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Araştırma Makalesi / Research Article

The Effect of Tracheal Diverticulum and Chronic Ostructive Lung Disease on Chest Anthropometry

Trakeal Divertikül Ve Kronik Obstrüktif Akciğer Hastalığının Göğüs Antropometrisi Üzerine Etkisi

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Abstract

Aim: In this study, we aimed to evaluate the effect of tracheal diverticula (TD) on chest anthropometry and its relationship with chronic obstructive pulmonary disease (COPD).

Material and Method: Between January 2019 and March 2020, 995 patients who underwent chest CT were retrospectively analyzed and TD was detected in 62 cases. Group 1 is only TD, Group 2 is TD + COPD, Group 3 is only COPD, Group 4 is defined as control group. We measured the localization, size, the distance to carina and vocal cord of TDs. In all groups chest diameters at T4 and T9 levels were measured as transverse and vertical plans.

Results: TDs detected mostly at the T2 and T3 levels. In Group 1 and Group 2, there was a statistically significant difference the distance to TD of vocal chords. A statistically significant difference was found between Group 1 and Group 3 only in the anteroposterior diameter at the T4 and T9 levels.

Conclusion: The fact that TDs, which we do not know clearly whether they are acquired or congenital, have different TD levels in COPD patients made us think that TDs may be acquired. We also observed that COPD affects TD localization and TD has the opposite effect in increasing anteroposterior chest parameters in COPD. Precence of TD is essential on COPD patients about thorax anthropometry.

Keywords: Tracheal diverticulum, anthropometry, radiology, COPD, chest diameter

Öz

Amaç: Bu çalışmada trakeal divertikülün (TD) göğüs antropometrisine etkisi ve kronik obstrüktif akciğer hastalığı (KOAH) ile ilişkisi değerlendirmeyi amaçladık.

Materyal ve Metot: Ocak 2019 ile Mart 2020 tarihleri arasında göğüs BT yapılan 995 hasta retrospektif olarak incelendi ve 62 vakada TD tespit edildi. Grup 1 sadece TD, Grup 2 TD + KOAH, Grup 3 sadece KOAH, Grup 4 kontrol grubu olarak tanımlandı. TD'lerin lokalizasyonu, boyutu, karina ve vokal korda uzaklığı ölçüldü. Tüm gruplarda T4 ve T9 seviyelerinde transvers ve vertikal planda göğüs çapları ölçüldü.

Bulgular: TD'ler çoğunlukla T2 ve T3 seviyelerinde tespit edildi. Grup 1 ve Grup 2'de vokal kordun TD'ye uzaklığında istatistiksel olarak anlamlı bir fark vardı. Grup 1 ve Grup 3 arasında sadece anteroposterior çapta T4 ve T9 seviyelerinde istatistiksel olarak anlamlı fark bulundu.

Sonuç: Edinsel mi konjenital mi olduğunu net bilmediğimiz TD'lerin, KOAH hastalarında TD seviyelerinin farklı olması bize TD'lerin edinsel olabileceğini düşündürdü. Ayrıca, KOAH'ta anteroposterior artan göğüs parametrelerinde, KOAH'ın TD yerleşimini etkilediğini ve TD'nin ters etki yaptığını gözlemledik. KOAH hastalarında toraks antropometrisi konusunda TD'nin varlığı önemlidir.

Anahtar Kelimeler: Trakeal divertikül, antropometri, radyoloji, KOAH, göğüs çapı

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INTRODUCTION

Tracheal diverticulum (TD) is a benign condition of the tracheal wall. The longest axes of TDs can extend up to 3 cm and they can be single or multiple as oval peduncular cysts or sessile formations that can communicate with the trachea through channels (1). TD can occur as a result of congenital anomalies of the tracheobronchial tree or cavitation in a weak tracheal wall. TD is divided into two with regard to the implantation site and the histological features of the wall. These are congenital and acquired TD (2). Congenital TD is usually smaller than acquired TD and is more closely related to the trachea. Congenital ones usually occur on the right side, 4-5 cm below the vocal cords or a few centimeters above the carina (3). On the other hand acquired TD occur along the right posterolateral wall near the thoracic inlet. This one occurs with chronic cough or chronic obstructive pulmonary disease (COPD) as a result of prolonged increased intraluminal pressure - weakening of the tracheal wall (3, 4).

