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Clinical and CT characteristics which indicate timely radiological reexamination in patients with COVID-19: A retrospective study in Beijing, China

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Abstract

Objective: Chest CT is useful in assessing the disease course of coronavirus disease 2019 (COVID-19). This study aims to identify the characteristics of patients in whom imaging progression occurred while clinical symptoms were relieved and to guide radiological reexamination.

Methods: This retrospective study included 73 patients with reverse transcription-polymerase chain reaction (RT-PCR) confirmed severe acute respiratory syndrome-2 (SARS-CoV-2) infection. All patients received CT reexaminations within 24 h after symptomatic remission. We divided patients into two groups according to the matching degree between clinical and imaging outcomes.

Results: 21 patients displayed imaging progression while symptoms relieved. Patients with imaging progression were prone to be advanced in age [years: 60 (46 65) v 47 (37 60.75), \( P = 0.030 \)]; lymphopenia (66.7% v 40.4%, \( P = 0.042 \)) and low level of C-reactive protein [mg/L: 5.7 (1.9 20.2) v 18.9 (6.7 38.9), \( P = 0.038 \)]. An age over 50 was an independent risk factor for imaging progression (OR = 3.41, 95%CI 1.14 10.20, \( P = 0.028 \)). In CT images, they were inclined to present lesions with clear border (94.7% v 64.7%, \( P = 0.012 \)), pure peripheral distribution (89.5% v 39.2%, \( P < 0.001 \)), without bilateral lungs involved (57.9% v 29.4%, \( P = 0.028 \)) especially with left lung involved only (42.1% v 17.6%, \( P = 0.034 \)).

Conclusion: In order to improve the therapeutic effect, the interval before radiological follow-up should be shortened appropriately especially in patients over the age of 50. It is essential to proceed to CT reexamination before symptomatic remission.

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Keywords: Coronavirus disease 2019; Computed tomography; Prognosis

1. Introduction

The spread of coronavirus disease 2019 (COVID-19) has lasted for nearly four months since the first cluster of cases emerged in Wuhan, China [1,2]. Severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) has been identified as the causative agent of COVID-19 [3]. Due to the human-to-human transmission of SARS-CoV-2, the number of confirmed and suspected patients elevated rapidly [4 6]. On March 11, 2020, the World Health Organization (WHO)
announced that COVID-19 could be characterized as a pandemic [7]. By April 16, 2020, 1,991,562 confirmed patients with 130,885 deaths were reported globally [8]. Many countries immediately took appropriate measures, thus greatly contributing to the prevention and control of the pandemic [9].

Wuhan Huanan seafood market was considered to be the origin of COVID-19, because the majority of initial cases had an epidemiological link to this market [10]. Consequently, Wuhan and its adjacent area were affected most seriously. The characteristics of many severe cases from Wuhan have been described, and recently published literature has summarized the clinical and radiological features of patients with COVID-19 in Wuhan [10–13]. There have, however, been numerous cases in other places across the world. The pandemic situation in Beijing, as the capital of China, can characterize the situation in many metropolises around the world. It is, therefore, significant to describe the characteristics of patients with COVID-19 in Beijing.

Due to time constraints, few reports in the literature have recorded the dynamic changes in the complete course of COVID-19, especially in locations other than Wuhan. In addition, we found some patients had radiological progression while clinical symptoms were relieved. The mismatch between clinical and imaging outcomes complicated treatment and assessment. We aimed to analyze the clinical and imaging characteristics of COVID-19 patients with mismatches in order to facilitate treatment and follow-up.

2. Materials and methods

2.1. Patients

This study was conducted in accordance with the Declaration of Helsinki. Informed consent was waived because of the retrospective nature of the study and the use of anonymized clinical data for analysis. In this retrospective single center study, the clinical information and CT imaging data of 78 patients with SARS-CoV-2 infection from January 21, 2020 to February 24, 2020 in Beijing were reviewed. SARS-CoV-2 infection was confirmed by reverse transcription-polymerase chain reaction (RT-PCR) in accordance to previously published protocols [10].

