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A Study of Variations of Lobes and Fissures in Human Fetal Lungs

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Abstract
Introduction:*The human lungs are divided by fissures into lobes, which facilitate movements of lobes in relation to one another. Anatomical variations of lungs including number, fissures and lobes are at utmost important.*
Aim: The study was done to note the morphological variation of the fissures and lobes in fetal lungs.
Materials and Methods:*62 human fetusesfrom 12 weeks to 40 weeks of gestational age were collected from the department of Obstetrics and Gynaecology, RIMS Hospital Imphal, after getting formal permission from the concern authority/ persons and the Institutional Ethics Committee. After fixation in 10% formalin, fetuses were dissected and both lungs were removed for examinations.*
Results:*On the right side, 8 specimens showed incomplete oblique fissure, 39 specimens showed incomplete horizontal fissure, 1specimen showed absence of horizontal fissureand 9 specimens showed superior accessory fissure. On the left side, 5 specimens showed incomplete oblique fissure and the left minor fissure was seen in 8 specimens.*
Conclusion:*Knowledge of lobes and fissures in a particular population might help the clinician during diagnosis and partial resection of lungs. This may reduce morbidity and mortality associated with lung disease.*
Key words:*Lungs, Oblique fissure, Horizontal fissure, Fetuses*

I. Introduction

When the embryo is approximately 4 weeks old, the respiratory diverticulum(lung bud) appears as an outgrowth from the ventral wall of the foregut [1]. Two endodermal bronchial buds grow from the caudal end of this bulb-shaped diverticulum, and are surrounded by splanchnic mesoderm. The bronchial smooth muscle and connective tissue and the pulmonary connective tissue and capillaries are derived from the mesoderm [2].

Amongst the pair of lungs in the thoracic cavity, the right lung is broader and heavier than the left lung. Oblique and horizontal fissures divide it into three lobes namely, upper, middle and lower. The oblique fissure separates the lower lobe from the remaining two lobes. It runs obliquely and crosses the inferior border of the lung about 7.5 cm behind its anterior end. The horizontal fissure separates the upper and middle lobe. It begins from the oblique fissure, runs horizontally and cuts the anterior border at inner end of fourth costal cartilage. The longer and lighter left lung is divided into a superior and an inferior lobe by an oblique fissure which extends from costal to medial surfaces of the lung both above and below the hilum. It begins on the medial surface posterosuperior to the hilum, runs obliquely upwards and backward to cut the posterior border of the lung about 6 cm below the apex and then passes downward and forward across the costal surface. The more vertical left oblique fissure is approximately indicated by vertebral border of scapula in fully abducted arm [3]. The fissures may be complete, incomplete or absent. In case of complete fissure the lung lobes are held together only at the hilum by the bronchi and the pulmonary vessels. There is parenchymal fusion of varied extent along the floor in case of incomplete fissure [4].

Finding accessory fissures in lung specimens is not uncommon, but appreciating them on radiographs and CT scans is difficult and hence they are either not appreciated as distinct entities or are completely misinterpretated. They usually occur at the boundaries between bronchopulmonary segments. The commonly found accessory fissures are superior accessory fissure, inferior accessory fissure and left minor fissure. The superior accessory fissure (SAF) separates superior segment from the rest of the segments of lower lobe of lung, the inferior accessory fissure (IAF) separates a small 'infracardiac lobe' from other segments of lower lobe of lung on the diaphragmatic surface and the left minor fissure (LMF) separates the lingula from the other segments of upper lobe of left lung [5].

Craig and Walker [6] have proposed a manner of classification of fissure for describing operative technique and also for comparing different surgical series. The criteria used to classify the lung fissures were degree of completeness of fissure and the location of the pulmonary artery at the base of the oblique fissure. Four grades 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; and Grade IV- complete fusion of lobes with no evident fissure line.

Hence, this study aims to find out the variations in the morphology of lung fissures and lobes in the human fetuses; and compare the findings with previous studies to derive a conclusion.

