Case Report

Clinical features and chest CT findings of 3 cases of 2019 novel coronavirus (COVID-19) pneumonia✩✩✩

Xiaoyan Hu, M.Sa,b, Jie Gou, B.Sa,b, Liang Guo, M.Sb,*

a Department of Radiology, Chengdu First People's Hospital, 18 Wanxiang North Road, Chengdu, 610000, Sichuan Province, China
b The Public Health Clinical Center of Chengdu, 18 Jingjusi Road, Chengdu, 610000, Sichuan Province, China

Abstract

Since December 2019, a new type of acute respiratory disease caused by the 2019 novel coronavirus (COVID-19) appeared in Wuhan, China. Currently, positive of virus nucleic acid in respiratory or blood samples is the gold standard for the diagnosis of the disease, but the nucleic acid test may be false negative. Chest CT examination plays an important role in diagnosis of COVID-19 pneumonia. The clinical manifestations, laboratory examination, and chest CT characteristics of 3 patients with COVID-19 pneumonia were reported. The main clinical manifestation of the 3 patients was fever. White blood cell, neutrophil cell, and lymphocyte cell count can be normal, only C-reactive protein slightly elevated. Real-time fluorescence polymerase chain reaction of throat swab detection can be negative. Chest CT showed multifocal ground-glass opacities in the peripheral of bilateral lungs. Ground-glass opacities with consolidation, air bronchogram, vascular enlargement, and halo sign were found. In the early stages of COVID-19 pneumonia, the laboratory parameters may be normal, the nucleic acid test may be false negative. Chest CT examination may be helpful for diagnosis of COVID-19 pneumonia.

© 2020 The Authors. Published by Elsevier Inc. on behalf of University of Washington. This is an open access article under the CC BY-NC-ND license. (http://creativecommons.org/licenses/by-nc-nd/4.0/)

Background

Since December 2019, multiple pneumonia cases of unknown causes have occurred across Wuhan, Hubei Province, China. The epidemic disease, which had been confirmed to have been caused by a novel coronavirus through high-throughput sequencing [1–3], has rapidly spread across the country and abroad. On February 11, 2020, the World Health Organization officially named the virus as COVID-19. The clinical features and chest CT findings of 3 cases of COVID-19 pneumonia are reported as follows.

✩ Declaration of Competing Interest: The authors declare that they have no conflict of interest.
✩✩ Ethics approval: With the approval of the hospital ethics committee, the informed consent was waived.
* Corresponding author.
E-mail addresses: hxy6293@qq.com (X. Hu), 18215681467@163.com (L. Guo).
* These two authors contributed equally to this study.
https://doi.org/10.1016/j.radcr.2020.06.031
1930-0433/© 2020 The Authors. Published by Elsevier Inc. on behalf of University of Washington. This is an open access article under the CC BY-NC-ND license. (http://creativecommons.org/licenses/by-nc-nd/4.0/)
Case presentation

Case 1: A 22-year-old woman, who had a history of close contact with COVID-19 pneumonia patient, was admitted to hospital due to fever (38.6°C) and cough for 3 days. Her laboratory examination showed the normal white blood cell count, neutrophil cell count, lymphocyte cell count, and C-reactive protein. Real-time fluorescence polymerase chain reaction of throat swab was positive for COVID-19. The initial chest CT manifestation was normal. 8 days after admission, follow-up chest CT showed multifocal ground-glass opacities (GGO) in the peripheral of bilateral lungs. GGOs with consolidation, air bronchogram, vascular enlargement, and halo sign were found. After 15 days of admission, follow-up chest CT showed the consolidation was completely resolved and the halo sign was disappeared. The GGOs were partial resolution (Fig. 1).