Inclusion criteria were: ① Confirmed SARS-CoV-2 infection. ② Age≥18 years. ③ Thin-section CT having been undertaken. ④ Imaging reexamination data available. ⑤ No acute respiratory distress syndrome (ARDS). Excluded were 1 patient younger than age 18, 3 patients who had not undergone CT reexamination, and 1 patient who developed into ARDS. Finally, a total of 73 patients were included. All patients received CT examinations at least twice, and every patient received CT reexamination within 24 h after symptomatic remission. The median time from admission to clinical symptomatic remission was 9.0 days (IQR 5.0–12.5). We recorded the clinical and imaging outcomes of each patient and divided participants into two groups according to matching degree between clinical remission and imaging improved. Group 1 (n = 52) contained patients with radiological improvement synchronized with symptom remission or at least without imaging progression. Group 2 (n = 21) consisted of patients who presented imaging progression while symptoms relieved. Imaging improvement was defined as previous lesions dissipated or vanished and without new lesions. Imaging progression was defined as previous lesions aggravated or new lesions appeared.

2.2. CT image acquisition

All patients received thin-section chest CT examinations. The median time from illness onset to initial CT scan was 6 days (IQR 4–8). All examinations were imaged with Philips iCT 256 (Philips; Amsterdam, Netherlands) without intravenous contrast materials. The CT protocols were as follows: tube voltage, 120 kV; automatic tube current, 30–300 mA; rotation time, 0.75s; collimation, 0.625 mm; pitch, 0.945; matrix, 512 × 512; section thickness, 5 mm; breath hold at full inspiration. The images were transmitted to the workstation and picture achieving and communication systems (PACS) for multiplanar reconstruction and post-processing.

2.3. CT image interpretation

All images (both axial CT images and multiplanar reconstruction images) were reviewed by two radiologists (with 22 years’ experience and 7 years’ experience respectively) blinded to clinical and laboratory data. Two estimators assessed the CT features independently. After separate evaluations, any divergences were resolved by discussion or consultation from a specialist in infectious imaging (with 33 years’ experience).

CT images were evaluated for the pattern of pulmonary abnormalities including: ① pure ground-glass opacity (GGO), ② pure consolidation, ③ GGO with consolidation, ④ GGO with inter- and intra-lobular septal thickening (crazy-paving pattern). GGO was defined as hazy increased pulmonary attenuation with margin of bronchi and vessels preserved. Consolidation was defined as opacification with obstruction of vascular margins and airway walls [14]. The size, border, distribution (outer one-third of lung was defined as peripheral and the remaining portion as central) of lesions were assessed. Air bronchogram sign, situation of lung involved and other findings were analyzed. Other findings included discrete pulmonary nodules, pleural thickening, pleural effusion, pericardial effusion, thoracic lymphadenopathy (defined as a lymph node＞10 mm in short-axis diameter), pulmonary emphysema, and pulmonary fibrosis. Changes in the above-mentioned radiological features were analyzed throughout follow-up until every patient showed imaging improvement.

2.4. Statistical analysis

Statistical analyses were performed using SPSS version 19.0. Continuous variables were assessed for distribution normality with the Kolmogorov–Smirnov test. Normally
distribute data were described as mean (SD) while non-normally distributed data as median (IQR). Categorical variables were present as frequency (%). Groups were compared using the t test if normally distributed or the Mann–Whitney U test if not; categorical variables were compared with the Chi-square test or, where appropriate, Fisher’s exact test. Binary Logistic regression was used to find and assess the risk factors for imaging progression. Statistical significance was determined at the level of 0.05.

Table 1
Clinical characteristics of patients with COVID-19.

