

Morphological Study of Human Fetal Lung with Respect to Gestational Age in the Tertiary Care Center of Kumaon Region of Uttarakhand

Pragya Jaiswal, Deepa Deopa, Vandana Sharma, Sonali Thomas

Department of Anatomy, Government Medical College, Haldwani, Uttarakhand, India

Abstract

Introduction: The lung fissures are helpful in the movement of lobes in relation to one another. Variation in the presence or absence of fissures indicates about the pattern of development of the lung. The study was done to observe the appearance of lung fissures in human fetal lungs in relation to the gestational age. **Materials and Methods:** This cross-sectional study was conducted in the Department of Anatomy on 32 pairs of human fetal lungs of either gender which were divided into five subgroups of various gestational ages ranging from 15 weeks to 40 weeks. The morphological details of the appearance of fissures of lungs and the presence of any variation were noted. **Results:** Out of 32 specimens of the right fetal lung, the horizontal fissure was absent in two fetuses. The oblique fissure was complete and present in all 32 specimens of the right lung. Among 32 specimens of the left lung, the absence of oblique fissure was observed in one lung. No accessory fissure and lobe was seen. **Conclusion:** In our study, there was no correlation between the appearance of fissure and gestational age as the absence of horizontal fissure in the right lung is found among two gestational age groups; one in 21–25 weeks and one in 36–40 weeks. Furthermore, the absence of oblique fissure in the left lung is seen in the age group of 36–40 weeks. However, it was found that oblique fissure in both lungs and horizontal fissure in the right lung appear as early as 15 weeks of gestation.

Keywords: Fissures, fetal lungs, lung lobes

INTRODUCTION

The lungs are organs of respiration. In adults, they are normally two in number, right and left, located in the thoracic cavity, on either side.^[1] There are three lobes in the right lung divided by its oblique and horizontal fissures. There are two lobes in the left lung divided by its oblique fissure.^[2]

These fissures are helpful in the movement of lobes in relation to one another and aid in the expansion of the lung. Sometimes the fissure can be incomplete or absent. Occasionally, accessory fissures occur at boundaries between bronchopulmonary segment.^[3]

Any variation in the morphological pattern of fissures indicates variations from the normal pattern of development of the lung.^[4] A wide range of variation in the occurrence of oblique, horizontal, and accessory fissures might be due to genetic

and environmental factors during its development.^[5] The morphology of lungs at the molecular level is controlled by a signaling pathway regulated by the HOX gene,^[6] transforming growth factor-beta, and fibroblastic growth factor.^[7]

The development of the lung and its fissures starts during 4th week of intrauterine life, with the appearance of the respiratory diverticulum (lung bud), from the ventral wall of the foregut.^[8] The lung bud develops into two primary bronchi, the right forms three secondary bronchi and three lobes and the left forms two secondary bronchi and two lobes. The spaces present in between the bronchopulmonary segments are known as fissures. Later in intrauterine life, the lung fissures

Address for correspondence: Dr. Pragya Jaiswal,
Department of Anatomy, Government Medical College, Rampur Road,
Nainital, Haldwani - 263 139, Uttarakhand, India.
E-mail: dr.pragya15111990@gmail.com

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gradually get obliterated except along the lines of division of principal bronchi.

Lungs cannot be identified only by the presence of fissures but more precisely by the identification of different structures at the hilum of the lung.^[9] The fissures delimit the lobes and are also helpful in the interpretation of radiological images.^[10] The fissure which contains the mesoazygos and the azygos vein extends almost to the root of the lung which resembles a normal lung fissure. On a radiograph, it appears as a line extending from the apex toward the hilum of the lung. The line represents mesoazygos and the shadow is the azygos vein. Surgeons use the depth of the lung fissure to ligate the blood vessels.^[11] Accessory fissures act as anatomic barriers to the spread of neoplastic and inflammatory diseases and can resemble a lesion. They can also alter the spread of disease in the lung. An incomplete fissure perhaps can cause postoperative leakage.^[12]

The objective of the present study is to observe the appearance of fissures in the human fetal lung with respect to gestational age.

MATERIALS AND METHODS

Study design and setting

It is a cross-sectional (observational) study conducted on 32 cadaveric human fetuses (as per availability) conducted in the Department of Anatomy of our medical college. After getting informed and written consent from the parents, 32 aborted human fetuses ranging from 15 weeks to 36 weeks were collected from the obstetrics and gynecology department. The institutional ethics committee in its meeting held on December 19, 2022, Letter no: 691/GMC/IEC/2022/Reg no. 620/IEC/R-20-11-2022 approved the research work. The study was done for 14 months, from January 2023 to February 2024.

Inclusion criteria

All the aborted human fetuses of various gestational age were included in the study.

Exclusion criteria

Fetuses with visible congenital anomaly and macerated fetus.