Case 2: A 49-year-old woman, who had a history of close contact with COVID-19 pneumonia patient, was admitted to hospital due to a high-grade fever (38.4°C) for 6 days. Her laboratory examination showed the normal white blood cell count, neutrophil cell count, and lymphocyte cell count. The C-reactive protein was elevated (37.24 mg/L, normal range 0-10 mg/L). The 4 times of COVID-19 by real-time fluorescence polymerase chain reaction of throat swab were negative. The fifth time real-time fluorescence polymerase chain reaction for COVID-19 with alveolar lavage fluid was finally confirmed to be positive. Chest CT showed multifocal GGOs with air bronchogram, vascular enlargement, interlobular septal thickening, crazy paving pattern, and halo sign in the peripheral of bilateral lower lobes. Some consolidation and fibrous were appeared in the right lower lobe. After 4 days of admission, follow-up chest CT showed progression of consolidation, and new multiple spots GGOs and mixed density lesions in upper lobes of bilateral lungs were found (Fig. 2).

Case 3: An 81-year-old man had a history of contact with Wuhan people. He admitted to hospital with 7 days of fever (38.6°C), cough, fatigue, dyspnea, and myalgia. At admission, his laboratory examination showed the normal white blood cell count, neutrophil cell count, lymphocyte cell count, and elevated C-reactive protein (38.25 mg/L, normal range 0-10 mg/L). Influenza virus and real-time fluorescence polymerase chain reaction of throat swab for COVID-19 were positive. Chest CT showed chronic bronchitis, reticular and/or interlobular septal thickening, and GGOs in the peripheral of bilateral lungs. After 6 days of treatment, the white blood cell still normal. The lymphocyte cell count (0.57 × 10^9/L, normal range 0.80-4.00 × 10^9/L) and lymphocyte ratio were decreased (7.75%, normal range 20%-40%). Repeat chest CT showed progression of GGOs and interlobular septal thickening. Air bronchogram, crazy paving pattern, and pleural effusion were appeared (Fig. 3).

Discussion and conclusions

The main clinical manifestation of COVID-19 pneumonia was fever. White blood cell and lymphocyte count may be normal in the early stage. According to the guideline of Diagnosis and Treatment of Pneumonitis Caused by 2019-nCoV (trial sixth version) published by the China government [4], COVID-19 diagnosis must be confirmed by the reverse transcription polymerase chain reaction (RT-PCR) or gene sequencing for respiratory or blood specimens. However, due to the limitations of sample collection and transportation, as well as the performance of the kit, it has been reported that the overall positive rate of RT-PCR initially presented by throat swab samples is about 30% to 60%.[5]. Chest CT, as a conventional imaging tool for the diagnosis of pneumonia, is relatively easy to perform and can produce rapid diagnosis. In this context, chest CT may provide benefit for COVID-19 diagnosis [6]. As previously reported [7-9], almost all patients with COVID-19 have typical chest CT features, including pure GGOs, GGOs...
Fig. 2 – 2a and 2b: Chest CT showed multifocal GGOs. GGO with air bronchogram, vascular enlargement, interlobular septal thickening, consolidation, and crazy paving pattern in the peripheral of right lower lobe. 2c and 2d: 4 days later, follow-up chest CT showed progression of consolidation.

Fig. 3 – 3a: Chest CT showed GGOs and interlobular septal thickening in the peripheral of bilateral lungs. 3b and 3c: After 6 days of treatment, repeat chest CT showed progression of GGOs and interlobular septal thickening. Air bronchogram, crazy paving pattern, and pleural effusion were appeared.

with interstitial and/or interlobular septal thickening, GGOs with consolidation, multifocal patchy consolidation, broncholar wall thickening, and interlobular septal thickening, with a peripheral distribution with bilateral, multifocal lower lung involvement.

