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Lung morphology: a cadaver study in Indian population

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Summary

Knowledge of anatomical variations of lung is required by clinicians for accurate interpretation on different imaging techniques. During routine dissection in the anatomy department, a single lung extending uniformly throughout the thoracic cavity was detected in a 35 year old male cadaver. Thereafter a cadaver study was undertaken to report the prevalence of variations involving number, lobes and fissures of lung in Indian population. The thoracic cavities of 29 properly embalmed cadavers containing lungs were dissected and morphological features like number, fissures and lobes were observed for the presence of anatomical variations. The aforementioned single lung cadaver had associated dextrocardia. One accessory lobe on the inferior aspect was observed in 27.2% of lungs studied, whereas supernumerary fissures which were most common in right lower lobe were detected in 35% of lung specimens. The transverse fissure on the right lung was absent in 7.1% and incomplete in 50% of lung specimens. In the right lung, the oblique fissure was absent in 7.1% and incomplete in 39.3% of specimens. The oblique fissure was absent in 10.7% and incomplete in 35.7% of left lungs. Comparative analysis of our work with previous data in the literature suggest that different studies performed on radiological images reported greater prevalence of incomplete or absent pulmonary fissures as compared to various cadaver studies. Our aforementioned findings regarding the variations seen in fissures and lobes of both lungs were different from previous studies. Variations of lung anatomy are important for both the diagnosis and treatment of various diseases involving all the domains of medicine.

Key words

Lung, cadaver, anatomy, fissure

Introduction

Anatomical variations of lungs including number, fissures, and lobes are important for clinicians. Hayashi et al. (2001) concluded that the knowledge of the anatomy and normal variants of the major fissures is essential for recognizing their variable imaging appearances as well as related abnormalities. Aziz et al. (2004) suggested that interlobar fissures are important landmarks for proper identification of normal pulmonary anatomy and evaluation of disease. Accurate knowledge of anatomy is recommended for appropriate interpretation of medical imaging including computed tomography scans. Aldur et al. (1997) concluded that a surgeon must always remem-

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ber the anatomical variations of the location of the lungs especially in lobectomies and in segmental resection. Anatomical knowledge of variations is required to alert surgeons to potential problems encountered during operation (Climen et al., 2005).

Cadavers are still the best means to study all the domains of anatomy. Various workers in different studies of lungs performed on cadavers have reported their findings time and again (Medlar, 1947; Raasch et al., 1982; Aldur et al., 1997; Lukose et al., 1999; Meenakshi, 2004; Gesase, 2006; Modgil et al., 2006) .During routine dissection on cadavers in the anatomy department we encountered a single lung extending throughout the thoracic cavity, a condition which is not reported in literature (Bergman et al., 2008) and which was different from horseshoe shaped lung, which has been reported in literature (Hasserburg et al., 1992; Dupuis et al., 1994; Luttermen et al., 2004; Dikensoy et al., 2006; Teksam et al., 2008). Hence the present study was undertaken on cadavers to determine the morphology of lungs in Indian population.

Both the right and left lungs are divided by fissures into lobes. The right lung commonly has two fissures, namely oblique and transverse, dividing it into superior, middle, and inferior lobes (Standring, 2005). The left lung is commonly divided by an oblique fissure into upper and lower lobes (Standring, 2005). Any finding different from the aforementioned pattern may be referred as anatomical variation.

Materials and methods

The lungs of twenty-nine cadavers (16 males and 13 females) were studied. The thoracic wall of properly embalmed and formalin fixed cadavers was dissected and the lungs were exposed to study the morphological features including number, lobes, and fissures. The anatomical classification proposed by Craig and Walker (1997) was followed to determine the presence and completeness of pulmonary fissures.

Results

Twenty-eight out of 29 cadavers contained two lungs; one on the right side and the other on the left side.

One 34 years old male cadaver had a single lung extending uniformly throughout the thoracic cavity; it was different from a horseshoe shaped lung in which two halves are only connected from the posterior aspect (Fig. 1). Another important finding was a small right sided heart inside the pericardium (dextrocardia) with the cardiac apex pointing rightward (Fig. 1). One incomplete transverse fissure and one incomplete oblique fissure were observed on the lung (Fig. 1).

One accessory inferior lobe was observed in 11 cases on the right side and in 5 cases on the left side, in total in 16 out of 57 (27.2%) lungs studied. The presence of supernumerary fissures, most common in the right lower lobe, was observed in 20 out of 57 (35.1%) lung specimens. The transverse fissure on the right lung was absent in 2 out of 28 (7.1%) specimens and incomplete in 14 out of 28 (50%) specimens. The major (oblique) fissure was absent in 2 out of 28 (7.1%) right lungs, whereas it was absent in 3 out of 28 (10.7%) left lungs. The oblique fissure was incomplete in 11 out of 28 (39.3%) right lungs and 10 out of 28 (35.7%) left lungs.