II. Materials And Methods

This cross sectional study was done on 62 formalin fixed human fetuses, ranging from12 weeks to 40 weeks gestational ages in the Department of Anatomy, RIMS Imphalafter getting formal permission from the Institutional Ethics Committee, RIMS Imphal. The fetuses were collected from the department of Obstetrics and Gynaecology, RIMS Hospital with due permission from the concern authorities and parents. After fixation in 10% formalin for two weeks, the fetus was dissected and both the lungs were removed. For each lung, details of the morphology of lobes and fissures, presence of any variant fissure, accessory fissure were recorded. The specimens were photographed by a digital camera (Sony Cybershot; Model-W830 20.1MP Digital Camera)

III. Results

The observations regarding incidence of oblique and horizontal lung fissures are tabulated in Table 1.

Right lung specimens:

The horizontal fissure was absent in one lung (1.6%) and hence middle lobe was not appreciated (Fig.1). The horizontal fissure was incomplete in 39 (62.9%)lungs (Fig.2). In 8 lungs (12.9%), oblique fissure was incomplete (Fig.3). Out of 62 lungs, twenty-two lungs (35.5%) exhibited the normal pattern of fissures and lobes.

g.1:- Right lung (19 wks fetus) with absent horizontal fissure

Left lung specimens:

The oblique fissure was incomplete in 5(8.1%) of the specimens. 51(91.9) out of 62 lungs, exhibited the normal pattern of fissures and lobes.

Fig.2:- Right lung (28 wks fetus) with incomplete horizontal fissure (arrow)

Fig.3:- Right lung (20 wks fetus) with incomplete oblique fissure and SAF

Fig.4:- Right lung (21 wks fetus) with superior accessory fissure (SAF) (arrow)

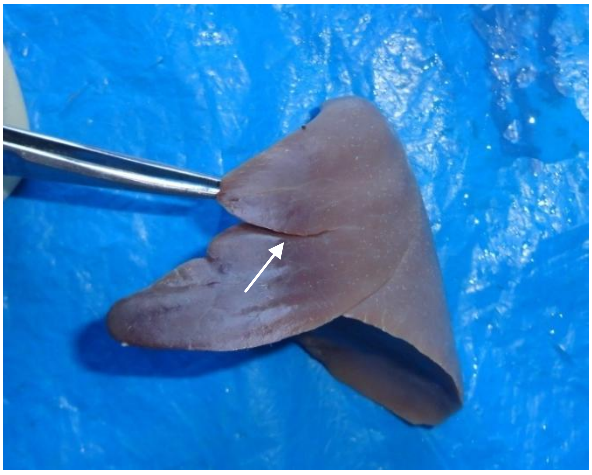

Fig 5- Left lung (33 wks fetus) showing left minor fissure (LMF) (arrow)

Table: 1

Lung	Fissure parameters		Meenakshi et al	IEHAV	Aziz et al	Medlar	N. Bhimai Devi et al	Present study
Right	Horizontal	Incomplete	63.3	67	63	62.3	18	62.9
		Absent	16.6	21	-	-	-	1.6
	Oblique	Incomplete	36.6	30	48	25.6	09	12.9
		Absent	0	0	-	-	-	0
Left	Oblique	Incomplete	46.6	30	43	10.6	36	8.1
		Absent	0	0	-	-	-	0

Accessory fissures:

The observations regarding accessory fissures of the lungs are tabulated in Table 2 and it shows incidence of accessory fissures was more on the right side than left side. The SAF occurred in 9 (14.5%) of all cases in right lung (Fig.4) while it was not seen at all in left lung. IAF was not found. The LMF was seen in 8(12.9%) of lung specimens (Fig.5).

Table: 2

Accessory fissure	Right lungs (n = 62)	Left lungs (n = 62)
SAF	9 (14.5%)	0
IAF	0	0
LMF	0	8 (12.9%)

The observations regarding incidence of major and minor lung fissures according to Craig and Walker's criteria are tabulated in table3.

