

Variations in lung fissures and lobes morphology in population of Andhra Pradesh of South India (a cadaveric study)

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Abstract

Knowledge of the position of lung fissures is necessary for the appreciation of lobar anatomy and thus locating the bronchopulmonary segments. The study aimed to investigate the patterns of fissures and lobes of the lungs and their variations in Andhra Pradesh, India and to find their clinical implications and compare them with the previous studies. **Methods:** The patterns of lobes, fissures, and hilar anatomy of lungs and its variations of 47 lungs by dissection method of embalmed cadavers was performed in the Department of Anatomy, Narayana Medical College (Nellore, India). The specimens were macroscopically observed for gross morphology of fissures and lobes. **Results.** The study showed oblique fissure in 33 % (grade 1), 26 % (grade 2), 24 % (grade 3) and 14 % (grade 4) of right lungs and 27 % (grade 1), 31 % (grade 2), 12 % (grade 3) and 12 % (grade 4) of left lungs. The incomplete horizontal fissure was seen in 38 % of right-sided lungs (grade 1). 19 % of right lungs and 10 % of left lungs had accessory lung fissures. **Conclusions.** Awareness of the variations in the lobes and fissures of the lungs is important for radiologists while interpreting magnetic resonance imaging and computed tomography scans. Also, we believe that the data from the present study certainly adds an important reference in the medical literature to thoracic surgeons in performing pneumonectomy and segmental resection.

Key words: lung abnormalities, cadaver, dissection, pneumonectomy.

Conflict of interest. The authors declare no conflict of interest.

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Вариации морфологии щелей и долей легких населения штата Андхра-Прадеш Южной Индии (посмертное исследование)

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Резюме

Информация о положении расщелин легких необходима для оценки анатомии долей и, таким образом, определения местоположения бронхолегочных сегментов. Цель исследования – изучить расположение расщелин и долей легких и их вариации у населения штата Андхра-Прадеш, Индия, выявить их клиническое значение и сравнить с предыдущими исследованиями. **Методы.** На кафедре анатомии медицинского колледжа Нараяна (Неллор, Индия) проведено исследование долей, фиссур, хиларной анатомии легких и ее вариаций 47 легких методом препарирования забальзамированных трупов. Образцы подвергались макроскопическому исследованию на предмет грубой морфологии фиссур и долей. **Результаты.** Исследование показало наличие косой фиссуры в 33 % (степень 1), 26 % (степень 2), 24 % (степень 3) и 14 % (степень 4) правых легких и 27 % (степень 1), 31 % (степень 2), 12 % (степень 3) и 12 % (степень 4) левых легких. Неполная горизонтальная фиссура наблюдалась в 38 % правых легких (степень 1). 19 % правых легких и 10 % левых легких имели добавочные расщелины легкого. **Заключение.** Знание о изменении долей и фиссур легких важно для радиологов при интерпретации магнитно-резонансных и компьютерных томограмм. Кроме того, мы считаем, что данные настоящего исследования, безусловно, добавляют важную информацию для торакальных хирургов, выполняющих пневмонэктомию и сегментарную резекцию.

Ключевые слова: аномалии легких, труп, диссекция, пневмонэктомия.

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Introduction

The lungs are a pair of vital organs for respiration situated within the thoracic cage on either side of the mediastinum. Each lung is conical in shape and is divided into lobes by double folds of visceral pleura called fissures. Anatomically, the right lung is divided into upper, middle, and lower lobes by oblique and horizontal fissures, and the left lung is divided into upper and lower lobes by an oblique fissure. The right oblique fissure is similar to the left one, although it is less vertical and separates the inferior lobe from the middle and upper lobes. The oblique fissure begins from the upper part of the hilum on the mediastinal surface and cuts the vertebral border at the fourth or fifth level of the thoracic spine. Then, it courses along the costal surface, cuts the inferior border, reappears on the mediastinal surface, and ends at the lower end of the hilum. The horizontal fissure, which is seen only in the right lung, begins at the oblique fissure, courses along the costal surface, cuts the anterior border, appears on the mediastinal surface, and ends at the hilum [1]. Frontal chest radiography can detect horizontal fissures in 60 % of cases. The oblique fissure is usually seen via lateral radiography and appears as a curved band from the lateral aspect to the hilum under high-resolution computed tomography (CT) [1–4].

