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Original Research Article

STUDY OF ABNORMAL LOBAR PATTERN OF LUNGS

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ABSTRACT

Introduction: Lungs are divided into lobes by the oblique and the transverse (horizontal) fissures. The fissures may be complete or incomplete and they may be absent. The fissures facilitate the movement of the lobes in relation to one another, which accommodates the greater distension and movement of the lower lobes during respiration. 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. Hence, the awareness of their variations is essential in performing lobectomy and in segmental resection. It could also be of significance in interpreting radiological images.

Materials and Methods: Study on abnormal lobar pattern and position of fissures in human lungs was carried out in the department of anatomy SVS Medical College, Mahaboobnagar, India, With 50 human lungs (30 adult, 20 foetus) were examined by standard dissection method.

Results: Present study, the right lungs have incomplete horizontal fissures 50%, complete horizontal fissure 31.25%, absent of horizontal fissure 18.75%. Complete oblique fissure 87.5%, incomplete oblique fissure 12.5% and in left lungs complete oblique fissure 57.14% , incomplete oblique fissure 42.86% and also specimen no 13 in adult Right lung , specimen no 6 in foetus Right lung were showed accessory fissure because of it the right lung divides in to 4 lobes and in these specimens the left lungs were normal.

Discussion: Anatomical knowledge of anomalous lobar pattern of the lungs is important for identifying bronchopulmonary segments. Many times, radiologists may misinterpret an X-ray or CT scan. Anatomical knowledge of such variations is helpful for Thoracic surgeons performing lobectomy and clinicians for managing certain diseases that are limited to a single lobe or segment. Many a times the accessory fissures fail to be detected on CT scans, because of their incompleteness, thick sections and orientation in relation to a particular plane.

Conclusion: knowledge of abnormal fissures and lobes are clinically important for surgeons performing lobectomy and also academic interest to all medical personnel.

KEY WORDS: Lobar pattern, Bronchopulmonary Segments, Fissures, Lobectomy, Segmental resection.

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INTRODUCTION

Lungs are the essential organs of respiration. They are situated on either side of the heart and other mediastinal contents. Each lung is free in its pleural cavity, except for its attachment to the heart and trachea at the hilum and pulmonary ligament [1].

Lungs are divided into lobes by the oblique and the transverse (horizontal) fissures. The oblique fissure cuts the vertebral border of both the lungs at the level of 4th or 5th thoracic spine. Traced downwards on the medial surface it ends above the hilum: traced downwards on the coastal surface, it will be found to continue across the diaphragmatic surface and turn upward on to the medial surface to end just below the lower end of the hilum [2].

Horizontal fissure seen only in the right lung, Begins laterally at the oblique fissure and runs almost transversely across the coastal surface to the anterior margin and around this margin back to the hilum [2].

The fissures may be complete, when the lobes remain held together only at the hilum by the bronchi and pulmonary vessels, or they may be incomplete when there are areas of parenchymal fusion between the lobes, or they may be absent altogether.

The fissures facilitate the movement of the lobes in relation to one another, which accommodates the greater distention and movement of the lower lobes during respiration. Thus, they help in more uniform expansion of the whole lung[6]. As the fissures from 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. Hence, the awareness of their variations is essential in performing lobectomies and in segmental resection. It could also be of significance in interpreting radiological images.

The anamoly of the lobar pattern has been explained earlier by many research workers from the radiologist point of view but not much work has been published regarding the gross features of the condition.

Such abnormally fissures and lobes are clinically important for radiologists and clinicians in identifying and managing certain disease conditions which limit them to a single segment or lobe.

The exact knowledge of anatomy about the areas of dominant distribution of bronchi enables identification of the variable bronchi distribution areas, as well as the establishment of their identification criteria. The knowledge of anatomy on the variations of the trachea-bronchial tree enables and makes easier to recognise a clinical picture and pathology of human lungs, as well as the application of therapeutic and diagnostic methods (bronchoscopy and bronchography).

