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Indigenous Cadaveric Variations in Lung Fissures and Lobes

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ABSTRACT

Introduction: Lung fissures are responsible for uniform expansion. These fissures may be complete, incomplete or absent causing lobar variation. A detailed knowledge of variations of classical and accessory fissures is necessary for proper pulmonary radiological interpretation. Patients benefit from accurate assessment of integrity of pulmonary fissures during cardiothoracic surgery as surgeons can perform segmental lung resections and lobectomies safely to have an uncomplicated perioperative outcome. So, the cadaveric study was done to note the morphological variation of the fissures of lung in Pakistan cadaveric population and compare it with the previous study.
Aims & Objectives: To determine the frequency of variations in fissures and lobes of the lungs on cadaveric Pakistani population.
Place and duration of study: Anatomy Departments of KEMU and AIMC, Lahore. Duration of study was from 2020 to 2022
Material & Methods: An observational cross-sectional study was conducted on 160 cadaveric lung specimens from AIMC and KEMU Anatomy Departments. They were preserved in 10% formalin and were studied for morphological details of their lung lobes and fissures. Data was collected and graded using Craig and Walker classification. Data was analysed using SPSS 22 version. p value ≤ 0.05 was taken as significant
Results: Out of 160, 77% of the left lung and 75% of the right lungs were normal. Among the variations, horizontal fissure had shown to be more variable as compared to oblique fissure .18% of the right-side specimens were shown to have incomplete horizontal fissures and in 4% of the specimen, they were totally absent. 15% of the left side specimen had incomplete oblique fissures whereas only 2% of the right-side specimen had incomplete oblique fissures. Accessory fissures were more common in the left side specimens as compared to the right-side specimens.
Conclusion: Morphological variations do occur in normal population, and they must be kept in mind during radiological and surgical interventions.

Keywords: Cadavers, lung fissures, Lung lobes, lung resections.

INTRODUCTION

The lungs are the mediastinal structures located on either side of the heart and are two in number. A serous membrane called pleura covered each lung. Lungs are free in its pleural cavity, except where it is attached to the trachea and heart at the hilum and pulmonary ligament. Right lung has three lobes divided by two fissures whereas left lung has two lobes divided by one fissure. Right lung has superior, middle and inferior lobes divided by horizontal and oblique fissures whereas left lung is divided into superior and inferior lobes by oblique fissure only[1].Any finding different from this is referred to as anatomical variation. Persistence of prenatal fissures occurred as accessory fissures of the lungs.An incomplete fissure may be responsible for postoperative air leakage in lobectomies and bronchopulmonary resections. To avoid postoperative complications it is necessary to have sound knowledge of morphological variations. The fissure can be complete or incomplete and even accessory resulting in varied lobes. In complete fissure the lobes remain held together only at the hilum by bronchi and pulmonary vessels. When there occurs parenchymal fusion between the lobes, fissure is said to be incomplete and at times the entire fissure may be absent[2].

In 2011, a case was reported in the Journal of Cardiothoracic Surgery in which right lung was noted to have four lobes. An extra fissure separated the superior segment of the right lower lobe from its native and was not observed in preoperative CT scan due to bullous lung disease and inappropriate slice thickness[3].

In 2019, it was observed during routine dissection of a female cadaver that right lung had only two lobes divided by one fissure. Left lung was normal[4].Various studies were conducted by anatomists on cadavers in different regions of the world and they reported morphological variations of fissures and lobes based on the Craig and Walker proposed fissural classification[5,6]. Radiologists also conducted various studies to see variations of lungs on CT Scan[7,8].

This study was aimed to get some data regarding morphological variations of lung lobes and fissures from the regional population that would help cardiothoracic surgeons in appropriate planning of surgeries. Anatomical awareness of inconsistency in fissures and lobes of lungs is important in recognition of bronchopulmonary segments on a standard chest Xray or a CT scan. Knowledge of such variations is very important in surgical interventions like lobectomy or a segmental resection.