As a result of an inward extension of the visceral pleura, these fissures provide a smooth surface between the lobes. It acts as a plane of cleavage so that during inspiration, the upper part of the lung enlarges forward and laterally, and the lower part of the lung

expands downward and backward. Lung fissures may be complete when the lobes remain intact at the hilum by bronchi and pulmonary vessels, but they may also be incomplete when a parenchymal fusion occurs between the lobes [5]. The incomplete fissure may be a source of collateral ventilation, wherein the alveolar structures are ventilated through passages that bypass the normal airways and connect two lung lobes [6].

The position of lobes and fissures is useful in locating the bronchopulmonary segments which is significant both anatomically and clinically. Accurate anatomical knowledge of the lungs is needed to interpret radiological findings and is crucial during surgery. In many diseases, segment localization is needed for proper resection, and the preoperative anatomical knowledge required to plan for pneumonectomy or segmental resection lowers the probability of postoperative complications such as air leaks, which lead to significant morbidity [7, 8]. Considering the clinical importance of this topic, the present study is undertaken to assess the pattern of the lung concerning lobes and fissures in Andhra Pradesh of South India.

Material and methods

Forty seven (47) isolated, properly embalmed formalin-fixed cadaveric lungs preserved in the dissection hall were taken into consideration for the study. This was an observational study conducted in the Department of Anatomy, Narayana Medical College (Nellore, India) from June 2020 to

Table 1. Grading of fissure completeness) [9]

Grade	Criteria of fissure completeness
1	Complete fissure with entirely separate lobes
2	Complete visceral cleft but parenchymal fusion at the base of the fissure
3	Visceral cleft evident for part of the fissure
4	Complete fusion of the lobes with no evident fissural line

Table 2. Prevalence of accessory fissures in right and left lungs

Lung	Accessory fissure	n	%
Right lungs (n = 21)	Superior accessory fissure	3	14 %
	Inferior accessory fissure	1	5 %
Left lungs (n = 26)	Superior accessory fissure	2	10 %
	Inferior accessory fissure	0	0

November 2021, and institutional ethical clearance was obtained. The specimens were macroscopically observed for gross morphology of fissures and lobes. The specimens having pathological lesions, marks of previous surgery, and those that were damaged during removal were excluded from the study. Study limitations include the gender, age, ethnicity, and ecological living conditions were not examined.

Only those lungs which were covered all over by pleura except at the hilum were used in the study. If any part of the lung was cut off during its removal, such lung was excluded from the study. Out of the 47 lungs, 21 were right lungs and 26 were left lungs. These lungs were examined for the patterns of lobes and fissures, variations were observed and photographed.

The anatomical classification based on the degree of fissure completeness proposed by Craig and Walker was followed to determine the presence and completeness of fissures (Table 1) [9].

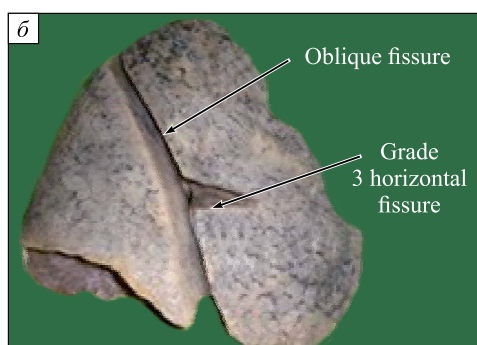
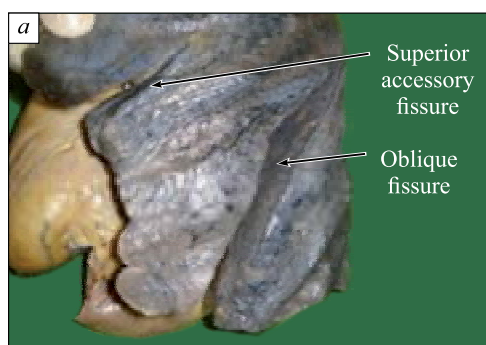
Results

Results showed oblique fissures were present in 7 (33 %, grade 1), 6 (26 %, grade 2), 3 (24 %, grade 3) and 4 (14 %, grade 4) of 21 right lungs and 7 (27 %, grade 1), 8 (31 %, grade 2), 3 (12 %, grade 3) and 3 (12 %, grade 4) of 26 left lungs. The incomplete horizontal fissure was seen in 8 (38 %, grade 1), 7 (19 %, grade 2), 4 (19 %, grade 3) and 5 (24 %, grade 4) right-sided lungs. Figure displays the superior

accessory fissure of the left lung and the right lung with oblique and horizontal fissures. Accessory lung fissures are shown in Table 2, 19 % of the right lung and 10 % of the left lung had accessory lung fissures.

