RESUMEN
Antecedentes: La conciencia y el conocimiento de las variaciones anatómicas de las fisuras del pulmón es requerido por los discípulos de especialidades interesados para una interpretación precisa sobre diferentes técnicas de imagen. Este conocimiento es necesario para el reconocimiento de la anatomía lobular y así localizar los segmentos broncopulmonar. Por lo tanto, se realizó un estudio cadavérico que informa la prevalencia de variaciones de número de fisuras del pulmón en población Punjabi. Método: Las cavidades torácicas de 50 cadáveres debidamente embalsamados que contienen los pulmones fueron disecados y se observaron las características morfológicas de las variaciones anatómicas como número, fisuras y los lóbulos. Resultados: Cien fisuras pulmonares se observaron en 55 pulmones. Había variaciones en 41 pulmones derecho y 14 pulmones izquierdos. Cinco pulmones derechos mostraron ausencia de fisura horizontal, un pulmón derecho no tenía fisura, quince pulmones derechos mostraron fisura horizontal incompleta. Once pulmones derechos y seis pulmones izquierdos tuvieron fisuras oblicuas incompletas. En cuatro pulmones izquierdos la fisura oblicua estuvo ausente. Se observaron fisuras supernumerarias en cuatro pulmones izquierdos y nueve pulmones derechos. Las conclusiones: El conocimiento anatómico de las variaciones de fisuras y lóbulos puede ser importante, y también para académicos en el campo médico. Las conclusiones con respecto a las variaciones vistas en fisuras de ambos los pulmones fueron comparables con estudios anteriores. Las variaciones de anatomía pulmonar son importantes para ambos: el diagnóstico por radiólogos que interpretan radiografías y escáneres de tomografía computada y el tratamiento de varias enfermedades pulmones por cirujanos a realizar lobectomías y por clínicos que implican todos los dominios de la medicina.

Palabras clave: Pulmones, fisuras, lóbulos pulmonares, variación.

ABSTRACT
Background: Awareness and knowledge of anatomical variations of fissures of lung is required by the disciples of concerned specialties for accurate interpretation on different imaging techniques. This knowledge is necessary for the appreciation of lobar anatomy and thus locating the bronchopulmonary segments. Therefore a cadaveric study was undertaken to report the prevalence of variations involving number of fissures of lung in Punjabi population. Methods: The thoracic cavities of 50 properly embalmed cadavers containing lungs were dissected and morphological features like number, fissures and lobes were observed for the presence of anatomical variations. Results: A total of 100 variant pulmonary fissures appeared in 55 lungs. There were variations in 41 right lungs and 14 left lungs. Five right lungs showed the absence of horizontal fissure, one right lung was without any fissure, fifteen right lungs showed incomplete horizontal fissure. Eleven right lungs and six left lungs had incomplete oblique fissures. In four left lungs oblique fissure was absent. Supernumerary fissure was seen in four left lungs and nine right lungs. Conclusions: Anatomical knowledge of variations of fissures and lobes may be important, and also to academicians in the medical field. The findings regarding the variations seen in fissures of both the lungs were comparable with previous studies. Variations of lung anatomy are important for both the diagnosis by radiologists interpreting X-rays and CT scans and treatment of various lungs diseases by surgeons performing lobectomies and by clinicians involving all the domains of medicine.

Key words: Lungs, fissures, pulmonar lobes, variations.
INTRODUCTION

Conventionally, according to the text books of Anatomy, the left lung is divided into two lobes by a deep oblique fissure and the right lung has two fissures, an oblique and a horizontal dividing it into three lobes namely the superior, middle and lower lobes (Figure 1B). The oblique fissure runs downwards, thereby meeting the inferior border of the lung at a distance of approximately 7.5 cm behind anterior end (Standring, 2005). During the development, as the lung grows, the fissures that separate individual bronchopulmonary buds or segments become obliterated except along two planes which form oblique or horizontal fissures in the fully developed lungs. Supernumerary fissures (Figures 2C, 2E, 1A) could be the result of non-obliteration of fissures which normally are obliterated (Larsen et al, 1993). The supernumerary fissure may be of varying depth occurring between bronchopulmonary segments. Absence or incomplete oblique or horizontal fissure could be due to obliteration of these fissures either completely or partially (Figures 3G, 3H, 3I, 3J). The fissures may vary in the degree of completeness and tend to divide the lobe into smaller subdivisions. Complete fissures show continuity of lobes at their bottom only by the parts of bronchial tree and blood vessels. In the region of incomplete fissures the adjacent lobes are connected by a sizeable chunk of pulmonary tissue as the cleft fails to reach the hilum. The fissure may be absent altogether (Figures 2F, 3J). The fissures are conducive to uniform expansion of lobes. They provide routes for movements of lobes in relation to each other. This is more relevant to distension and movement of the lower lobes during breathing (Rosse et al, 1997).

