

A study of morphological variations of fissures and lobes of formalin fixed cadaveric lungs

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ABSTRACT

Background: Variation of morphology of lung fissures and lobes affects the interpretation of results of radiological examination as well as line of action in cardiothoracic surgical procedures. A research was done to find out the incidence of variations of fissures and lobes in embalmed cadaveric lungs.

Materials and methods: This was a cross sectional study. All the formalin fixed lung specimens present in dissection halls and museums of the Anatomy Departments were observed for any abnormal fissures that are adding accessory lobes to lungs. Data was entered and analyzed by using SPSS 22.0. Descriptive analysis was applied by using frequencies and percentages for qualitative variables.

Results: Total 80 formalin-fixed specimens of lungs were examined and a total of 29 (36.25%) (%) were found to have incomplete fissures. It was observed that 14 (17.5 %) out of 80 lungs had incomplete oblique fissures, and out of these 6 (17.65%) were found in right lungs and 08 (19.05%) were present in left lungs, whereas 15 (39.47%) right lungs showed incomplete horizontal fissure. Among 80 lungs, 6 (7.5%) presented unusual accessory fissures and lobes, whereas 5 (14.7%) showed absent horizontal fissure reducing the number of lobes to two in right lung specimen.

Conclusion: There is a prevalent incidence of incomplete horizontal fissure that must be kept in mind when investigating and treating any lung pathology.

Keywords:

Lung lobes, fissures, accessory fissures, accessory lobe

INTRODUCTION

The division of right lung is into superior, middle, and inferior lobes by its major (oblique) and minor (horizontal) fissures. The major fissure of right lung extends obliquely from hilum crossing the inferior border of the lung roughly 7.5 cm behind its anterior end, whereas the horizontal fissure cuts the oblique fissure near the mid-axillary line and separates the superior and middle lobes at the level of fourth costal cartilage. Left lung is divided into superior and inferior lobes by an oblique fissure.¹ These fissures are called complete when the lobes are separated only at hilum, and they are designated incomplete when parenchyma is continuous and fissures do not reach hilum.² During respiration these fissures make expansion of lung lobes easier in relation to one another.³

The division of lung bud gives rise to bronchopulmonary segments that are surrounded by splanchnopleuric mesenchyme. The sequential division and growth cause the space obliteration resulting in fusion of these segments. All the parenchyma that is

progeny of a lobar bronchus is separated from adjoining bronchus by splanchnic mesenchyme that will form visceral pleura separating the lobes at two planes forming two fissures (oblique and horizontal) in right lung with consequent formation of three lobes and only one oblique fissure in left lung dividing it into two lobes.^{4,5}

The presence of a variant fissure can be due to partial or complete failure of obliteration of these fissures that causes the formation of accessory lobes or results in absent lobes and fissures.^{6,7} The knowledge of location of fissures in the normal lungs and their position during normal breathing make reliable landmarks in identifying lesions within the thorax, in general and within the lungs in particular. Morphological knowledge of fissures and lobes of the lungs is important for radiologists in interpretation of MRI and CT scans.^{7,8} It is essential for cardio-thoracic surgeons to be aware of the variations in morphology of lungs, in order to plan lobectomies and segmental resections effectively.⁸⁻¹⁰

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MATERIALS AND METHODS

A cross sectional study was done in two medical colleges including Fatima Jinnah Medical University (FJMU) and Allama Iqbal Medical College (AIMC), Lahore, during a period of two years from 2019 - 21. Following

ethical clearance, the data was collected according to classification of lung fissures proposed and identified by Craig and Walker (Table 1).¹¹ Intact and complete formalin fixed lung specimens present in dissection halls & museums of these medical colleges were examined. Data was entered and analyzed by using SPSS 22.0. Descriptive analysis was applied by using frequencies and percentages for qualitative variables.