| Items                        | All patients (n = 73) | Group 1 (n = 52) | Group 2 (n = 21) | P value |
|------------------------------|-----------------------|------------------|------------------|---------|
| Demographics                 |                       |                  |                  |         |
| Age, years                   | 51 (39–63)            | 47 (37–60.75)    | 60 (46–65)       | 0.030   |
| ≤50                          | 36 (49.3%)            | 30 (57.7%)       | 6 (28.6%)        | 0.024   |
| >50                          | 37 (50.7%)            | 22 (42.3%)       | 15 (71.4%)       | 0.977   |
| Sex                          |                       |                  |                  |         |
| Male                         | 28 (38.4%)            | 20 (38.5%)       | 8 (38.1%)        |         |
| Female                       | 45 (61.6%)            | 32 (61.5%)       | 13 (61.9%)       |         |
| Epidemiological history      |                       |                  |                  | 0.469   |
| Exposure to Wuhan            | 36 (49.3%)            | 26 (50.0%)       | 10 (47.6%)       |         |
| Contact with COVID-19 patients | 29 (39.7%)       | 19 (36.5%)       | 10 (47.6%)       |         |
| Unknown reason               | 8 (11.0%)             | 7 (13.5%)        | 1 (4.8%)         |         |
| Current smoker               | 3 (4.1%)              | 2 (3.8%)         | 1 (4.8%)         | 0.858   |
| Current drinker              |                       |                  |                  | 0.501   |
| Symptoms and signs           |                       |                  |                  |         |
| Fever                        | 61 (83.6%)            | 44 (84.6%)       | 17 (81.0%)       | 0.702   |
| Highest temperature, °C      |                       |                  |                  | 0.542   |
| <37.3                        | 12 (16.4%)            | 8 (15.4%)        | 4 (19.0%)        |         |
| 37.3–38.0                    | 30 (41.1%)            | 20 (38.5%)       | 10 (47.6%)       |         |
| 38.1–39.0                    | 27 (37.0%)            | 20 (38.5%)       | 7 (33.3%)        |         |
| Cough                        | 53 (72.6%)            | 35 (67.3%)       | 18 (85.7%)       | 0.110   |
| Sputum production            | 27 (37.0%)            | 17 (32.7%)       | 10 (47.6%)       | 0.232   |
| Dyspnea                      | 22 (30.1%)            | 17 (32.7%)       | 5 (23.8%)        | 0.454   |
| Days from illness onset to dyspnea | 5.5 (1.0–9.0) | 2.0 (1.0–8.5) | 7.0 (5.5–11.5) | 0.075   |
| Fatigue or myalgia           | 21 (28.8%)            | 13 (25.0%)       | 8 (38.1%)        | 0.263   |
| Headache                     | 8 (11.0%)             | 6 (11.5%)        | 2 (9.5%)         | 0.803   |
| Comorbidities                |                       |                  |                  |         |
| Hypertension                 | 15 (20.5%)            | 9 (17.3%)        | 6 (28.6%)        | 0.281   |
| Diabetes                     | 11 (15.1%)            | 9 (17.3%)        | 2 (9.5%)         | 0.400   |
| Cardiovascular disease       | 6 (8.2%)              | 4 (7.7%)         | 2 (9.5%)         | 0.796   |
| COPD                         | 2 (2.7%)              | 2 (3.8%)         | 0                | 0.362   |
| ICU care                     | 2 (2.7%)              | 2 (3.8%)         | 0                | 0.362   |

Table 2
Laboratory results of patients with COVID-19.

| Items                        | All patients (n = 73) | Group 1 (n = 52) | Group 2 (n = 21) | P value |
|------------------------------|-----------------------|------------------|------------------|---------|
| Laboratory findings          |                       |                  |                  |         |
| Leukocyte count, ×10⁹/L      | 4.43 (1.75)           | 4.57 (1.86)      | 4.08 (1.41)      | 0.281   |
| <4                           | 32 (43.8%)            | 23 (44.2%)       | 9 (42.9%)        | 0.803   |
| 4-10                         | 40 (54.8%)            | 28 (53.8%)       | 12 (57.1%)       |         |
| >10                          | 1 (1.4%)              | 1 (1.9%)         | 0                |         |
| Lymphocyte count, ×10⁹/L     | 1.09 (0.52)           | 1.07 (0.54)      | 1.12 (0.48)      | 0.760   |
| <1.0                         | 35 (47.9%)            | 21 (40.4%)       | 14 (66.7%)       | 0.042   |
| ≥1.0                         | 38 (52.1%)            | 31 (59.6%)       | 7 (33.3%)        |         |
| Platelet count, ×10⁹/L       | 202.93 (80.11)        | 207.08 (86.64)   | 192.67 (61.70)   | 0.490   |
| Hemoglobin, ng/mL            | 134.75 (17.65)        | 135.73 (17.43)   | 132.33 (18.38)   | 0.460   |
| Prothrombin time, s          | 12.4 (11.9–12.9)      | 12.5 (12.1–12.9) | 12.3 (11.9–12.9) | 0.227   |
| Activated partial thromboplastin time, s | 32.7 (30.6–34.3) | 32.7 (30.4–34.4) | 32.7 (32.0–34.2) | 0.630   |
| Albumin, g/L                 | 36.34 (4.49)          | 35.78 (4.70)     | 37.72 (3.68)     | 0.095   |
| Total bilirubin, μmol/L      | 9.2 (6.5–12.5)        | 9.2 (7.0–12.7)   | 7.6 (5.9–12.2)   | 0.214   |
| Creatine kinase, U/L         | 69.0 (46.0–118.5)     | 69.5 (51.0–122.0) | 58.0 (40.0–109.5) | 0.249   |
| C-reactive protein, mg/L     | 16.3 (3.1–34.8)       | 18.9 (6.7–38.9)  | 5.7 (1.9–20.2)   | 0.038   |
| Procalcitonin, ng/mL         | 0.11 (0.10–0.14)      | 0.11 (0.10–0.15) | 0.11 (0.10–0.13) | 0.690   |

