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Usual interstitial pneumonia and nonspecific interstitial pneumonia: Correlation between CT findings at the site of biopsy with pathological diagnoses

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ABSTRACT

Objectives: The aim of this study was to correlate high-resolution CT (HRCT) findings at the site of biopsy with the whole lung CT and pathologic diagnoses in usual interstitial pneumonia (UIP) and nonspecific interstitial pneumonia (NSIP).
Methods: The study included 35 patients (25 UIP and 10 NSIP) diagnosed both pathologically and clinically. 81 surgical biopsy specimens (54 UIP, and 27 NSIP) and extracted areas corresponding to biopsy sites on HRCT were analyzed. CT interpretations were compared with pathological diagnoses in both extracted images and the whole lung. Concordant and discordant cases in multiple extracted images were divided and analyzed. Then the whole cases were categorized by including or not at least one UIP diagnosis of extracted images and evaluated.
Results: The diagnoses in extracted sites significantly correlated with pathological diagnoses ($p = 0.047$). There were significant differences in the concordances of extracted images compared with the diagnosis of whole lung and pathology ($p = 0.008$, 0.003, respectively). All 7 cases that were not concordant were diagnosed as radiological UIP with whole lung CT. The cases with at least one UIP diagnosis of extracted CT images were diagnosed as UIP in pathology more frequently (18 in 25) ($p = 0.007$).
Conclusions: Radiological UIP in whole CT had more frequently discordant diagnoses from multiple extracted images than NSIP. And there were more cases in pathological UIP that included at least one UIP diagnosis of extracted images compared with pathological NSIP.

1. Introduction

According to the American Thoracic Society and European Respiratory Society 2002 working group consensus classification of idiopathic interstitial pneumonias, the presence of typical clinical and high-resolution CT (HRCT) features of usual interstitial pneumonia (UIP) are sufficiently characteristic to allow a confident diagnosis and eliminate the need for surgical lung biopsy [1]. However, it is often difficult to differentiate UIP from nonspecific interstitial pneumonia (NSIP) with CT alone [2–7]. When CT findings are atypical, surgical biopsy is indicated. An important role of HRCT on surgical biopsy is to designate appropriate regions for biopsy [8]. Biopsy specimens that were taken from areas with end-stage fibrosis frequently exhibit non-diagnostic findings (such as honeycombing).

Findings of surgical lung biopsy are important for the categorization of patients with idiopathic interstitial pneumonia (IIP). However, different diagnoses are sometimes made from surgical lung biopsies when the specimens are taken from multiple lobes or multiple sites in one lobe [9]. HRCT findings may also depend on discordant histologic features. Radiologists generally diagnose HRCT by using the features of whole lung evaluation. It has not yet been determined whether radiologists can diagnose HRCT with CT findings of only narrow areas corresponding to a surgical biopsy. In addition, previous reports said that patients with histologic pattern

Abbreviations: HRCT, high-resolution computed tomography; UIP, usual interstitial pneumonia; NSIP, nonspecific interstitial pneumonia; IIP, idiopathic interstitial pneumonia.

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of UIP in any lobe should be classified as having UIP [9]. Should radiologists classify having UIP in the cases with UIP pattern in extracted CT images? The correlation between the diagnosis in whole lung and local areas would give more information for CT diagnosis and be useful for quantitative study. The aim of this study was to correlate HRCT findings in focal biopsy sites with corresponding pathologic diagnoses in cases of UIP and NSIP, and to correlate radiological diagnosis in extracted images and whole lung images.

2. Materials and methods

2.1. Patients and diagnoses

This study was approved by the ethical review boards of the institution and the review boards did not require the patients' approval or informed consent for the retrospective review of their records and images. Cases who underwent surgical biopsies at each institution and who met the clinical and histologic criteria for diagnosis recommended by the American Thoracic Society/European Respiratory Society International Multidisciplinary Consensus Classification of the Idiopathic Interstitial Pneumonias were identified [1]. Clinical diagnoses were reviewed by two physicians with 25 and 20 years of experience, and the cases with interstitial pneumonia other than IIP (such as collagen disease, drug-induced pneumonia and hypersensitivity pneumonitis) were excluded. A total of 38 cases that were diagnosed as idiopathic UIP or NSIP were selected. Pathological specimens from a single case from one to three sites were resected, for a total of 98 specimens. Two pathologists independently diagnosed each specimen as UIP, NSIP or other/unclassified, in accordance with the ATS/ERS criteria. Disagreement between the two pathologists was resolved by consensus.

