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Incomplete and accessory fissures of the lung evaluated by high-resolution computed tomography

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ABSTRACT

Purpose: The aim of our study was to assess incomplete and accessory interlobar fissures using volumetric thin-section high-resolution computed tomography (HRCT).
Materials and methods: Retrospective assessment of HRCT examinations of 250 patients was performed. We assessed the localization, extension, and type of the incompleteness of fissures as well as the presence and localization of accessory fissures. We searched for possible correlation among the localization of interlobar fissures, the presence of incompleteness, and accessory fissures.
Results: On the left side, an incomplete oblique fissure was found in 24%. The discontinuity was present in the parahilar region and the area of the incompleteness was most frequently between 21% and 40%. The right oblique fissure was incomplete in 35%, mostly parahilarly, 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.
Conclusion: Incomplete and accessory fissures are frequent anatomic variations of interlobar fissures.

1. Introduction

Knowledge of the frequency and extent of incomplete interlobar fissures and the presence of accessory fissures is part of basic anatomy, but it might also improve understanding of the spread of pulmonary disease [1]. If we considered possible variations, we would be less likely surprised by an atypical progression of disease. This knowledge is also important for the thoracic surgeon and leads to optimal operative assessment and strategic planning [2]. The recognition of accessory fissures is helpful for segmental localization of pulmonary lesions, assessment of pulmonary disease processes, and assistance in differentiating accessory fissures from normal anatomical or pathological structures [3].

2. Materials and methods

2.1. Subjects

This study was approved by the institutional review board.

We retrospectively reviewed all HRCT examinations of the chest performed in adult patients (≥18 years old) from April 2009 to July 2010 scanned in our department. Examinations with the presence of pathological changes were excluded, leaving a group of 250 patients comprising 128 men and 122 women, ranging in age from 18 to 83 years (mean, 51 years). The men's age ranged from 18 to 79 years (mean, 52 years), the women's age from 18 to 83 years (mean, 50 years). Using the Mann–Whitney *U* test, no statistically significant difference in ages between genders was found.

2.2. Imaging

CT examinations were performed on either a 64-row CT scanner LightSpeed VCT or a 16-row scanner LightSpeed RT16 (both General Electric, Milwaukee, USA). No contrast material was used.

Basic acquisition was performed from lung apices to bases at inspiration in a single breath-hold. Parameters used in the 64-row scanner were as follows: spiral acquisition with 5-mm collimation and retrospective reconstruction to 0.625 mm thin slices using lung

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algorithm with a 0.625-mm interval between the centers of slices. Additional parameters: 120 kVp, adaptive 200–800 mA (average 350 mA), rotation time 0.4 s. The average time of the whole acquisition was 2.9 s. Parameters used in the 16-row scanner were as follows: spiral acquisition with 5-mm collimation and retrospective reconstruction to 1.25 mm thin slices using lung algorithm with a 0.6-mm interval between the centers of slices (overlapping slices). Additional parameters: 120 kVp, adaptive 200–800 mA (average 370 mA), rotation time 0.5 s. The average time of the whole acquisition was 7.3 s. From thin axial scans obtained in both scanners, continuous 1-mm coronal and sagittal reconstructions were created.

Afterwards, 6–8 incremental 1.25-mm scans at expiration with a 3-cm interval between them were obtained in both scanners, as a part of standard HRCT examination.

All obtained and reconstructed images were stored in the hospital's Picture Archiving and Communication System (PACS) (Impax 6.4, Agfa HealthCare, Mortsel, Belgium).

2.3. Assessment

Assessment was performed using a diagnostic PACS station by an educated and supervised medical student, with a possibility of consultation with experienced radiologists. The PACS station was used to obtain interactive multiplanar reconstructions.

Incomplete fissures. We assessed the presence, extension, localization, and type of incompleteness of oblique interlobar fissures and horizontal fissures. The extension of incompleteness was expressed as percentage of the whole fissure area and divided into five categories (1–20%, 21–40%, 41–60%, 61–80% and ≥81%). Two localizations of discontinuity of fissures were followed – parahilar and other. The following findings were used as diagnostic criteria for incomplete interlobar fissure: (I) the interlobar line was not observed, the zone was avascular; (II) vessels in the adjacent lobes crossed over the interlobar region; (III) pulmonary blood vessels, particularly the pulmonary vein, penetrated the interlobar region; (IV) the pulmonary vein was observed in the interlobar region and was related to the vessels in the adjacent lobes [4] (Fig. 1). When more types of incompleteness were present simultaneously, the type with a higher number was prioritized.