TD is usually asymptomatic and therefore their frequency can be underestimated (5). Diagnosis is made on X-rays, CT scans, bronchoscopy, and sometimes autopsies. However, CT also provides information about the location, origin and size of the lesion. Therefore, CT should be performed for differential diagnosis (6, 7).

Although rare and nonspecific, tracheal diverticulum may present with symptoms such as chronic cough, dyspnea, dysphagia, dysphonia, recurrent nerve palsy, cervical neck swelling, hematemesis, and hemoptysis (7).

TD may be associated with COPD (8). COPD is a chronic disease with progressive airflow limitation which against harmful gases and particles emerging airlines. This restriction is usually progressive. Lung parenchyma and pulmonary in COPD various inflammatory cells are collected. As a result of this inflammatory factors, interalveolar connective tissue and elastic elastic back gravitational force is a deterioration. COPD causes damage to the small airways and emphysema occurs as a parenchymal destruction. Emphysema, usually defined anatomically, abnormal permanent enlargement of air spaces distal to the terminal bronchioles (9, 10). Emphysema is seen as low density areas surrounded by normal lung tissue on CT (computed tomography) (11). Depending on this condition, there may be a decrease in lung height and width in patients with COPD (12), that's why chest diameter can change.

In this article, our aim is to investigate how the presence of TD, which is a limited study in the literature, affects chest anthropometry in patients with COPD.

MATERIAL AND METHOD

This study was planned in accordance with the Declaration of Helsinki and approved by the Malatya Clinical Research Ethics Committee (Protocol code 2020-1260). 995 patients between the ages of 40-80 who underwent thorax CT between January 2019 and March 2020 were retrospectively screened by a radiologist and 62 TDs were detected. These images were divided into four groups. Group 1 was only TD, Group 2 was TD + COPD, Group 3 was only COPD, Group 4 was the control group. The control group consisted of healthy individuals of the same age and gender who had thoracic CTs on the same dates. The number of people in the group was 19, 12, 12, 19, respectively. The relationship of chest diameters with TD and COPD was evaluated in all groups.

CT scans were examinations taken on a spiral CT scanner and 1 mm slice thickness. The window width was 1200 Hounsfield Units (HU) for the parenchymal window and 350 HU for the mediastinal window. Axial, coronal and sagittal plans were used for measurements.

Patients whose identity and demographic information were missing on CT images and whose investigated parameters were not evident were excluded from the study. Patients between the ages of 40-80 years without mediastinal injury or operation were included in the study. The localization, size, vocal cord and carina distance and level of all detected TDs were noted (Figure 1). In addition, the widest transverse chest diameter at the T4 vertebra and T9 vertebra levels and the widest anteroposterior chest diameters in both hemithoraces were measured and the mean was calculated (Figure 2).

Figure 1. CT image of tracheal diverticulum in the axial (A) and saggital (B) planes, located in the right osterolateral part of the trachea

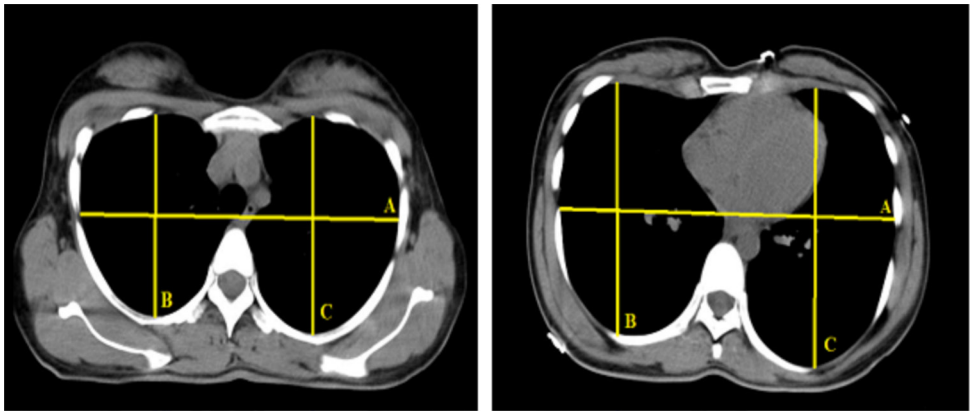

Figure 2. The widest transverse chest diameter measurement (A) and widest anteroposterior chest diameter measurement in both hemithoraces (B, C) an the axial CT T4 and T9 levels

Statistical analysis

Statistical analysis of this study was performed using IBM SPSS Statistics 22.0 package program. The normal distribution fit of the variables was examined with the One sample Kolmogorov-Smirnov test. Normally distributed variables are expressed as mean and standard error mean (× ± SD). Student's-T test was used for statistical analysis. Intergroup nanparametric data were analyzed using the Mann Witney U test. Pearson Correlation Coefficient was used to determine the direction and strength of the relationship between two quantitative variables. For statistical significance, a value of p <0.05 was accepted.

