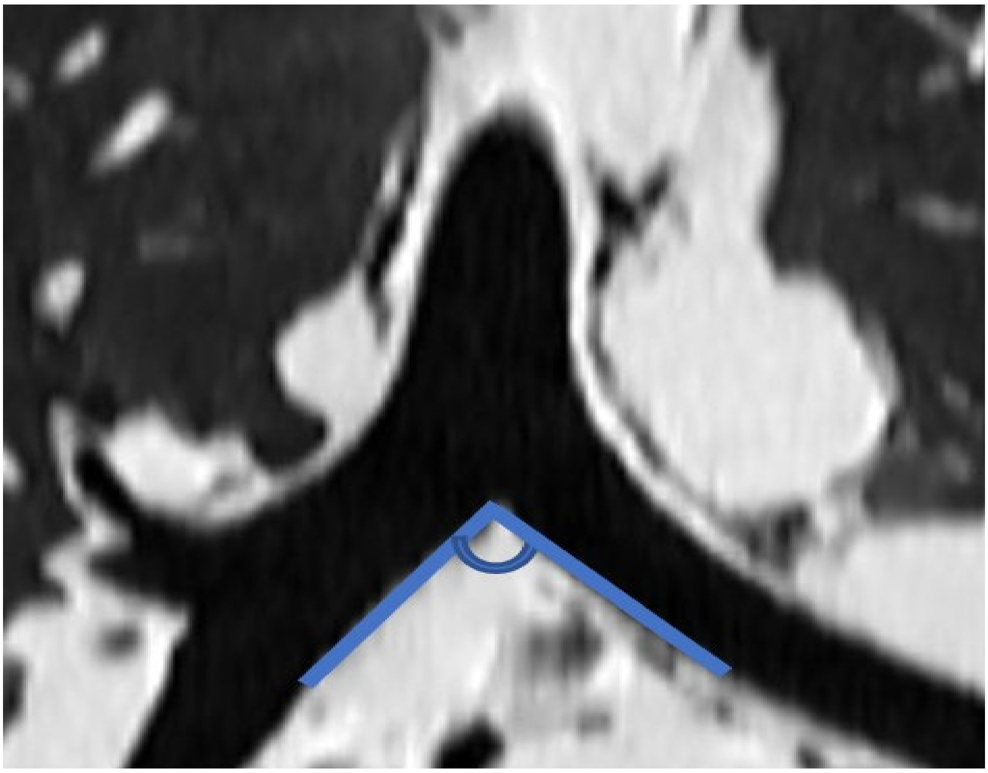

Figure 2d. Subcarinal angle (SCA): The angle formed by the intersection of the inferior margins of the right and left main bronchi on a coronal reformatted CT image

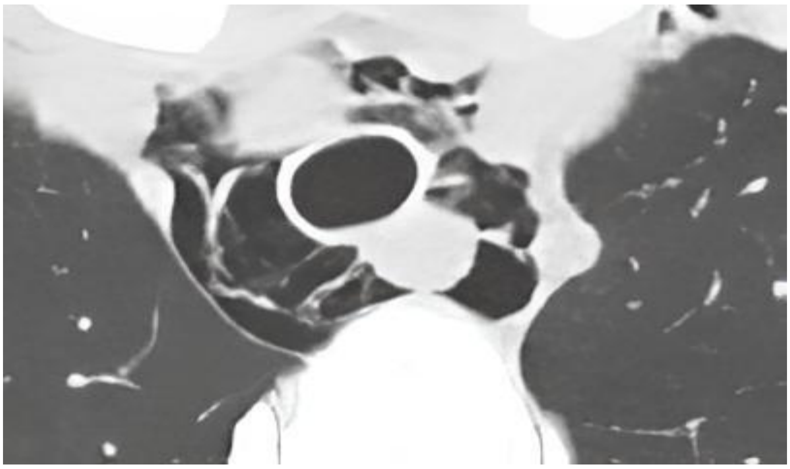

Figure 3a. Grade 1 pneumomediastinum: Air localized in the superior paratracheal region on an axial CT image

