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To Investigate the Morphological Characteristics of Lung Fissures and Trachea

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Abstract

Background: The study of tracheal length and lung architecture has been infrequent, although it has been shown that the structure of the lung exhibits substantial variation. Furthermore, there are only a limited number of surgeries performed on the trachea, resulting in a lack of substantial knowledge among surgeons in this area. The aim is to investigate the Morphological Characteristics of Lung Fissures and Trachea. **Methodology:** This research is an observational investigation that analyzes data on tracheal length, body length, sex, and the physical architecture of the lungs in 50 cadavers. A study was conducted to examine the association between tracheal length and body length, as well as tracheal length and sex. Additionally, the study investigated morphological changes in lung structure. The lungs were categorized based on their side, either right or left, and the structure of the fissures was documented, including the number, extent, and completeness, using the Craig-Walker classification. **Results:** The mean tracheal length, measured from the inferior margin of the cricoid cartilage to the subcarinal region, was 9.88±1.98 cm, while the mean height of the individual was 147.32±12.54 cm. The research sample consisted of 35 male and 15 female cadavers. The average tracheal length for men was 10.34±1.78, and the average height was 151.11±11.46. The mean tracheal length for females was 9.06±1.74, whereas the mean height was 138.12±8.94. A direct relationship was seen between the length of the trachea and the height of the body. The Pearson's coefficient was 0.76 with a p value of 0.001. **Conclusion:** The lungs possess diverse anatomical features, and a comprehensive understanding of their morphology, including the extent of fissure incompleteness, can aid in comprehending the development of conditions such as pneumonia and pleural effusion, as well as the dissemination of diseases acquired via the lungs.

Keywords: lung morphology, body height, tracheal length, cadaver.

INTRODUCTION

There is a scarcity of research on the anatomical dimensions of the lung and trachea. The right lung is split into three lobes (upper, middle, and lower lobes) by two fissures, one horizontal and one oblique. Similarly, the left lung is separated into two lobes (upper and lower) by a horizontal fissure.[1,2] Several studies have shown that there is considerable variation in the structure of the lung across people. For instance, research conducted by Craig and Walker revealed that this variation manifests in the presence of atypical fissures.[3] The length of the trachea ranges from 10 centimetres to 12 centimetres. The trachea consists of 12-16 cartilages and its characteristics are influenced by factors such as age, sex, and ethnicity.[4] In addition, trachea operations are conducted seldom, resulting in surgeons lacking substantial expertise in the field of trachea procedures. The extent of trachea that can be surgically removed and the length of the endotracheal tube required by an anaesthesiologist are typically determined by the expertise of experienced medical practitioners. Precise understanding of the anatomical structure of the lungs is essential for interpreting radiological observations and plays a critical role in surgical procedures. Accurate localization of segments is crucial for the successful removal of affected areas in many illnesses. Prior understanding of the anatomy is necessary to effectively design a lobectomy or segmental resection, which reduces the likelihood of postoperative issues such air leaks that may cause substantial health problems.

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METHODS

Table 1 Craig and Walker classification.

Grade	Description
Grade 1	Complete fissure with entirely different lobes
Grade 2	Complete visceral cleft but parenchymal fusion at the base of the fissure
Grade 3	Visceral cleft evident for part of the fissure
Grade 4	Complete fusions of the lobes with no evident fissure line

This research is an observational investigation that analyzes data on tracheal length, body length, sex, and the physical architecture of the lungs in 50 cadavers. A study was conducted to examine the association between tracheal length and body length, as well as tracheal length and sex. Additionally, the study investigated morphological changes in lung structure. A total of 50 recently deceased bodies were obtained from the anatomy department for the purpose of the research. The eligibility criteria for participation in the study were those above the age of 18, with the exception of those who had thoracic injuries or pathological abnormalities in their lungs. During the postmortem examination, we performed a standard dissection of the organs from the neck to the pelvis. Specifically, we dissected the trachea and lungs individually in order to retrieve the data we needed. The lungs were

categorized based on their side, either right or left, and the structure of the fissures was documented, including the number, extent, and completeness, using the Craig-Walker classification [Table 1].[3]

The length of the trachea was measured from the bottom edge of the cricoid cartilage to the border of the lymph node at the subcarinal region. Additionally, the age, sex, and height of the individual were recorded. Specimens that were damaged were not included in the research. The data was compiled using pictures and subjected to statistical analysis at the Kidwai Memorial Institute of Oncology (KMIO), located in Bangalore. The study was performed using the SPSS Statistics program version 23, developed by IBM Corp. in Armonk, NY.

RESULTS

Various variations in the structure of the right lung were detected, while the majority of the specimens showed entire fissures. Furthermore, discrepancies were noted across all samples and are shown in [Table 2].

There was a complete fissure in the majority of the left lung specimens collected. A single specimen had a complete fusion of the fissure, and there were various other variations [Table 3].

