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Morphological Variations in Right Human Lungs in Rajasthan: A Cadaveric Study

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Abstract:
Introduction: *The fissures in lung enhance uniform expansion. These fissures may be complete, incomplete or absent. A detailed knowledge of variation of classical and accessory fissures is neccessary for cardiothoracic surgeons and radiologist.*
Aims of study: *There were few studies done on gross anatomical specimens so the cadaveric study was done to know every morphological details and variation in fissures, lobes & hilar structures of Right lung.* ***Material and Methods:*** *Formalin fixed adult cadaveric lungs of right side (55) were studied in Department of Anatomy Government Medical College Kota. The specimens having any pathological lesion or damage during removal were excluded from the study. Details of morphology of right lung were recorded and variations were noted and photographs taken. The anatomical classification proposed by Craig & Walker was followed to determine completeness of fissures.*
Results*: Classically complete oblique fissure was found in 40% (22) of lung specimens. 58%(32) were incomplete either at its beginning or at its end or both . Accessory fissure was found in 5.45%(3) lungs ,out of which 3.63%(2) were superior fissure and 1.81% (one) inferior accessory fissure. Variations of hilar structures were observed.*
Conclusion*: Results and comparison with previous studies shows wide range of variations in morphological pattern of lungs among different populations. Knowledge of such variation and frequency of occurrence in a regional population might help to clinician and radiologist to exactly diagnose,plan and modify a surgical procedure.*
Keywords: *Lung, Lobe,Fissures,Accessory Fissure,Variations*

I. Introduction

The lungs are essential organs of respiration situated in thoracic cavity on either side of heart and other mediastinal contents[1]. Each lung developed from lung bud arising from distal end of laryngotracheal tube. The tube bifurcates into two bronchi, surrounded by splanchopleuric mesoderm, subsequently it developed into three lobes on right side and two lobes on left side divided by fissure[2]. The Right lungs is broad and heavier than left lung. The two fissures oblique and horizontal divide it into three lobes namely upper, middle, lower[1]. The oblique fissure cross obliquely on costal surface and reaches inferior border then turns upward on medial surface below the hilum. It cuts the vertebral border at the level of fourth or fifth thoracic spine.[1] The horizontal fissure starts from oblique fissure and runs horizontally crossing costal surface to anterior border and then reaches to hilum. Thus separates a wedge shaped middle lobe from upper lobe. The fissures may vary in the degree of completeness. Complete fissures show continuity of lobes at their bottom by the parts of bronchial tree and blood vessels. In the region of incomplete fissures the adjacent lobes are connected by pulmonary tissue as the fissure fails to reach the hilum.[3] Lungs expand uniformly due to presence of fissures therefore used as landmarks in identifying lesions and performing segmental lung resections.[4] Although the fissures & their pattern has been studied in few population but ,hilar structure variations have not been studied.[5] Accessory fissures of varying depth may be present which limits abnormal lobes or bronchopulmonary segment.[3]The position of lobes and fissures is useful in locating the bronchopulmonary segments which is significant both anatomically and clinically. A good knowledge of the variations in the lobes and fissures of the lungs is required for radiologists for accurate radiological interpretation and so for cardiothoracic surgeons for the appreciation of lobar anatomy and thus locating the bronchopulmonary segments while performing segmental resections or pulmonary lobectomy .[6] Therefore this cadaveric study was undertaken to report the prevalence of variations in lung fissure, lobes and hilar structures in Rajasthan population.

II. Material And Methods

With prior permission from Institutional ethical committee and HOD of the Department of Anatomy and Forensic medicine, Government Medical College, Kota. This cadaveric study was carried out in Department of Anatomy Government Medical College, Kota and other medical colleges of Rajasthan. Formalin fixed adult cadaveric lungs of right side (55) were studied. The specimens having any pathological lesion or damage during removal were excluded from the study. Details of morphology of right lung were recorded and variations were noted and photographs taken. The anatomical classification proposed by Craig & Walker[7] was followed to determine completeness of fissures. The depth of oblique fissure was noted by introducing a rigid probe perpendicular to the surface of the lung and then measuring it to the nearest millimeter, at three sites. Maximum depth obtained either at upper end, lower end or in the floor of the fissure throughout its length was recorded. In the specimens where the oblique fissure was found incomplete, the obliterated distances were measured from the nearest point of the hilum.Data thus obtained were analyzed by Microsoft excel software.