Figure 3b. Grade 2 pneumomediastinum: Mediastinal air extending inferiorly down to the level of the carina on an axial CT image

Figure 3c. Grade 3 pneumomediastinum: Diffuse mediastinal air involving the lower mediastinum on an axial CT image

Statistical analysis

Data analysis was performed using SPSS software (version 27.0 for Windows; IBM Corp., Armonk, NY). Descriptive statistics were presented as mean ± standard deviation for continuous variables and as frequencies and percentages for categorical variables. Independent-samples t-tests were used to compare continuous variables. Pearson correlation analysis was also performed for the group of PP. A p-value <0.05 was considered statistically significant. Interobserver reliability between the two radiologists was assessed using intraclass correlation coefficient (ICC) analysis with corresponding 95% confidence intervals.

Results

In the study group, significant differences were observed between patients with and without pneumomediastinum in thoracic transverse diameter, tracheal diameter and length, and right main bronchus diameter when analyzed by sex. In the group without pneumomediastinum, thoracic anteroposterior (AP) diameter and left main bronchus diameter also differed significantly between males and females (Table 1).

Table 1. Comparison of tracheobronchial angles and diameters in patients with and without pneumomediastinum according to gender

Pneumomediastinum		Negative			Positive		
	Sex	**n**	**Mean ± SD**	***p***	**n**	**Mean ± SD**	***p***
TAPD	M	49	137.86±16.2 mm	0.02* (t=2.382)	40	142.65±18.7 mm	0.96 (t=0.050)
	W	14	125.43±20.5 mm		23	142.39±21.4 mm	
TTD	M	49	222.50±15.1 mm	0.001* (t=5.089)	40	227.23±19.4 mm	0.001* (t=3.790)
	W	14	205.43±9.6 mm		23	209.13±15.9 mm	
TL	M	49	103.16±10.1 mm	0.01* (t=2.598)	40	91.10±13.5 mm	0.002* (t=3.290)
	W	14	95.21±10.1 mm		23	80.13±11.1 mm	
TD	M	49	16.32±1.9 mm	0.001* (t=5.087)	40	17.13±3.4 mm	0.08* (t=1.757)
	W	14	13.50±1.2 mm		23	15.70±2.4 mm	
RMBD	M	49	11.58±1.5 mm	0.001* (t=4.492)	40	11.45±2.6 mm	0.05* (t=2.019)
	W	14	9.57±0.9 mm		23	10.13±2.1 mm	
LMBD	M	49	10.34±1.6 mm	0.001* (t=4.168)	40	9.58±2.3 mm	0.10 (t=1.626)
	W	14	8.43±0.8 mm		23	8.65±1.7 mm	
RMBA	M	49	36.00±9.1°	0.89 (t=-0.142)	40	36.73±9.6°	0.80 (t=-0.243)
	W	14	36.36±4.5°		23	37.30±7.9°	
LMBA	M	49	35.76±8.1°	0.19 (t=-1.299)	40	30.88±8.6°	0.22 (t=-1.204)
	W	14	39.14±10.5°		23	33.57±7.6°	
SCA	M	49	60.72±19.4°	0.11 (t=-1.604)	40	71.58±23.8°	0.12 (t=-1.579)
	W	14	69.50±11.6°		23	81.13±21.7°	
IBA	M	49	71.76±11.8°	0.31 (t=-1.021)	40	67.80±18.1°	0.49 (t=-0.692)
	W	14	75.50±13.1°		23	70.87±14.6°	

TAPD= Thoracic anteroposterior distance, TTD= Transverse thoracic distance, TL= Tracheal length, TD= Tracheal Diameter
RMBD= Right Main Bronchus Diameter, LMBD= Left Main Bronchus Diameter, RMBA= Right Main Bronchus Angle
LMBA= Left Main Bronchus Angle, SCA= Subcarinal Angle, IBA= Interbronchial Angle, M= Men, W= Women, n= number of patient
*=p<0.05, t: Independent samples t test

Although the study population consisted entirely of adults, no significant age-related differences were found in thoracic distance or angle measurements in the group without pneumomediastinum. In contrast, in the PP group, thoracic AP diameter (r=0.587) and tracheal diameter (r=0.445) showed significant positive correlations with age. Correlation analysis also demonstrated strong relationships between the diameters of the main bronchi and the trachea, as well as between the subcarinal angle and other tracheobronchial angles (Table 2).

