Research Article

Congenital Abnormal Shapes of Lungs in Relation to Abnormal lobes and Fissures and Its Clinical Implications

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Abstract

Background: Detailed knowledge of congenital abnormalities of lungs is essential for proper evaluation and treatment of respiratory diseases, identi ication of broncho-pulmonary segments during lobectomies and surgical resection, identification and interpretation of their variable radiological imaging. **Aim**: Accordingly, the aim of this study was designed to evaluate the prevalence of congenital abnormal shapes of lungs in relation to abnormal lobes and issures. **Materials and methods**: This study was carried out on 270 isolated lung specimens (right lungs-135 and left lungs-135) from 135 formalin embalmed middle aged human cadavers irrespective of gender. **Results**: Out of 270 lung specimens following congenital abnormalities were reported. 1) Three lungs (1.1%), had unusual different abnormal shapes, such as typical snail shaped right lung with single abnormal circular issure, bearded axe shaped left lung with huge cardiac notch and single lobed classical pointed hat shaped right lung. 2) One right lung (0.37%) and 9 left lungs (6.67%) showed complete absence of issures. 3) Among 9 single lobed left lungs one had split apex separated by a left subclavian groove with absence of lingual and cardiac notch. 4) Cardiac notch and ligula were noted absent in 3 left lungs (2.36%). 5) One right lung (0.37%) showed ive lobes with complete one oblique and three incomplete horizontal issures. **Conclusion**: To the best of our knowledge such abnormalities of lungs has not been cited in the recent medical literature. Awareness of these abnormalities is necessary to avoid complications during various radio diagnostic procedures or cardiothoracic surgeries.

Keywords: Auscultation; Lobectomy; Oligohydramnios; Pneumonia; Takayasu's arteritis

Introduction

Human lungs are pair of essential respiratory organs situated in the thoracic region. Each lung is separated into lobes by the fissures, with three lobes superior, middle and inferior on the right separated by oblique (major) and horizontal (minor) fissures and two lobes superior and inferior on the left separated by oblique fissure. Anatomically normal fissures and lobes help the lungs in a uniform expansion during respiration. Each lung is half conical in shape and the left lung is longer, narrower, smaller than the right lung and has a cardiac notch on its anterior boarder and lingula a tongue like projection below the cardiac notch [1,2]. Each lung is covered by a delicate closed serous sac known as pleura consists of two layers visceral and parietal. Visceral pleura adhere closely to the lung surface follows the interlobar fissures and cover each lobe of lung. The folded portions of the pleura in the interlobar fissures of lungs are the only normal pleura that can be visualized radiologically. Radiological signs of pleural

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shadow in any other regions will be consider as pathological pleural abnormalities. Recognizing the fissures is essential in the localization and diagnosis of both pleural and parenchymal abnormalities of lungs, the oblique fissure is visible in lateral view of chest X-ray whereas the horizontal fissure is visible in 60 percent in X-ray PA view of chest. Any change in morphological features of lungs such as abnormal shapes, fissures and lobes will disturb normal intake of oxygen and can cause hypoxia, asthma, obstructive pulmonary disease and pneumonia. In radiograph accessory fissures can also mimic diseases such as atelectasis, scars, pleural effusion and masses. Very few reports have been reported in the literature in relation to congenital abnormal shapes of lungs associated with abnormal fissures and lobes. Accordingly, the present study was designed to evaluate the prevalence of congenital abnormal shapes of lungs in relation to lobes and fissures.

Materials and Methods

This study was carried out on 270 isolated lung specimens (right lungs-135 and left lungs-135) of 135 formalin embalmed middle aged human cadavers irrespective of gender. Study was performed in the laboratory of anatomy in accordance with the institutional ethical standards and Indian anatomy act. This study was reviewed and approved by the Institutional Ethics Committee (Reference number: VAMC-HAREC19 JUN 021). Congenital abnormal shapes of lungs in relation to abnormal lobes and fissures were observed and photographs were taken for proper documentation.

Results

Out of 270 lung specimens following very rare and unreported abnormalities of lungs were observed.

Three lungs (1.1%) had unusual different abnormal shapes, such as typical snail shape, bearded axe shape and classical pointed hat shape.

Typical snail shape: Typical snail shape was noted in the right lung with a deep and incomplete circular fissure. Circular fissure was dividing the lung in to three unusual upper, middle and lower lobes. Middle lobe was cone shaped and elevated towards lateral thoracic wall. Sternocostal surface view of the arrangement of three lobes with circular fissure resembles the shape of typical snail shell (Figure 1).