III. Results

Classically complete oblique fissure was found in 40% (22) of lung specimens (55 right sided).Only 30.91%(17) belonged to Grade I variety. In 1.81%(1)of lungs specimen, no oblique fissure was found, rest 58%(32) were incomplete either at its beginning or at its end or both .The mean length of oblique fissures were 24.21±6.57 cm when all the lungs with oblique fissure were considered. Average depth of oblique fissure was 4.99± 2.07 cm. In one right lung both oblique & horizontal fissure were completely absent belonging to Grade IV variety (Fig-2). Horizontal fissure was completely absent in 12.72% (7). In specimens where horizontal fissure was present, 40% (22) were incomplete. Accessory fissures were found in 5.45%(3) lungs ,out of which 3.63%(2) were superior fissure and 1.81% (one) inferior accessory fissure .Only one right lung specimen had accessory fissure. It was transversely placed above the horizontal fissure, around 2.8 cm in length, was of incomplete Grade III variety (Fig 3). Oblique fissure was found to be deepest near the middle on the costal surface in majority of cases; in very few specimens it was deepest at either ends. The depth of the fissure was not uniform even in a single specimen. This pattern shows that the fusion of prenatal fissure starts from its either ends and then meet in the middle. Only one right lung showed lobe of azygos vein.

Table1: Incidence of Oblique and Horizontal Fissures of Right Lung

Side of lung	Lung fissure	Grade I	Grade II	Grade III	Grade IV
Right (n=55)	Oblique	17(30.91%)	05(9.09%)	32(58.18%)	01(1.81%)
	Horizontal	20(36.6%)	6(10.9%)	22(40%)	07(12.72%)

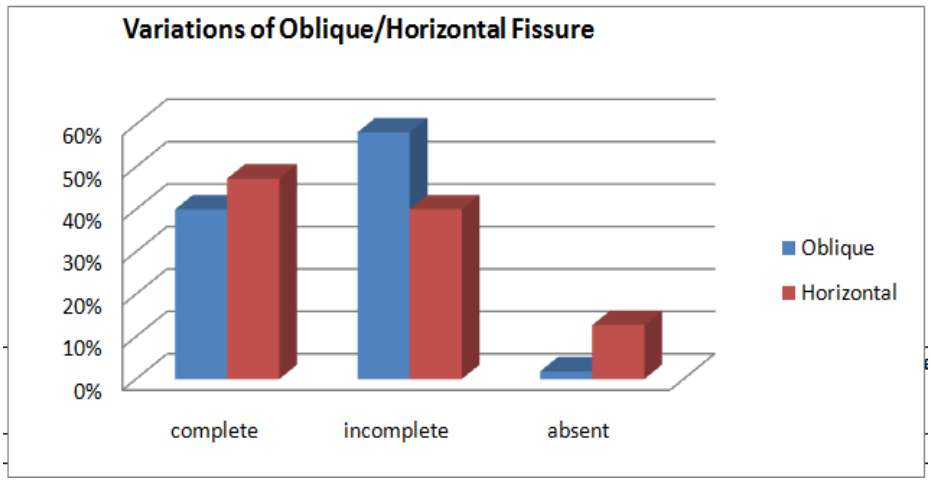

Fig 1: Shows variation of Oblique/Horizontal Fissure of Right lung

Table 2: Relationships between OF and HF of Right Lungs

Right lung (n=55)	Number of specimens (%)
Complete oblique fissure with complete horizontal fissure	10 (18.18)
Complete oblique fissure with incomplete horizontal fissure	09 (16.36)
Complete oblique fissure with no horizontal fissure	03 (05.45)
Incomplete oblique fissure with incomplete horizontal fissure	13 (23.63)
Incomplete oblique fissure with complete horizontal fissure	16 (29.09)
Incomplete oblique fissure with no horizontal fissure	03 (05.45)
Absent oblique fissure and absent horizontal fissure	01 (01.81)

Highest percentage of incomplete OF with complete HF was found in our study (29.09%) while lowest incidence of absent OF with absent HF was found 1.81%(single lobe) in right lung specimens. Only 5.45%(3) specimens showed complete OF with absent HF. 18.18%(10) specimens showed complete OF and complete HF resulting into complete separation of all the three lobes of right lungs.