Table 2. Correlation analysis of tracheobronchial angles and diameters in patients with pneumomediastinum

		TAPD	TTD	TL	TD	RMBD	LMBD	RMBA	LMBA	SA	IBA
Age	**Pearson r**	0.587	-0.266	0.135	0.445	0.299	0.191	-0.103	-0.098	0.038	-0.110
	p	0.000	0.035	0.293	0.000	0.017	0.133	0.420	0.445	0.767	0.393
TAPD	**Pearson r**		0.190	0.179	0.419	0.351	0.355	-0.026	-0.006	0.210	-0.017
	p		0.135	0.161	0.001	0.005	0.004	0.838	0.960	0.099	0.895
TTD	**Pearson r**			0.389	0.068	0.310	0.315	-0.160	-0.239	-0.226	-0.192
	p			0.002	0.594	0.014	0.012	0.211	0.059	0.075	0.132
TL	**Pearson r**				0.158	0.460	0.424	-0.233	-0.283	-0.202	-0.267
	p				0.217	0.000	0.001	0.066	0.025	0.113	0.034
TD	**Pearson r**					0.693	0.569	-0.267	-0.241	-0.174	-0.261
	p					0.000	0.000	0.034	0.057	0.173	0.039
RMBD	**Pearson r**						0.836	-0.471	-0.402	-0.353	-0.455
	p						0.000	0.000	0.001	0.005	0.000
LMBD	**Pearson r**							-0.437	-0.388	-0.350	-0.431
	p							0.000	0.002	0.005	0.000
RMBA	**Pearson r**								0.835	0.807	0.962
	p								0.000	0.000	0.000
LMBA	**Pearson r**									0.786	0.952
	p									0.000	0.000
SCA	**Pearson r**										0.828
	p										0.000

TAPD= Thoracic anteroposterior distance, TTD= Transverse thoracic distance, TL= Tracheal length, TD= Tracheal Diameter
RMBD= Right Main Bronchus Diameter, LMBD= Left Main Bronchus Diameter, RMBA= Right Main Bronchus Angle
LMBA= Left Main Bronchus Angle, SCA= Subcarinal Angle, IBA= Interbronchial Angle

Among PP, 22.2% (n=14) were classified as grade 1, 30.2% (n=19) as grade 2, and 47.6% (n=30) as grade 3. No statistically significant association was found between pneumomediastinal grade and either sex or age. The mean thoracic AP distance was significantly greater in PP (142.56±19.62 mm) compared with those without pneumomediastinum (*p*=0.028).

Tracheal length and left main bronchus diameter were significantly higher in the group without pneumomediastinum than in the PP group. No significant differences were found between the two groups in thoracic transverse diameter or in the diameters of the trachea and right main bronchus.

The mean subcarinal angle was 75.06°±23.40° in the PP group, significantly greater than in the group without pneumomediastinum (p=0.001). Conversely, the angle between the trachea and the left main bronchus (LMBA) was significantly larger in patients without pneumomediastinum compared with those with pneumomediastinum (p=0.003) (Table 3).

Interobserver agreement for the measurements of TAPD, TTD, RMBA, LMBA, SCA, and IBA on CT images was excellent, with an ICC score ranging between 0.896-0.924 (95% CI).

