Morphological Variations of the Lung Fissures and Lobes

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ABSTRACT

Background. Knowledge of the position of fissures of the lungs is necessary for the appreciation of lobar anatomy and thus locating the bronchopulmonary segments.

Methods. Morphological variations of fissures and lobes of the lungs were studied in 30 pairs of lungs from cadavers.

Results. Five right-sided lungs showed absence of horizontal fissure, 19 showed incomplete horizontal fissure. Eleven right-sided and 14 left-sided lungs showed incomplete oblique fissure and two right-sided lungs showed both absence of horizontal fissure and an incomplete oblique fissure. Accessory fissure was seen in three left-sided and one right-sided lungs.

Conclusions. Awareness regarding anatomical variations is essential for performing lobectomies and segmental resection and interpreting radiological images.

Key words: Fissures, Lobes, Bronchopulmonary segments.

INTRODUCTION

Lungs are divided into lobes by the oblique and the transverse (horizontal) fissures. The oblique fissure cuts the vertebral border of both the lungs at the level of 4th or 5th thoracic spine. Traced downwards on the medial surface it ends above the hilum; traced downwards on the costal surface, it will be found to continue across the diaphragmatic surface and turn upward on to the medial surface to end just below the lower end of the hilum (Figure 1 a, b, c, d).

Horizontal fissure, seen only in the right lung begins laterally at the oblique fissure and runs almost transversely across the costal surface to the anterior margin and around this margin back to the hilum (Figure 1 a and b).

The fissures may be complete, when the lobes remain held together only at the hilum by the bronchi and pulmonary vessels, or they may be incomplete when there are areas of parenchymal fusion between the lobes, or, they may be absent altogether.

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The fissures facilitate the movement of the lobes in relation to one another, which accommodates the greater distention and movement of the lower lobes during respiration. Thus, they help in a more uniform expansion of the whole lung\(^1\). As the fissures form the boundaries for the lobes of the lungs, knowledge of their position is necessary for the appreciation of lobar anatomy and thus for locating the bronchopulmonary segments which is significant both anatomically and clinically. Hence, the awareness of their variations is essential in performing lobectomies and in segmental resection. It could also be of significance in interpreting radiological images.

**MATERIAL AND METHODS**

Thirty pairs of lungs from dissection room cadavers (22 males) of South Indian origin were used for this study. Details regarding parameters such as, details of lobes and fissures (i.e., complete or incomplete); presence of any variant fissure, accessory fissure were recorded in a proforma.

**RESULTS**

**Right Lungs**

The horizontal fissure was absent in five right-sided lungs and hence middle lobe was not appreciated. The horizontal fissure was incomplete in 19 lungs and oblique fissure was incomplete in 11 lungs and hence the lobation was imperfect. In two of the specimens, the horizontal fissure was absent and the oblique fissure was incomplete. Totally, out of 30 right-sided lungs, only four lungs exhibited the normal pattern of fissures and lobes. One of the lungs showed an accessory fissure.

**Left Lungs**

The oblique fissure was incomplete in 14 left-sided lungs and hence 16 out of the 30 left-sided lungs, exhibited the normal pattern of fissures and lobes. Three of them showed an accessory fissure.

**DISCUSSION**

During the development, as the lung grows, the spaces or fissures that separate individual bronchopulmonary buds/segments become obliterated except along two planes, evident in the fully developed lungs as oblique or horizontal fissures\(^2\). Absence or incomplete oblique or horizontal fissures could be due to obliteration of these fissures either completely or partially. Accessory fissure could be the result of non-obliteration of spaces which normally are obliterated.

Incomplete pulmonary fissures indicating partial fusion between lobes, are common and more than half of the pulmonary fissures are incomplete. Several authors\(^3\)-\(^7\) have reported varying percentages of incidence of the incompleteness of the fissures (Table 1). Medlar\(^3\) in his examination of 1200 pairs of lungs found incomplete oblique fissure in 10.6% and 25.6% of the left- and right-sided lungs, respectively and incomplete horizontal fissure in 17.1% of the right-sided lungs. Oblique fissures were absent in 7.3% of the left-sided and 4.8% of the right-sided lungs; horizontal fissure was absent in 45.2% of the right-sided lungs.