The position of fissure could be used as reliable landmark in specifying lesions within the thorax, in general and within the lungs in particular (Kent et al, 1942). Sometimes especially in infant, supernumerary fissures of varying depth can be seen in unusual locations of the lung delimiting abnormal lobes which correspond to the normal
bronchopulmonary segments (Rosse et al, 1997). Radiologically, an supernumerary or variant fissure is important as it can be mistaken for a lung lesion (Aldur et al, 1997). The supernumerary fissure might act a barrier to spread in the tissue creating a sharply demarcated pneumonia, which could be misinterpreted as an atelectasis or consolidation (Nene et al, 2010). Segmental localisation is must for a thoracic surgeon and knowledge of supernumerary fissure is a great significance to cardio thoracic surgeon for planning segmental resections or pulmonary lobectomy. In the present case observation of a transverse fissure only on the medial side of left lung is of great clinical and surgical importance, since it may be presumed as an independent lobe. Considering all the above facts the knowledge of fissure comes to bear greater role for clinicians, surgeons as well as radiologists. (Devi et al, 2011)

Figure 2.- C) Left lung showing supernumerary fissure at anterior border. D) Right lung with one oblique fissure. E) Right lung showing supernumerary fissure at base of lung. F) Right lung with no fissure
MATERIAL AND METHODS

Fifty pairs of lungs from equal number of both the sexes, formalin-fixed Punjabi cadavers were used for this study. Details of fissures complete, incomplete or absent; presence of any variant fissure, supernumerary fissures were recorded. The specimens were photographed and the records were compared with previous data. The anatomical classification proposed by Craig and Walker was followed to determine for the presence and completeness of fissures (Craig et
Craig and Walker 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.

<table>
<thead>
<tr>
<th>Type</th>
<th>Incomplete Right Horizontal Fissure</th>
<th>Incomplete Right Oblique Fissure</th>
<th>Absent Right Oblique Fissure</th>
<th>Absent Left Oblique Fissure</th>
<th>Absence of right oblique fissure</th>
<th>Incomplete Left Oblique Fissure</th>
<th>Supernumerary fissures Right Lung</th>
<th>Supernumerary fissures Left Lung</th>
<th>Complete absence of fissures in right Lung</th>
<th>Complete absence of fissures in left Lung</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>27.2% (Fig. 1B, 3G)</td>
<td>20.0% (Fig. 3G)</td>
<td></td>
<td></td>
<td>11.0% (Fig. 3H)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2</td>
<td>9.0% (Fig. 2D)</td>
<td>7.3% (Fig. 3J)</td>
<td></td>
<td></td>
<td>0%</td>
<td></td>
<td></td>
<td></td>
<td>1.8% (Fig. 2F)</td>
<td>7.3% (Fig. 3J)</td>
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<tr>
<td>3</td>
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<td></td>
<td></td>
<td></td>
<td>16.4% (Fig. 2E)</td>
<td>7.3%</td>
<td></td>
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</table>

Table 1.- Types of variations of pulmonary fissures in the present study.

RESULTS

Variations of pulmonary fissures appeared in 55 (55%), among them, 41 cases (74.6%) were right variations while 14 cases (25.4%) were left variations. Three types of variations were observed (Table 1):

Type 1: There were Incomplete Right Horizontal fissures (Figure 1B and 3G), Incomplete Right Oblique fissures (Figure 3G) and Incomplete Left Oblique fissures (Figure 3H).

