Journal of Infection xxx (xxxx) xxx

Contents lists available at ScienceDirect

Journal of Infection

journal homepage: www.elsevier.com/locate/jinf

Letter to the Editor

Clinical and CT imaging features of 2019 novel coronavirus disease (COVID-19)

Dear Editor,

Tang JW, et al. and colleagues have written to this Journal describing the emergence of 2019 novel coronavirus disease (COVID-19).[1] We have had an opportunity to examine in detail the chest computed tomography (CT) findings in cases with microbiologically confirmed severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection, to familiarize radiologists and clinicians with the imaging manifestations of this new outbreak. Meanwhile, we also studied the clinical characteristics of the cases, combined with CT manifestations, to provide more clues for the correct diagnosis of the disease.

Fourteen patients (P1-P14) aged from 10 to 75 years were referred to the fever clinic of our hospital, 7 of them (P8-P14) were from Hui-Ya branch of our hospital. P9 and P14 had diabetes and other patients had no underlying diseases. Among the 14 cases, 10 of them had a history of exposure to Wuhan or Hubei, while, P6 and P7 had no clear epidemiological history. P3/P4, P10/P11 were family clustering disease. All the patients performed oropharyngeal swabs test and confirmed as COVID-19. Common respiratory viruses, mycoplasma and chlamydia were negative. For patients' venous blood tests at disease onset, as given in (Table 1), we found that leucocytes and lymphocytes were slightly decreased or normal, eosinophil count were slightly decreased in 12 cases and normal in 2 cases. Neutrophil counts were normal for all the patients, and CRP was increased in 6 cases. PCT was normal or slightly elevated.

On admission, 11 patients (P1–P11) underwent high resolution chest CT examination and their manifestations were shown in (Table 2). P1 (Fig. 1, F0, A1–A4): CT images showed patchy-like pure ground glass opacity (GGO) involving subpleural regions of the right middle lobe (Fig. 1, F0, A3, arrow) and the right lower lobe. The slightly thickened interlobular septa within the lesion makes it appear the crazy paving sign (Fig. 1, F0, A2, arrowhead). P2 (Fig. 2, P2, A1-A2): CT images showed mixed GGO and consolidation that appeared at subpleural area of the right middle lobe and the right lower lobe. The lesion presented as patchy-like morphology. P3 (Fig. 2, P3, A1-A2): CT images showed two well circumscribed, round nodular-like GGO lesions (Fig. 2, P3, arrow) located in the central area of the left upper lobe. P4 (Fig. 2, P4): CT images showed a small nodular-like pure GGO (Fig. 2, P4, arrow) located in the central area of the left lower lobe. P5 (Fig. 2, P5): CT images showed a slight of irregular pure GGO (Fig. 2, P5, arrow) located in the subpleural region of the right lower lobe. P6 (Fig. 2, P6, A1-A2): CT images showed bilateral multi-focal mixed GGO and consolidation appeared at subpleural area of lung. Mild bronchiectasis (Fig. 2, P6, A2, arrow) can also be observed within the lesion. P7 (Fig. 2, P7, A1–A4): CT images showed bilateral subpleural lesions, among which the lesion in the left lower lobe was nodular-like with pseudocavitary sign (Fig. 2, P7, A3, arrow). P8 (Fig. 3, P8) and P9 (Fig. 3, P9): CT images showed bilateral subpleural lesions with crazy paving sign. P10 (Fig. 3, P10, A1-A2): CT images showed bilateral multiple lesions, some of them were pure GGO located in the central region of the lung. P11 (Fig. 3, P11, A1-A2): CT images showed bilateral subpleural small nodular-like lesions.

P1 had three follow-up CTs (Fig. 1, F1–F3). The time interval between initial chest CT and follow-up were 4, 8, 14 days. Follow-up 1(Fig. 1, F1, B1–B4): CT images showed diseases progression. The lesions showed diversified morphology and distribution, appearing as coexisted nodular-like (Fig. 1, F1, B4, arrow) and patchy-like lesions as well as peribronchial (Fig. 1, F1, B2, arrowhead), central and subpleural distribution. CT images of F1 showed the that lesions were migratory manifested as the absorption of the primary lesions and the emergence of new lesions. CT images of Follow-up 2 (Fig. 1, F2, C1-C4) and Follow-up 3 (Fig. 1, F3, D1–D4) showed the diseases were obviously absorbed.