RESULTS

In the statistical analysis made, Group 1 and Group 4, Group 2 and Group 3 show a homogeneous distribution in terms of age and gender distribution. It was found that the groups were not similar in the distribution between Group 1 and Group 2, Group 3 and Group 4 (P = 0.001) (Table 1).

Table 1. Age and gender distribution of patients

		Group 1	Group 2	Group 3	Group 4
Gender (N)	Woman	14	8	8	14
	Man	5	4	4	5
Age (year)		47.31±14.88	61.66±7.49	61.66±7.49	47.05±15.05

While there was a statistically significant difference in the vocal chorda distance of TD in the individuals in Group 1 and Group 2, no significant difference was found in the distance to the carina. While the average distance of TD of all individuals in both groups to the vocal chord is 5.75 ± 1.57, the average distance to the carina is 7.02 ± 2.36 (Table 2).

No statistically significant difference was found in the transverse and anteroposterior magnitude of TD in individuals in Group 1 and Group 2. While the mean transverse size of the TDs of all individuals in both groups is 6.63 ± 3.04, the average anteroposterior size is 19.10 ± 7.24 (Table 3).

Table 2. Opinions of the participants on the conduct of distance education and anatomy practice courses

	Distance to vocal chord		Distance to Carina	
Group	(X±SD) Cm	P*	(X±SD) Cm	P*
1	6.26±1.56	0.015	6.94±2.56	0.82
2	4.95±1.25		7.14±2.09	
Total Average	5.75±1.57		7.02±2.36	

* Independent student's t-test

Table 3. Transverse and anteroposterior sizes of TDs of individuals in Group 1 and Group 2

	Transverse size of TD		Anteroposterior size of	
Group	(X±SD) mm	P*	(X±SD) mm	P*
1	6.60±2.66	0.95	19.93±6.71	0.46
2	6.68±3.69		17.81±8.14	
Total Average	6.63±3.04		19.10±7.24	

* Independent student's t-test

It was observed that the vertebra levels of TDs in Group 1 and Group 2 were mostly at the T2 and T3 levels (Table 4).

Table 4. Percentage of vertebra level of TDs in Group 1 and Group 2

	T1	T2	T3	T4	T5
Group 1	**1(%5)**	6(%32)	**10(%53)**	1(%5)	1(%5)
Group 2	2(%17)	6(%50)	4(%33)	-	-

The average of transverse and anteroposterior diameter lengths at T4 and T9 levels of all groups are shown in Table 5. In this evaluation, a statistically significant difference was found between Group 1 and Group 3 (p = 0.016) (p = 0.017) only in the anteroposterior diameter at T4 and T9 levels.

Table 5. Transverse and anteroposterior diameters of all groups at T4 and T9 level

Group	T4 transvers diameter (mm)	T4 anteroposterior diameter (mm)	T9 transvers diameter (mm)	T9 anteroposterior diameter (mm)
1	215.76±19.36	130.06±18.13	251.74±22.14	181.85±22.32
2	209.21±24.94	132.39±26.04	253.01±21.51	190.63±15.60
3	219.33±16.53	146.83±17.13	258.16±30.94	200.91±18.98
4	211.63±20.50	137.94±21.36	255.57±21.65	192.42±19.43

DISCUSSION

The number of studies investigating the effects of TD and COPD on chest anthropometry and their relationship with each other is limited in the literature.

Kurt et al. (13) Polat et al. (14) and Marina et al. (15) reported that the age of onset of TD was between the 5th and 6th decades. These mean ages are 58, 55 and 59.8, respectively. In our study, the mean age was 47.31±14.88 years only in the TD patient group, and 61.66±7.49 years in the TD+COPD patient group, and the incidence of TD was between the 4th and 6th decades. We think that the younger age of TD patients in our study is due to the larger sample of patients screened.

There are different opinions regarding the incidence of TD according to gender. While TD is more common in males than females in some studies (13, 16, 17), it is more common in females than males in other studies with opposite views (18, 19, 20). In our study, the incidence of TD was higher in women than men by a rate of 70.9%.

