PATTERN OF NORMAL AND ACCESSORY FISSURES OF THE LUNG; EVALUATION WITH HIGH RESOLUTION CT IN PATIENTS ATTENDING TIKUR ANBESA SPECIALIZED HOSPITAL

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NOVEMBER, 2020

Addis Ababa, Ethiopia

Addis Ababa University

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This is to certify that the thesis prepared by Mebratu Abera, entitled “Pattern of normal and Accessory Fissures of the Lung; Evaluation with High Resolution Computed Tomography in Patients Attending Tikur Anbesa Specialized Hospital, Addis Ababa, Ethiopia” is submitted in partial fulfillment of the requirements for the specialty certificate program in radiology complies with the regulations of the University and meets the accepted standards with respect to the originality and quality.

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ACKNOWLEDGEMENT

I would like to acknowledge my advisors Dr. Amir Alwan and Dr. Azmera Gissila for their valuable and constructive comments and advice on every step of this research.

I would also like to express my gratitude to my colleagues who have helped me in collecting data and encouraging me throughout the steps in the process of finalizing the research.

ACRONYMS

CT- computed tomography

HRCT- high resolution computed tomography

IIF- incomplete interlobar fissure

MAF- major accessory fissure

MF- major fissure

MRI- magnetic resonance imaging

MPR- Multiplanar reconstruction

MDCT- multidetector computed tomography

OF- oblique fissure

PACS- picture archiving and communication system

SPSS- Statistical package for social sciences

VATS- video assisted thoracoscopic surgery

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DEFINITION OF TERMS

Computed tomography- a form of tomography in which a computer controls the motion of the X-ray source and detectors, processes the data, and produces the image.

Magnetic resonance imaging- a technique for producing images of bodily organs by measuring the response of the atomic nuclei of body tissues to high-frequency radio waves when placed in a strong magnetic field.

Emphysema- a condition in which the air sacs of the lungs are damaged and enlarged, causing breathlessness.

Pulmonary fissure- a boundary between the lobes in the lungs.

Lung lobe- a subdivision of a lung.

Lobectomy- surgical removal of a lobe of an organ such as a lung.

Sleeve lobectomy- A procedure in which the involved lobe with part of the main stem bronchus is removed. The remaining lobe(s) is reimplanted on the main stem-bronchus. This procedure is indicated for central tumors of the lung as an alternative to pneumonectomy.

ABSTRACT

Objective: To determine morphological variations of major and minor fissures, to assess frequency of accessory fissures as well as incomplete major and minor fissures in patients attending at Tikur Anbesa Specialized Hospital, Addis Ababa.

Methods: This is an institutional based cross sectional prospective observational study where a total of 1020 patients whose Chest CT images have no lung pathology included in the study group for evaluation. Then an assessment of the chest CT images on multiplanar reconstructions done to determine frequency of accessory fissures and incomplete major and minor fissures in both lungs.

Results: Out of 1020 patients who have no any lung abnormality on CT images selected within the study period 2% of them have absent right minor fissure making bilobed right lung. The most common accessory fissure in the right lung was inferior accessory fissure comprising 10% of the study group. Azygos fissure happened to occur in 12 patients (1.2%) of the sample under study. On the left lung the most common accessory fissure was the left minor fissure which accounted for 3.5% of the included study group making trilobed left lung. The major fissures on both sides have significant amount of incompleteness making 45% and 32% on the right and left sides respectively. Classic three right and two left lung lobes with complete major and minor fissures and no accessory fissure is found in only 418 subjects (41%).

Conclusion: Variations of lung fissures assessed based on chest CT with multiplanar reconstructions showed no significant deviation from other studies done on large sample size. The degree of incompleteness of the fissures and percentage of accessory fissures are more common on the right lung than the left lung. The uppermost extent of the left major fissure was always higher than the right lung major fissure invariably.