Accessory fissures and their localization in the lungs were followed and described according to previous papers [5–7].

Correlations. We searched for possible correlation between the presence of incomplete and accessory fissures, and atypical localization of interlobar fissure and the presence of incomplete or accessory fissures. Atypical localization of the interlobar fissure was defined as 5% of the least frequent combinations of localizations described earlier [8].

2.4. Statistical analysis

Descriptive statistics was used to describe the occurrence of incomplete and accessory fissures. Fisher's exact test was used to assess potential difference between genders, lung sides and to find out possible correlation between the presence of incomplete and accessory fissures. The same test was used to find possible correlation between the presence of incomplete and accessory fissures and atypical localizations of the interlobar fissures. In addition, McNemar's test of symmetry was used to compare the right and left lung and the Mann–Whitney *U* test to investigate possible correlation between the area of incompleteness and the presence of accessory fissures. Statistical software SPSS version 15 was applied for the processing. All statistical tests were performed at the level of significance of 0.05.

Table 1
The numbers of incomplete and accessory fissures in the left and right lung. No statistically significant difference between men and women was found.

Fissure	Women	Men	Total
Incomplete left oblique fissure	31 (25%)	30 (23.4%)	61 (24.4%)
Incomplete right oblique fissure	42 (34.4%)	44 (34.4%)	88 (35.2%)
Incomplete horizontal fissure	90 (73.8%)	96 (75%)	186 (74.4%)
Completely missing horizontal fissure	4 (3.3%)	4 (3.1%)	8 (3.2%)
Accessory fissure(s) in the left lung	18 (14.8%)	22 (17.2%)	40 (16%)
Accessory fissure(s) in the right lung	18 (14.8%)	22 (17.2%)	40 (16%)

Table 2
Extension of incompleteness.

Extension	Left oblique fissure	Right oblique fissure	Horizontal fissure
1–20%	21 (34.4%)	29 (33%)	8 (4.3%)
21–40%	26 (42.6%)	27 (30.7%)	18 (9.7%)
41–60%	10 (15.4%)	25 (28.4%)	55 (29.6%)
61–80%	3 (4.9%)	6 (6.8%)	37 (19.9%)
≥81%	1 (1.6%)	1 (1.1%)	68 (36.6%)

Table 3
The types of incomplete fissures according to the relation with adjacent blood vessels: (I) the interlobar line is not observed, the zone is avascular; (II) the vessels in adjacent lobes cross over the interlobar region; (III) pulmonary blood vessels, particularly the pulmonary vein, penetrate the interlobar region; (IV) the pulmonary vein is observed in the interlobar region and is related to the vessels in adjacent lobes.

Type	Left oblique fissure	Right oblique fissure	Horizontal fissure
I	20 (32.8%)	33 (37.5%)	17 (9.1%)
II	16 (26.2%)	10 (11.4%)	41 (22%)
III	12 (19.7%)	21 (23.9%)	72 (38.7%)
IV	13 (21.3%)	24 (27.3%)	56 (30.1%)

3. Results

3.1. Left side

We found an incomplete oblique fissure in 61 cases (24.4%) (Table 1). Incompleteness was always present parahilarly (Fig. 2). The most frequent area of incompleteness was between 21% and 40% – it comprised 42.6% of cases. The second most frequent was discontinuity of less than 20% of the fissure (Table 2). Table 3 shows the types of incomplete fissures according to the relation with surrounding blood vessels. The most frequent type was type I, present in 32.8%.

Accessory fissures in the left lung were detected in 40 cases (16%) (Table 1). Seventy percent of them were localized in the upper lobe (Table 4). One patient had two accessory fissures in the left lung, one in the upper lobe, and the other

Table 4
Localization of accessory fissures, patients with combinations of more than one accessory fissure. Sixty-seven patients (26.8%) had one or more accessory fissures.

Lobe	Frequency
LU	18 (7.2%)
LL	8 (3.2%)
LU + LL	1 (0.4%)
RL	26 (10.4%)
LU + RU	1 (0.4%)
LU + RL	9 (3.6%)
LL + RL	2 (0.8%)
LL + RL + RM	1 (0.4%)
LU + RL × 2	1 (0.4%)

Left upper (LU), left lower (LL), right upper (RU), right middle (RM), right lower (RL).