Case 1 patient who was confirmed by positive of real-time fluorescence polymerase chain reaction of throat swab for COVID-19 was admitted to hospital due to fever. The initial chest CT manifestation and laboratory examination were normal. However, follow-up chest CT 8 days after admission showed the relevant manifestations of COVID-19 pneumonia including multifocal GGOs, GGOs with consolidation, air bronchogram, vascular enlargement, and halo sign. The repeated CT after 15 days later of admission showed the consolida-
tion was completely resolved and the halo sign was disappeared. Similar results have been found in previous studies [7,10]. Chung [7] found that some patient developed GGO 3 days later of follow-up chest CT, whose initial chest CT was normal. While in Xu’s [10] research, follow-up chest CT found that most lesions were absorbed 4 to 10 days after treatment. This may indicate that the lesions may change in a short time, and repeated CT scans may provide evidence for clinical diagnosis and treatment.

In case 2, the initial chest CT examination showed typical signs of COVID-19 pneumonia, including multifocal GGOs with air bronchogram, interlobular septal thickening, crazy paving pattern, and halo sign in the peripheral of bilateral lower lobes, which were in consistent with previous studies [7–9]. However, the laboratory examination showed no specific abnormalities in white blood cell count, neutrophil cell count and lymphocytes cell count and only a slight increase in C-reactive protein. The 4 times of COVID-19 by real-time fluorescence polymerase chain reaction of throat swab were negative. The fifth time real-time fluorescence polymerase chain reaction for COVID-19 with alveolar lavage fluid was finally confirmed to be positive. It may be due to the influence of sampling errors, laboratory testing technology and other reasons, nucleic acid testing has a certain false negative [11,12]. Previous studies showed that the majority of cases of COVID-19 had similar features on CT imaging, such as GGOs, GGOs with consolidation, GGOs with interstitial and/or interlobular septal thickening [7–9]. In the context of typical clinical manifestation and exposure to other COVID-19 patients, CT features of viral pneumonia may be strongly suspicious for COVID-19 infection despite negative RT-PCR results. In these cases, repeat swab testing and patient isolation should be considered.

In case 3, the patient had COVID-19 and other influenza virus infections with coexisting chronic bronchitis. His chest CT showed reticular and/or interlobular septal thickening, and GGOs in the peripheral of bilateral lungs. The CT manifestations of influenza virus pneumonia were similar to COVID-19 pneumonia [13], Chest CT of both COVID-19 and influenza virus pneumonia can show pure GGOs, GGOs with consolidation, and interlobular septal thickening, which was difficult to differentiate from them. Studies showed that both COVID-19 and influenza pneumonia involved bilateral lungs with multiple lung lobes, and a majority of patients in both COVID-19 and influenza involved all 5 lobes [14–16]. However, the COVID-19 pneumonia mainly involved peripheral part of the lung, while influenza pneumonia was more diffuse and involved both central and peripheral parts [17]. Wang et al. [18] found that COVID-19 presented a distinct lesion margins and a shrinking contour compared with influenza pneumonia. And COVID-19 had a patchy or combination of GGO and consolidation opacities, while a cluster-like pattern and bronchial wall thickening were more frequently seen in influenza pneumonia. These characteristics may distinguish COVID-19 with influenza pneumonia.

In the early stages of COVID-19 pneumonia, the laboratory parameters and chest CT manifestation may be normal, the nucleic acid test may be false negative, and it is difficult to differentiate from chronic bronchitis or other influenza virus infections. Therefore, doctors should combine the clinical manifestations and epidemiological history, and cannot easily exclude the COVID-19, so as to avoid missed diagnosis and misdiagnosis of the disease, delay the treatment of patients and increase the risk of disease transmission.