CHAPTER ONE
INTRODUCTION

1.1 BACKGROUND INFORMATION

Pulmonary diseases are among the most prevalent serious health problems in both developed and developing nations. Due to prevalent habit of smoking and widespread infections like tuberculosis the disease burden is higher in developing nations. Earlier age of smoking initiation in Africa (developing nations) contribute for high prevalence of lung cancer. Age of smoking initiation was as early as less than or equal to 7(seven) years in a study done among adolescents in Africa(1). Tuberculosis is a significant cause of morbidity and mortality among children and adults in African countries. The vague symptoms, the uncertain diagnostic tests and lack of adequate awareness among families all contributed in masking the progression of the disease and later presentation of advanced tuberculosis cases (2). As seen from the above figures advanced pulmonary tuberculosis cases and lung cancers account for high proportion of patients with higher morbidity and mortality. In addition to these prevalent pulmonary health problems lung abscess of any causative organism, emphysema and COPD are challenges for cardiothoracic surgeons in case lobectomies and segmental resections are recommended as management options. The procedures done will be dependent on the detailed comment made by radiologists on the morphology of fissures and lobes. Detailed knowledge of the normal and accessory fissures of the lung on imaging modalities like high resolution CT is of paramount importance for the attending radiologist in charge.

1.2 STATEMENT OF PROBLEM

Multi-detector Computed Tomography (CT) has become an effective and invaluable tool for the diagnosis of chronic respiratory diseases. Using modern CTs, within one breath hold the lung can be imaged resulting in several hundreds of high-resolution and near-isotropic sections with thicknesses of approximate 0.5 mm. Based on these images, advanced techniques of image processing can quantitatively assess the volumes of the lung, the characteristics of lung cancer, the structures of airway tree, and blood vessel, and the size of emphysema-like region, and help study human lungs from both structural and functional viewpoints. With the arrival of more precise diagnosis and treatment, it is essential to segment the lung into its constituent regions, or lobes, which are separated by fissures. In non-pathological cases, pulmonary fissures are double layers of in-folded invaginations of visceral pleura, and exit between the different lobes. In the left lung, the oblique fissure separates the lower lobe from the upper lobe, whereas in the right lung, the oblique and horizontal fissures separate the lower lobe from the upper and middle lobes respectively. Once the lobe is extracted accurately, one can regionally characterize and quantify, amongst others, the lung density, texture, airway structure, blood vessel structure, ventilation and perfusion. For the diagnosis of pulmonary emphysema for example, the volume, emphysema volume (EV), emphysema index (EI) and mean density can be specified for each lobe, which facilitates preoperative planning and postoperative evaluation of lung-volume reduction surgery. Segmentation of lung lobes from the chest CT images is a grand challenge for several reasons. First of all, the normal fissures are about 1–3 mm thick, and have a density near that of the soft tissue, which makes it hard to see the full stretch of the fissure. Secondly, the appearances of the fissures exhibit a large range of natural variations, and may be incomplete or even absent and distorted by various diseases. Furthermore, different CT protocols may lead to different appearances of the fissure. For conventional CT, the fissures are visualized as lucent bands devoid of vascularity, whereas they appear as sharp lines for high-resolution CT.

In our country unlike most developed nations, HRCT is not widely available and there is also scarcity of literatures done on this title. Therefore, in this study, I have showed the anatomical variations of the lung fissures including the accessories on HRCT.

1.3 LITERATURE REVIEW

A study done on 50 patients with standard computed tomography (10-mm-thick sections) and (2-mm-thin sections) the major fissures were seen in 90%-100% of cases as hypoattenuating bands and less often as lines or hyperattenuating bands. An incomplete major fissure was noted in the right lung in 32 cases (64%) and in the left lung in 26 cases (52%). The upper and middle portions of the left major fissure were less frequently incomplete than were the comparable portions of the right major fissure. Thin-section CT provided better delineation of the major interlobar fissures than did standard CT (3).

Thin-section computed tomographic scans of both lungs in 154 patients, including seven cadavers, with lung diseases have incomplete interlobar fissure (IIF) in 128 of 154 right lungs (83.1%) and 77 of 154 left lungs (50.0%). Some broncho-vascular structures crossed or passed through two contiguous lobes in the fused area. The most common broncho-vascular structure associated with an IIF was a pulmonary vein; this association was found in 87 right lungs (56.5%) and 20 left lungs (13.0%). An IIF was traversed by a pulmonary artery in only seven right lungs and 13 left lungs or by a bronchus in only three lungs. It is concluded that recognition of an IIF might improve understanding of the spread of pulmonary disease (4).