Fixation of fetuses was done using 10% formalin by multiple injection method. Gestational age was obtained from hospital records and also calculated using foot length. Fetuses of various gestational ages were divided into five subgroups (A to E) ranging from 15 weeks to 40 weeks of gestation as shown

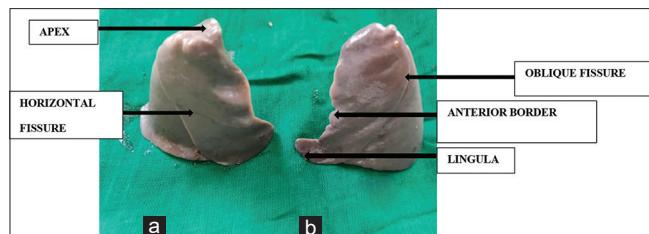


Figure 1: (a) Complete oblique and horizontal fissure in the right fetal lung (b) complete oblique fissure in the left fetal lung

in Table 1. The morphological details regarding fissures of the lungs and presence of any variation in the fissures were noted. The classification given by Craig and Walker has been followed.^[13]

Four grades have been proposed:

- Grade 1: Presence of complete fissure
- Grade 2: Complete fissure present but parenchyma is fused near the base
- Grade 3: Presence of incomplete fissure, and
- Grade 4: Absence of fissure.

RESULTS

Out of 32 specimens of the right fetal lung, the horizontal fissure was absent in two fetuses; one each in the gestational age group of 21–25 weeks and 36–40 weeks. Horizontal fissure was complete in 30 fetuses, as shown in Table 2. No accessory fissure and lobe was seen. The oblique fissure was present in all 32 specimens of the right fetal lung. Among 32 specimens of the left fetal lung, there was no oblique fissure in one lung of the gestational age group of 36–40 weeks. No accessory fissure and lobe was seen. As mentioned in Table 3, the absence of horizontal fissure in the right lung was observed to be 6.25% and the absence of oblique fissure in the left fetal lung was observed to be 3.12% according to Craig and Walker classification.

Table 1: Distribution of fetus according to gestational age group and gender

Gestational age (weeks)	Group	Male	Female	Number of foetus
15–20	A	1	2	3
21–25	B	3	2	5
26–30	C	1	3	4
31–35	D	5	4	9
36–40	E	6	5	11
Total		16	16	32

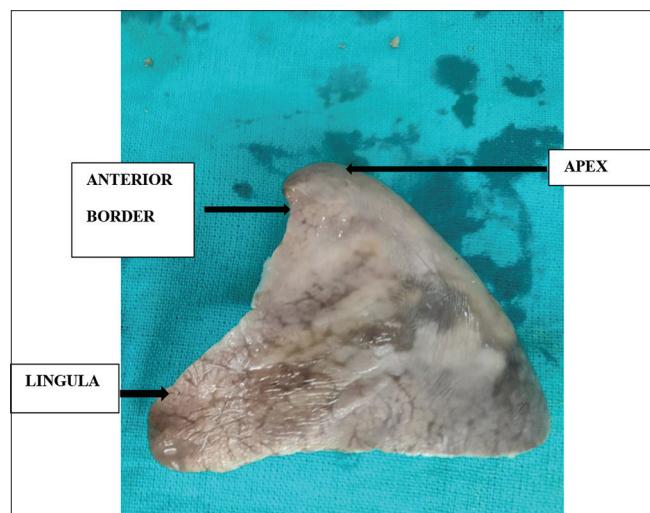


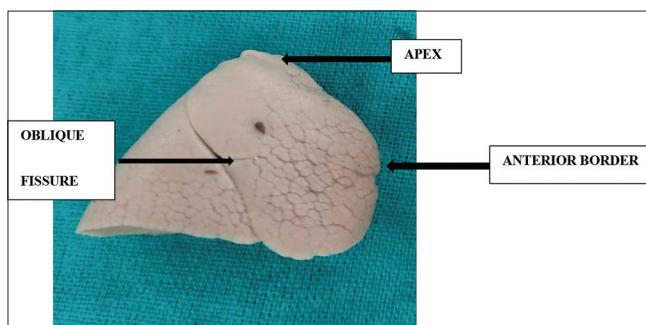
Figure 2: Absence of oblique fissure in the left fetal lung

Table 2: Variation in fissures of right and left human fetal lung according to gestational age groups

Gestational age groups and (n) number of fetus (weeks)	Right fetal lung				Left fetal lung (oblique fissure)	
	Horizontal fissure		Oblique fissure		Complete	Absent
	Complete	Absent	Complete	Absent		
A (15–20) (n=5)	3	0	3	0	3	0
B (21–25) (n=3)	4	1	5	0	5	0
C (26–30) (n=4)	4	0	4	0	4	0
D (31–35) (n=9)	9	0	9	0	9	0
E (36–40) (n=11)	10	1	11	0	10	1