Data are mean (SD), median (IQR) or n (%). COVID-19, coronavirus disease 2019; COPD, chronic obstructive pulmonary disease; ICU, intensive care unit.
Fig. 1. A, Differences in age between patients with and without imaging progression; B, Differences in CRP level between patients with and without imaging progression.

Fig. 2. Differences in situations of age, lung involved, distribution, lesion border and lymphopenia between patients with and without imaging progression.
3. Results

3.1. Clinical and laboratory findings

Tables 1 and 2 show clinical characteristics and laboratory findings of patients with COVID-19 separately. 73 patients included 28 men (38.4%) and 45 women (61.6%) with a median age of 51 (IQR 39–63). 36 patients (49.3%) had exposure history to Wuhan (having lived there or travelled there) and none had been to the Hunan seafood market. 29 patients (39.7%) had no direct Wuhan exposure history but had had contact with confirmed patients in Beijing. 8 patients (11.0%) had no direct Wuhan exposure history but had had contact with confirmed patients in Beijing. 8 patients (11.0%) had no direct Wuhan exposure history but had had contact with confirmed patients in Beijing.

No patients occurred hemoptysis or diarrhea. Among 73 patients, 15 patients (20.5%) had comorbidities of hypertension, 11 (15.1%) had diabetes, 6 (8.2%) had cardiovascular disease, 2 (2.7%) had chronic obstructive pulmonary disease (COPD). 2 of 73 patients (2.7%) were sent to intensive care unit (ICU). Half of patients (40/73, 54.8%) had normal leukocyte counts (4e10^9/L) and 32/73 (43.8%) presented leukocytopenia (<4e10^9/L).

In comparison with patients in whom no imaging progression was found while experiencing symptomatic remission, patients with imaging progression were prone to have advanced age [median (IQR) years: 60 (46–65) v 47 (37–60.75), P = 0.030, Fig. 1A]; more patients had age over 50 [15/21 (71.4%) v 22/52 (42.3%), P = 0.024, Fig. 2]. Lymphopenia [lymphocyte count <1.0e10^9/L, 14/21 (66.7%) v 21/52 (40.4%), P = 0.042, Fig. 2] and low level of C-reactive protein [CRP median (IQR) mg/L: 5.7 (1.9–20.2) v 18.9 (6.7–38.9), P = 0.038, Fig. 1B] were more commonly
3.2. Chest CT imaging findings

Table 3 shows initial CT findings of patients with COVID-19 at admission. The median duration from illness onset to CT examination was 6.0 days (IQR 4.0–8.0). In the total of 73 patients, 3 patients (4.1%) presented no obvious abnormality, 29 patients (39%) presented pure GGO, 3 patients (4.1%) presented pure consolidation, 32 patients (43.8%) presented GGO with consolidation, 6 patients (8.2%) presented GGO with inter- and intra-lobular septal thickening (crazy-paving). Among the 70 patients with abnormalities, lesions of 37 patients (52.9%) distributed in peripheral region and 33 (47.1%) in both peripheral and central, no patient’s lesions located in central region purely. Right lower lobes were most commonly involved (61/70, 87.1%), followed by left lower lobes (53/70, 75.5%). 44 of 70 patients (62.9%) showed bilateral lungs affected. 32 of 70 patients (45.7%) presented air bronchogram sign. 3 of 70 patients (4.3%) had pleural thickening and 1/70 (1.4%) pulmonary emphysema. No patient showed discrete pulmonary nodules, pleural effusion, pericardial effusion, thoracic lymphadenopathy or pulmonary fibrosis.