Table 3. Comparison of tracheobronchial angles and tracheobronchial diameters according to the presence of pneumomediastinum

	Pneumomediastinum	**Mean±SD**	***p***
TAPD	Negative	135.14±17.8 mm	0.028* (t=-2.225)
	Positive	142.56±19.6 mm	
TTD	Negative	218.77±15.7 mm	0.56 (t=-0.577)
	Positive	220.62±20.1 mm	
TL	Negative	101.42±10.5 mm	0.001* (t=6.587)
	Positive	87.10±13.7 mm	
TD	Negative	15.70±2.1 mm	0.06 (t=-1.870)
	Positive	16.60±3.1 mm	
RMBD	Negative	11.14±1.6 mm	0.65 (t=0.447)
	Positive	10.97±2.5 mm	
LMBD	Negative	9.92±1.7	0.05* (t=1.962)
	Positive	9.24±2.1	
RMBA	Negative	36.08±8.2°	0.57 (t=-0.558)
	Positive	36.94±9.1°	
LMBA	Negative	36.50±8.6°	0.003* (t=3.072)
	Positive	31.86±8.3°	
SCA	Negative	62.64±18.3°	0.001* (t=-3.327)
	Positive	75.06±23.3°	
IBA	Negative	72.58±12.1°	0.16 (t=1.401)
	Positive	68.92±16.8 °	

TAPD= Thoracic anteroposterior distance, TTD= Transverse thoracic distance, TL= Tracheal length, TD= Tracheal Diameter RMBD= Right Main Bronchus Diameter, LMBD= Left Main Bronchus Diameter, RMBA= Right Main Bronchus Angle LMBA= Left Main Bronchus Angle, SCA= Subcarinal Angle, IBA= Interbronchial Angle, *= p<0.05, t: Independent samples t test

Discussion

Tracheobronchial angles include the right and left main bronchus angles (RMBA and LMBA), which are measured between each main bronchus and the trachea, the interbronchial angle (IBA), which is measured between the right and left main bronchi, and the subcarinal angle (SCA). These angles may widen in the presence of cardiac pathologies, pericardial effusion, neoplastic processes, or other mediastinal conditions and may decrease following lung lobectomy. Ruan et al. [11] reported that changes in SCA were positively correlated with left atrial size. In addition to cardiomegaly and heart failure, chronic obstructive pulmonary disease (COPD) has also been associated with alterations in tracheobronchial angles [6].

In our study, the tracheobronchial angle measurements in the group without pneumomediastinum were as follows: RMBA 36.08±8.27°, LMBA 36.50±8.66°, IBA 72.58±12.11°, and SCA 62.64±18.33°. All tracheobronchial angles were strongly correlated with one another. Karabulut [12] reported that both IBA and SCA were larger in women than in men and demonstrated a correlation between these angles and left atrial dimensions. Kahraman et al. [13] found that tracheal bifurcation angles increased with age. Khade et al. [14] found that although SCA was larger in men, the difference by sex was not statistically significant. Ulusoy et al. [15] separately defined the right and left subcarinal angles (analogous to RMBA and LMBA) and the right and left interbronchial angles. They reported right and left SCA values of 34.5±8.1° and 38.1±8.9°, respectively, and right and left IBA values of 32.4±7.7° and 35.2±8.1°. In their study, SCA values were larger in women than in men. Mi et al. [10] similarly reported that SCA was wider in women than in men and found RMBA and LMBA values of 34.9° and 42.5°, respectively. Fernandes and Pradhan [8] found no significant sex-related difference in SCA, but reported significantly larger SCA values in adults aged 20-40 years compared with those aged 41-60 years. Parry et al. [9] likewise reported higher SCA values in women than in men. In our study, all tracheobronchial angles were higher in women than in men, although these differences were not statistically significant (Table 4).

