A cadaveric study of the variations in the pulmonary fissures and lobes of the human lungs

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Abstract

Introduction: Lungs are divided into lobes by fissures. The right lung usually has three lobes divided by two fissures (horizontal and oblique) and the left lung has two lobes divided by one fissure (oblique). Sometimes there is absence or incomplete fissures are present in both or one lung. The present study was conducted to know the variations of fissures and lobes of the lungs. Nowadays, lung diseases and lung cancer are also increasing globally and also in India. This study is useful to cardiothoracic surgeons during resection of individual lung segments during surgery.

Aim: The present cadaveric study was done to know the variations in fissures and lobes of the lung and their applications in clinical and surgical field.

Materials and Methods: During routine dissection of thorax, eighteen pairs (36) of lungs were obtained from embalmed cadavers of both the sex. These lungs were assessed on the basis of presence, absence and variations in fissures and lobes. The data obtained was compiled and analyzed.

Results: Based on the data obtained, the incidence of absence of horizontal fissures in the right lungs is 25% (4 lungs out of 18). In 3 lungs out of 18 i.e. 16.66% horizontal fissure is not so prominent in the right lungs. The incidence of oblique fissure present on the anterior surface but absent on the posterior surface of the left lung is 5.5% (1 lung out of 18). The absence of oblique fissure in the left lung is 5.5% (1 lung out 18). No accessory fissures or lobes were observed on either left or right lungs.

Conclusion: The nature of fissure is of great importance in planning pulmonary surgeries. As the fissures form the boundaries for the lobes of the lungs, knowledge of their position is necessary for the appreciation of lobar anatomy and thus for locating the bronchopulmonary segments which is significant both anatomically and clinically. The lobes of lungs show partial fusion as a result of incomplete pulmonary fissures. Hence it is important to know the variations of lungs with respect to its lobes and fissures as they are of great significance.

Keywords: Lungs, Lobes, Fissures, Cadavers, Bronchopulmonary segments

Introduction:

The lungs are a pair of respiratory organs situated within the thoracic cage. Lungs are present on the either side of the mediastinum and are divided by it into right and left lungs. Usually the right lung is divided into three lobes (upper, middle and lower lobes) by two fissures (horizontal and oblique).

Each lung is having a base, apex, three borders and two surfaces. The left lung usually has two lobes which are separated by oblique fissure[1].

Oblique fissure starts from the level of 4th and 5th thoracic spine. It ends above the hilum on medial surface. From the lateral side i.e. on the costal surface, it continues across the diaphragmatic surface and turns upwards on medial surface below the hilum. Horizontal fissure which is seen on right lung only begins laterally at the oblique fissure and runs almost horizontally across the costal surface to the anterior margin and back to the hilum[1].

The right lung constitutes about 55% of the total lung mass and function. Inhalation of oxygen into the body and removal of carbon dioxide from the body take place through the lungs. On inspiration, the volume of the thoracic cavity increases. The maximum expansion of

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the lungs is in the direction of base of the lungs.

The fissures help in the movement of the lobes in relation to one another which accommodates the greater distension and movement of lower lobes during respiration. In this way they help in equal expansion of whole lung.

Delimit exists between the lobes by the fissures. They also help in location of bronchopulmonary segments. The knowledge of these variations in fissures is helpful both anatomically as well as clinically for planning lobectomies in surgery. The present study will throw further light into fissure pattern of human lungs.

Materials and Methods:

18 embalmed cadavers of both the sex were obtained from the Department of Anatomy, KAHER's J.N. Medical College, Belagavi. Upon dissection, 18 pairs of lungs (36 in total) were obtained. All the lungs were observed and studied in relation to fissures and lobes. Variations of fissures and lobes were also studied according to the Craig and Walker classification[2]. This theory was proposed in 1997. The above parameters were studied and photographed. Lungs which were damaged or showed pathological changes were excluded from the study.