There was no significant difference in the duration from illness onset to initial CT examination between the two groups. In comparison with the patients who did show radiological improvement synchronized with symptoms remission, patients with imaging progression were inclined to present lesions with a clear border (18/19, 94.7% v 33/51, 64.7%, \( P = 0.012, \text{Fig. 2} \)), pure peripheral distribution (17/19, 89.5% v 20/51, 39.2%, \( P < 0.001, \text{Fig. 2} \)), without bilateral lungs involved (11/19, 57.9% v 15/51, 29.4%, \( P = 0.028, \text{Fig. 2} \)) especially with left lung involved only (8/19, 42.1% v 9/51, 17.6%, \( P = 0.034, \text{Fig. 2} \)). The frequency of involvement of the lower left lobe in patients with progressive imaging is lower than in patients without imaging progression (11/19, 57.9% v 42/51, 82.4%, \( P = 0.034 \)).

The median time from admission to lesions having dissipated or vanished on CT images for all patients was 13.0 days (IQR 7.5–21.5), this is longer than the time taken to symptomatic remission (9.0 days, IQR 5.0–12.5). Due to previous lesions aggravated or new lesions appeared, the duration from admission to radiological improvement of patients with imaging progression was much longer [median (IQR) days: 25.0 (18.0–29.5) v 10 (6.3–15.0), \( P < 0.001 \)].

3.3. Changes of CT imaging features

Table 4 shows changes in CT images of patients with imaging progression when getting symptomatic remission \((n = 21)\). All patients presented an increase in attenuation of opacities and 20/21 (95.2%) had size of previous lesions increased, 11 of 21 (52.4%) patients’ lesion borders turned unclear. New lesions occurred in all patients, most of them had new GGO with consolidation (11/21, 52.4%) and most of new lesions (11/21, 52.4%) distributed in central pulmonary regions (Figs. 3 and 4). 8 patients (38.1%) increased more than two lobes involved. 2 patients (9.5%) appeared pleural effusion.

4. Discussion

We have the following important findings: (1) Patients with advanced age, lymphopenia, low level of CRP and presenting purely peripheral distributed lesions with clear border involving only the left lung were prone to the occurrence of imaging progression while demonstrating symptomatic remissions. (2) An age of over 50 years was an independent risk factor for imaging progression. Radiological reexamination before symptomatic relief was necessary for this population. (3) Imaging progression occurred in nearly one third of patients when the symptoms were relieved even though there was no significant difference in time from illness onset to admission between patients with and without imaging progression. (4) Common CT progression features included increase in attenuation and size of previous lesions and blurred borders, new GGO with consolidation located at the central part of

| Table 4 |
| --- |
| Follow-up CT changes of COVID-19 patients with imaging progression \((n = 21)\). |
| Changes on CT imaging when symptoms remission | Value |
| Attenuation of previous opacity |  |
| Unchanged | 0 |
| Increased | 21 (100%) |
| Decreased | 0 |
| Size of previous opacity |  |
| Increased | 20 (95.2%) |
| Decreased | 1 (4.8%) |
| Change of lesion border |  |
| Unchanged | 4 (19.0%) |
| Turned clear | 6 (28.6%) |
| Turned unclear | 11 (52.4%) |
| Any new lesions |  |
| No | 0 |
| New GGO | 2 (9.5%) |
| New consolidation | 5 (23.8%) |
| New GGO with consolidation | 11 (52.4%) |
| New GGO interlobular septal thickening | 3 (14.3%) |
| Change of distribution |  |
| Unchanged | 4 (19.0%) |
| Peripheral lesion(s) appeared | 6 (28.6%) |
| Central lesion(s) appeared | 11 (52.4%) |
| Change of air bronchogram sign |  |
| Unchanged | 11 (19.3%) |
| Appeared | 2 (9.5%) |
| Disappeared | 8 (38.1%) |
| Increased more than 2 lobes | 8 (38.1%) |
| Change of other findings |  |
| Unchanged | 18 (85.7%) |
| New Pleural thickening | 1 (4.8%) |
| Pleural effusion | 2 (9.5%) |

CT, computed tomography; COVID-2019, coronavirus disease 2019; GGO, ground glass opacities.

seen in patients with imaging progression. We found being over 50 years of age to be an independent risk factor for imaging progression \((OR = 3.41, 95\% CI 1.14–10.20, P = 0.028)\) after lymphopenia rate and CRP level were adjusted.