After exclusion of patients with pulmonary parenchymal distortion, pleural disease or those who had had lobectomy, 186 patients were included in the study with HRCT scans in which 59 out of 186 patients (32%), a total of 69 accessory fissures were detected. The most common fissure was the inferior accessory fissure (n=40; 21%, 38 on the right, 2 on the left) followed by the left minor fissure (n=17; 9%). Other accessory fissures observed were the right superior accessory fissure (n=2; 1%), the azygos fissure (n=1; 0.5%) and intersegmental fissures between the medial and lateral segments of the right middle lobe (n=3; 2%), the superior and inferior segments of the lingula (n=2; 1%), the antero-basal and latero-basal segments of both the right (n=1; 0.5%) and the left (n=3; 2%) lower lobe. In conclusion, the inferior accessory fissure and the left minor fissure were the most common accessory fissures seen on HRCT examinations (5).

In a prospective study done on 115 patients with HRCT scan to classify the accessory fissures and to determine their frequency, forty-four accessory fissures were detected in 35 of 115 patients. The most common accessory fissure was the inferior accessory fissure (12%). The second most common accessory fissure was the left minor fissure (8%). The right superior accessory fissure (5%), the accessory fissure between the medial and lateral segments of the right middle lobe (5%), and the accessory fissure between the superior and inferior segments of the lingula (5%) were seen in equal frequencies. Also, intersegmental accessory fissures, namely the fissure between the antero-basal and latero-basal of both the right (1%) and the left (2%) lower lobes were detected. We found only one subsegmental accessory fissure. The inferior accessory fissure and the left minor fissure were the most common accessory fissures found in this study (6).

HRCT of the lungs performed in 622 patients with a slice thickness of 1mm and slice interval of 10mm, both major fissures were mostly facing laterally in their upper parts (100% and 89% right and left, respectively). The left major fissure faced medially (69%) while the right major fissure faced lateral (60%) in their lower parts. The right major fissure was more often incomplete (48% as compared with 43% on the left, $P < 0.05$). Minor fissures were convex superiorly with the apex in the anterolateral part of the base of the upper lobe, and were incomplete in 63% of cases. Azygos, inferior accessory, superior accessory, and left minor fissures were also seen in 1.2%, 8.6%, 4.6%, and 6.1% of the cases, respectively. The pulmonary fissures are highly variable and the right major fissure differs considerably from the left. The fissures are often incomplete (7).

Morphological variations of fissures and lobes of the lungs studied in 30 pairs of lungs from cadavers showed absence of horizontal fissure in five right-sided lungs and incomplete horizontal fissure in 19 cadavers. 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 (8).

The study done on the presence of accessory fissure and anomalies in the major fissure and lobation in both the right and left lungs indicated that out of 102 lung specimens observed in the dissection room 37.26% appeared to have fissure or lobation anomalies and 63% of the anomalies were described in the right lung. Anomalies of the fissure accounted for 28.44% while the lobation anomalies were observed in 8.82% of the specimens. The abnormal fissure that were observed included the left minor fissure 10.78%, incomplete horizontal fissure 7.84%, diaphragmatic fissure 7.84%, right minor fissure 0.98% and azygos fissure 0.98%. Further observation revealed that 5.88% of the right lungs appeared to have two lobes and 2.94% of the left lungs had three lobes. The study indicates that the right lung is commonly affected with fissure and lobation anomalies and that the left minor fissure is the commonly occurring fissure anomaly (9).

A retrospective study done in Ankara, turkey HRCT scans of 144 patients with normal parenchyma were reviewed, which showed that the radiological anatomy of the right OF differs from the left OF. The uppermost extent of the left OF is almost always higher than the right. Thus, higher position of the right OF compared with the left almost always indicates a pathological process. Assessment of the angles of the OFs or comparison of the two sides cannot be used for the diagnosis of parenchymal disease like atelectasis. Occasionally, the classical propeller-like configuration is disrupted by the reverse course of the caudal part of the OF (10).

In another study done in japan to examine incomplete lobes and their variation using MPR techniques, 1000 patients underwent thoracic examinations using 16-row multidetector CT with a slice thickness of 1 mm. Interlobar fissures were observed by scrolling MPR techniques for various directions. Incomplete interlobar fissure was observed in 42.2% of subjects. Incomplete interlobar fissures between the right upper and middle lobes were observed in 20.4% of subjects, right major fissure was recorded in 17.4%, and left major fissure in 19.2%. Excessive fissure formation was observed in 8% of subjects (4 lobes on the right in 5.7%, 3 lobes on the left in 2.3%). Approximately half of the subjects with incomplete interlobar fissures had coexisting abnormalities in other lobes, whereas approximately one third of those with excessive fissures had coexisting abnormalities in other lobes (11).