The “scimitar syndrome” is a rare complex of disorders which have been variously called pulmonary venolobar syndrome, hypogenetic lung syndrome, and right pulmonary artery syndrome, first described by Cooper and Chassinat.

1. Hypogenetic lung syndrome and right pulmonary artery syndrome. First described by Cooper and Chassinat in 1836, Halasz first coined the term “scimitar syndrome”to refer to the appearance of the abnormal draining vein, which he likened to the shep of a Turkish sword [3].

2. The classic components of the scimitar syndrome are abnormal venous drainage of the affected lung, dextrocardia, and systemic arterial supply to the affected lung.

3. The right lung is affected in the vast majority of cases, and there is a slight female predominance, with scattered reports of familial cases. Incidence is estimated to be between 1-3/ 100,000 births.

Along with the abnormal scimitar vein (abnormal pleural vein-IVC), there is a spectrum of abnormalities of the tracheobronchial tree. There is often abnormal lobation, and the right lung may be bi-or unilobed. The right bronchus is often hyparterial and abnormally long.

The accessory lobe of the azygos vein was first described in the right lung by Weisberg. This anamoly was caused by” an alteration in the relationship of the developing lung to the developing azygous vein. Azygos lobes generally mean accessory or supernumerary lobes of the lungs. Three types of azygos lobes may be encountered – upper azygos lobe, lower azygos lobe and lobe of the azygos vein. The upper and

lower azygos lobes are mentioned with reference to the hilum of the lung [4].

Although the etiology of scimitar syndrome is unknown, a majority of these are sporadic; but some are familial and transmitted as an autosomal dominant trait. Frequency is about 1-3 per million live births or even more as majority of asymptomatic patients remain undiagnosed.

Present study was conducted to study the morphological variations of lung fissure and lobes, with regards to various parameters, such as number lobes, Length, Depth of the fissure, Accessory fissures, Complete/incomplete and Absence of the fissure.

Anatomical knowledge of these fissures and lobes of the lung is important for identifying broncho-pulmonary segments and accurate interpretations on CT scans. Awareness regarding anatomical variations is essential for performing lobectomies and semental resection and interpreting radiological images. This also helps in precise planning of the surgery and obviates more invasive procedures and convertional lungs surgeries.

MATERIALS AND METHODS

Present study was conducted in the Department of Anatomy, Sri Venkatasai Medical College, Mahaboobnagar, Talangana, India, with a total number of 30 normal adult lungs and 20 foetal lungs were studied. Upon the standard dissection procedure lungs were studies for the various parameters.

OBSERVATIONS

Among 30 specimens 5 were with variations irrespective of their side and detailed morphological parameters, were tabulated for further interpretation of data.

The right lung displayed a variation in the lobar pattern with an accessory fissure and an accessory lobe. There was no abnormal lobar pattern noticed in the left lung. The right lung displayed an oblique fissure which originated at 8.5cms from the apex on the vertebral part of the medial surface, after traversing 6.8 cms it subdivided into two fissures.

One fissure continued towards the anterior border at a distance of 13.5cms from the apex forming the horizontal fissure.

The other fissure continued towards as the oblique fissure till the inferior border at a distance of 3cms from the anterior border. An accessory fissure was noted in the superior segment of inferior lobe, thus forming four lobes of the right lung.

An accessory fissure was preset at a distance of 16cms from the apex in the superior segment of the inferior lobe dividing thus the inferior lobe diving thus the lung into four lobes.

In the foetal specimens among the 20, 1 was found with an abnormal morphology and other morphological features were tabulated for further analysis.

Fig. 1: a. Showing the four lobes on Right side (Adults), **b.** Showing the measuring the length of the Oblique and accessory fissure.

a.

b.

Fig. 2: Showing the Bi-lobed Lungs on Right side (Adults)

Fig. 3: Showing the four lobes on Right side (Foetus), Also showing the measuring the length of the Oblique and accessory fissure.

