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## Letter to the Editor

## Running title: The CT progression of COVID-19 pneumonia

**The progression of computed tomographic (CT) images in patients with coronavirus disease (COVID-19) pneumonia**


Dear Editor

We read with interest the recent papers in Journal of Infection by Chen who described *clinical progression of patients with COVID-19 in Shanghai, China*<sup>1</sup>. The radiological manifestations in disease progression they got were that radiological aggravation of initial image was observed in 65.7% (163/248) of patients on day 7 after onset of symptoms, 94.5% (154/163) of patients showed radiological improvement on day 14<sup>1</sup>, which means that the patients had a typical transition from early stage to advanced stage, and then from advanced stage to dissipating stage. We would like to share the progression of computed tomographic (CT) images in patients with COVID-19 pneumonia in our hospital after hospital discharge. Actually, pulmonary fibrosis may develop early in patients with COVID-19 pneumonia after hospital discharge. However, the older patients with severe illness were more prone to develop fibrosis during treatment.

Recently, study on the early transmission dynamics had been reported that human-to-human was the epidemiologic characteristics for COVID-19 infection<sup>2</sup>. Until Mar. 14, 2020, the World Health Organization (WHO) reported 1,42,539 confirmed cases (9769 new) globally, and 5393 deaths (438 new) in 135 countries (13 new) (including China, Korea, Japan, USA, Canada, Italy, Iran, Thailand, Brazil, Algeria, etc.), and COVID-19 infection had been almost prevalent all around the world<sup>3</sup>. This is global public health problem, we should pay more attention to current situation of COVID-19 infection. However, the progress of the disease after the treatment and discharge of the patient was rarely reported, and it is unclear whether there is a residual focus or fibrosis.

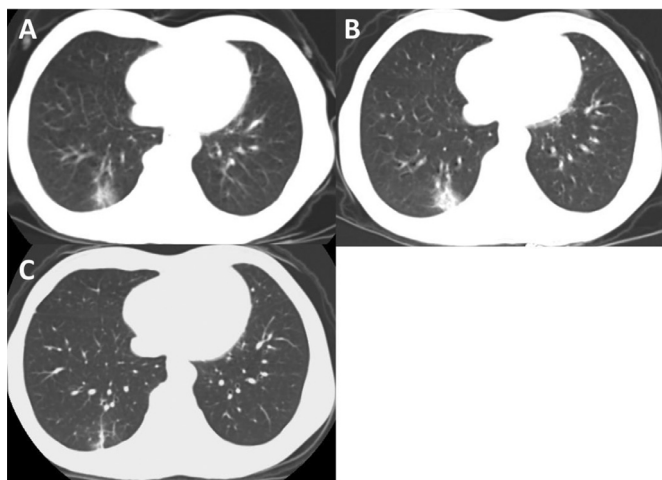
Here we reported forty-nine patients (27 males, 22 females; mean age: 41 years, range: 25–70 years) who were performed follow CT to evaluate the progression of COVID-19 pneumonia. The average CT follow-up time is 30.5 days (range, 24 to 38 days) after the initial hospital admission and 15.8 days after discharge (range, 7–25 days). The CT features were evaluated by two experienced radiologists in consensus, the CT characteristics include ground-glass opacities, interstitial thickening, and consolidation, and fibrosis (parenchymal band, traction bronchiectasis, and irregular interfaces). The demographics, length of stay (LOS) in hospital, and rate

of intensive care unit (ICU) were also analyzed to evaluate the progression.

The results suggested that 89.8% (44/49) of patients had a typical transition from early stage to advanced stage and advanced stage to dissipating stage (Fig. 1), 42.9% (21/49) of patients with the evidence fibrosis in follow CT examination whereas 57.1% (28/49) of patients without the definite fibrosis. The age of patients with fibrosis in follow CT was older than that of those who without fibrosis (mean age, 45.4 vs. 33.8 years,  $P < 0.05$ ), the LOS of patients with fibrosis was longer than that of patients without fibrosis (19.1 vs. 15.0 days,  $P < 0.05$ ), and percentage of patients with fibrosis in ICU was higher than that of those who without fibrosis (19.0% vs. 3.6%,  $P = 0.08$ ). That is to say, Patients with fibrosis in follow CT were older, with longer LOS, higher rate of ICU admission than that of those who without fibrosis.

Ground-glass opacities and consolidation were observed in the follow CT. However, in the early stage, the manifestations of single or multiple ground-glass opacities were observed and distributed along the bronchovascular or subpleural in the pulmonary parenchyma, higher density consolidations were presented in the advanced stage, and ground-glass opacities and consolidations were absorbed in dissipating stage. Previous study had suggested that the CT findings were various at different stages of COVID-19 infection<sup>4,5</sup>. Particularly, more ground-glass opacities and less consolidation were the principal manifestation in the CT images (CT scans before onset of symptoms or CT scans done  $\leq 1$  week after onset of symptom). Ground-glass opacities were decreased with increasing the stages of COVID-19 pneumonia. However, the consolidation or ground-glass opacities mixed consolidation increased, and reticular was demonstrated in the later stages (scan  $> 1$  week after symptom onset)<sup>5</sup>. In our present study, the evolution of CT manifestations was familiar to the previous literature.

In conclusion, the patients with COVID-19 pneumonia had a typical transition from early stage to advanced stage and advanced stage to dissipating stage. The manifestations of single or multiple ground-glass opacities were observed and distributed along the bronchovascular or subpleural in the pulmonary parenchyma in the early stage, higher density consolidations were presented in the advanced stage, and ground-glass opacities and consolidations were absorbed in dissipating stage. However, the patients with fibrosis in follow CT were older, with longer LOS, higher rate of ICU admission than that of those who without fibrosis.



**Fig. 1.** Chest CT for evaluation of COVID-19 pneumonia for an eighty-three years old man with COVID-19 pneumonia who had the exposure history to epidemic area, with fever and fatigue for 1 day. GGO and consolidation were observed at early stage of COVID-19 pneumonia (A), GGO decreased and consolidation increased were demonstrated at advanced stage (B), and fibrosis was shown at dissipating stage (C).

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Accepted 17 March 2020