Section: Anatomy

Original Research Article

TO ASSESS THE MORPHOLOGICAL CHARACTERISTICS OF LUNG FISSURES

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Abstract

Background: The recognition of anatomical variations in the lungs, such as fissures and lobes, is of great importance for clinicians in order to identify their diverse imaging characteristics and associated abnormalities. **Aim:** The purpose of this study is to assess the morphological characteristics of lung fissures. **Materials and Methods:** This study involved the examination of 50 cadaveric lungs to assess their morphology and differentiation of fissures. The thoracic wall of cadavers that had been embalmed and fixed with formalin was dissected in order to expose the lungs and conduct an analysis of their morphological characteristics, including the examination of factors such as the number of lobes and fissures. The anatomical categorization proposed by Craig and Walker in 1997 was employed to ascertain the presence and magnitude of pulmonary fissures. **Results:** This study examined a total of 50 cadaveric lungs, with 36 lungs obtained from male individuals and 14 lungs obtained from female individuals. The findings of this study indicate that 32 out of the total sample size, accounting for 64%, exhibited incomplete horizontal fissure in the right lungs. It is noteworthy that this study also demonstrates the absence of a horizontal fissure in 1 (2%) of the right lung. In contrast, it was observed that out of the total sample of 16 lungs, all of them exhibited incomplete oblique fissures, with one lung (2%) showing the absence of an oblique fissure. Conversely, the remaining lungs exhibited typical fissures and lobes. In a similar vein, the findings of this study indicate the presence of 21 incomplete oblique fissures in the left lung, accounting for 42% of the observed cases. Interestingly, it was observed that there was an absence of a fissure in the left lung. While the anatomical structure of other left lungs was normal. **Conclusion:** Based on the findings of the present study, it was observed that the right lung exhibited a greater prevalence of partial horizontal fissures, with a minority of right lungs displaying an absence of such fissures.

INTRODUCTION

The lungs, which are vital respiratory organs, are situated within the thoracic cavity, flanking the heart on both sides. The lungs serve as the primary respiratory organs in humans and various other animal species. The primary function of the respiratory system is to facilitate the uptake of oxygen from the surrounding environment and its subsequent transportation to the bloodstream. Additionally, this system is responsible for the elimination of carbon dioxide from the circulatory system into the atmosphere, a vital process referred to as gas exchange. The lungs are anatomically divided into lobes by fissures.[1] It is imperative for clinicians to possess knowledge regarding pulmonary anatomical alterations, including variations in number, fissures, and lobes. According to Hayashi et al. (year), it is crucial to have a comprehensive understanding of the structure and common variations of the primary fissures in order to accurately identify their diverse imaging characteristics and associated issues. In a similar vein, Aziz and colleagues proposed that interlobar fissures play a crucial role in accurately identifying normal pulmonary anatomy and assessing disease.[3] The presence of fissures facilitates enhanced mobility between the lobes, thereby enabling increased distention and movement of the lower lobes in the process of respiration.[4] Consequently,

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they contribute to a more homogeneous expansion of the entire pulmonary system. The comprehension of the location of fissures is crucial for comprehending lobar anatomy and subsequently identifying the broncho-pulmonary segments. This knowledge holds significance in both physical and therapeutic contexts. The right lung is comprised of three lobes, which are distinguished by the presence of the oblique and horizontal fissures.[5]

The right lung is anatomically divided by two fissures: the oblique fissure and the horizontal fissure. The oblique fissure serves to separate the superior and middle lobes from the inferior lobe, while the horizontal fissure specifically demarcates the superior lobe from the middle lobe. The left lung is composed of two lobes, namely the superior and inferior lobes, which are demarcated by a solitary oblique fissure.[5] The oblique fissure originates at the posterosuperior aspect of the hilum, specifically at the level of the 5th thoracic spine. It then traverses the posterior border of the lung, approximately 6cm away from the apex, at the level of the 4th thoracic spine. The fissure on the sternocostal surface is observed to traverse the 6th rib and intersect the inferior border in close proximity to its anterior extremity. Subsequently, it proceeds in a retrograde manner towards the mediastinal surface, ultimately terminating at the lower aspect of the hilum. The horizontal fissure, which is exclusively observed on the right lung, originates from the oblique fissure at the midaxillary line. It traverses the costal surface, aligning with the 4th costal cartilage, and extends onto the hilar surface until it terminates anteriorly to the hilum.[6] Consequently, in light of the aforementioned statements, the present study was conducted to investigate the morphological characteristics of the lungs.