MATERIAL AND METHODS

With the permission of Heads of Anatomy Department of KEMU, AIMC and Institutional Review Board received vide letter number IRB number 2192/RC/KEMU dated 16.12.2019, an observational cross-sectional study was conducted on 80 cadaveric lungs each in the stated Departments. The sample size was calculated using open epi software at 95% confidence level and margin of error as 5%. The frequency of anticipated factors (variation in oblique fissure on right lung) was 16%.[9]The calculated sample size was 160 for this study and the same number of cadaveric lungs were selected through nonprobability convenient sampling technique. All lungs were either taken from already dissected specimens that were preserved or from cadavers dissected in the dissection hall. All those lungs which had intact pleura were included. There was no demarcation of sex and age. Cadavers having history of trauma of the thoracic regions were excluded from the study. Lungs were examined for the presence of normal fissures and lobes, their variations in the form of complete fissures, incomplete fissures, absent fissures and presence of any accessory fissures or lobes if present. Data was collected and graded using Craig and Walker classification.

Statistical Analysis:

Data was analysed using SPSS version 22,
p value ≤ 0.05 was taken as significant.

RESULTS

Out of 160 lungs studied, 90 were right lungs and 70 were left lungs. After examination of the right lungs, it was observed that 86 lungs were having complete oblique fissures and 68 were having complete horizontal fissures. Among lungs having complete horizontal fissures, 18 lungs were found to have incomplete horizontal fissures and in 4 lungs horizontal fissure were entirely absent and there were two lobes instead of three on the right lungs.

2 lungs with absent horizontal fissure also had incomplete oblique fissures while 2 lungs with incomplete horizontal fissure had an accessory lobe. Out of 70 left lungs, 5 lungs had accessory fissure and hence three lobes instead of two and in 6 lungs, oblique fissure was entirely absent, and 5 lungs had a single lobe, no fissure present. 6 lungs showed incomplete oblique fissures. The remaining 54 left lungs were normal with complete oblique fissure. Figures were shown below in Fig-1 Absent horizontal and Incomplete horizontal fissure is shown, while in Fig-2 Absent and Incomplete obligue fissures were shown.

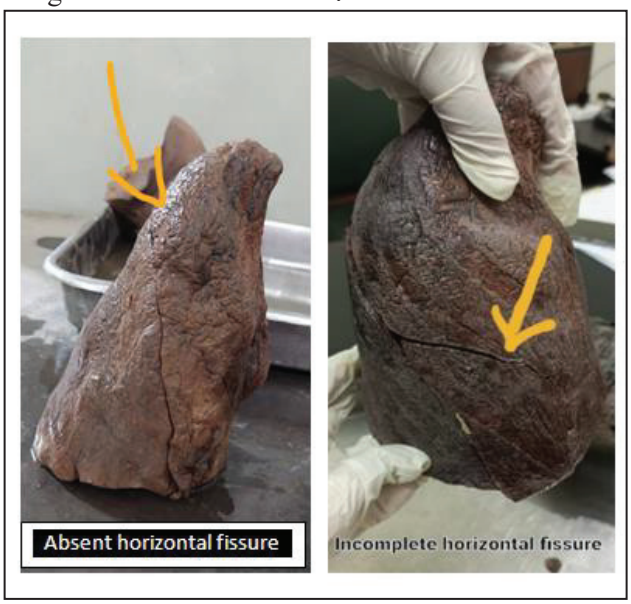

Fig-1: Absent horizontal and Incomplete horizontal fissure.

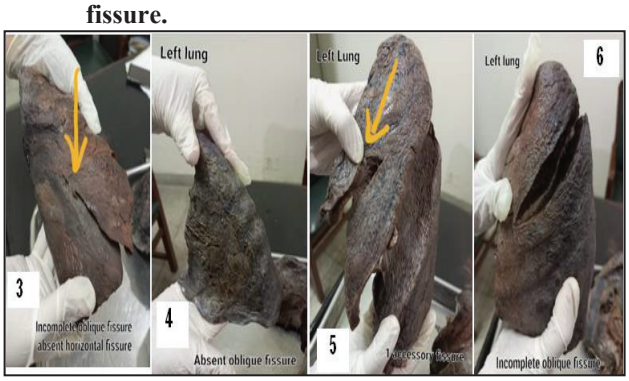

Fig-2: Absent and Incomplete Obligue Fissures.