Table 1: Showing the data for Adult lungs Morphological features on Right side.

Sl.No	Horizontal fissure and its length				Accessory Fissure	Oblique fissure and its length			
	Complete	Incomplete	Abscent	Depth	Length	Complete	Incomplete	Abscent	Depth
1	8cm	-	-	3cm	-	20cm	-	-	5cm
2	8.5cm	-	-	3.5cm	-	25cm	-	-	5.2cm
3	9cm	-	-	3.2cm	-	21cm	-	-	5cm
4	-	6cm	-	3.8cm	-	-	18cm	-	5.8cm
5	--	6.5cm	-	3.8cm	-	20cm	-	-	5cm
6	-	-	-	-	-	19cm	-	-	5.2cm
7	-	-	-	-	-	-	14cm	-	6cm
8	-	7cm	-	3cm	-	21cm	-	-	5.2cm
9	-	6cm	-	3.8cm	-	17.5cm	-	-	5cm
10	-	5cm	-	3cm	-	21cm	-	-	6.5cm
11	-	-	-	-	-	22cm	-		5cm
12	13.5cm	-	-	3cm	-	26cm	-	-	4cm
13	-	6.5cm	2.5cm	2.5cm	7.5cm	23cm	-	-	4.5cm
14	-	-	-	3cm	-	20cm	-	-	4.6cm
15	9cm	9cm	3cm	2.5cm	-	25cm	-	-	4.8cm
16	-	7.5cm	-	2.6cm	-	18.5cm	-	-	4.5cm

Table 2: Showing the data for adult lungs Morphological features on Left side.

Sl.No	Oblique fissure & its length		
	Complete	Incomplete	Depth
1	20cm	_	5cm
2	18cm	_	4cm
3	20cm	_	5.5cm
4	_	15cm	4cm
5	25cm	_	4.2cm
6	23cm	_	3.5cm
7	21cm	_	4cm
8	_	14cm	3cm
9	23cm	_	3.5cm
10	_	15cm	3cm
11	_	17cm	4cm
12	_	15cm	3.5cm
13	23cm	_	5.5cm
14	_	17cm	4cm

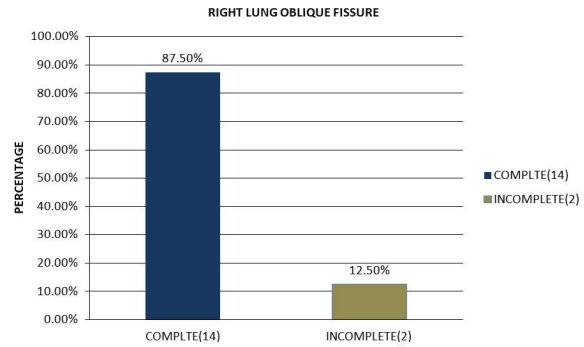
Table 3: Showing the data for Foetal lungs Morphological features on Right side.

Sl.no	Horizontal & its length			Accessory Fissure	Oblique fissure & its Length	
	Complete	Incomplete	Abscent	Length	Complete	Incomplete
1	4cm	_	_	_	_	5.5cm
2	_	2cm	_	_	6.5cm	_
3	_	1.8cm	_	_	_	4.5cm
4	_	1.2cm	_	_	7cm	_
5	_	1.5cm	_	_	_	5cm
6	3cm	_	_	2cm	_	5cm
7	3.3cm	_	_	_	_	5.2cm
8	_	1.5cm	_	_	6cm	_
9	3.8 cm	_	_	_	6.8cm	_
10	3.5cm	_	_	_	_	4.8cm

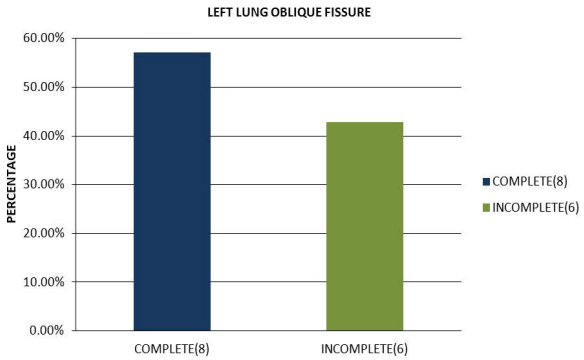
Table 4: Showing the data for Foetal lungs Morphological features on Left side.