MATERIALS AND METHODS

This study involved the examination of 50 cadaveric lungs to assess their morphology and differentiation of fissures. Among the sample of 50 cadaveric lungs, 36 were obtained from male individuals, while the remaining 14 were sourced from female individuals. The thoracic wall of cadavers that had been embalmed and fixed with formalin was dissected in order to expose the lungs and conduct an analysis of their morphological characteristics, including the examination of factors such as the number of lobes and fissures. The anatomical categorization proposed by Craig and Walker in 1997 was employed to ascertain the presence and magnitude of pulmonary fissures.[7]

RESULTS

This study examined a total of 50 cadaveric lungs, with 36 lungs obtained from male individuals and 14 lungs obtained from female individuals. The findings of this study indicate that 32 out of the total sample size, accounting for 64%, exhibited incomplete horizontal fissure in the right lungs. It is noteworthy that this study also demonstrates the absence of a horizontal fissure in 1 (2%) of the right lung. In contrast, it was observed that out of the total sample of 16 lungs, all of them exhibited incomplete oblique fissures, with one lung (2%) showing the absence of an oblique fissure. Conversely, the remaining lungs exhibited typical fissures and lobes.

Table 1: Fissure in right lungs

Right Lung			
Horizontal fissure		Oblique fissure	
Incomplete	Absent	Incomplete	Absent
32	1	16	1
64%	2%	32%	2%

Table 2: Fissure in left lungs

Left lung		No fissure	
Oblique fissure		Right lung	Left lung
Incomplete	Absent		
21	2	Nil	2
42%	4 %	-	4%

In a similar vein, the findings of this study indicate the presence of 21 incomplete oblique fissures in the left lung, accounting for 42% of the observed cases. Interestingly, it was observed that there was an absence of a fissure in the left lung. While the anatomical structure of other left lungs was normal.

DISCUSSION

The lobation of the lungs can exhibit anomalies due to various factors, such as the fusion of neighbouring lobes resulting in the obliteration of a fissure, the presence of abnormal fissures, or the underdevelopment or absence of a portion of a lung.

The horizontal fissure frequently exhibits an incomplete configuration at its anterior extremity. The lung bud is composed of the terminal lobe of the endodermal outgrowth and the surrounding splanchnopleuric mesenchyme. It serves as the precursor for all the tissues found in the corresponding lung and bronchial tree. The right lung bud exhibits a trilobar arrangement of

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bronchial tubes, whereas the left lung bud demonstrates a bilobar configuration. During the subsequent stages of development, the stem bronchi undergo dichotomous division. The presence of accessory bronchi and lobes can be attributed to the intermittent monopodial branching of the stem bronchi.[8]