Studies in the literature report that TD is mostly seen on the right posterolateral side of the trachea, similar to our study (7, 13, 17, 21, 22). As the reason for this situation, Goo et al. (22) stated that the esophagus supports the left side, Gayer et al. (17) stated that the right side of the trachea is weaker than the increased intratracheal pressure, and the left side is more resistant due to the support of the esophagus and arcus aorta. Amaral et al. (7) reported that tracheal diverticula acquired due to weakening of the structures and vulnerability of the mucous membrane after increased intraluminal pressure or surgical procedures can typically be seen along the right posterolateral wall near the thoracic inlet, but can also be seen at any level. In addition to these comments, we think that the reason why TDs are more common at T2 and T3 levels in our study is because the structures supporting the trachea are weaker at these levels.

The relationship between the TD and the tracheal lumen is shown with axial, coronal and sagittal multiplan images (3). According to Linn et al. (23), multidetector CT is the best method for imaging TD, and stated that it is an important method for evaluating localization, size, contour and wall thickness in TD. Rahalkar et al. (24) reported that the best method for the diagnosis of TD is CT scanning of the trachea at various angles in the coronal plane. In our study, tracheal diverticula were demonstrated with axial, coronal and sagittal multiplan images by CT. Even if the TD is very small, it can be diagnosed noninvasively with CT. In addition, the borders of the diverticulum, its content and its connection with the tracheal lumen can be shown without the need for fiberoptic bronchoscopy.

According to Amaral et al.'s (7) study examining the relationship between COPD and TD, since the diverticulum usually serves as a reservoir for respiratory secretions, it is sometimes associated with chronic cough and can become infected. Flores et al. (8) stated that COPD and other inflammatory conditions may result in tracheomegaly or acquired TD in relation to changes in the elastic properties of the airways. Kurt et al. (13) detected bronchial DV and COPD in 84 out of 412 TDs by performing chest CT retrospective scanning, and the incidence of association between localization of TD and bronchial COPD was shown as 2.38%. Similarly, Goo et al. (22) and Polat et al. (14) found a significant correlation between COPD and TD. Contrary to these studies, Buterbough et al. (18) reported that there was no relationship between emphysema and paratracheal air cysts, and Marina et al. (15) reported that TD was not associated with respiratory symptoms and COPD.

In our study, we thought that TDs in which we did not know clearly whether they were acquired or congenital, may be acquired, since TDs in COPD patients have different TD levels. We found that COPD affects the TD level, and the diverticula is localized closer to the vocal cord. This shows that there is a relationship between COPD and TD. Although TD levels changed in COPD patients, we did not detect a significant difference in TD dimensions. In terms of this result, our study is similar to the studies of Kurt, Goo and Polat.

Griscom et al. (25) investigated the effect of COPD on chest diameters and stated that the anteroposterior tracheal diameter can increase for many reasons, but COPD is the most dominant among chronic inflammatory diseases. Similarly, we think that factors such as TD and COPD may

affect this diameter in our study. As a matter of fact, the mean anteroposterior diameter values were higher in the group with only COPD than in the other groups, and this difference was statistically greater than in the group with only TD. However, there is a need for studies investigating the effect of COPD on the anteroposterior diameter of the chest with studies with a larger number of cases.

In our study, T4 and T9 levels were evaluated in the evaluation of thorax anteroposterior diameter, it was observed that there was a significant difference between only TD and only COPD group, but no significant difference with the control group. Based on this result, we determined that COPD did not have a significant effect on the change of chest anteroposterior distance compared to healthy people, and the effect of COPD was greater than in patients with only TD. In addition, the fact that the COPD+TD group took a value between only TD and only COPD groups indicates that TD has an opposite effect on the anteroposterior distance of the chest in COPD patients, reducing this diameter.

CONCLUSION

In this study, we concluded that by affecting the level of TD of COPD, diverticulum is formed in the upper levels of the trachea, and TDs are more common at T2 and T3 levels. Since there was no significant difference in the transverse and anteroposterior sizes of TDs, we found that COPD had no effect on diverticulum dimensions, but COPD only affected the level of diverticulum. In addition, we concluded that TD reduces the anteroposterior chest diameter in patients with COPD. With all these results we found, we thought that TD had an effect on chest parameters in patients with COPD.

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Conflict of Interest: *The authors declare that they have no competing interest.*

Ethical approval: *This study was planned in accordance with the Declaration of Helsinki and approved by the Malatya Clinical Research Ethics Committee (Protocol code 2020-1260).*

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