In the current study, we investigated the detailed information including clinical features and CT imaging characteristics of 6 patients with COVID-19. Our research has some new findings on the basis of previous study: (1) The decrease of eosinophil count may be helpful for the early diagnosis of the disease. Nevertheless, till now, there is no study refer to blood tests[2,3] mentioned eosinophil, which is worthy of further study. (2) Our CT study found that COVID-19 has a variety of manifestations. In the early stage of the disease, the lesion can manifest as round nodular-like GGO in the central area of the lung lobe, which is different from the common imaging manifestations that are patchy-like lesion in subpleural region.[4–6] (3) The follow-up CT images showed the lesions are migratory manifested as the absorption of the primary lesions and the emergence of new lesions, which had not been reported yet. (4) The false negative rate of oropharyngeal swabs seems high. As we know that, oropharyngeal swabs are the recommended upper respiratory tract specimen types for SARS-CoV-2 diagnostic testing,[7,8] so a new detection technique should be developed as soon as possible.

https://doi.org/10.1016/j.jinf.2020.03.033

Table 1
Clinical characteristics of the 14 patients infected with 2019-nCoV.

Patient	Gender	Age, years	Epidemiology	2019-nCoV-RNA test results of oropharyngeal swabs	Chief complaint	CRP, mg/L, 0.00-10.00	WBC#, x10^9/L, 4.00-10.00	NEUT#, x10^9/L, 1.80-6.40	LY#, x10^9/L, 1.00-3.30	EO#, x10^9/L, 0.05-0.50	PCT, ng/mL, 0.00-0.05
P1	F	27	Went to Wuhan 17 days ago	The second test was positive	Fever (<38°)	5.78	3.77	2.55	0.98	0.01	NA
P2	F	32	Went to Wuhan 12 days ago	Two tests were positive	Fever for 1 day (<38°)	1.47	3.40	2.22	0.80	0.01	NA
P3	F	56	Went to Hubei 1 day ago	The first test was positive	Fatigue and fever for 1 day (<38°)	6.40	5.69	3.45	1.42	0.20	0.04
P4	F	32	Family cluster with P3	The second test was positive	Fever for 1 hour (<38°)	1.60	6.87	5.30	1.01	0.12	0.04
P5	F	63	Went to Wuhan 2 days ago	Two tests were positive	Fever (<38°)	2.85	4.08	3.13	0.55	0.01	NA
P6	F	54	No clear history related to Wuhan	The first test was positive	Fever (40°C)	63.79	5.89	4.15	1.31	0.01	NA
P7	F	49	No clear history related to Wuhan	The first test was positive	Fever	10.36	3.76	2.56	0.94	0.00	NA
P8	F	35	Went to Wuhan 14 days ago	The first test was positive, the second test was negative	Fever for half day (37.5°C)	6.50	3.25	1.93	1.10	0.00	0.027
P9	F	63	Went to Wuhan 7 days ago	The fourth test was positive	Fever for 2 days (37.1°C)	88.20	5.92	5.20	0.55	0.00	0.208
P10	M	41	Contacted with person from Wuhan 25 days ago	The first test was positive	Fever for 2 days (37.8°C)	15.90	6.13	3.43	1.99	0.00	0.028
P11	F	10	Family cluster with P10	Two tests were positive	Asymptomatic (37.1°C)	0.00	6.92	5.11	1.59	0.00	0.020
P12	F	66	Went to Wuhan 4 days ago	The first test was positive	Dizziness, vomiturition, fever (38.9°C) and myalgia for more than 1 day	25.80	6.84	4.99	1.56	0.00	0.065
P13	F	54	Went to Wuhan 3 days ago	The first test was positive	Chills and headache for 3 days, fever (37.6°C) for 1 day	9.70	3.38	2.34	0.61	0.01	0.050
P14	M	75	From Wuhan	The first test was positive	Cough and fever 1 week (38.9°C)	78.70	5.36	4.28	0.93	0.00	0.105

Abbreviations: F, female; M, male; CRP, C-reactive protein; WBC, white blood cells; NEUT, neutrophil; LY, lymphocyte; EO, eosnophils; #: cell count; NA, not applicable. Note: The normal reference value range is listed behind the blood test index.