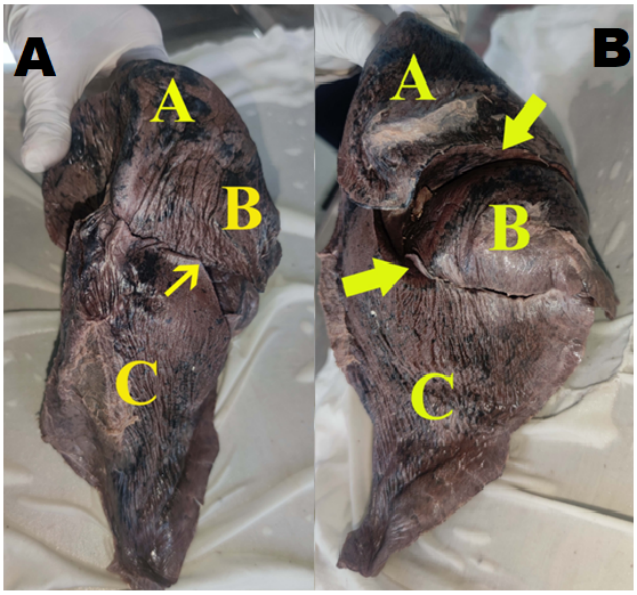

Figure 1: Photograph showing snail shaped right lung (A and B). A: Upper lobe; B: Elevated middle lobe; C: Lower lobe; Yellow coloured arrows-Circular fissure.

Bearded axe shape: It was noted in the left lung with incomplete oblique fissure. When viewed from stern costal surface incomplete oblique fissure divides the lung in to upper large quadrilateral upper lobe and cone shaped lower lobe. Both lobes were separated by a huge cardiac notch resembles the shape of bearded axe. Pointed index finger shaped small third lobe was also noted in the large gap between the upper and lower lobes (Figure 2).

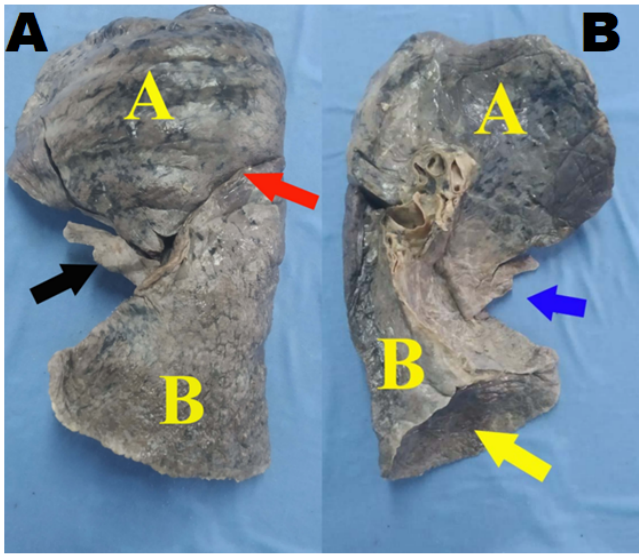

Figure 2: Showing sternocostal and mediastinal surface of bearded axe shaped left lung (A and B). A: Quadrilateral upper lobe; B: Cone shaped lower lobe; Black coloured arrow: Pointed index finger shaped small third lobe; Red coloured arrow: Incomplete oblique fissure; Blue coloured arrow: huge cardiac notch; Yellow coloured arrow: Small base.

Classical pointed hat shape: It was noted in right lung with complete absence of oblique and horizontal fissures. Its pointed apex, deeply concave diagrammatic surface with unusual round and sharp margins of inferior boarder sloping over the mediastinal surface resembles the classical pointed hat shaped lung (Figure 3).