Table 4. Summary of tracheobronchial angle and diameter values in the english literature

Study	n	IBA	SCA	
Karabulut et al. (2005) [12]	120	77°±13°	73°±16°	
Khade et al. (2016) [14]	110	-	79.92°±11.6°	
Fernandes et al. (2016) [8]	110	-	69.75°±3.38°	
Herek et al. (2017) [7]	118	85.5º±10*	81.8º±11 º	
Mi et al. (2015) [10]	2500	-	W 80.1°±13.4°	M 75.1°±13.4°
Parry et al. (2019) [9]	552	-	W 78.90°±11.04°	M 67.60°±14.55°
Kahraman S et al. (2023) [13]	1511	73.3°±13.7°	-	
Our study	126	72.58±12.11º	62.64±18.33º	

n=number of patient, IBA=Interbronchial Angle, SCA=Subcarinal Angle, W=women, M=Men

Tracheobronchial angle measurements in pediatric populations differ markedly from those in adults. Since our study included only adults, pediatric comparisons could not be made. Wani et al. [16] reported mean right and left bronchial angles of 42±7° and 43±9°, respectively, with no significant correlation between bronchial angles and age. Herek et al. [7] found that tracheal bifurcation angles were wider in children aged 10 years or younger, with SCA, IBA, and RMBA values decreasing with age. In their study, RMBA ranged from 40.2±6.4° to 41.3±6.6°, LMBA from 41.6±5.6° to 42.4±7.3°, and SCA from 81.8±11° to 83.7±13° in children under 10 years of age.

In patients without pneumomediastinum, thoracic anteroposterior (AP) and transverse diameters were measured at the level of the carina, tracheal length was measured on coronal reformatted images, and the AP diameters of the trachea and main bronchi were obtained at locations close to the carina. All thoracic morphological measurements were significantly greater in men than in women; however, no age-related differences were detected. These findings are consistent with previous reports in the literature. Mi et al. [10] reported a mean tracheal length of 104.9±13.4 mm, with measurements significantly higher in men

(107.8±13.2 mm) than in women (101.4±12.8 mm). Matsuoka et al. [17] reported a tracheal length range of 8.8-14.4 cm in 215 adults and noted that the intrathoracic tracheal segment was significantly longer in men than in women. Adhikari et al. [18] found that tracheal length averaged 109.5±8.9 mm in men and 100.5±7.4 mm in women and reported that the AP tracheal diameter was also larger in men (15.7±2.4 mm) than in women (12.9±2.2 mm). These authors concluded that airway dimensions are generally greater in males than in females.

In our pneumomediastinum cohort, the extent of mediastinal air was visually categorized into three grades: grade 1 for air predominantly in the superior paratracheal region, grade 2 for air extending to the carina, and grade 3 for diffuse mediastinal air. Of the patients with pneumomediastinum, 22.2% were classified as grade 1, 30.2% as grade 2, and 47.6% as grade 3. No significant association was found between pneumomediastinum grade and sex or age.

Thoracic AP diameter at the carinal level was significantly greater in patients with pneumomediastinum compared with controls. Conversely, tracheal length was significantly shorter in the pneumomediastinum group. SCA was significantly wider in patients with pneumomediastinum, whereas LMBA was significantly narrower compared with the control group. Onoe et al. [6] evaluated tracheobronchial angles during inspiration and expiration in patients with COPD and reported that LMBA was significantly smaller in expiration, while the angle between the right and left main bronchi (equivalent to IBA in our study) was significantly larger. These findings support our results and suggest that barotrauma-often associated with Valsalva maneuvers-may facilitate alveolar rupture in individuals with a narrower LMBA, wider SCA, shorter trachea, and larger thoracic AP diameter, thereby predisposing them to pneumomediastinum.

Our study has several limitations. First, its retrospective design may introduce inherent biases; however, it allowed for comprehensive evaluation of patients' clinical courses and diagnostic data. Second, the number of patients included in the study was relatively small compared with larger series reported in the literature. Third, although various distance measurements were performed in the lungs and tracheobronchial tree, lung volumes were not assessed. Similarly, left atrial volumes-which may influence tracheobronchial angle measurements-were not evaluated. Finally, information regarding patients' smoking status and pulmonary function tests was not available.

In conclusion, although tracheobronchial angles were wider in women, thoracic and airway diameters were larger in men. Individuals with a narrower LMBA, shorter trachea, larger thoracic AP diameter, and wider SCA may be at increased risk of developing pneumomediastinum in the setting of barotrauma.

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