In another study of 100 fixed and inflated lung specimens (50 of each side), fusion was observed across the upper right major (oblique) fissure in 70%, across the lower right major fissure in 47%, across the upper left major fissure in 40%, across the lower left major fissure in 46% and across the minor (horizontal) fissure in 94%. In the only available Indian study\(^8\), incomplete and absent horizontal fissure was reported in 21%, and 10.5%, respectively. Incomplete oblique fissure with absent horizontal fissure was described in 5.3% of the right-sided lungs. Incomplete oblique fissure was present in 21% of left-sided lungs. When compared with the study by Lukose et al\(^9\), a higher incidence of variations was observed in the present study whereas nearly similar incidence was observed when compared to the figures quoted in the IEHAV\(^7\), except for incomplete oblique fissure of the left-sided lung (Table 1). When compared with the study reported by Medlar\(^3\), the incidence of
incomplete fissure was higher and the incidence of absence of horizontal fissure was lower in the present study.

The nature of fissure is of great importance in planning operative strategy for thoracoscopic pulmonary resection where an incomplete fissure may contribute to post-operative air leakage. In order to provide a frame work for description of operative technique and to allow meaningful comparison between different surgical series, Craig and Walker⁹ have proposed a fissural classification based on both the degree of completeness of the fissures and the location of the pulmonary artery at the base of the oblique fissure. Four stages 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 fissural line. From the data in this study, morphological variations involving the oblique fissure in four left-sided lungs, 16 right-sided lungs fissure and variations involving the horizontal fissure in six right-sided lungs can be classified as Grade I. Similarly, variations involving the horizontal fissure in 11 left-sided and the 14 right-sided lungs and variations involving the horizontal fissure in 19 right-sided lungs can be categorised as Grade III. Horizontal fissure was totally absent in five right-sided lungs (Grade IV) (Figure 2).

The presence of fissures in normal lungs enhances uniform expansion, and their position could be used as reliable landmarks in specifying lesions within the thorax, in general and within the lungs in particular⁵.

Sometimes, especially in the infant, accessory fissures of varying depth can be seen in abnormal locations of the lung, delimiting anomalous lobes which correspond to the normal bronchopulmonary segments¹. From a radiological point of view, an accessory fissure is important as it can be mistaken for a lung lesion¹⁰. In this study, one right-sided lung and three left-sided lungs showed accessory fissures.

Incomplete fissure may alter the usual patterns of collapse seen in patient with endobronchial lesions and may also give rise to

### Table 1. Comparative incidence of variation of fissures

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<td>Horizontal fissure</td>
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<td>Absent</td>
<td>10.5%</td>
<td>21%</td>
<td>16.6%</td>
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<td>Incomplete</td>
<td>21%</td>
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<td>63.3%</td>
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<td>30%</td>
<td>36.6%</td>
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<tr>
<td>Absent horizontal fissure and incomplete oblique fissure</td>
<td>5.3%</td>
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<td>6.66%</td>
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<td><strong>Left Lung</strong></td>
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<td>Incomplete oblique fissure</td>
<td>21%</td>
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IEHAV: Illustrated Encyclopedia of Human Anatomic Variation.

**Figure 2.** The percentage of the incidence of the pattern of the lung fissures in the present study as per the criteria suggested by Craig and Walker⁹.
atypical appearance of pleural effusions. An incomplete major fissure causes the odd appearance of fluid tracking within the fissure. Incomplete fissures may also alter the spread of disease within the lung. Pneumonia in particular lobe is often limited to that lobe alone by the fissures. In patients with incomplete fissures, pneumonia may spread to adjacent lobes through the incomplete fissures. Odd lobar involvement with carcinoma of the lung may be explained on a similar basis.

REFERENCES

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