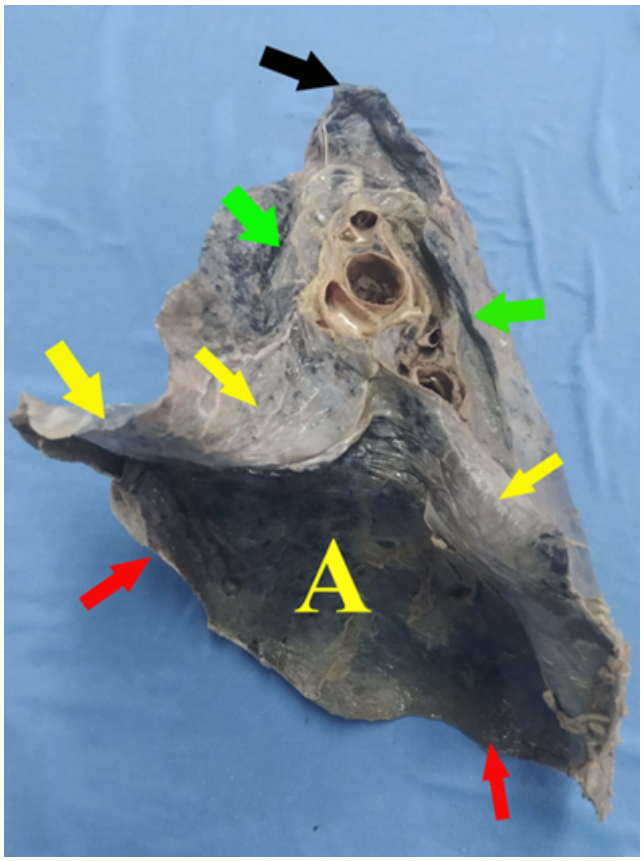

Figure 3: Showing mediastinal surface of classical pointed hat shaped right lung with absence of oblique fissure. A: Deep concave base of the right lung; Yellow and red coloured arrows: Sloping round and sharp margins of inferior boarder; Green coloured arrow: Flat mediastinal surface; Black coloured arrow: Pointed apex.

Cardiac notch and ligula were noted absent in 3 left lungs (2.36%) (Figure 4).

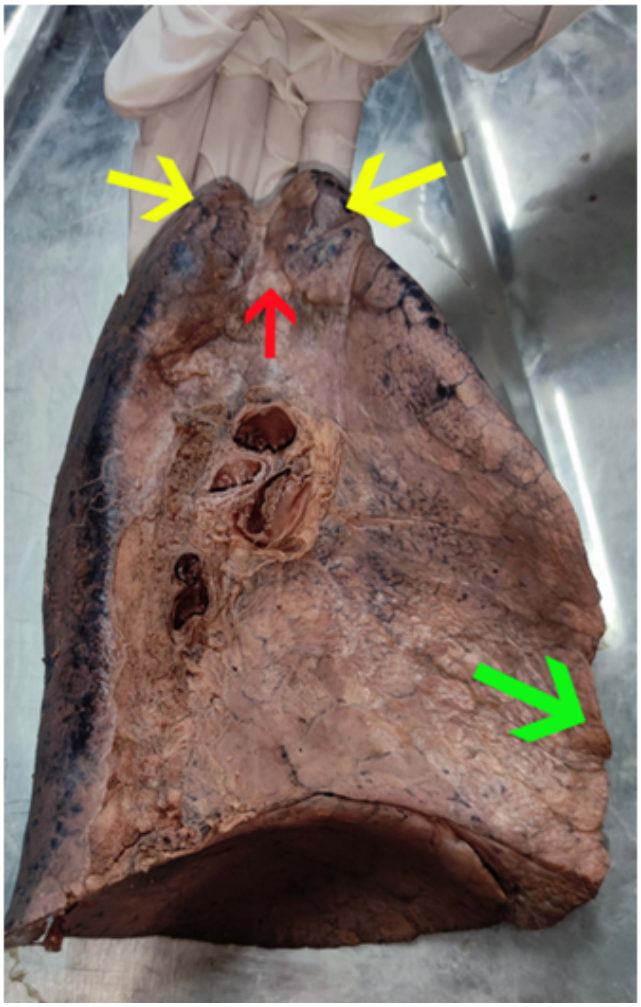

Figure 4: Showing mediastinal surface of split (bifid) apex of left lung with absence of oblique fissure. Yellow coloured arrows: Split (bifid) apex of left lung; Red coloured arrow: Left subclavian groove; Green coloured arrow: Lingula and cardiac notch were absence.

Prevalence of complete absence of fissures was noted in one right lung (0.37%), and in 9 left lungs (6.67%) Surprisingly out of 9 left lungs one had split apex separated by a subclavian groove. Two apexes of left lung were round and cardiac notch and lingula were also noted absent.

One right lung (0.37%) showed five lobes with complete oblique and three incomplete horizontal fissures. These four fissures divide the lung in to upper apical and lower apical, middle, upper apical basal and lower basal lobes (Figure 5).