Variations of hilar structures were observed in Right lung specimen. 9.09% (5) of right lungs had three arteries, 70.90% (39) had two arteries, and 20% (11) had only one artery in hilum. 70.90% (39) had two veins in hilum, (20%(11) had three veins in the hilum and 1.81%(1) had more than three veins in hilum. 76.36%(42) showed two bronchi in hilum,and 9.09%(5) showed three bronchi in hilum.None of the lung showed artery passing across the oblique fissure.

Fig 2: Showing absence of oblique and horizontal fissure (single lobe)

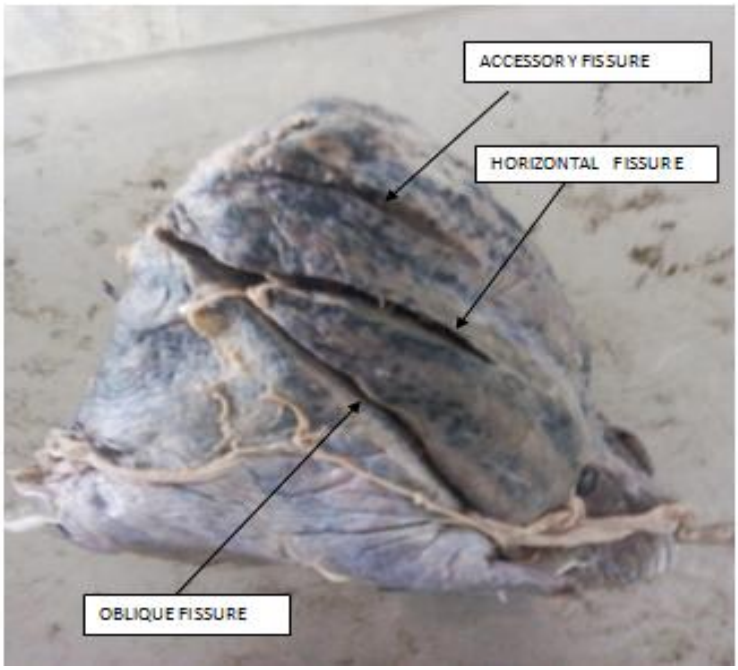

Fig 3: Showing accessory fissure above horizontal fissure Right lung

IV. Discussion

Lungs are composite of endodermal and mesoderm tissues. The endoderm of the endotracheal bud gives rise to the mucosal lining of the bronchi and lungs The vasculature of the lung, muscles and cartilage supporting the bronchi are derived from splanchnopleuric mesoderm. Except, along the line of division of principal bronchi where deep complete fissures divides the right lung into three lobes and left lung into two lobes, all the spaces between bronchopulmonary segment oblitrated.[8] Defective pulmonary development will result into variable fissures and lobes of lungs.[9] Defect in the obliteration of these fissures either completely or in completely give rise to Incomplete or Absent fissures [10].

