Early Clinical and CT Manifestations of Coronavirus Disease 2019 (COVID-19) Pneumonia

OBJECTIVE. The purpose of this study was to investigate early clinical and CT manifestations of coronavirus disease (COVID-19) pneumonia.

MATERIALS AND METHODS. Patients with COVID-19 pneumonia confirmed by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) nucleic acid test (reverse transcription–polymerase chain reaction) were enrolled in this retrospective study. The clinical manifestations, laboratory results, and CT findings were evaluated.

RESULTS. One hundred eight patients (38 men, 70 women; age range, 21–90 years) were included in the study. The clinical manifestations were fever in 94 of 108 (87%) patients, dry cough in 65 (60%), and fatigue in 42 (39%). The laboratory results were normal WBC count in 97 (90%) patients and normal or reduced lymphocyte count in 65 (60%). High-sensitivity C-reactive protein level was elevated in 107 (99%) patients. The distribution of involved lobes was one lobe in 38 (35%) patients, two or three lobes in 24 (22%), and four or five lobes in 46 (43%). The major involvement was peripheral (97 patients [90%]), and the common lesion shape was patchy (93 patients [86%]). Sixty-five (60%) patients had ground-glass opacity (GGO), and 44 (41%) had GGO with consolidation. The size of lesions varied from smaller than 1 cm (10 patients [9%]) to larger than 3 cm (56 patients [52%]). Vascular thickening (86 patients [80%]), crazy paving pattern (43 patients [40%]), air bronchogram sign (52 patients [48%]), and halo sign (69 [64%]) were also observed in this study.

CONCLUSION. The early clinical and laboratory findings of COVID-19 pneumonia are low to midgrade fever, dry cough, and fatigue with normal WBC count, reduced lymphocyte count, and elevated high-sensitivity C-reactive protein level. The early CT findings are patchy GGO with or without consolidation involving multiple lobes, mainly in the peripheral zone, accompanied by halo sign, vascular thickening, crazy paving pattern, or air bronchogram sign.

Keywords: clinical manifestations, coronavirus, COVID-19, CT, pneumonia, SARS-CoV-2
The CT findings of the 108 patients are shown in Table 3. Seventy (65%) patients had involvement of two or more lobes, and 97% of lesions were located in the peripheral zone of the lung. When a single lobe was involved, the right lower lobe was most often affected (30/38 [79%]). The most common CT features (Figs. 1 and 2) were patchy GGO (86%) and GGO with consolidation (41%). Eighty-six (80%) patients had vascular thickening (Figs. 3 and 4), and 43 (40%) had the crazy paving pattern (Fig. 4). The air bronchogram sign (Figs. 3 and 5) was visualized in 52 (48%) patients and the halo sign in 69 (64%) (Figs. 2 and 5). Most (68/108 [63%]) of the lesions were larger than 1 cm. No patient had mediastinal or hilar lymph node enlargement, pleural effusion, or pleural thickening.

### Table 3: Early CT Features of Coronavirus Disease (COVID-19) Pneumonia

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<th>High-Resolution CT Feature</th>
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| Distribution of lesions in lung           | Peripheral: 97 (90)  
                                         | Central: 2 (2)  
                                         | Peripheral and central: 9 (8)  
| No. of lobes                              | 1: 38 (35)  
                                         | 2 or 3: 24 (22)  
                                         | 4 or 5: 46 (43)  
| Shape of lesions                          | Patchy: 93 (88)  
                                         | Nodular: 12 (11)  
| Appearance of lesions                     | Ground-glass opacity: 65 (60)  
                                         | Consolidation: 6 (6)  
                                         | Ground-glass opacity with consolidation: 44 (41)  
| Specific signs                            | Vascular thickening: 86 (80)  
                                         | Crazy paving pattern: 43 (40)  
                                         | Air bronchogram sign: 52 (48)  
                                         | Fibrosis: 0  
                                         | Halo sign: 69 (64)  
| Size of the single largest lesion (cm)    | 1: 10 (9)  
                                         | 1–3: 42 (39)  
                                         | > 3: 56 (52)  
| Extrapulmonary manifestations             | Mediastinal and hilar lymph node enlargement: 0  
                                         | Pleural effusion: 0  
                                         | Pleural thickening: 0  

Note—Values in parentheses are percentages.
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Discussion

By February 13, 2020, nearly 60,000 cases of COVID-19 pneumonia had been diagnosed in China and more than 1300 patients had died, and there were confirmed reports of the disease in other countries. How to stop spread of the pandemic has become an urgent problem. It is critical to detect and diagnose COVID-19 pneumonia early and to immediately isolate and treat the patient. Although SARS-CoV-2 nucleic acid detection is the reference standard, it has a high false-negative rate due to nasopharyngeal swab sampling error, which often requires repeated samples. Many patients delay treatment, causing spread of the disease because of delay in diagnosis. High-resolution CT can depict millimeter-size lesions and play an important role in early diagnosis of viral pneumonia [5], including COVID-19 pneumonia [6, 7].

COVID-19 pneumonia is common in adults (mean age, 45 years) but rare in children and infants. In this study, the early clinical symptoms varied; fever, dry cough, and fatigue were common. Ninety-four of 108 (87%) patients had low to midgrade fever (range, 37.3–38.5°C), which was followed in early lesions of COVID-19 pneumonia. These findings may be seen in the later phase and severe type of the disease.

There were limitations to this study. First, there was no follow-up CT to evaluate early treatment efficacy. Second, lung tissue biopsies to investigate our hypothesis on the relation between CT and histopathologic manifestations were not available.

Conclusion

The early common clinical symptoms of COVID-19 pneumonia are low to midgrade fever, dry cough, and fatigue. The early CT features are multiple patchy pure GGOs or GGO with consolidation in the peripheral zone of the lung, often with vascular thickening and the crazy paving pattern, air bronchogram sign, or halo sign.

References


(Figures start on next page)
Fig. 1—50-year-old man with fever and dry cough. A–C, Axial (A), coronal (B), and sagittal (C) CT images show scattered patchy ground-glass opacity in peripheral aspect of both lungs and poor definition of area surrounding lesions.

Fig. 2—44-year-old woman with fever and fatigue. A–C, Axial (A), coronal (B), and sagittal (C) CT images of left lung show scattered ground-glass opacity with consolidation and accompanying halo sign. Largest lesion measures 1–3 cm.
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Fig. 3—35-year-old man with fever, dry cough, and fatigue. A–C, Axial (A), coronal (B), and sagittal (C) CT images of right lung show multiple patchy ground-glass opacities with consolidation scattered in peripheral zone of lower lobe, poorly defined boundary, air bronchogram sign, and vascular thickening. Largest lesions are larger than 3 cm.

Fig. 4—40-year-old woman with dry cough, fatigue, and diarrhea. A–C, Axial (A), coronal (B), and sagittal (C) CT images of right lung show multiple patchy ground-glass opacities with consolidation scattered in peripheral zone of lower lobe, poorly defined boundary, vascular thickening, and crazy paving pattern. Largest lesions are larger than 3 cm.
Fig. 5—35-year-old man with fever, fatigue, and myalgia. A–C, Axial CT scans show patchy ground-glass opacities with consolidation in peripheral zones of both lower lobes, poorly defined boundary, air bronchogram sign (B), and vascular thickening (A, C). Largest lesions, seen in B, are larger than 3 cm.