2.2. Thin-section CT images and review

Thin-section CT scans of all patients were obtained at end inspiration and in the supine position on a variety of scanners. The protocols consisted of 1 to 3-mm collimation sections reconstructed with a high spatial-frequency algorithm at 1 or 2-cm intervals. Images were photographed at window settings appropriate for viewing the lung parenchyma (window level from −600 to −700 HU; window width from 1200 to 1500 HU).

To compare the histological specimens, the areas of lung on the CT images corresponding to the biopsy sites were extracted (Figs. 1 and 2). Areas of lungs were selected with both medical records and follow-up CT images by a chest radiologist with 9 years of experience. CT images were obtained with a commercially available image scanner (GT-9500, EPSON, Tokyo, Japan). Images were recorded at 300 dpi in Tagged Image File Format (TIFF) format. In order to limit the image information other than biopsy site, a 2-cm square area of lung surrounding the biopsy site was extracted using commercially available software (Photoshop Elements 2.0, Adobe, San Jose, CA). Two chest radiologists with 22 and 18 years of experience in HRCT interpretation read the extracted images independently without knowledge of clinical information or whole lung images. However, the observers had known that cases were diagnosed as UIP or NSIP in pathology. The observers evaluated the presence of CT findings, the main CT pattern, the impression of extracted images, and the margin of the abnormal area. CT findings including air-space consolidation, ground-glass attenuation, intralobular reticular opacity, microcyst and traction bronchiectasis were reviewed. Air-space consolidation was defined as a homogeneous increase in pulmonary parenchymal attenuation that obscured underlying vessels. Ground-glass attenuation was defined as hazy increased attenuation of lung which did not obscure the underlying vessels. Intralobular reticular opacity was considered present when interlacing line shadows separated by a few millimeters were seen. Microcysts were defined as round air spaces several millimeters in diameter with well-defined walls. Traction bronchiectasis was defined as irregular bronchial dilatation within or around areas with parenchymal abnormality. The degree of fibrosis in the extracted images was classified with as follows: 1, normal lung; 2, ground-glass attenuation and/or fine reticular opacity; 3, coarse reticular opacity and/or microcyst; 4, air-space consolidation; and 5, honeycombing. The impression of extracted images was classified as homogeneous or heterogeneous based on the variety of the CT findings. The margin of the abnormal area was evaluated as a clear or unclear borderline between normal and abnormal areas in the extracted sites. Moreover, the observers decided which extracted sites were more appropriate for

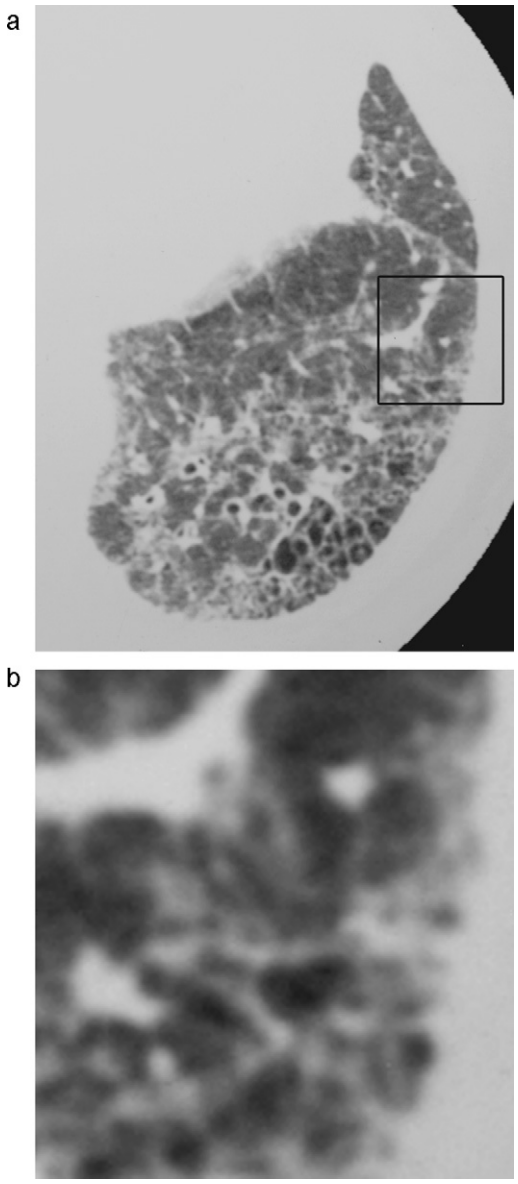

Fig. 1. (a) Transverse thin-section CT image of left lower lung in a 56-year-old man with radiological and pathological UIP shows peripheral ground-glass opacity, reticular opacity and honeycombing. (b) Extracted image from left segment 8 in the biopsy site shows ground-glass opacity, reticular opacity and microcysts. The impression of images is heterogeneous. This site was diagnosed as UIP pattern by radiologists and pathologists.