Side	Fissure	Type	Present Study	
Right Lung Total: 90	Oblique	Complete	86	95%
		Incomplete	02	2.22%
		Absent	02	2.22%
	Horizontal	Complete	68	75%
		Incomplete	18	20%
		Absent	04	4.44%
	Accessory Fissure	Present	02	2.22%
Left Lung Total: 70	Oblique	Complete	54	77%
		Incomplete	11	15.7%
		Absent	05	7.1%
	Accessory Fissure	Present	05	7.1%

Table-1: Showing number of morphological fissural variations.

The criteria used to classify the lungs depends upon Craig and Walker classification, it depends upon completeness of fissure

Side	Fissures	Grade I	Grade II	Grade III	Grade IV
Right Lung	Horizontal	**68**	**-**	**18**	**4**
	Oblique	**86**	**2**	**-**	**2**
	Accessory	**2**	**-**	**-**	**-**
Left Lung	Oblique	**54**	**8**	**3**	**5**
	Accessory	**5**	**-**	**-**	**-**

Table-2: Craig and Walker classification of morphological fissural variations. (Grading of completeness of fissure)

Year	Mode Of study	Horizo-ntal fissure (right lung) Incomplte	Oblique fissure (right lung) Incomplete	Oblique fissure (left lung) Incomplete	Accessory fissure		Absent Horizontal /oblique	
					Right	Left	Right	Left
1947[12]	Cadaveric	62.3%	30%	18%	0	0	13.3 %	0
1991[13]	Ct scan	-	64%	52%	-	-	-	-
1999[14]	Cadaveric	21.5%	-	21%	-	-	10%	-
2004[15]	Ct scan	63%	48%	43%	-	-	-	-
2004[16]	Cadaveric	63%	-	-	-	-	16%	0%
2011[17]	Cadaveric	8%	12%	6%	18 %	26 %	14%	2%
2014[18]	Cadaveric	52.5%	60%	42.5%	9%	8%	-	-
2014[19]	Foetus	100%	0%	0%	0	0	13	0
2018[20]	Cadaveric	66.7%	35.8%	16%	-	-	11.1 %	2.5 %
2021[21]	Cadaveric	42%	36.84 %	34.4%	5%	12 %	10.5 %	-
2022[22]	Ct scan	0.9%	17.5%	35%	8%	9%	-	-
Present study	Cadaveric	20%	2.2%	16%	2%	7%	6%	7%

Table-3: Comparison of the present study with the literature.

DISCUSSION

In the present study it was concluded that lung does show variation in its morphological pattern of fissures and lobes but they were more pronounced on the right side as compared to the left. The embryological basis of variations is defective pulmonary development. At 4th week of development ventral wall of foregut gives origin to respiratory diverticulum, a primordium of lung bud. As the lung bud develops and invades surrounding mesenchyme, it gets differentiated into right and left bronchial buds which undergo division and branching giving rise to primary, secondary and tertiary bronchi. Bronchopulmonary segments are formed as a result of branching of these bronchi. These bronchopulmonary segments are separated by spaces that are known as fissures. These fissures get obliterated during foetal life and persist only at interlobar planes giving rise to horizontal and oblique fissures. Visceral pleura is reflected along these planes covering individual lobes. Variations seen in this study were due to the fact that there was defect in the obliteration of prenatal fissures resulting in either incomplete or absence adult fissures[10]. Presence of accessory lobe was due to monopodial branching of stem bronchi.[11]The present study concluded that there was incomplete horizontal fissure of the right lung more as compared to the incomplete oblique fissure. Oblique fissure was incomplete in large percentage on the left lung as compared to the right lung. Accessory fissure with extra lobe was more pronounced on the left lung. These findings were being compared with the findings of other researchers in table 3 and the results of present study were in accordance with the previous research carried out in different parts of the world.

Knowledge of accessory fissure helps clinicians to analyse spread of disease pattern as it may tackle across the accessory fissure. Often these fissures misinterpret atelectasis or consolidation, so knowledge of accessory fissures are also helpful for radiologists[22]. Incomplete fissures are misinterpreting on CT Scans because of their incompleteness and thick sections.In X –rays, incomplete fissure always gives a typical appearance of pleural effusion[22].

CONCLUSION

Recognition of variations in lung morphology improves understanding the spread of disease in pneumonia and pleural effusion. It also helps in determining collateral air drift spread of malignancies and postoperative complications as air leakage. Accessory fissure is very important from the radiological viewpoint as it may be misinterpreted as a lung lesion.

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