RESULTS

A morphological study was conducted on 80 formalin-fixed specimens of lungs (38 of right side and 42 of left side) from cadavers. The specimens were observed and classified using the classification described by Craig and Walker.¹¹

Out of these 80 lung specimens, 29 (36.25%) presented with incomplete fissures. It was observed that 14 (17.5 %) out of 80 lungs exhibited incomplete oblique pulmonary fissures, and out of these 06

Table 1: Craig and Walker grading of lung fissures¹¹

| Grade | Description |
|-------|------------------------------------------------------------------|
| I | Complete fissures (unite the lung lobes at hilum only) |
| II | Incomplete fissures (parenchymal fusion at the base of the lung) |
| III | Incomplete fissures (some part of the cleft is visible only) |
| IV | Absent fissures (complete fusion of lobes) |

(15.79%) were found in right lungs and 08 (19.05%) were present in left lungs (Figure 1), whereas the incidence of incomplete horizontal fissure in right lungs was 15 (39.47%) (Figure 2). Among these 80 lungs, 06 (7.5%) presented unusual accessory fissures and lobes (Figure 3), whereas 05 (13.16%) of 38 right lungs showed absent horizontal fissure (Figure 4) reducing the number of lobes to two in right lung specimen (Table 2). These observations are of academic interest for the anatomists and are of clinical importance to surgeons and radiologists.

Table 2: Gross morphological variations of fissures and lobes in human lungs.

| S. No. | No. of Lungs (n) | Incomplete oblique fissure | Incomplete horizontal fissure | Accessory fissures & lobes | Absent/ Incomplete lobes |
|--------|------------------|----------------------------|-------------------------------|----------------------------|--------------------------|
| 1 | Right n = 38 | 06 15.79% | 15 39.47% | 03 7.89% | 05 13.6% |
| 2 | Left n = 42 | 08 19.05% | - | 03 7.14% | 00 |
| 3 | N = 80 | 14 17.5% | 15 18.75% | 06 7.5% | 05 6.25% |

Table 3: Comparison of present study for variations in fissures and lobes of lungs

| Author | Year of publication | Incomplete oblique fissure of right lung | Incomplete horizontal fissure | Incomplete oblique fissure of left lung | Accessory fissures & lobes | Absent/ Incomplete lobes |
|-----------------------------------------------|---------------------|------------------------------------------|-------------------------------|-----------------------------------------|----------------------------|--------------------------|
| Mutua and associates ¹⁷ | 2021 | 14 (36.84%) | 16 (42.11%) | 11 (34.38%) | 14 (20%) | 14 (10.53%) |
| Halagatti and Channabasanagouda ¹⁸ | 2020 | 11 (35%) | 17 (45.94%) | 09 (24.32%) | - | 03 (8.1%) |
| Vasuki and colleagues ¹⁴ | 2019 | 13 (32.5%) | 23 (57.5%) | 20 (50%) | 5 (6.25%) | 20 (25%) |
| Sudikshya and fellows ¹⁵ | 2018 | 7 (30.43%) | 8 (34.78%) | 14 (51.85%) | 7 (30.34%) | 3 (13.04%) |
| Wattamwar and Siddiqui ²⁰ | 2017 | 02 (6.25%) | 12 (37.5%) | 02 (7.14%) | 06 (10%) | 12 (20%) |
| Quadros and associates ¹⁹ | 2014 | 2 (5.55%) | 09 (25%) | 01 (2.5%) | 14 (18.42%) | 04 (11.11%) |
| George and fellows ¹⁶ | 2014 | 2 (3.07%) | 23 (35.38%) | 11 (15.06%) | 5 (3.62%) | 2 (1.45%) |
| Current Study | 2022 | 6 (15.79%) | 15 (39.47%) | 8 (19.05%) | 6 (7.5%) | 5 (6.25%) |

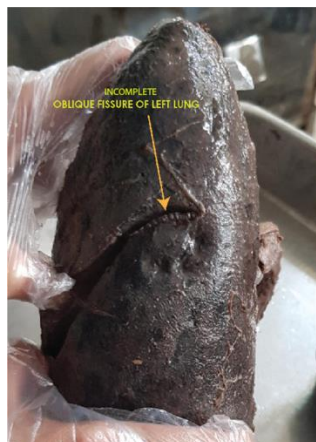


Figure 1: Showing incomplete oblique fissure of left lung



Figure 2: Showing incomplete horizontal fissure of right lung



Figure 3: Showing accessory fissure and extra lobe in right lung.