150 consecutive MDCT examinations were retrospectively assessed and all subjects had a right and a left major fissure. 96.7% of subjects also had a right minor fissure. 40% had an accessory fissure, the most common, the left minor in 16% of subjects. An azygos fissure was present in 1 subject (0.7%). The most common accessory fissures are the left minor fissure, the inferior and the superior accessory fissure (12).

The study done in Mangalore, India, included 60 adult cadaveric lungs which were obtained from the human anatomy laboratory. Only 32 (53.3%) lungs showed the fissures and lobes as described in the standard anatomy texts. Among the right lungs, 15 (46.9%) had incomplete horizontal fissure, 6 lungs (18.7%) had absence of the horizontal fissure and one lung (3.1%) had the azygous lobe. The remaining 10 right lungs (31.3%) showed the usual morphology. In the left lungs, normal morphology was observed in 22 cases (78.6%), 2 lungs had incomplete oblique fissure (7.1%), one lung had (3.6%) absence of the oblique fissure, one lung showed an accessory fissure and lobe (3.6%). The anomalous multiple fissures and lobar pattern was observed in 2 cases (7.1%) (13).

Morphological variations of accessory fissures and lobes of the lungs were studied in 40 pairs of lungs from cadavers. Four left-sided lungs and two right-sided lungs showed accessory fissure in the lower lobe. Only one accessory fissure of left lung belongs to grade-ii and the remaining belongs to grade iii. [According to Craig and Walker's fissure classification] (14).

In a study done to describe the surface anatomy of the interlobar fissures using volumetric thin-section high-resolution computed tomography (HRCT), retrospective assessment of HRCT examinations of 250 patients was performed. The most frequent localization of the oblique fissure on the left side was posteriorly at the fourth rib (45%), laterally at the sixth rib (52%), and inferiorly in the anterior third of the hemidiaphragm (60%). The right oblique fissure was located posteriorly at the fifth rib (50%), laterally at the sixth rib (50%), and inferiorly in the anterior third of the hemidiaphragm (71%). The horizontal fissure most commonly originated in the middle third of the oblique fissure (61%) and met the anterior thoracic wall at the level of the fourth rib (51%). The most frequent shape of the left oblique fissure was linear (78%), whereas S-shaped and linear configurations (28% each) were most frequent on the right. No difference was found in the surface markings of the fissures between inspiration and expiration in 90% of cases (15).

Retrospective assessment of HRCT examinations of 250 patients was performed. On the left side, an incomplete oblique fissure was found in 24%. The discontinuity was present in the para-hilar region and the area of the incompleteness was most frequently between 21% and 40%. The right oblique fissure was incomplete in 35%, mostly para-hilar, with the most frequent discontinuity below 20%. An incomplete horizontal fissure was found in 74%. Accessory fissures were identified in 16% of patients, with the same frequency on both sides. The most frequent finding was accessory horizontal fissure with 8.0% on the left side, superior accessory fissure (7.2%) and inferior accessory fissure (5.2%) on the right side. No correlation was found among the localization of interlobar fissures, the presence of incompleteness, and accessory fissures. Incomplete and accessory fissures are frequent anatomic variations of interlobar fissures (16).

A study done to assess the variations in presence and completeness of fissures and lobes of the lungs in human cadavers in selected universities of Ethiopia, 17.39% right lungs showed absence of horizontal fissure while no specimen showed absence of oblique fissure on both sides. 35% of left lungs had

incomplete oblique fissure compared to 47.82% of the right lungs. In addition, 2 right sided and 3 left sided lungs showed presence of accessory fissure and accessory lobe (17).

Study done in Croatia, was aimed at determining major accessory fissures (MAF) and absence or incompleteness of lobar or major fissures (MF) during routine forensic autopsies. Prior to starting this prospective study, forms were prepared to collect data on pulmonary lobes and fissures. In this study, 420 lungs of 210 autopsy cases were examined for incompleteness and absence of MF and complete accessory fissures. Horizontal fissures were incomplete in 18 right lungs. Incomplete oblique fissures were noted in three right and two left lungs. Unidentified abnormal fissures were determined in one left lung and five right lungs. The most common fissure abnormality was less than half complete horizontal fissure. Four right lungs had four lobes and two left lungs had three lobes because of complete accessory fissures. The number of lobes in the left and right lungs and the morphological features of both incomplete MF and MAF were determined in detail and the variations were photographed. It is concluded that, in addition to studies on computed tomography scans, autopsy series are useful for determining the variations of MF and MAF of the lungs in different populations (18).