The lungs, which are vital respiratory organs, are situated bilaterally within the thoracic cavity adjacent to the heart. The lungs serve as the primary organs of the respiratory system in humans and various other animal species. The respiratory system facilitates the uptake of oxygen from the surrounding environment and its subsequent transportation to the bloodstream. Additionally, it aids in the elimination of carbon dioxide from the circulation, releasing it into the atmosphere. This physiological mechanism is commonly referred to as gas exchange. The divisions between broncho-pulmonary buds/segments become indiscernible as the lung undergoes maturation, with the exception of two planes that manifest as oblique or horizontal fissures in fully developed lungs.[9] The absence or incompleteness of oblique or horizontal fissures may be attributed to the obliteration of these fissures, either in their entirety or partially. Accessory fissures may arise due to the persistence of gaps that are typically eliminated but remain unobliterated. Incomplete pulmonary fissures, a common occurrence in the human respiratory system, are frequently observed and account for a significant proportion, exceeding 50%, of all pulmonary fissures. Multiple authors (10-13) have documented different rates of occurrence for the incompleteness of fissures. In a comprehensive analysis conducted by Medlar, a total of 1200 pairs of lungs were examined. The findings revealed that an incomplete oblique fissure was observed in 10.6% of the left lungs and 25.6% of the right lungs. Additionally, an incomplete horizontal fissure was identified in 17.1% of the right-sided lungs [10]. The absence of oblique fissures was observed in 7.3% of the left lungs and 4.8% of the right lungs. Additionally, the absence of horizontal fissures was found in 45.2% of the right lungs. Fusion was detected in the upper right major (oblique) fissure in 70% of lung specimens that were fixed and inflated, with an equal distribution of 50 specimens on each side. The fusion was observed in the lower right major fissure in 47% of the specimens, in the upper left major fissure in 40% of the specimens, in the lower-left major fissure in 46% of the specimens, and in the minor (horizontal) fissure in 94% of the specimens. In a separate study conducted in India, it was observed that 21% of the participants exhibited partial horizontal fissures, while 10.5% of the participants displayed nonexistent horizontal fissures.[14] An incomplete oblique fissure without a horizontal fissure was observed in 5.3% of the right-sided lungs. A prevalence rate of 21% was observed for incomplete oblique fissures in the left lungs. This study revealed that 19 out of 30 cases (63.3%) exhibited incomplete horizontal fissures in the right lungs. Remarkably, the present investigation did not observe any horizontal fissure in one (2 percent) of the right lungs. In 16 lungs, which accounted for 32% of the sample, the oblique fissure was observed to be partially present. Additionally, in 1 lung, constituting 2% of the sample, no oblique fissure was observed. In this study, it was observed that the left lung exhibited a total of 21 incomplete oblique fissures, accounting for 42% of the observed cases. Unexpectedly, a lack of fissure was observed in two of the lungs. In contrast, the left and right lungs exhibited anatomical normalcy. The present study aims to contribute valuable insights that can be of considerable value to both patients and clinicians.

Table 3: Incidence of variations in fissures of lung reported by various authors are

Author	Lung	Fissure	Incomplete	Absent
Radha K et al. 2015.[15]	Right	Horizontal	43%	17%
		Oblique	17%	0%
	Left	Oblique	23%	0%
Prakash et al. 2010.[16]	Right	Horizontal	50%	7.10%
		Oblique	39.30%	7.10%
	Left	Oblique	35.70%	10.70%
Muralimanju et al. 2012.[17]	Right	Horizontal	46.90%	18.70%
	Left	Oblique	7.10%	3.60%
Present study	Right	Horizontal	64%	2%
		Oblique	32%	2%
	Left	Oblique	42%	4%

The presence of an accessory fissure holds significance in radiology interpretation due to the potential for misidentification as a lung lesion. In the field of radiology, it is observed that the presence of an incomplete fissure in X-ray imaging consistently results in an atypical manifestation resembling pleural effusion. Occasionally, the identification of accessory fissures on CT scans may prove challenging due to factors such as their incomplete visibility, the use of thick sections, and their orientation in relation to a specific imaging plane. An incompletely formed fissure can also contribute to the occurrence of postoperative air leakage. The lobes of the lungs exhibit partial fusion due to the presence of incomplete pulmonary fissures.[18] The lymphatic vessels of the lung exhibit a centripetal drainage pattern, moving from the pleura towards the hilum. If the course of the

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oblique fissure is modified, it would result in a corresponding modification of the course of the visceral pleura. Consequently, this alteration would lead to a change in the arrangement of lymphatic drainage.

CONCLUSION

Based on the findings of the present study, it was observed that the right lung exhibited a greater prevalence of partial horizontal fissures, with a minority of right lungs displaying an absence of such fissures. In order to mitigate the mortality and morbidity rates linked to invasive lung procedures, it is imperative for radiologists and surgeons to possess a comprehensive understanding of the diverse patterns and divisions of lung fissures and lobes. A comprehensive comprehension of the anatomical structure of lung fissures plays a crucial role in the assessment of diverse radiographic presentations of interlobar fluid. The author expresses optimism regarding the potential utility of this research for the aforementioned practitioners.

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