Type 2: There was Absent Right Horizontal Fissure (Figure 2D), Absent Left Oblique Fissure (Figure 3J), Complete absence of fissures in right Lung (Figure 2F) and Complete absence of fissure in left lung (Figure 3J).

Type 3: There were Supernumerary fissures Right Lung (Fig. 2E), Complete absence of fissure in left lung (Fig. 1A, 2C).

DISCUSSION

Incomplete pulmonary fissures indicating partial fusion between lobes are most common. In a radiological study, the inferior supernumerary fissure which demarcates the medial basal segment, and superior fissure which demarcates the superior segment, was the most common supernumerary fissure detected on CT scan (Tarver et al, 1995). Several authors have reported varying percentages of incidence of the incompleteness and absence of the fissures (Table 2). (Medlar et al, 1947, Raasch et al, 1982, Kent et al, 1942, Bergman et al, 2002) When compared with the study reported by Medlar (Medlar et al, 1947), the incidence of incomplete fissure (Figures 1B, 3G 3H and 3I) was higher and the incidence of absence of horizontal fissure (Figures 2D, 2F) was lower in the present study whereas incidence of absence of oblique fissure (Figure 3J) in left lung was in accordance. In the study of Lukose et al complete and absent horizontal fissure were reported in 21%, and 10.5%, respectively. When compared with the study by (Lukose et al, 1999) incidences of a few variations observed were not in accordance with the present study. Prevalence of incomplete oblique fissure of left lung (Figures 3H, 3I) was lower in our work, where as it was more prevalent in both the lungs in the study of Prakash et al (2010) (Table 2).
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, When compared with the studies by (Bergman et al, 2002; Meenakshi et al, 2004), a lower incidence of variations was observed in all the parameters taken in the present study. In the study of Nene et al (2011) incomplete (Figures 1B, 3G) and absent horizontal fissure (Figure 2D, 2F) was reported in 8% and 14% in right lung and absent oblique fissure in none of the left lungs.

<table>
<thead>
<tr>
<th>S no</th>
<th>Authors &amp; Year</th>
<th>Fissures of Right lung</th>
<th>Fissures of Left lung</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Horizontal</td>
<td>Oblique</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Absent</td>
<td>Incomplete</td>
</tr>
<tr>
<td>1</td>
<td>Medlar, 1947</td>
<td>45.2%</td>
<td>17%</td>
</tr>
<tr>
<td>2</td>
<td>Lakose et al., 1999</td>
<td>10.5%</td>
<td>21%</td>
</tr>
<tr>
<td>3</td>
<td>IEHAV7 (2002)</td>
<td>21%</td>
<td>67%</td>
</tr>
<tr>
<td>4</td>
<td>Meenakshi et al., 2004</td>
<td>16.6%</td>
<td>63.3%</td>
</tr>
<tr>
<td>5</td>
<td>Bergman et al., 2008</td>
<td>21%</td>
<td>67%</td>
</tr>
<tr>
<td>6</td>
<td>Prakash et al., 2010</td>
<td>7.1</td>
<td>50</td>
</tr>
<tr>
<td>7</td>
<td>Nene et al., 2011</td>
<td>14%</td>
<td>8%</td>
</tr>
<tr>
<td>8</td>
<td>Present study, 2012 (Figure 2D, 2F)</td>
<td>9.0%</td>
<td>27.2%</td>
</tr>
</tbody>
</table>

Table 2.- Comparison of the present study with the studies reported by other scientists

Knowledge of such variations might explain bizarre presentation of certain clinical cases pertaining to lung pathologies. Also knowing the frequency of occurrence of a variant fissure in a particular population might help the radiologist and clinician to make correct diagnosis, plan, execute and modify a surgical procedure depending on the merit of the case (Nene et al, 2011). The results of present study and their comparison with the previous works show that there is a wide range of difference in occurrence of major, minor and supernumerary fissures between and among different populations. This implies that a variety of genetic and environmental factors might affect development of these fissures. Recognition of the supernumerary fissures provides additional information in segmental localization of pulmonary lesions and assists in differential diagnosis of supernumerary fissures from normal anatomical and pathological structures. Being aware of these variations before a thoracic procedure may sometimes facilitate surgery.

REFERENCES

Variations of fissures of lungs