REFERENCES

[1] Huang CL, Wang YM, Li XW, Ren LL, Zhao JP, Hu Y, et al. Clinical features of patients with 2019 novel coronavirus in Wuhan, China. Lancet. 2020. doi:10.1016/S0140-6736(20)30183-5.
[2] World Health Organization. Novel coronavirus–China. http://www.who.int/csr/don/12-january-2020-novel-coronavirus-china/en. 12 January 2020.
[3] World Health Organization. WHO/novel coronavirus–China. Geneva, Switzerland: World Health Organization; 2020.
[4] General Office of National Health Committee. Notice on the issuance of a program for the diagnosis and treatment of novel coronavirus (2019-nCoV) infected pneumonia (trial sixth edition)2020. http://www.nhc.gov.cn/yyzt/s7653p/202002/8334a8326dd4329d551d7a9a8ec2.shtml#from-timeLine (Accessed February 24, 2020).
[5] Yang Y, Yang M, Shen C, Wang F, Yuan J, Li J, et al. Evaluating the accuracy of different respiratory specimens in the laboratory diagnosis and monitoring the viral shedding of 2019-nCoV infections. Medrxiv 2020. doi:10.1101/2020.02.11.20021493.
[6] Ai T, Yang ZI, Hou HY, Zhan CN, Chen C, Lv W, et al. Correlation of Chest CT and RT-PCR Testing in Coronavirus Disease 2019 (COVID-19) in China: A Report of 1014 Cases. Radiology 2020. doi:10.1148/radiol.2020200642.
[7] Chung M, Bernheim A, Mei XY, Zhang N, Huang MQ, Zeng XJ, et al. CT imaging features of 2019 novel coronavirus. (2019-nCoV). Radiology 2020. doi:10.1148/radiol.2020200230.
[8] Song FX, Shi NN, Shan F, Zhang ZY, Shen J, Lu H, et al. Emerging coronavirus 2019-nCoV pneumonia. Radiology 2020;295(1):200274.
[9] Kanne J. Chest CT findings in 2019 novel coronavirus (2019-nCoV) infections from Wuhan, China: key points for the radiologist. Radiology 2020. https://pubs.rsna.org/doi/10.1148/ radiol.2020200241.
[10] Xu YH, Dong JH, An WM, Lv XY, Yin XP, Zhang JZ, et al. Clinical and computed tomographic imaging features of novel coronavirus pneumonia caused by SARS-CoV-2. J Infect 2020. doi:10.1016/j.jinf.2020.02.017.
[11] Huang PK, Liu TZ, Huang LS, Liu HL, Lei M, Xu WD, et al. Use of chest CT in combination with negative RT-PCR assay for the 2019 novel coronavirus but high clinical suspicion. Radiology 2020. doi:10.1148/radiol.202020030.
[12] Xie X, Zhong Z, Zhao W, Zheng C, Wang F, Liu J. Chest CT for typical 2019-nCoV pneumonia: relationship to negative RT-PCR testing. Radiology 2020. doi:10.1148/radiol.2020000943.
[13] Wang QL, Zhang ZY, Shi XY, Jiang YB. Emergent H7N9 influenza A (novel reassortant avian-origin) pneumonia: radiologic findings. Radiology 2013;268(3):882−9.
[14] Kim MC, Kim MY, Lee HJ, Lee SO, Choi SH, Kim YS, et al. CT findings in viral lower respiratory tract infections caused by parainfluenza virus, influenza virus and respiratory syncytial virus. Medicine (Baltimore) 2020;99:e4003. doi:10.1097/MD.0000000000004003.
[15] Pan Y, Guan H, Zhou S, Wang Y, Li Q, Zhu T, 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.
[16] Lei J, Li J, Li X, Qi X. CT imaging of the 2019 novel coronavirus (2019-nCoV) pneumonia. Radiology 2020. doi:10.1148/radiol.2020200236.

[17] Koo HJ, Lim S, Choe J, Choi SH, Sung H, Do KH. Radiographic and CT features of viral pneumonia. Radiographics 2018;38:719–39.

[18] Wang H, Wei R, Rao G, Zhu J, Song B. Characteristic CT findings distinguishing 2019 novel coronavirus disease (COVID-19) from influenza pneumonia. Eur Radiol 2020. doi:10.1007/s00330-020-06880-z.