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CASE REPORT

Incomplete Transverse Pulmonary Fissures: A Cadaveric Case Report with Clinical Application

Andrew Emmanuel Tito*, Joseph Atupele Mwabaleke, Atuganile Mwasunga, Flora Masumbuo Fabian

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Abstract

Incomplete pulmonary fissures (IPF) represent a common anatomical variation in the human lung. While often considered silent, incomplete pulmonary fissures can have notable clinical and surgical implications, necessitating a comprehensive understanding of their anatomical characteristics. IPF may have significant implications in both clinical practice and surgical interventions. We report a case of an incomplete transverse fissure of the right lung from an adult male cadaver, exploring the embryological basis, clinical significance, and surgical implications. The findings underscore the importance of understanding the lung embryology and resulting normal anatomy, and associated anatomical variations to ensure accurate diagnosis, appropriate management, and optimal surgical outcomes.

Key Words: *Incomplete transverse fissures; Embryology; Clinical implications; Surgical implications*

Introduction

Pulmonary fissures are formed from double folds of the visceral pleura that invaginate the parenchyma of the lungs thereby dividing them into lobes. Each human lung features an oblique fissure that divides the superior and inferior lobes while the right lung features an additional transverse fissure that divides the superior and middle lobes [1]. The oblique fissure, which is also referred to as the major fissure is similar in both lungs and has a little wavy texture extending from the posterosuperior level of the T4/T5 vertebrae to the anteroinferior hemidiaphragms with that of the left lung having a more vertical trajectory [2]. The oblique pulmonary fissure passes from a point corresponding to the third thoracic spine to the sixth costochondral junction. In other words, it also corresponds to the medial border of the scapula when the arm is abducted above the head [3]. The horizontal fissure extends horizontally from the hilum to the anterior and lateral surfaces of the right lung at the level of the fourth costal cartilage on the right side [4]. Pulmonary fissures are crucial anatomical landmarks that demarcate the lobes of the lungs, facilitating proper ventilation and gas exchange [5]. During breathing, the fissures allow the lung to expand uniformly, allowing for a greater intake of air [6]. Pulmonary fissures

Department of Anatomy and Histology, School of Medicine and Allied Health Sciences, Mwanza University, Tanzania

Corresponding author: Andrew Emmanuel Tito, Assistant Lecturer, Mwanza University, Department of Anatomy and Histology, School of Medicine and Allied Health Sciences, Tanzania, E-mail: titoandrewss@gmail.com

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are also a basis for pulmonary segmentation [7]. The pulmonary fissures are considered complete only when the lobes remain held together only at the hilum by the bronchi and pulmonary vessels [8]. However, these fissures may not always be fully formed, leading to absent or incomplete pulmonary fissures [9,10] While often considered silent, incomplete pulmonary fissures can have notable clinical and surgical implications, necessitating a comprehensive understanding of their embryological formation and anatomical characteristics. This case report identified an incomplete transverse fissure of right lung from a dissected adult male cadaver during routine dissection session.

Case Report

During routine dissection session of the thorax at Mwanza University, undergraduate medical students dissected a cadaver of a 50 years-old Black African male individual who had died from pneumonia. After the removal of the parietal pleura and exposure of the sternocostal surface of the lungs, an interesting finding was observed as the transverse fissure of the right lung was incomplete. In this particular case, the oblique fissure of the right lung, commences from the posterior border of the lung about 5.5 cm below the apex, crosses obliquely anteroinferiorly to terminate at about 7 cm from the median plane. Moreover, it presents a short horizontal fissure about 4.5 cm running horizontally from its commencement on the oblique fissure about 11 cm from the apex ending into the tissue parenchyma of the lung about 4 cm away from the medial border. Thus, the middle lobe remains incompletely separated from the superior lobe. With permission from the Mwanza University ethical committee, photographs were taken for documentation as depicted in Figure 1.

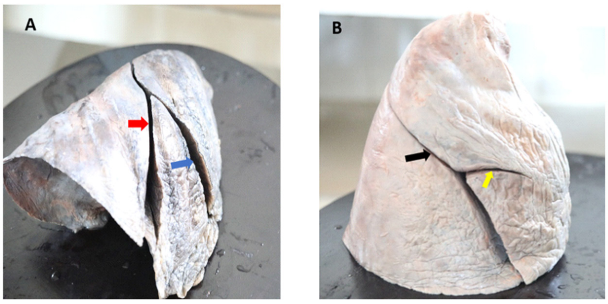

Figure 1) *Right lung photographs: A) A normal right lung obtained from a cadaveric specimen showing complete oblique fissure (red arrow) and transverse fissure (blue arrow). B) The right lung being presented in this case, with complete oblique fissure (black arrow) and an incomplete transverse fissure (yellow arrow) that does not extend towards the medial border of the lung.*