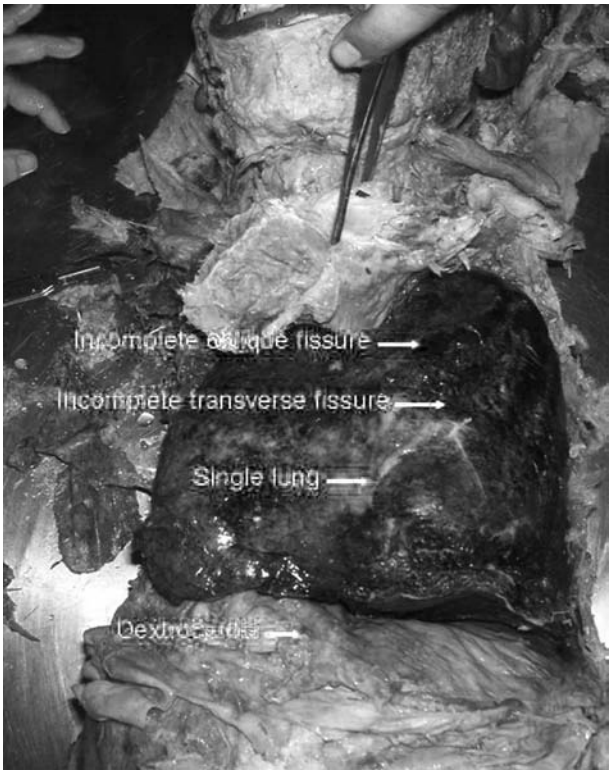

Fig. 1 – Single lung with incomplete oblique and transverse fissures extending throughout the thoracic cavity and associated with dextrocardia.

Discussion

The respiratory diverticulum or lung bud develops from the foregut and during subsequent development, at around 28 days after fertilization, divides into two primary bronchial buds, the right and left ones, which will ultimately develop into the right and left lungs (Sadler, 2004). The primitive heart tube rotates and folds from 22 day post fertilization till cardiac loop formation is complete by day 28 (Sadler, 2004). An embryological insult around 4 weeks post fertilization might have resulted in developmental anomaly involving both the respiratory and cardiovascular system. Failure of the division of the respiratory diverticulum into a right and a left bud resulted in the formation of a single lung extending uniformly throughout the thoracic cavity. Concomitant dextrocardia (the heart lies on the right side of the thorax) resulted from defective rotation of the heart tube, the heart looping to the left instead of right; which would also be the developmental basis of single lung formation as observed in the aforementioned cadaver.

Lung development involves the formation of numerous bronchopulmonary buds which usually fuse completely in the later part of development except at sites of fis-

sure formation, resulting in the formation of lobes and fissures (Frija et al., 1988). Any deviation from the normal pathway of fusion of the bronchopulmonary buds results in the formation of variations involving lobes and fissures of the lungs (Sadler, 2004).

Table 1 compares the work of previous authors regarding the prevalence of pulmonary fissures with our present study. Analysis of comparative data on Table 1 reveals that absent or incomplete major (oblique) and minor (transverse) fissure was more prevalent in radiographic studies including computed tomography scan than in whole cadaver and isolated lungs studies. Prevalence of absent or incomplete horizontal fissure of the right lung was greater in our work than in the study by Lukose et al. (1999), whereas it was less prevalent (57.1%) than in the reports published by various other authors (Medlar, 1947; Raasch et al., 1982; Frija et al., 1988; Glazer et al., 1991; Otsuji et al., 1993; Aziz et al., 2004; Meenakshi et al., 2004; Bergman et al., 2008). Prevalence of incomplete oblique fissure of the right lung was higher in our study (39.3%) than in previous works by Medlar (1947), Meenakshi et al. (2004) and Bergman et al. (2008); on the other hand it was less prevalent than in earlier reports by different authors (Raasch et al., 1982; Frija et al., 1988; Glazer et al., 1991; Otsuji et al., 1993; Aziz et al., 2004). Our study reported greater prevalence of incomplete

Table 1 – Comparative prevalence of anatomical variations of fissures of lung

Author(s) and year	Method of study[1]	Prevalence of absent or incomplete horizontal fissure of right lung (%)	Prevalence of incomplete oblique fissure of right lung(%)	Prevalence of incomplete oblique fissure of left lung (%)
Medlar, 1947	Cadaver & specimen	62.3	25.6-30	10.6-18
Raasch et al., 1982	Fixed inflated specimen & radiograph	94	47 -70	40 -46
Frija et al., 1988	High resolution CT	96.7	87	77
Glazer et al., 1991	Thin section CT	-	64	52
Otsuji et al., 1993	Thin section CT & cadavers	96	83.1	50
Lukose et al., 1999	Cadaver & specimen	31.5	-	21
Aziz et al., 2004	High resolution CT	63	48	43
Meenakshi et al., 2004	Cadaver & specimen	63.3	36.6	46.6
Bergman et al., 2008	Cadaver & specimen	67	30	30
Present study	Cadaver & specimen	57.1	39.3	35.7

[1] CT = computerized tomography; cadaver study = on whole cadaver; specimen study = on isolated lungs.

oblique fissure of the left lung than the reports published by Medlar (1947), Lukose et al. (1999) and Bergman et al. (2008); whereas it provided a lower prevalence than works by many other authors (Raasch et al 1982; Frija et al 1988; Glazer et al 1991; Otsuji et al 1993; Aziz et al 2004; Meenakshi et al 2004).

Knowledge of fissural anatomy can also help explain various radiological appearances of interlobar fluid (Raasch, 1982). An incomplete fissure is also a cause of postoperative air leakage (Craig and Walker, 1997). Accurate recognition of incomplete major and minor interlobar fissure in different populations may lead to improve the understanding of lesions like pneumonia, pleural effusion, and collateral air drift along with disease spreading through the lung, as seen by imaging techniques.

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