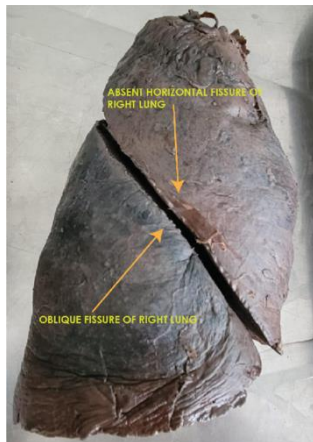


Figure 4: Showing absent fissure in right lung.

DISCUSSION

Understanding of normal anatomy and its variations forms the foundation of surgery. If the process of normal lung development gets compromised, then incomplete or accessory fissures and lobes are formed.^{12,13} The present study was conducted on 80 formalin-fixed lung specimens (38 right and 42 left) from cadavers to identify the variations of the fissures and lobes of lung specimens. It was found that the incidence of incomplete oblique fissures was 17.5%, with a prevalence in left sided incomplete fissures 19.05%, that is in accordance with the studies of Vasuki and colleagues, Sudikshya and associates and George and fellow workers.¹⁴⁻¹⁶ Vasuki and colleagues found 50% prevalence in cadavers from Tamil Nado, India, Sudikshya and associates did their study in Nepali cadavers that revealed 51.85% incidences of incomplete oblique fissures in left lungs, whereas George and his fellow workers reported 15.06% incidences of oblique fissures in left lungs in Indian cadavers (Table 3).¹⁴⁻¹⁶ By

comparison the studies of Mutua and associates, Halagatti and Channabasanagouda and work of Quadros and colleagues is contradictory to the present study.¹⁷⁻¹⁹ Mutua and colleagues did their research in cadaveric Kenyan population and found incomplete oblique fissures in 34.38% of left lungs as compared to 36.84% of right lungs.¹⁷ Similarly, Halagatti and Channabasanagouda found an incidence of 24.32% incomplete fissures in left lungs in cadavers found in Indian Karnataka as compared to 35% of right lungs. Quadros and colleagues reported an incidence of only 2.5% in oblique fissure of lung, whereas Wattamwar and Siddiqui found an equal incidence in both lungs (Table 3).^{19,20}

Regarding incomplete horizontal fissure of right lung, all these researchers reported a similar incidence as present study except Sudikshya and associates who found less occurrence of incomplete horizontal fissures in right lung as compared to incidence of oblique fissures. Vasuki and colleagues reported an incidence of 57.5%, George and fellows reported 35.38% occurrence, Mutua and associates proclaimed an incident of 42%, whereas the cadaveric study done by Halagatti and Channabasanagouda showed higher incidence 45.94% of incomplete horizontal fissures of right lung (Table 3).^{14,15,17,18}

Accessory fissures found in 3.95% lungs is in agreement with studies of Vasuki and colleagues (6.25%) and George and fellows (3.62%), whereas Mutua and associates (20%), Sudikshya and colleagues (30.34%), Quadros and associates (18.42%) and Wattamwar and Siddiqui (10%) reported higher incidence.^{14,16,17,19,20} Halagatti and Channabasanagouda had not reported about accessory fissures or lobes (Table 3).¹⁸

Regarding absence of fissures, the studies of Vasuki and colleagues (25%) and Wattamwar and Siddiqui (20%) showed a higher incidence in comparison to present study, others are in agreement with our findings (Table 3).^{14,20}

CONCLUSION

Pakistani population has prevalent incidence of incomplete horizontal fissure. The results of present study showed a 39.47% incidence of incomplete horizontal fissure in right lungs and 17.5% incidence of incomplete oblique fissure that must be kept in mind when investigating and treating any lung pathology. An incomplete fissure can change the spread of the diseases like pneumonia and carcinoma within the lung. If there is an incomplete fissure, these pathologies may spread

to the other lobes. In cases where resection was recommended to treat patient, the knowledge of accessory lung fissures and lobes provide a guideline to use further procedures in these patients, for example the use of stapling and pericardial sleeves. Incomplete fissures might be misjudged for pleural effusion on radiological examination.

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