Table 1: Grades of Craig and Walker criteria [2]

Grades	Craig and Walker Criteria of Completeness of a Fissure
GRADE I	Complete fissure with entirely separate lobes
GRADE II	Complete visceral cleft but parenchymal fusion at the base of the fissure
GRADE III	Visceral cleft evident for part of the fissure
GRADE IV	Complete fusion of the lobes with no evident fissural line

Results:

A total 18 pairs of lungs were observed (i.e. 36 lungs-18 left lungs and 18 right lungs). The incidence of absence of horizontal fissure in the right lungs was found to be 25% (4 lungs out of 18) (Figure 2). Horizontal fissure was not so prominent in the right lungs was 16.66% (3 lungs out of 18) (Figure 3). The incidence of oblique fissure present on the anterior surface but absent on the posterior surface of the left lung was found to be 5.5% (1 lung out 18) (Figure 4). Absence of oblique fissure in the left lung was 5.5% (1 lung out 18) (Figure 5). No accessory fissures or lobes were observed on either left or right lungs.

Figure 1: Lungs Sample which were observed and studied

Figure 2: Absence of horizontal fissure in the right lung

Figure 3: Horizontal fissure not so prominent in the right lung

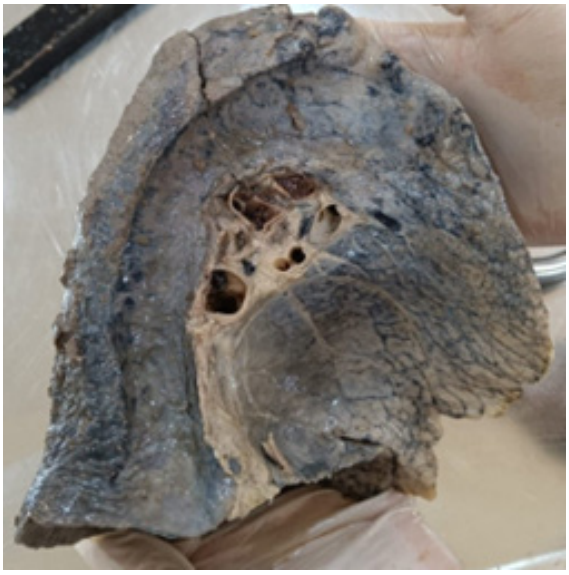

Figure 4: Oblique fissure present on the anterior surface but absent on the posterior surface of the left lung

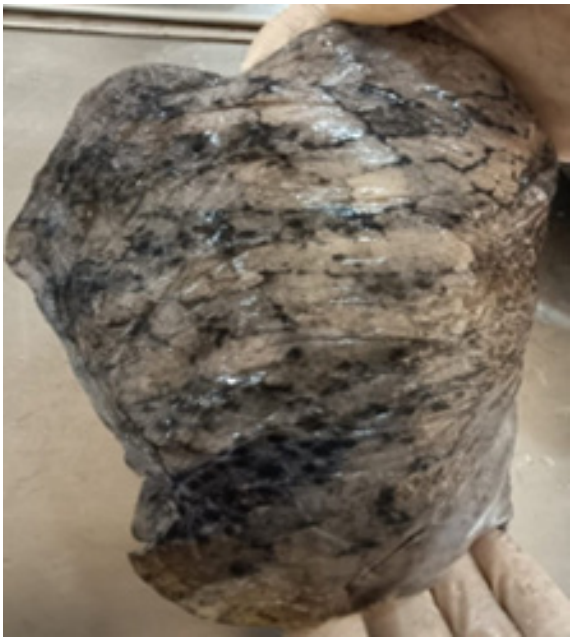

Figure 5: Absence of oblique fissure in the left lung

In 1997, Craig and Walker gave a classification based on completeness of a fissure [2]. All the lungs were observed and studied based on it.

Table 2: Observations based on the Craig and Walker criteria

LUNG	FISSURE	GRADE I	GRADE II	GRADE III	GRADE IV
Right Lung	Horizontal Fissure	61.11% (11/18)	11.11% (2/18)	5.55% (1/18)	22.22% (4/18)
	Oblique Fissure	83.33% (15/18)	11.11% (2/18)	5.55% (1/18)	0
Left Lung	Oblique Fissure	77.77% (14/18)	11.11% (2/18)	5.55% (1/18)	5.55% (1/18)

Figure 6: GRADE I

Figure 7: GRADE II

Figure 8: GRADE III

Figure 9: GRADE IV

Discussion:

In our study, the incidence of absence of horizontal fissure in the right lungs is 25% (4 lungs out of 18) and horizontal fissure not so prominent in the right lungs is also 16.66%(3 lungs out of 18).