Table 2
Imaging characteristics during the first visit.

Imaging characteristics	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11
Lobar location											
RUL						√		√	√	√	
RML	√	√							√	√	
RLL	√	√			√	√	√	√	√	√	√
LUL			√					√	√	√	
LLL				√		√	√	√	√	√	
Distribution											
Subpleural	√	√			√	√	√	√	√		√
Random or diffuse			√	√						√	
Morphology											
Patchy-like	√	√			√	√		√	√		
Nodular-like			√	√							√
Both							√			√	
Contour											
Clear			√			√					√
Blurry	√	√		√	√		√	√	√	√	
Attenuation											
GGO only	√		√	√	√				√		
Mixed GGO and consolidation		√				√	√	√		√	√
Consolidation only											
Other signs											
Reticulation						√					
crazy paving	√							√	√	√	
Cavitation											
Bronchiectasis						√					
Pleural effusion											
Lymphadenopathy											

Abbreviations: RUL-right upper lobe, RML-right middle lobe; RLL-right lower lobe, LUL-left upper lobe, LLL-left lower lobe; GGO, ground glass opacity. "P#" represents one patient. Note: Check mark (√) indicate the appearance of the corresponding sign.

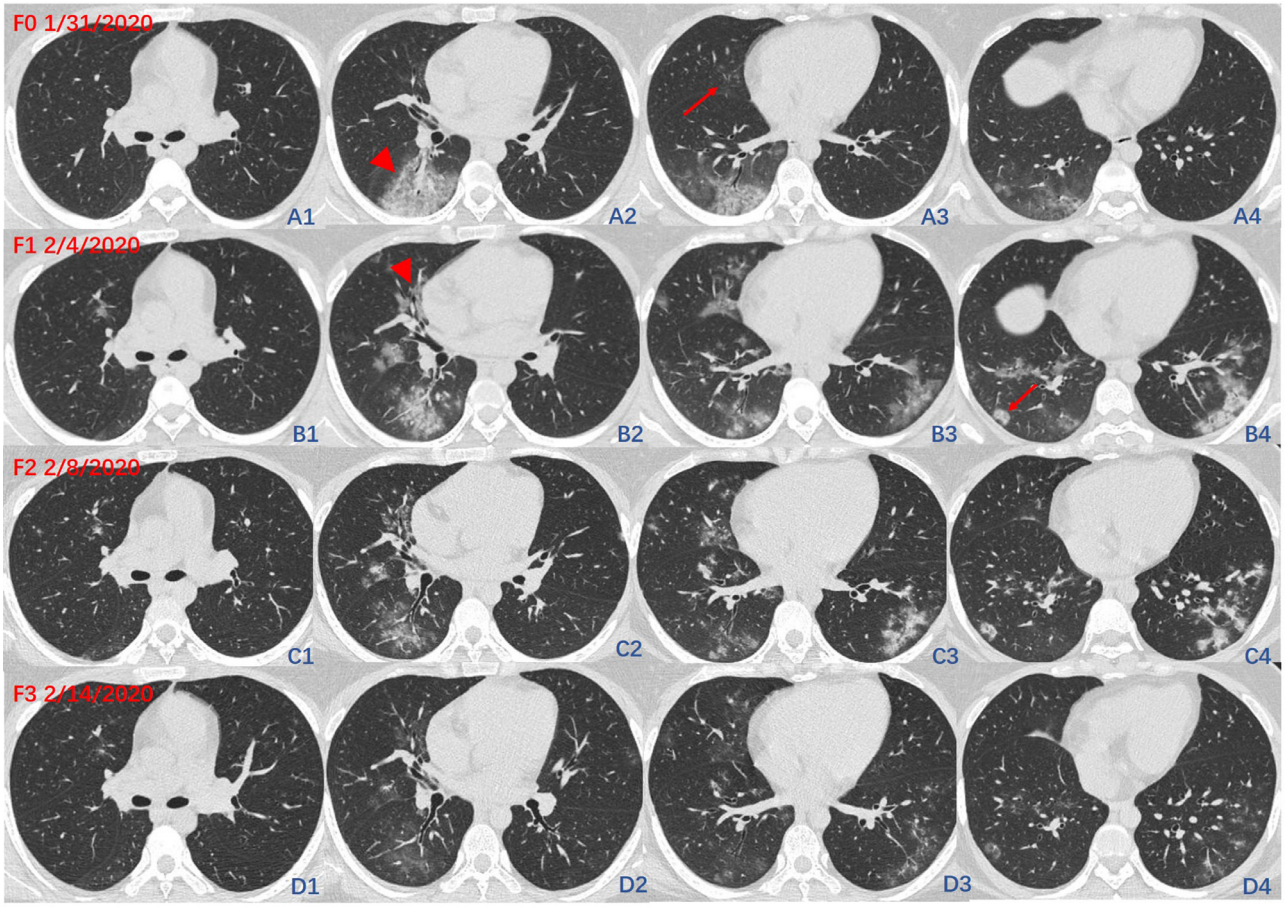

Fig. 1. The initial CT images (F0) and three times of follow-up CT images (F1–F3) of P1. F0 showed patchy-like pure GGO located in the subpleural regions of the right middle lobe (F0, A3, arrow) and the right lower lobe, accompanied by crazy paving sign (F0, A2, arrowhead). Follow-up 1(F1, B1–B4): CT images showed diseases progression. The lesions manifested as coexisted nodular-like (F1, B4, arrow) and patchy-like lesions as well as peribronchial (F1, B2, arrowhead), central and subpleural distribution. The lesions are migratory manifested as the absorption of the primary lesions and the emergence of new lesions. CT images of Follow-up 2 (F2, C1–C4) and Follow-up 3 (F3, D1–D4) showed lesion absorption.