Table: 3

Grade	Right lungs (n=62)		Left lungs (n=62)
	Horizontal fissures	**Oblique Fissures**	**Oblique fissures**
I	35.5%	87.1%	91.9%
II	37.1%	9.7%	4.9%
III	25.8%	3.2%	3.2%
IV	1.6%	0	0

IV. Discussion

In the available literatures, many authors have described about the variations of lobes and fissures of lungs. Similarly, many variations were found in the present study also. A comparison showing the finding of present study with the findings of other studies is shown in Table1.

Medlar[7] found incomplete oblique fissure in 10.6% and 25.6% of the left and right sided lungs respectively, and incomplete horizontal fissure in 62.3% of the right sided lungs. Oblique fissures were absent in 7.3% of the left sided lungs and 4.8% of the right sided lungs; horizontal fissure was absent in 45.2% of the right sided lungs.Lukoseet al. [8] found incomplete and absent horizontal fissure in 21% and 10.5% respectively. Incomplete oblique fissure was present in 21% of left-sided lungs. Meenakshiet al. [9] found incomplete oblique fissures in 36.6% and 46.6% of the right and left sided lungs respectively. Incomplete horizontal fissure was in 63.3% right lungs. In CT scan (HRCT) study, Aziz et al. [10] observed incomplete right oblique fissure in 48% of cases and incomplete left oblique fissure in 43% of cases. Incomplete horizontal fissure was observed in 63% right lungs. According to Bhimai Devi etal [11], incomplete horizontal and oblique fissures were seen in 18% and 9% of the total right lungs studied. In the present study, incomplete horizontal fissure was observed in 62.9% right lungs. 1.6% right lungs showed absent horizontal fissure. Incomplete oblique fissure was observed in 12.9% and 8.1% of the right and left-sided lungs respectively.

Sometimes, the medial part of the upper lobe is partially separated by a fissure of variable depth containing the terminal part of the azygos vein, enclosed in the free margin of a mesentery derived from the mediastinal pleura, so forming the 'lobe of the azygos vein'. Less common variations are the presence of an inferior accessory fissure, which separates the medial basal segment from the remainder of the lower lobe, and a superior accessory fissure, which separates the apical segment of the lower lobe from the basal segments [4]. The superior accessory fissure (SAF) was seen in 4% and 0% of lungs on right and left sides respectively. Inferior accessory fissure (IAF) was found in 14% and 24% on right and left sides, respectively. The incidence of left minor fissure (LMF) was found to be 26% [12]. Godwin and Tarver [13] observed IAF in 40%-50% of specimens. The incidence of SAF ranged from 5% of left lower lobes to 14% on the left, 30% on the right, and 12% bilaterally. In the imaging study, Berkmenet al. [14] found 18 accessory fissures. In the present study, accessory fissure was observed in 17 lung specimens. 14.5% right lungs showed SAF. LMF was observed in 12.9% left lungs. No IAF was observed. Table 4 shows a comparison of the present study with other studies on the accessory fissures.

Table: 4

Accessory Features		Nene AJ et al	Godwin & Tarver	Present Study
SAF	**Right lung**	4%	30%	14.5%
	Left lung	-	5-14%	-
IAF	**Right lung**	14%	40%	-
	Left lung	24%	50%	-
LMF		26%	-	12.9%

Regarding these variations, it has been described that during the development, as the lung grows, the spaces or fissures that separate individual bronchopulmonary buds or segments become obliterated except along two planes, evident in the fully developed lungs as oblique or horizontal fissures. Absent or incomplete oblique or horizontal fissure could be due to obliteration of these fissures either completely or partially [15].
Occasional monopodial branching of the stem bronchi account for the accessory bronchi and lobes often found in the adult lungs [16]. Accessory fissure could be the result of non-obliteration of spaces which normally are obliterated [17].

V. Conclusion

The finding of the present study showed a wide range of differencein occurrence of major, minor and accessory fissures. Knowledge of such variations might explain bizarre presentationof certain clinical cases pertaining to lungpathologies.Similarly,it might help the surgeon to plan, execute and modify asurgical procedure depending on the merit of the case.

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