According to studies conducted by Bhima Devi et al., Nene et al. and Lukose et al., absence of horizontal fissure of right lung was 9%, 14% and 10.5% respectively while the incidence of incomplete horizontal fissure of right lung was reported by the same authors as 18%, 8% and 21% respectively[3,4,5]. The incidence of absence of horizontal fissure in the right lungs was maximum i.e. 25%. Also, the incidence of incomplete horizontal fissure of right lung was 16.66% which was within the range of the previous studies.

In our study, the incidence of oblique fissure present on the anterior surface but absent on the posterior surface of the left lung is 5.5% (1 lung out 18) and absence of oblique fissure in the left lung is 5.5% (1 lung out 18). According to studies conducted by Minakshi et al., Prakash et al., Bhima Devi et al., there was high incidence (46.6%, 35.7% and 36.3% respectively) of incomplete oblique fissure of left lung[6,7,3]. Prakash et al. and Bhima Devi et al. also reported 10.7% and 9% incidence of absence of oblique fissure of left lung[7,3]. The incidence of incomplete oblique fissure of left lung in our study reports the lowest incidence of 5.5%. Also, the range of incidence of absence of oblique fissure of left lung was of lowest incidence i.e. 5.5%.

Craig and Walker (1997) have proposed a fissural classification based on the degree of completeness of the fissures. Four stages have been described. Grade I - complete fissure with entirely separate lobes; Grade II - complete visceral cleft but parenchymal fusion at the base of the fissure; Grade III - visceral cleft evident for a part of the fissure; and Grade IV - complete fusion of lobes with no evident fissural line[2].

According to the data obtained in our study, the horizontal fissure in 11 right lungs and the oblique fissure in 15 right lungs and 14 left lungs can be classified as Grade I. Variations involving horizontal fissure in 2 right lungs and variations involving oblique fissure in 2 right lungs and 2 left lungs can be classified as Grade II. Variations involving horizontal fissure in 1 right lung and variation involving oblique fissure in 1 right lung and 1 left lung can be classified as Grade III. Absence of horizontal fissure was noted in 4 right lungs and absence of oblique fissure was noted in 1 left lung which can be considered as Grade IV.

Table 3: Comparison with the previous studies

Authors	Right lung				Left Lung	
	Oblique fissure		Horizontal fissure		Oblique fissure	
	Incomplete (%)	Absent (%)	Incomplete (%)	Absent (%)	Incomplete (%)	Absent (%)
Bhima Devi et al.[3]	9.0 (2/22)	-	18.0 (4/22)	9.0 (2/22)	36.3 (8/22)	9.0 (2/22)
Nene et al.[4]	6.0 (3/50)	2.0 (1/50)	8.0 (4/50)	14.0 (7/50)	12.0 (6/50)	0
Lukose et al.[5]	-	-	21.0 (4/19)	10.5 (2/19)	21.0 (4/19)	-
Meenakshi et al.[6]	36.6 (11/30)	-	63.3 (19/30)	16.6 (5/30)	46.6 (14/30)	-
Prakash et al.[7]	39.3(11/28)	7.1(2/28)	50.0 (14/28)	7.1 (2/28)	35.7 (10/28)	10.7 (3/28)
Present study	11.11% (2/18)	0	16.66% (3/18)	25% (4/18)	5.5% (1/18)	5.5% (1/18)

Conclusion:

The lung fissures are usually used as a landmark in specifying pulmonary lesions, and its completeness is critical in planning the treatment for pulmonary diseases. Recognition of lung anomalies improves our understanding disease process of pneumonia, pleural effusion, and collateral air drift along with the disease spreading through the lungs and its treatment.

Thus it can be concluded that a thorough knowledge of fissures and lobes of lung with the possible variation is essential for radiologists, cardiothoracic surgeons, physiotherapists among other practitioners of general medicine.

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