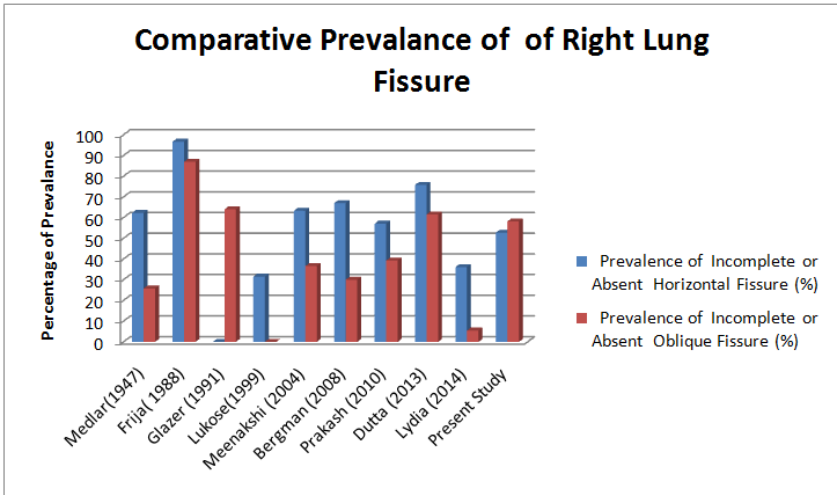

Fig 4 : Showing comparative Prevalence of Right Lung Fissure

In present study prevalence of incomplete Oblique Fissure of right lung was 58.18% which was higher than Medlar[10] (25.30%), Bergman[9] (30%), Meenakshi[14] (36.6%), Prakash[15] (39.3%), whereas it was less than Glazer[12] (64%), Dutta[16] (61.54%), Frija[11] (87%). Thus incidence of incomplete oblique fissure in right lung varied from 5.5 % to as high as 87 %.Increased incidences of incomplete oblique fissures indicates early commencement of fusion of the fissures before birth leading to fusion along floor of the oblique fissure. The position of the lung fissure used as reliable landmarks in identifying lesions of lungs [18]. The identification of the completeness of the fissures is necessary for surgeons for performing pulmonary resections ,as incomplete fissures are more prone to develop postoperative complications , and may require further procedures to manage the patients such as stapling and pericardial sleeves. Comparative cadaveric data's of incomplete horizontal fissure shows that previous works had higher prevalence than present study except Lukose (21%), Medlar[10] (17.1%), Lydia[17] (36.1%). Comparison of data reveals that absent or incomplete oblique and transverse fissure was more prevalent in radiographic studies (including CT scan) than in cadaveric lungs studies.

The length of Oblique Fissure found comparable with other Indian studies done by Bhimai devi[20] and Dutta[16] . Dutta also studied depth of oblique fissure, Average Depth of Oblique Fissure was found to be more (5.73 ± 1.41 cm) as compared to present study (4.992 ± 2.077 cm) , ranging from 0.5 to 9 cm . Likewise average length of Horizontal Fissure (6.719± 3.207 cm) is also comparable with Bhima Devi[20] and Dutta[16]. The surgeon approaches through the depth of the fissure to ligate the structures therefore gradation is important. During surgical pulmonary resection Grade I oblique fissure facilitates the approach [21].

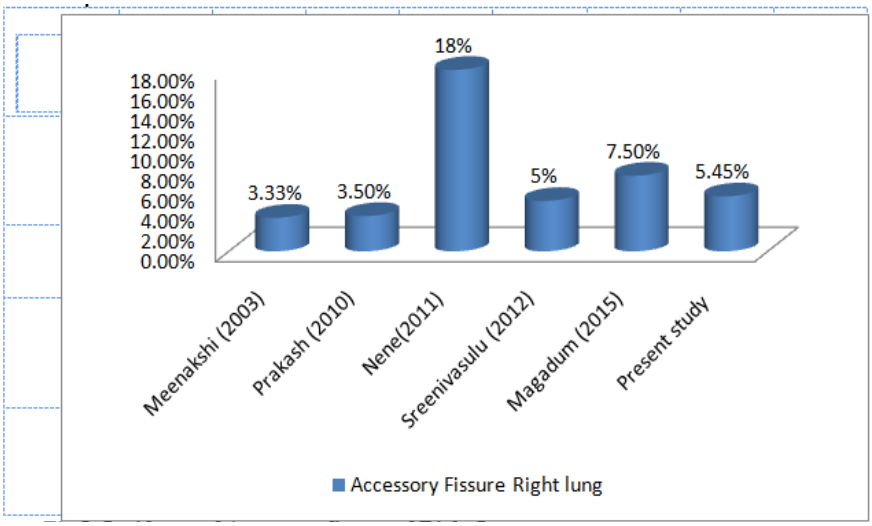

Fig 5: Incidence of Accessory fissure of Right Lung

Accessory Fissure was found in 6% (3) right lungs in present study while 18% by Nene[6]. Meenakshi et al[14] found, 3.33% of right lung accessory fissure while Prakash et al[15] observed in 3.5% and 5% by Sreenivasulu et al[23]. In patients with any pulmonary lesion, an accessory fissure might alter the usual pattern of collapse of

lungs resulting into difficulty in diagnosing the lesion and its extent. The accessory fissures hampers spread of infection resulting into a marginated pneumonic patch, thus misdiagnosed as atelectasis or consolidation[25]. Variations of the lung fissures and normal lung anatomy is essential for assesment of disease and for analysis of various radiological appearance and related abnormalities of lungs [26]. As variable fissures resemble pleural effusion in radiographs, while even not detected in CT scan[27].

V. Conclusion

Proper anatomical knowledge, recognition of anomalies & variations in morphometry of lungs is essential for clinicians, surgeons and radiologist. The Comparison of results of present study with previous works shows a wide range of variation in fissures and hilar structures, among different populations .Thus present study add to the database although sample size is too small so author suggest a large scale study to establish any definitive conclusion about morphology of lungs in this particular region.

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