In a study conducted on Nepalese cadavers, fifty lungs (23 right side and 27 left side), obtained during routine dissection and preserved in formalin constituted the material for the study. In them, variations in fissures and lobes of lung were observed and compared with the previous studies. Seven right sided and 14 left sided lungs showed incomplete oblique fissure. Incomplete horizontal fissure of right lung was observed in eight lungs while it was completely missing in three specimens. A right lung with "lobe of the azygos vein" separated by a supernumerary fissure in medial surface was found. One of the right lungs had both superior accessory fissure and inferior accessory fissure and four other right lungs and one left lung presented only with inferior accessory fissure. A vertical notch was found in middle lobe of one right lung. Eight left lungs exhibited with left minor fissure among them two lungs had lingula appearing as a separate lobe. Knowledge of variations in fissures and lobes is of interest to all medical professionals to exactly interpret radiographs, computed tomography scans, to diagnose, plan and modify a surgical procedure depending on the merit of the case and also in certain classical clinical cases pertaining to lung pathologies (19).

1.4. JUSTIFICATION AND SIGNIFICANCE

Its known that COPD including bullous emphysema associated with smoking are common in sub-Saharan African countries including Ethiopia. Old post infectious conditions like aspergilloma are also common secondary to high prevalence of Tuberculosis infections in the region. Some of these chronic but serious health problems needs surgical intervention for better outcomes. Especially thoracoscopic surgery needs multidisciplinary team in which role of the chest radiologists is paramount. This is when knowledge of variations of the lung fissures is a necessity for better outcome.

Pre-operative CT scans were used to generate three-dimensional surface models for surgical planning and for multidisciplinary discussion and planning. Perioperative identification of the completeness of fissures and the presence of segmental localization is imperative before performing lobectomy. This is because individuals with an incomplete fissure are more prone to develop post-operative air leakage and thus possibly require further procedures such as sleeve lobectomy. Therefore, knowledge of the accessory and incomplete fissures on chest CT would be of paramount help in pre-operative planning.

This study is intended to identify accessory fissures and incomplete fissures including the variations with their frequencies using HRCT chest images from patients with no lung pathologies involving the fissure. Researchers will use this study for future development of research on pulmonary fissure imaging.

CHAPTER TWO

GENERAL OBJECTIVE:

- To assess the variations of pulmonary fissures on high resolution chest CT exams of patients seen at Tikur Anbessa specialized hospital.

SPECIFIC OBJECTIVES:

- To determine morphological variations of major and minor fissures in chest CT exams of patients seen at TASH.
- To assess the frequency of accessory fissures in chest CT exams of patients seen at TASH.
- To assess the frequency of incomplete major and minor fissures in chest CT exams of patients seen at TASH.

CHAPTER THREE

METHODS AND PARTICIPANTS

3.1Study area and period

The study was conducted in Tikur Anbessa specialized hospital, Addis Ababa Ethiopia.

Data was collected for a period of twelve months (from July 2019 to June 2020).

3.2Study design

Cross sectional study design was used.

3.3Population

3.3.1 Source population

All HRCT images taken in the TASH within the study period.

3.3.2Study population

All HRCT chest CT images taken in the TASH in the study period fulfilling the inclusion criteria.

3.4Sample size and sampling technique

All HRCT chest CT images of adult patients taken during the study period will be included.

3.5 Inclusion and exclusion criteria

Inclusion criteria:

All HRCT chest CT images with no pulmonary pathologies crossing the fissures.

Exclusion criteria:

All HRCT chest CT images with pathologies involving the fissures.

3.6 Data collection and measurements

4.6.1 Study Variables

Age

Sex

3.6.2 Data collection instrument

Data was collected by filling the information on pre-tested questionnaires. The questionnaire includes closed ended questions.

3.6.3**Data collection procedures**

Data was collected by filling up the information on the PACS on to the prepared questionnaire. All the HRCT images(0.625mm thin slices) on lung windows were evaluated with multiplanar reconstructions for assessment of incomplete fissures and as well as for accessory fissures available.