Discussion

Embryological basis

During the fourth week of gestation the lung buds arise as outgrowths from the ventral aspect of the foregut endoderm behind the pharynx [11]. After caudal extension, the parallel tube that forms the ventral wall cranial to the lung buds pinches off from the dorsal wall to create the trachea anteriorly and the esophagus posteriorly. The caudal end of the trachea bifurcates into left and right primary bronchial buds that grow into the pleural mesenchyme that is produced from splanchnopleuric mesoderm that lies close to which marks the beginning of branching morphogenesis. The primary bronchial buds split asymmetrically toward the end of the fifth week to form secondary bronchial buds, which create the future lobes of each lung (three on the right and two on the left). The division of the secondary bronchial buds into tertiary bronchial buds on each side eventually give rise to the bronchopulmonary segments of the mature lung which marks the end of the sixth week of development and the final round of branching in the embryonic stage. The lung tissue forms by obliteration of spaces separating the bronchopulmonary segments [12-15]. The pulmonary fissures are essentially formed from deep invaginations of the visceral pleura in the spaces between bronchopulmonary segments that divide the lungs into lobes [16]. However, fusion of adjacent lobes may occur at various points along the fissure line where visceral pleura does not cover the lobes completely, leading to either absence or incompleteness of the fissures [17,18]. Incomplete fissures could therefore result from partial fusion of lobes of adjacent lung parenchyma in areas where fissures are to be formed [19]. Another possible explanation is Tbx4 and Tbx5 genes, which their reduction or mutation have been shown to cause lung bud branching arrest in culture, and this has been explained by loss of expression of Fgf10 [20].

In this case the incomplete transverse fissure observed could be result of partial fusion of the medial lung parenchyma of the superior and middle lobes or disturbances in branching that could have been induced by downregulation of the molecules associated with lung branching morphogenesis. This finding aligns with several studies which reported the prevalence of incomplete transverse fissure of the right lung to vary from one population to another [21]. The difference in the prevalence may be due to difference in populations demography and sample size used in the study [22]. The degree of incompleteness of the right transverse fissure varies as well and in a recent study, the right transverse fissure was found to be 45.5% incomplete in which the fissure extends 6.5 cm from the right oblique fissure [23]. In contrary, the degree of incompleteness observed in this case is about 62.2%, i.e., the right transverse fissure is only 4.5 cm from the right oblique fissure. Moreover, the position of an incomplete transverse fissure also varies. In the current report the short transverse fissure runs horizontally and anteriorly from its commencement on the oblique fissure toward the costal surface of the lung ending into the tissue parenchyma of the lung and does not reach the medial border of the lung. Contrary to this trajectory is that the incomplete transverse fissure may run from the medial border posterior laterally and terminate into the tissue parenchyma of the lung the fissure without reaching the costal surface of the lung [24]. The precise embryological mechanisms underlying these variations remain the subject of ongoing research but likely involve disruptions in the signaling pathways responsible for fissure formation and fusion of lobes [25,26].

Clinical implications

Like many other anatomical variations, incomplete pulmonary fissures are often salient and only detected incidentally during radiological imaging or anatomical dissection [27-31]. However, they can pose diagnostic challenges and may be associated with certain clinical conditions [30]. Incomplete pulmonary fissures can mimic pathologic conditions like cancer, atelectasis and tissue fibrosis which may contribute to the misinterpretation of radiological findings, leading to errors in diagnosing pulmonary diseases [31,32]. Additionally, incomplete fissures may alter the spread of infection within the lungs [33,34]. Example pneumonia affecting a particular lobe can easily spread to an adjacent lobe through a point of fusion i.e., where the fissure is lacking or incomplete [35]. In this case it is easy for the infections to spread between the fused superior and middle lobes which may be linked to the death of this individual from pneumonia as it has been reported to be one of the leading source of death from respiratory causes [36]. Furthermore, in endobronchial lesions, incomplete fissure may alter the pattern of lung collapse in the sense that if the fissure between the obstructed and non-obstructed lobes is incomplete, the distal collapse may not occur and in this case it's unlikely for the middle lobe to collapse even when the superior lobe is obstructed [37].

Surgical implications

Incomplete pulmonary fissures may have implications for surgical interventions involving the lungs and must be carefully considered during surgical planning and intraoperative management [38]. In cases where surgical resection of lung tissue with fused lobes i.e., incomplete fissures like lobectomy is indicated, the surgeon should dissect the lung parenchyma over the pulmonary artery to ensure complete removal of pathological tissue while minimizing damage to healthy lung parenchyma [39]. In some instances, the presence of incomplete fissures may necessitate modification of standard surgical techniques or the use of adjunctive measures, such as intraoperative imaging or intraoperative bronchoscopy, to aid in accurate localization of the lesion and preservation of anatomical structures for ensuring optimal outcomes [40].

Conclusion and Recommendation

Incomplete pulmonary fissures represent a common anatomical variation with significant clinical and surgical implications. Understanding the embryological basis of these variations is essential for appreciating their clinical relevance and guiding appropriate management strategies. Through meticulous preoperative planning and intraoperative vigilance, surgeons can navigate around incomplete fissures effectively, minimizing the risk of complications and optimizing surgical outcomes. Further research is warranted to elucidate the prevalence of this particular pulmonary variant cise embryological mechanisms underlying incomplete fissures and to develop standardized approaches for their management in clinical practice.

Authors Contribution

Joseph A. Mwabaleke and Atuganile Mwasunga participated in conceptualization and investigation, Flora M. Fabian participated in writing and organization of the manuscript.

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