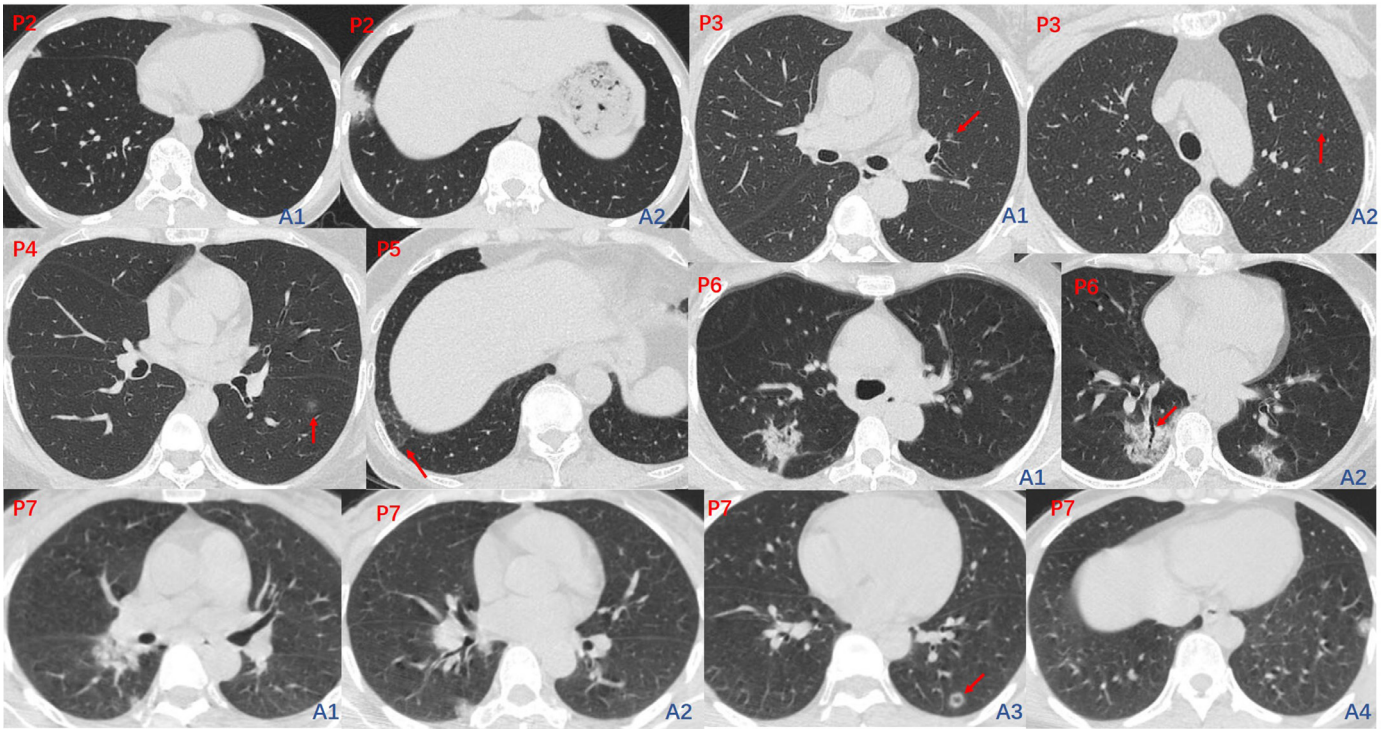

Fig. 2. The initial CT images of P2-P7. CT images of P2 (Fig. 2, P2, A1-A2), P5 (Fig. 2, P5), P6 (Fig. 2, P6, A1-A2) and P7 (Fig. 2, P7, A1–A4) showed subpleural lesions, a nodular-like lesion with pseudocavitary sign (Fig. 2, P7, A3, arrow) and mild bronchiectasis (Fig. 2, P6, A2, arrow) were also observed within the lesion. CT images of P3 (Fig. 2, P3, A1-A2) and P4 (Fig. 2, P4) showed round nodular-like GGO lesions (P3 and P4, arrow) located in the central area of the lung.