3.6.4 Quality control

In order to assure the clarity of the questionnaire and validity of the information on the PACS; the questionnaire pretest in 5% of the study population was done before the beginning of data collection and modified accordingly.

3.6.5 Data processing and analysis

The collected data was checked for completeness, coded, entered in to SPSS version 25 statistical software packages, cleaned and analyzed by principal investigator. Frequencies of each listed variables on the questionnaire are calculated.

3.7 Ethical considerations

Ethical approval was obtained from the Ethical Review Committee of the College of Health Science, Addis Ababa University.

4. RESULTS

4.1. Sociodemographic characteristics.

In this study a total of 1020 chest CT images of patients were included, among which females comprise about 52.9% and male counterpart comprise the remaining 47.1%. With regard to age group majority of our patients belong to age group between 40 and 60 years of age (37.1%).

Table 1. Age distribution among patients selected for chest CT evaluation of pulmonary fissures.

Age range	Frequency	Percent
<20 years	66	6.5
20 to 40 years	342	33.5
40 to 60 years	378	37.1
>60 years	234	22.9
Total	1020	100

4.2 Right lung pulmonary fissures anatomy

A right and a left major fissure were present in all 1020 subjects (100%). With regard to right lung both the major and minor fissure were present in 999 subjects (98%). Thus only 2% of subjects under study had only two lobes while the rest 98% had three lobes. I found incomplete major oblique fissure in 459 subjects (45%). Horizontal fissure was incomplete in 392 patients (38.5%). Azygos fissure was present in 12 patients (1.2%). The most common accessory fissure in the right lung was inferior accessory fissure which was seen in 102 patients (10%), followed by superior accessory fissure which was demonstrated in 41 patients (4%).

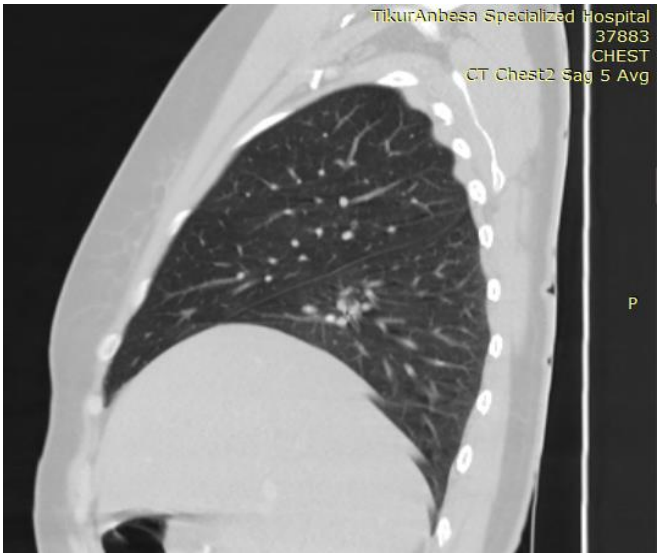

Fig. 1. Representative sagittal chest CT image of the right lung showing absent minor fissure thus bilobed right lung.

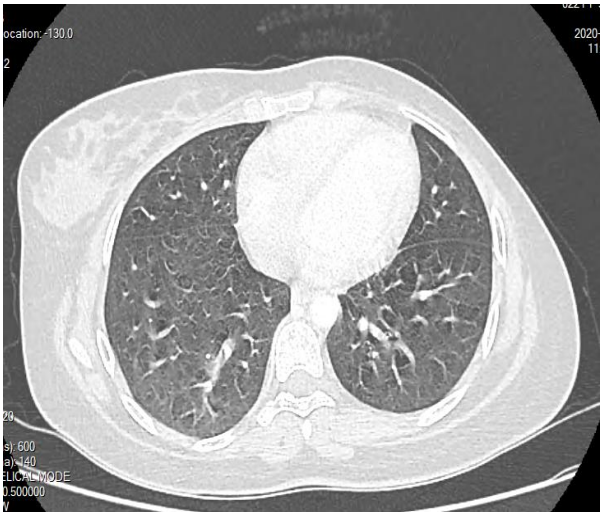

Fig. 2. Right inferior accessory fissure. The HRCT scan through lower lobes show right inferior accessory fissure that begins from the major fissure and extends posteriorly. Its posterior portion is incomplete.

Fig. 3. Right superior accessory fissure. Representative sagittal image of the right lung showed incomplete superior accessory fissure separating the superior segment from basal segments.