The mean tracheal length, measured from the inferior margin of the cricoid cartilage to the subcarinal region, was 9.88±1.98 cm, while the mean height of the individual was 147.32±12.54 cm. The research sample consisted of 35 male and 15 female cadavers. The average tracheal length for men was 10.34±1.78, and the average height was 151.11±11.46. The mean tracheal length for females was 9.06±1.74, whereas the mean height was 138.12±8.94. A direct relationship was seen between the length of the trachea and the height of the body. The Pearson's coefficient was 0.76 with a p value of 0.001. The Pearson correlation coefficient was 0.87 ($p < 0.001$) for male and 0.83 ($p < 0.001$) for females, as shown in [Table 4].

Table 1: Morphological characteristics of the right lung specimens.

Grade	Frequency	Percent (%)
Complete fissure (I)	31	62
Complete cleft but parenchymal fusion at the base (II)	4	8
Visceral cleft evident for part of the fissure (III)	15	30
Complete fusion (IV)	0	0
Total	50	100

Table 2: Morphological characteristics of left lung specimens.

Grade	Frequency	Percent (%)
Complete fissure (I)	31	62
Complete cleft but parenchymal fusion at the base (II)	2	4
Visceral cleft evident for part of the fissure (III)	16	32
Complete fusion (IV)	1	2
Total	50	100

Table 3: Relation between body length and tracheal length

Number	Body length	Tracheal length	Pearson's coefficient
Total: 50	147.32±12.54	9.88±1.98	0.76(P value = 0.001)
Male: 35	151.11±11.46	10.34±1.78	0.87 (P value = 0.001)
Female: 15	138.12±8.94	9.06±1.74	0.83 (P value = 0.001)

Table 5 Comparison between different studies for the association of tracheal length and body length.

Study	Association between body length and tracheal length	Body length (cm)		Tracheal length (cm)	
		Male	Female	Male	Female
Munguia et al.[9]	None	169 (+/- 6)	161 (+/- 7)	9.1 (+/- 0.9)	8.6 (+/- 0.5)
Cinar et al.[10]	Present	168 (+/- 5.6)	160 (+/- 6.4)	8.7 (+/- 1.1)	8.5 (+/- 0.6)
Pang et al.[11]	None	179 (+/- 8)	163 (+/- 8)	13.6 (+/- 1.4)	11.8 (+/- 1.3)
This study	Present	151.11±11.46	138.12±8.94	10.34±1.78	9.06±1.74

DISCUSSION

Lung development takes place during the 6th week of embryo development, and the structure of the bronchopulmonary segments is fully formed by the 14th week. The bronchopulmonary segments undergo closure of the gaps between them, with any remaining spaces transforming into fissures. Partial obliteration or non-obliteration may lead to the development of partial or nonexistent cracks. An auxiliary fissure occurs when gaps that would typically be eliminated fail to be eliminated. The trachea develops by the establishment of the longitudinal tracheoesophageal septum, which separates the tracheal groove and causes the foregut to differentiate into the trachea and esophagus. This process occurs during the 4th week of development. The formation of the left and right major bronchi occurs in the 5th week.[5]

Various techniques, including chest X-ray, computed tomography, flexible bronchoscopy, and examination of cadaver tissues, have been used to estimate the length of the trachea in different investigations. Furthermore, these investigations have shown a potential correlation between tracheal length and an individual's height.[6] The research found that the trachea measured 11 cm in cadavers and was somewhat longer in live persons.[7] Kamel et al. did a research where they noticed that the tracheal length was 8-12 cm in living subjects, but 2 mm shorter in deceased individuals.[8] Table 5 presents a comparative analysis of the results from several research on the length of the trachea and the length of the body.

In this investigation, we used the Craig-Walker classification.[3] 62% of the cadavers had grade 1 cracks in their right lungs, whereas 8% had grade 2 fissures, and 30% had grade 3 fissures. 62% of the cadavers had grade 1 cracks in their left lungs, whereas 4% had grade 2 fissures, 32% had grade 3 fissures, and 2% had grade 4 fissures. Thapa et al,[12] did a research and found that 30% of the patients had incomplete oblique fissures, 50% had an incomplete horizontal fissure, and 85% had a normal lung architecture. According to a research done by Meenakshi et al,[13] 36.66% of the right lungs and 46.66% of the left lungs had incomplete oblique fissures. Additionally, accessory fissures were found in 10% of the left lungs and 3.3% of the right lungs that were evaluated. In a research conducted by Lakshmi et al,[14] a total of 25 lungs were investigated. Out of them, only one lung exhibited the absence of a horizontal fissure, whereas eight lungs showed an incomplete horizontal fissure.

This research is limited by its retrospective character and reliance on case records. Additionally, the investigation was conducted using cadavers, which may have prevented the detection of certain clinical or physiological occurrences that might have affected the lung shape throughout the individuals' lifetimes.

CONCLUSION

The lungs possess diverse anatomical features, and a comprehensive understanding of their morphology, including the extent of fissure incompleteness, can aid in comprehending the development of conditions such as pneumonia and pleural effusion, as well as the dissemination of diseases acquired via the lungs. Examining the shape and structure of lung fissures assists medical professionals in comprehending lung disorders and devising treatment strategies, particularly for lobectomy and segmentectomy procedures. The average trachea length in proportion to body height within a certain ethnic group is valuable for endotracheal intubation and planning tracheal procedures.

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