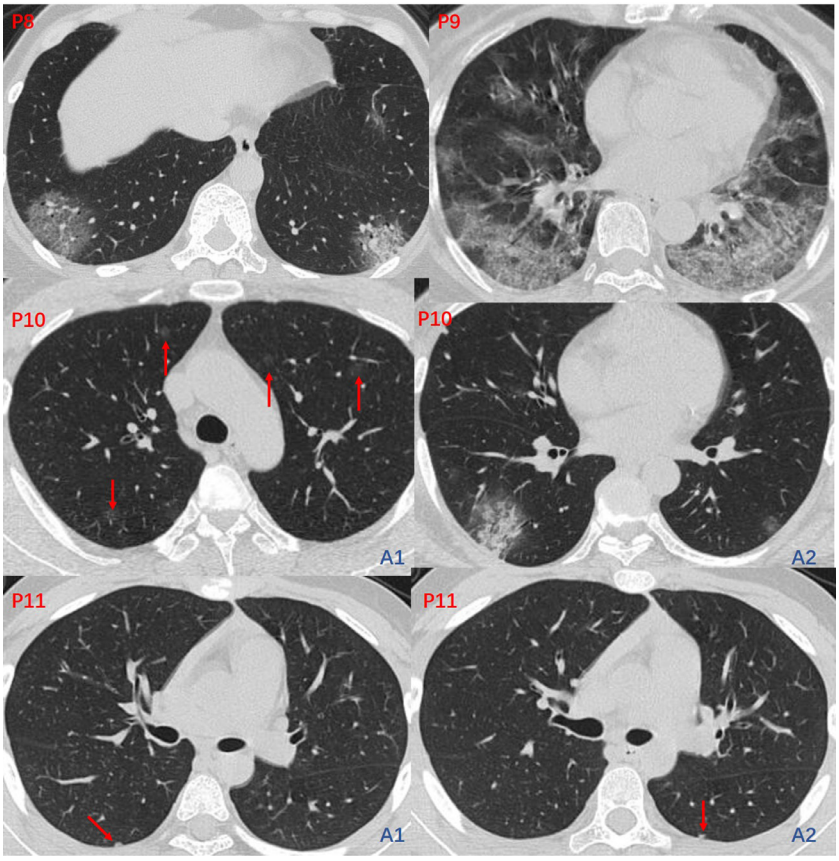

Fig. 3. The initial CT images of P8-P11. CT images of P8 (Fig. 3, P8) and P9 (Fig. 3, P9) showed bilateral subpleural lesions with crazy paving sign. CT images of P10 (Fig. 3, P10, A1-A2) showed bilateral multiple lesions, some of them were pure GGO located in the central region of the lung. CT images of P11 (Fig. 3, P11, A1-A2) showed bilateral subpleural small nodular-like lesions.

Declaration of Competing Interest

The authors declare that they have no competing interests.

References

1. Tang JW, Tambyah PA, Hui DSC. Emergence of a novel coronavirus causing respiratory illness from Wuhan, China. *J Infect* 2020 Jan 28. doi:10.1016/j.jinf.2020.01.014.
2. Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet* 2020;**395**(10223). doi:10.1016/S0140-6736(20)30183-5.
3. Wang D, Hu B, Hu C, et al. Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus-Infected Pneumonia in Wuhan, China. *JAMA* 2020. doi:10.1001/jama.2020.1585.
4. Song F, Shi N, Shan F, et al. Emerging Coronavirus 2019-nCoV Pneumonia. *Radiology* 2020. doi:10.1148/radiol.2020200274.
5. Xie X, Zhong Z, Zhao W, et al. Chest CT for Typical 2019-nCoV Pneumonia: Relationship to Negative RT-PCR Testing. *Radiology* 2020. doi:10.1148/radiol.2020200343.
6. Pan Y, Guan H, Zhou S, et al. Initial CT findings and temporal changes in patients with the novel coronavirus pneumonia (2019-nCoV): a study of 63 patients in Wuhan, China. *Eur Radiol* 2020. doi:10.1007/s00330-020-06731-x.
7. Chan JF, Yuan S, Kok KH, et al. A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster. *Lancet* 2020;**395**(10223). doi:10.1016/S0140-6736(20)30154-9.