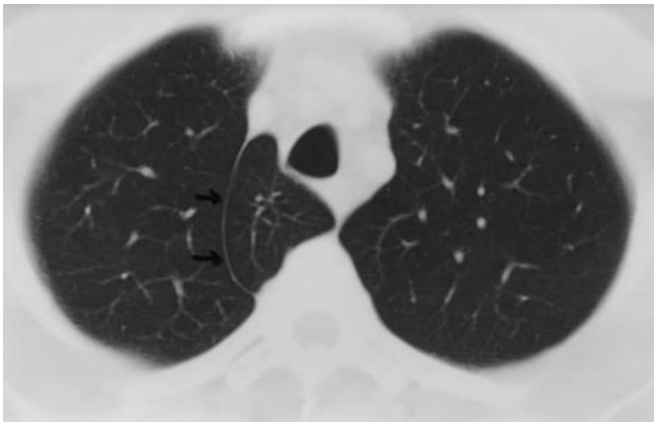

Fig. 4. Azygos fissure (arrow). The fissure is seen as a convex-laterally thick line curving in the upper part of the right lung.

4.3 Left lung pulmonary fissures anatomy

With regard to left side, three lobes seen in 36 subjects (3.5%). The rest 984 subjects (96.5%) have two lobes with no horizontal fissure seen. Left lung oblique fissures were incomplete in 357 subjects (32%). Left inferior accessory fissure was found in 29 subjects (2.8%). There was no left superior accessory fissure seen in the total study group.

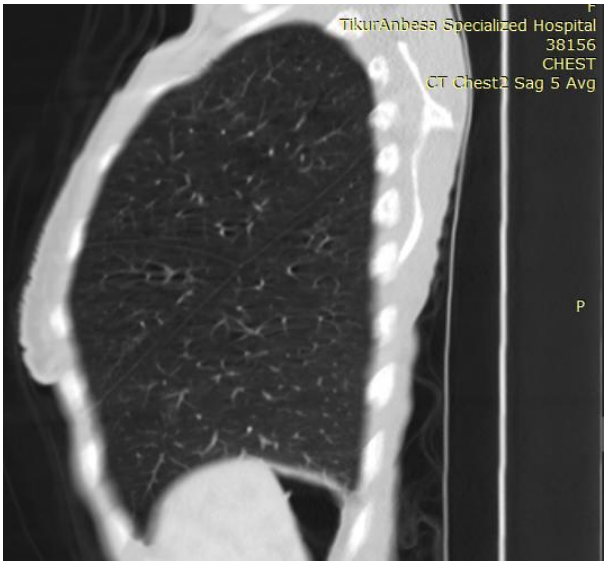

Fig. 5. Representative sagittal chest CT image of the left lung demonstrating presence of left minor fissure thus trilobed left lung.

NB. Classic three right and two left lung lobes with complete major and minor fissures and no accessory fissures found in 418 cases (41%).

5. Discussion

Thin section CT enables a more detailed delineation of the interlobar fissure anatomy, and greater accuracy in localizing pulmonary lesions, than does standard CT. Precise localization of disease in and around the fissure is especially important for video assisted resections where the surgeon does not have access to the whole lung and cannot palpate the lung easily. It is also important for wedge resections where the lobe is not removed. Delineation of fissure anatomy is helpful in differentiating fissure lesions from lung lesions. The extent of fissure completeness is also assessed more clearly on thin section scans. Awareness of incomplete minor fissure might be helpful in explaining why certain disease such as pneumonia or tumor, appear to cross fissure.

In our study, absent right horizontal fissure thus two right lung lobes seen in only 2% of subjects. A study done on 150 MDCT examinations 3.3% of the group had no horizontal fissure on the right lung (12). A study done on cadavers in India, has showed 18.7% has absent minor fissure on the right side (13). A study from Nepal done on cadavers showed 3 out of 23(13%) right lungs have no horizontal fissure (19). One study done in India, on 30 pairs of lungs from cadavers has shown 16.6% of the pairs had no minor fissure (8). A study done in Ethiopia human cadavers has also shown 17.39% had no minor fissure in right lung (17). Results from human cadavers has similar pattern and showed significant variation from our study uniformly. while the one done based on CT has similar pattern with our result.