Table 3: Variation of fissures according to Craig and Walker classification

Fetal lungs	Craig and Walker classification for fissures of lung	Occurrence among given lung specimen
Right lung (n=32)	Horizontal fissure Grade 1 (complete fissure) Grade 2 (complete fissure but parenchymal fusion at base) Grade 3 (incomplete fissure) Grade 4 (absent fissure)	30 (93.75) 0 0 2 (6.25)
	Oblique fissure Grade 1 (complete fissure) Grade 2 (complete fissure but parenchymal fusion at base) Grade 3 (incomplete fissure) Grade 4 (absent fissure)	32 100 0 0 0
Left lung (n=32)	Oblique fissure Grade 1 (complete fissure) Grade 2 (complete fissure but parenchymal fusion at base) Grade 3 (incomplete fissure) Grade 4 (absent fissure)	31 (96.87) 0 0 1 (3.12)

**Figure 3: Absence of horizontal fissure in the right fetal lung**

DISCUSSION

The studies done on fetal lung about the appearance of lobe and fissures and their relation with gestational age is very few and most of the studies are done on adult human cadaveric lung.

Zareena (2014) found that, among 10 right fetal lung specimens, the oblique fissure was normal in four fetuses, and incomplete in two fetuses. Four right-sided fetal lungs showed incomplete horizontal fissure. Six left-sided fetal lungs showed the normal pattern of the oblique fissure.

Lazarova and Dodevski conducted a study on 62 human fetuses from 12 weeks to 40 weeks of gestational age to note the morphological variation of the fissures and lobes in

fetal lungs and found that on the right side, eight specimens showed incomplete oblique fissure, 39 showed incomplete horizontal fissure, one showed absence of horizontal fissure, and nine had accessory fissure. On the left side, five showed incomplete oblique fissure and accessory fissure was seen in eight specimens.^[14]

Vimla et al. (2018)^[2] conducted the study among 50 fetal lung specimens in the age group of 10 weeks to 39 weeks of gestation and found that horizontal fissure was incomplete in 68%, complete in 28%, absent in 2% of fetuses and also accessory fissure was found among 2% fetuses.

Jessy et al. observed that among right fetal lung specimens incomplete horizontal fissure was present between age group 15–20 weeks. Single case each of absent horizontal fissure was present in 10–15 weeks, 15–20 weeks, and 25–30 weeks, respectively. Two left fetal lungs showed incomplete oblique fissure one in each gestational age group of 20–25 and 30 weeks, respectively.^[15]

Various research studies have also been done on fissures and lobes of adult cadaveric lung.

Oblique fissure in the adult right lung and left lung was observed to be incomplete in 36.6% and 46.6%, respectively, and horizontal fissure in the right lung was observed to be incomplete in 63.3% by Meenakshi et al.^[16]

Oblique fissure in adult right lung and left lung was observed to be incomplete in 29.4% by Varalakshmi *et al.*,^[17] 22.7% and 31.8% by Zareena *et al.* (2014),^[12] respectively. Horizontal fissure in the right lung was observed to be absent in 7.69% of specimens by Sharma *et al.*^[18]

Gayathri *et al.* conducted a study on 50 adult cadaveric lungs and observed variations in fissures and lobes in eight left lungs and three right lungs.^[19]

Singh *et al.* conducted a study on adult cadaveric lungs 40 right and 38 left lungs and observed that the absence of horizontal fissure was 25% and the presence of accessory fissures was 21.8%. Furthermore, the presence of azygos fissure was seen in two right lungs.^[20]

Das *et al.* conducted a study on 32 pairs of formalin-fixed adult cadaveric lungs and observed that horizontal fissure was incomplete in 37% and absent in 7% of the right lung.^[21]

Kanaujea *et al.* conducted a study on 50 pairs of adult cadaveric lungs and found the absence of oblique fissure in six left-sided lungs.^[22]

In our study, absence of horizontal fissure in right foetal lung was observed to be 6.25% and absence of oblique fissure in left foetal lung was observed to be 3.12 % among 32 pair of human foetal lungs. No correlation was found between the appearance of fissure and gestational age. The findings of our study show good congruence to previous human foetal lung studies on fissures and lobes.

CONCLUSION

In the present study we observed the appearance of fissures and lobes of the 32 pair of human foetal lungs with respect to gestational age of the foetuses. No correlation was found between the appearance of fissure and gestational age. In our study [Figures 1-3] absence of horizontal fissure in right lung is found among two gestational age groups; one in 21-25 weeks and one in 36-40 weeks. Also, absence of oblique fissure in the left lung is seen in the age group of 36-40 weeks which clearly. Knowledge of anatomical variants in the fissure of the foetal lungs can aid the pediatric surgeons to reduce the risk of damage during surgeries and also can be beneficial for academic purpose.

Recommendations

Knowledge about prenatal ontogenesis of the human fetal lung can help to understand the mechanism of pathology in the organ and could create methods of diagnosis and prevention.

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Conflicts of interest

There are no conflicts of interest.

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