Discussion

The development of the lung starts as multiple bronchopulmonary bud. Later the fissures that separate individual bronchopulmonary buds get obliterated. The remaining space along the interlobar planes gives rise to major (oblique) and minor (horizontal) fissures in a fully developed lung [8]. Defective pulmonary development is associated with the variations encountered in fissures and lobes [10]. Incomplete pulmonary fissures indicating partial fusion between lobes are common and more than half of the pulmonary fissures are incomplete. The detailed knowledge regarding the anatomy of fissures is of great significance for planning operative strategy for various procedures like thoroscopic pulmonary resection or pulmonary lobectomy where incomplete fissure may be the cause of post-operative air leakage. The presence of fissures in the lung enhances uniform expansion of the lungs and their position might be used as a reliable landmark in specifying lesions within the lungs or thorax as well [11]. Incomplete fissures usually change the pattern of collapse which is normally seen in the patients with endobronchial lesions and also contribute to the atypical appearance of pleural effusion. An incomplete major fissure



Left lung showing accessory fissure (a); right lung showing horizontal fissure and oblique fissure (b)

causes the pseudo appearance of fluid within the fissure. [12]. An incomplete fissure may alter the spread of disease within the lung. Pneumonia may spread to adjacent lobes via parenchymal continuation in case of incomplete fissures.

Several studies have been reported regarding the varying percentage of presence of incomplete fissures [10–15]. The current study indicates that the incompleteness of the fissures predominates in the right lung. The position of the lung fissure could be used as a reliable landmark in specifying lesions within the lung [10]. The identification of the completeness of the fissures is important before lobectomy, because individuals with incomplete fissures are more prone to develop postoperative air leaks, and may require further procedures such as stapling and pericardial sleeves [7]. In patients with incomplete fissures, pneumonia may spread to adjacent lobes through the incomplete fissures. Similarly, carcinoma of the lung may involve odd lobes via incomplete fissure [4].

In this study, four right-sided lungs showed accessory fissures. Accessory fissures of the lung are commonly observed in lung specimens, but are often unappreciated or misinterpreted on radiographs and CT scans. On CT scans accessory fissures are seen as high attenuation curvilinear bands and are confused with areas of linear atelectasis, pleural scars, or walls of bullae [8]. In patients with the endobronchial lesion, an accessory fissure might alter the usual pattern of lung collapse and pose difficulty in diagnosing a lesion and its extent. Often these accessory fissures act as a barrier to the spread of infection, creating sharply marginated pneumonia, which can wrongly be interpreted as atelectasis or consolidation [5]. The knowledge of the anatomy and variations of the lung fissures is essential for proper identification of normal lung anatomy and evaluation of disease, for identification and interpretation of their variable imaging appearance and related abnormalities [10].

The results of the present study and their comparison with the previous works show that there is a wide range of differences in the occurrence of classical and accessory fissures between and among different populations. This implies that a variety of genetic and environmental factors might affect the development of these fissures. However, there were limitations of study like genetic, gender, and environmental factors, which were not studied. So future study is needed to evaluate the various factors that influence the development of fissures. Knowing the frequency of occurrence of a variant fissure in a particular population is important for making correct radiological diagnosis and for proper surgical management of lung pathology.

Conclusions

The current study indicates that incomplete fissure prevails in the right lungs. Additional gaps in both lungs are present with a frequency of 5 to 14 %. Seeing the clinical and surgical importance of anomalies one can say that previous anatomical knowledge and a high directory of suspicion for probable variations in the fissures, lobes, and bronchopulmonary segments in the lung may be important for surgeons and radiologists.

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