In this study, incomplete right minor fissure was found in 38.5% of the study group. A study done in 622 patients with HRCT showed 63% of patients had incomplete right horizontal fissure (7). Another study done in Croatia, on autopsy cases has shown that incomplete minor fissure comprises 8.5% of the right lungs studied (18). In our study right oblique fissure is found to be incomplete in 45% of the cases. In a study done with 622 patients incomplete right oblique fissure appear to be seen in 48% of the cases (7). A study done on 50 patients has shown that 64% had incomplete right oblique fissure (3). HRCT study done on 250 patients has shown 35% of patients had incomplete right oblique fissure (16).

Inferior accessory fissure was the most commonly visualized accessory fissure in our study (10%). In a prospective study done on 115 patients with HRCT, right superior accessory fissure was found in 12% of the cases (6). In other study done on 186 patients with HRCT has shown that 20% had right inferior accessory fissure (5). A study done on 250 patients with HRCT has shown 5.2% had right inferior accessory fissure (16).

In our study superior accessory fissure was found in 4% of the subjects studied. A study done on 115 patients with HRCT has shown that superior accessory fissure has been seen in 5% of the cases (6). Another study done on 622 patients with HRCT has showed 4.6% had superior accessory fissure (7).

Azygos fissure was found in 1.2% of the cases in our study. A study done on 622 patients as mentioned above has shown the same result with our result which is 1.2% of the patients had azygos fissure (7). Another study done on 186 patients has shown 0.5% of the patients had azygos fissure (5).

Left minor fissures were seen in 3.5% of our cases making three lobes in left lung. A study done in 622 patients has shown left minor fissure in 6.5% of the patients evaluated (7). A study done in Tanzania, on cadavers has shown 2.9% of the left lungs had three lobes thus having left minor fissure (9).

In our study, left major fissure was found to be incomplete in 32% of the cases. A study done in japan to study incomplete fissures has shown that left incomplete major fissure found in 19.2% of the subjects (11). A study done on 622 patients with HRCT has shown incomplete left major fissure found in 43% of the cases (7).

Left inferior accessory fissure was seen in 2.8% of the subjects. A study done on 186 patients showed left inferior accessory fissure in 2(1.1%) of the patients (5).

Left superior accessory fissure was not found in our study.

6. CONCLUSION AND RECOMMENDATION

In our study there were a total of 1020 patients included whose chest HRCT images evaluated with multiplanar reconstructions. Even though studies performed with HRCT do not demonstrate the real frequency of the variants as well as incomplete fissures, results of our study and the other studies done with HRCT have indicated similar conclusions. Accordingly, the most common accessory fissures identified in our study are inferior accessory, superior accessory and left minor fissures in descending order. These results are also consistent with the anatomy literatures. Recognition of the accessory fissures as well as continuity of the major fissures provides additional information in segmental localization of pulmonary lesions, assessment of the extent of the pulmonary disease process and assists in differential diagnosis of accessory fissures from normal anatomical and pathological structures. Being aware of these variations before the pulmonary lobectomy and thoracoscopic segmentectomy may alter the preoperative strategy.

My recommendation would be to do further thorough investigation to know the real frequency of the incomplete fissures as well as accessory fissures available because literatures have shown far greater variation of frequencies when postmortem autopsy cases were studied. So, it will be more informative if large sample size of the autopsy cases or cadavers included in future studies. The essence of this is that accessory fissures can be missed on imaging studies and thus can make the surgical procedure more challenging.

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QUESTIONNAIRE

please indicates the answer appropriate to the specific item of the question based on the image being evaluated.

Section 1: Sociodemographic variables

1. Sex a. Male b. Female
2. Age _____

Section 2: Pulmonary fissure finding

1. How many lobes are there in right lung?
   a.3 b.2 c.4 d.1

2.Is there a minor fissure in right lung? a. yes b. no

3.Is minor fissure in right lung complete? a. yes b.no

4.Is major fissure in right lung complete? a. yes b.no

5.Is there an azygos fissure in right lung? a. yes b.no

6.What accessory fissures are there in the right lung?

a. superior accessory fissure b. inferior accessory fissure c. both d. none

7. How many lobes are there in left lung? a.3 b.2 c.4 d.1

8. Is there a minor fissure in the left lung? a. yes b.no

9.Is major fissure in left lung complete? a. yes b.no

10. What accessory fissures are there in the left lung?

a. superior accessory fissure b. inferior accessory fissure c. both d. none