8. To KK, Tsang OT, Chik-Yan Yip C, et al. Consistent detection of 2019 novel coronavirus in saliva. *Clin Infect Dis* 2020. doi:10.1093/cid/ciaa149.

Ying Zhu[1]
Department of Radiology, The First Affiliated Hospital, Sun Yat-sen University, Guangzhou 510080, Guangdong, PR China
Institution of Precision Medicine, The First Affiliated Hospital, Sun Yat-sen University, Guangzhou 510080, Guangdong, PR China

Zhen-Hua Gao[1]
Department of Radiology, The First Affiliated Hospital, Sun Yat-sen University, Guangzhou 510080, Guangdong, PR China
Department of Radiology, Hui Ya Hospital of The First Affiliated Hospital, Sun Yat-sen University, Huizhou 516080, Guangdong, PR China

Yang-Li Liu[1]
Division of Pulmonary and Critical Care Medicine, The First Affiliated Hospital, Sun Yat-sen University, Guangzhou 510080, Guangdong, PR China

Dan-Yang Xu
Department of Radiology, The First Affiliated Hospital, Sun Yat-sen University, Guangzhou 510080, Guangdong, PR China

Tian-Ming Guan
Department of Radiology, Hui Ya Hospital of The First Affiliated Hospital, Sun Yat-sen University, Huizhou 516080, Guangdong, PR China

Zi-Ping Li, Jian-Yi Kuang, Xiang-Min Li*, You-You Yang*, Shi-Ting Feng*
Department of Radiology, The First Affiliated Hospital, Sun Yat-sen University, Guangzhou 510080, Guangdong, PR China

*Corresponding authors.
E-mail addresses: lixiangm@mail.sysu.edu.cn (X.-M. Li), yangyouy@mail.sysu.edu.cn (Y.-Y. Yang), fengsht@mail.sysu.edu.cn (S.-T. Feng)
[1] These authors contributed equally to this work and should be consider as co-first authors.

Accepted 21 March 2020