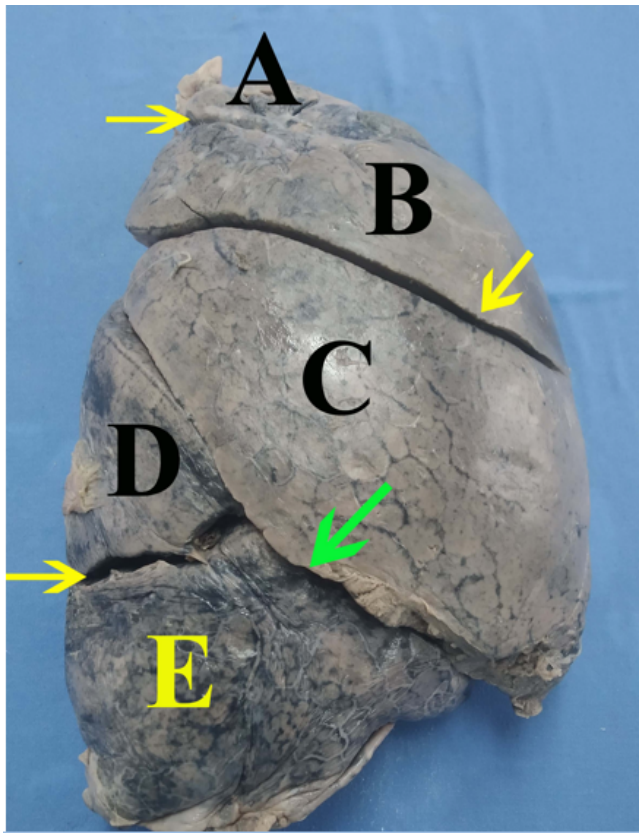

Figure 5: Showing mediastinal surface of five lobed right lungs. A: Upper small apical lobe; B: Lower large apical lobe; C: Middle lobe; D: Upper apical basal lobe; E: Lower basal lobe; Yellow coloured arrows: Incomplete horizontal fissure; Green coloured arrow: Oblique fissure.

Discussion

Normal anatomical conical shape of the lungs plays an important role in its proper expansion and contraction during the process of respiration within the thoracic cavity. In the present study an unusual three different abnormal shapes of lungs with unusual fissures were noted, such as typical snail shaped right lung, bearded axe shaped left lung and classical pointed hat shaped right lung. In the snail shaped right lung horizontal and oblique fissures were absent and shape is due to presence of an incomplete abnormal deep circular fissure in the middle of the costal surface arranged as coiled spiral pattern around the elevated central lobe. Elevated central lobe resembles as central anatomical feature of a coiled snail's shell. In the Bearded axe shaped left lung upper quadrilateral and lower cone shaped lobes were separated by a huge cardiac notch. Such huge cardiac notch between the two lobes was might be due to incomplete development of upper lobe parenchyma of the left lung. Such uncovered areas of heart look like a large bulge in the chest X-ray and are often confused with cardiomegaly or left ventricular hypertrophy during radio diagnostic procedures. At the same time large uncovered areas of heart by the left lung may increase the susceptibility of damage to the heart as the results of blunt trauma, typically to the anterior chest wall. In the classical pointed hat shaped single lobed right lung, the size of the lung was noted smaller than the left lung. Such rare and unusual abnormal shapes of lungs noted in the present study have not been documented yet in the medical literature. Embryologically lungs start developing as respiratory buds from the caudal end of the laryngotracheal diverticulum during the fourth week of intrauterine life. Soon the respiratory buds divide two principal bronchi and then subdivides to form lobar, segmental and respiratory bronchial. Even after birth three or more generations of new alveoli sprout from the terminal respiratory passages [3]. Development of kidneys plays an important role in normal lung development. Urine liberated from the fetal kidneys maintains the volume of amniotic fluid which is necessary for normal foetal lung development. Teratogens are the agents such as drugs, chemicals, infections, radiation known to cause human congenital abnormalities or birth defects when a mother is exposed to them during pregnancy. Three different abnormal morphological shapes of lungs presented in the present study might be due to insufficient production of amniotic fluid (oligohydramnios) during the intrauterine life or exposure of mother to the teratogens during pregnancy. Awareness of these abnormalities is clinically necessary to avoid complications during radio diagnostic procedures or cardiothoracic surgeries. The fissures of the lung play an important role in facilitating the movements of lobes to one another and provide greater distention and movements of lower lobes during respiration. Incomplete fissures or accessory fissures were common to find, but complete absence of fissures or in the lungs are very rare. Very few reports of complete absence of fissures of lungs were reported. Akashi Ghost et al. in their cadaveric study reported prevalence of complete absence of oblique fissure in left lung was 5.55% and 2.17% in right lung [4]. Reported complete absence of oblique fissure in one left lung (3.57%) out of 28 left lungs [5]. Whereas in the present study it was seen that prevalence of complete absence of fissures in the right lung was 0.37% and 6.67 % in left lung which is higher than the previous studies. Awareness of complete absence of fissure in the lung was clinically important to the clinicians during the lobar resection and bronchoscope procedures to avoid pre and post-operative complications. In embryological point of view split apex was observed as an accessory lobe in about 1% of people affects the upper lobe of right lung, where the apex of the lung splits in to medial and lateral parts by a fissure. The bottom of the fissure contains the arch of azygosvein, and the medial part of the split apex forms the lobe of azygosvein [6]. In the present study split apex was noted in the single lobed left lung. The mediastina surface of bifid apex was separated by a vertical groove for the lodgment of left subclavian artery. Such anatomical variations can compress the subclavian artery and may result in subclavian steal syndrome. Single lobed bifid apex of left lung separated by subclavian groove noted in the present study has not been previously reported by other researchers. These rare anatomical variations are clinically important because symptoms of subclavian artery compression arising from similar variations are often confused with more common causes, such as atherosclerosis, thoracic outlet