Sl.No	Oblique fissure & length	
	Complete	Incomplete
1	8cm	–
2	7cm	–
3	5.5cm	–
4	7cm	_
5	–	6cm
6	6.5cm	–
7	_	5.5cm
8	_	4.5cm
9	7.2cm	_
10	_	5cm

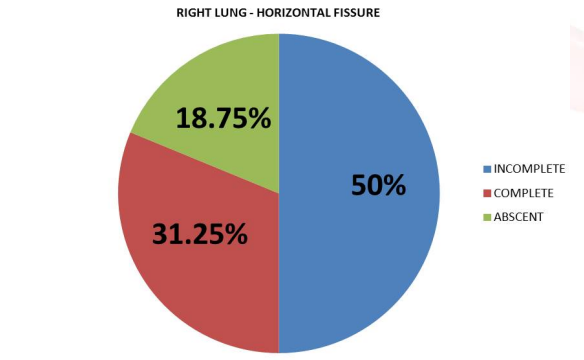
Graph 1: Showing the incidence of Oblique fissure on Right Lung (Adults).



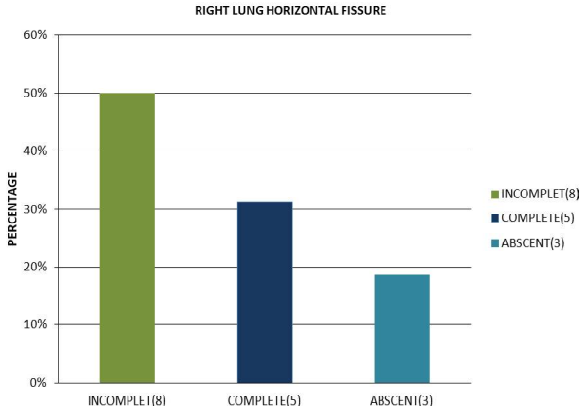
Graph 2: Showing the incidence of Oblique fissure on Left Lung (Adults).



Graph 3: Showing the incidence of Horizontal fissure on Right Lung (Adults).



Graph 4: Showing the incidence of Horizontal fissure on Left Lung (Adults).



DISCUSSION

The right lobe typically has two fissures, an oblique and a horizontal, dividing it into three lobes. The defective pulmonary development during the stage of obliteration of the spaces between individual broncho-pulmonary buds or segments may result in accessory fissures and thus leading to formation of accessory lobes.

Fissures are the spaces which separate individual broncho-pulmonary buds and they get obliterated except along the two planes which manifest later as major and minor fissures i.e. the oblique and horizontal fissures [5].

The defective pulmonary development gives rise to variations in lobes and fissures of lung. The fissures are the spaces which separate individual broncopulmonary buds or segments and they get obliterated except along the two planes which later manifests as horizontal or oblique fissure [5].

Craig and Walker have proposed a fissural classification based on both the degree of completeness of the fissures and the location of the pulmonary artery at the base of the oblique fissure [6].

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

Grade IV- complete fusion of lobes with no evident fissural line.

Several studies have been reported regarding the varying percentage of presence of incomplete fissures. Current study indicates that incompleteness of the fissures predominate in the right lung. The position of the lung fissure could be used as reliable landmarks in specifying lesions within the lung [7].

Among the accessory fissures most common one is the superior accessory fissure, a fissure in the superior segment of the inferior lobe of right lung [8-10].

The incidence of superior accessory fissure is

reported to be more common in the right lung as compared to the left one [8-10].