Common CT progression features included increase in attenuation and size of previous lesions and blurred borders, new GGO with consolidation located at the central part of
Fig. 3. Images of a 58-year-old man with a history of travel to Wuhan, with symptoms of fever for 6 days. Lymphocyte count: $0.61 \times 10^9/L$, CRP: 2.7 mg/L at admission. A, B Initial CT scan (6 days after symptoms onset) shows GGO with crazy-paving pattern distributed in right lung. The patient displayed symptomatic remission 7 days after admission. C, D Follow-up CT (8 days after admission) shows increase in size and attenuation of previous opacity and new GGO with consolidation extended to bilateral lungs. The air bronchogram sign was obvious but crazy-paving sign disappeared.

Fig. 4. Images of a 65-year-old man without direct exposure history to Wuhan, with symptoms of fever and fatigue for 3 days. Lymphocyte count: $0.98 \times 10^9/L$, CRP: 3.2 mg/L at admission. A, B Initial CT scan (4 days after symptoms onset) shows single GGO with clear border distributed in peripheral part of left lung. The patient experienced symptomatic remission 5 days after admission. C, D Follow-up CT (6 days after admission) shows increase in size and attenuation of previous opacity, the border turned unclear and new GGO with consolidation extended to bilateral lungs.
lung. Mild COVID-19 cases were more common in Beijing with lower intensive care unit (ICU) care rate. Only half of patients had a direct exposure history to Wuhan and none in our study had been to Huanan seafood market.

Previous studies indicated a general course of COVID-19 and described the typical pattern of CT images in different periods [13,15,16]. In the early period, unilateral peripheral GGO seems the most common pattern, then consolidation and hazy-paving appear and the abnormalities extend to bilateral lungs due to the aggravated infection. The severity of infection will progress until reaching a peak and showing more dense consolidation on images. When the infection is controlled, consolidation will be absorbed and crazy paving will disappear [15].

We consider most patients in our study to have basically conformed to the natural course; however, some patients had a persistently relative longer course and progress even though the symptoms had been controlled. Elderly patients and patients with lymphopenia may have lower immune response to SARS-CoV-2 and show low level of CRP in early stage. Increased CRP level is considered as the indicator of disease progression [10]. However, we also need to pay attention to those patients with a low level of CRP at admission, because CRP may increase gradually. For these patients it may take longer time to reach the progression peak so previous lesions will enlarge or new lesions will appear although the symptoms are controlled by treatment. Due to the anatomical factors, right lung is more easily involved, although no obvious abnormality present in right lung at first, the virus is likely to exist already and will cause a series of opacities gradually. Therefore, patients with only left lung involvement in the early stage may extend to both lungs.

There are several limitations in our study. Firstly, only 73 cases were included so the sample size was small. Secondly, we excluded patients in whom ARDS occurred so selection bias may exist. Thirdly, lung biopsy specimens were not available, the relationship between radiological and pathological findings still need to be investigated.

Recognizing these characteristics is helpful to improve clinical treatment and assessment. Above all, it is beneficial to the prognoses of patients with COVID-19.

5. Conclusion

Clinical and radiological outcomes may be not be mutually synchronized. Attention should be paid to patients with advanced age, lymphopenia, low level of CRP or presenting purely peripheral distributed lesions with clear border involved left lung only at early stage due to the tendency to imaging progression even after symptoms have been controlled. To improve the therapeutic effect, we can shorten the interval of radiological follow-up appropriately because taking CT reexamination after symptomatic relief may be delayed for these populations. It is essential in patients over the age of 50, in particular, to receive CT reexamination before symptomatic remission. Clinical doctors can adjust the treatment program in time with the guidance of dynamic changes in images.

5. Conclusion

Clinical and radiological outcomes may be not be mutually synchronized. Attention should be paid to patients with advanced age, lymphopenia, low level of CRP or presenting purely peripheral distributed lesions with clear border involved left lung only at early stage due to the tendency to imaging progression even after symptoms have been controlled. To improve the therapeutic effect, we can shorten the interval of radiological follow-up appropriately because taking CT reexamination after symptomatic relief may be delayed for these populations. It is essential in patients over the age of 50, in particular, to receive CT reexamination before symptomatic remission. Clinical doctors can adjust the treatment program in time with the guidance of dynamic changes in images.

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