syndrome and Takayasu's arteritis. Cardiac notch is the concave lateral deflection of the anterior boarder of the left lung below the level of fourth costal cartilage where the pericardium and heart are uncovered by the lung and pleura is known as cardiac dullness. The dullness overlies the anterior surface of right ventricle is clinically important in various procedures like ultrasound examination, auscultation, Percussion, pericardial and cardiac puncture. Absent of cardiac notch is very rare, reported absent of cardiac notch in the left lung of 40-year-old Indian male cadaver. Similar to his report in the present study also cardiac notch and ligula were noted absent in three left lungs (2.36%). In such abnormalities the heart is completely covered by the lungs results in increased resistance in ventricular dilatation of heart. Prior knowledge of such congenital abnormalities is important to radiologists, clinicians during surgical procedures such as ultrasound, Percussion, auscultation, pericardial and cardiac puncture. The anatomical knowledge of accessary lung lobes and fissures is important for radiologist and cardiothoracic surgeons to avoid misinterpretation on X-rays and CT scans and also to avoid confusion in some clinical conditions such as linear atelectasis, pleural scars or walls of bullae [8]. During the development of lungs individual bronchopulmonary segments were separated by spaces or fissures, as the lungs grows these spaces or fissures become obliterated except along oblique and horizontal planes which persists as major and minor fissures [9]. Permanent persistence of spaces or fissures between individual bronchopulmonary segments results in accessory fissures. Accessory right lung lobes and fissures have been reported by many researchers, but a very few reports were reported on four or five lobes of lungs. Reported an unusual rare case of complete vertical fissure in the left lung with complete separated anterior and posterior lobes with separate hilum and an incomplete oblique fissure divided the anterior lobe again in to upper and lower [10]. Reported unusual four lobed left lungs with three fissures (one oblique and two accessory fissures) [11]. Binky have been reported rare four lobed right lung with three fissures [12,13]. A five lobed right lung with accessory fissures in a 78-year-old white female whose cause of death was listed as chronic obstructive pulmonary disease [14]. Whereas in the present study very rare and unusual five lobed right lung (0.37%) with one complete oblique and three incomplete horizontal fissures were noted. Multiple lobar patterns with abnormal or accessory fissures or absence of fissures noted in the present study is might be due to the partial abnormal division of principal bronchi or incomplete or abnormal obliteration of spaces leads to the absence or incomplete oblique or horizontal or multiple fissures. Such developmental interlobar incomplete fissures of lungs are clinically important as they may spread the lung diseases such as carcinoma and pneumonia to adjacent lobes through parenchymal continuation. Coronavirus disease (COVID-19) is an infectious disease sweeps across the globe, primarily affects the lungs, during acute illness leads complications such as pneumonia and in the most severe cases causes death due to acute respiratory distress syndrome. Patients with respiratory issues such as congenital abnormalities of lungs in relation to abnormal shapes, multiple abnormal lobes with abnormal fissures may also increases the high risk of Coronavirus disease. Presence of incomplete fissures in lungs cause difficulties to cardiothoracic surgeons in identifying and separating the lobes is lobectomy and segmental resection may lead to increased risk of postoperative complications like air leak, bleeding, and bronchopleural fistula. Thus, prior anatomical knowledge five lobed right lung and its accessory fissural anatomy noted in the present study will reduce the complications for cardiothoracic surgeons performing lobectomies, during video-assisted lung resection surgery and radiologists interpreting X-rays and CT.

Conclusion

We believe that the rare and unreported congenital abnormalities of lungs in relation to shapes, lobes and fissures presented in the present study has provided some important anomalous morphological details of lungs which is essential for proper identification of normal lung anatomy, evaluation and treatment of respiratory diseases, identification of broncho-pulmonary segments during lobectomies and surgical resection, for identification and interpretation of their variable imaging appearance and related abnormalities to the radiologists and cardiothoracic surgeons.

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