Knowledge of an accessory fissure is helpful for clinicians in order to differentiate it from other normal anatomical and pathological structures. Interpretation of various radiographic appearances of interlobar fluid is important for clinicians.

Superior accessory fissure has a reported incidence of 5 to 30 % in autopsy studies as compared to 3% incidence in high resolution CT scans [8-10].

In the present study, the accessory fissure is observed one in adult right lung out of 30 lungs and one in foetal right lung out of 20 foetal lungs (4%) is correlated with the findings of David and Tarver 1984 [11,12].

During the development, as the lung grows, the spaces or fissures that separate individual bronchopulmonary buds/segments become obliterated except along with the two planes, evident in the fully developed lungs as oblique or horizontal fissures [13]. Absence or incomplete oblique or horizontal fissures could be due to obliteration of these fissures either completely or partially. Accessory fissure could be due to non-obliteration of spaces which are normally obliterated.

Incomplete pulmonary fissures indicating partial fusion between lobes are common and more than half of the pulmonary fissures are incomplete. Several authors [7,8,13-15] have reported varying percentages of incidence of the incompleteness of the fissures.

RIGHT LUNG

Incomplete Horizontal Fissure: According to Meddler EM (1947), in his examination of 1200 pair of lungs, he found incomplete horizontal fissure in 71% lungs [7], Lukose et al (1999)[16] in 21% lungs.

According to Iehav (2000) [15] he observed incomplete horizontal fissure in 67 % lungs and according to Meenakshi (2004) [5] in her examination of 30 pairs of lungs she found incomplete horizontal fissure **63.3%** lungs respectively. **In the present study** observed the incomplete horizontal fissure out of 30 adult lungs is 5**0%** (ie., 8 right lungs out of 16 right lungs) which are approximately correlating with the author Meenakshi.

Abscent horizontal fissure: According to the study done by the Meddler, Lukose et al 1999 [16], Iehav and Meenakshi, they found abscent of the horizontal fissure 45.2 % ,10.5%,21% and **16.6%** respectively.

In the present study, observed the absence of horizontal fissure in **18.75%** lungs (i.e., 3 right lungs out of 16 right lungs), which is correlated with the author Meenakshi.

Incomplete oblique fissure: According to Meddler EM (1947) incomplete oblique fissure in 25.6% lungs [7], Lukose et al (1999) [16] in 30% lungs and according to Meenakshi (2004) [5], in 36.6% lungs.

In the present study, incomplete oblique fissure is observed in **12.5%** lungs (i.e., 2 right lungs out of 16 right lungs).

LEFT LUNG

Incomplete oblique fissure: The study done by the authors Meddler EM [8], Lukose et al (1999) [16], Iehav [15] and Meenakshi et al. (2004) [5], they found incomplete oblique fissure in 10.6%, 21% , 30% and **46.6%** respectively.

In the present study, observed the incomplete oblique fissure in **42.86%** lungs (i.e.,6 left lungs out of 14 left lungs), which is correlating with the author Meenakshi et al. (2004) [5].

	Lukose et al (1999) [16]	Iehav (2000) [15]	S.Meenakshi et al (2004) [5]	Present study
Right Lung				
Horizontal fissure				
Absent	10.50%	21%	16.60%	18.75%
Incomplete	21%	67%	63.30%	50%
Incomplete oblique fissure	–	30%	36.60%	12.50%
absent Horizontal fissure incomplete oblique fissure	5.30%	–	6.66%	6.25%
Left Lung				
Incomplete oblique fissure	21%	30%	46.60%	42.86%

The knowledge of anatomy of fissures of lung may help in clarifying, radiographic findings like extension of fluid into an incomplete major fissure or spread of various diseases through

different pathways (Dandy, 1978) [17].

Considering the clinical importance of such anomalies, we as anatomists opine that prior awareness and anatomical knowledge of accessory fissures and lobes in the lung may be important for Clinicians, Radiologists and Thoracic surgeons.

Conflicts of Interests: None

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