

Available online at www.sciencedirect.com

ScienceDirect

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

Case Report

Pulmonary emphysema, bullae, and pneumothorax in COVID-19 pneumonia ☆

Wenrui Xu, MD^a, Xiaojie Luo, MD^a, He Wang, MD^b, Cheng Shen, MD^a, Yan Song, MD^{a,*}, Tieying Sun, MD^{b,*}, Min Chen, MD, PhD^a

^aDepartment of Radiology, Beijing Hospital, National Center of Gerontology; Institute of Geriatric Medicine, Chinese Academy of Medical Sciences, No.1 DaHua Road, Dong Dan, Beijing, 100730 P.R. China

^bDepartment of Respiratory and Critical Care Medicine, Beijing Hospital, National Center of Gerontology; Institute of Geriatric Medicine, Chinese Academy of Medical Sciences, No.1 DaHua Road, Dong Dan, Beijing, 100730 P.R. China

ARTICLE INFO

Article history:

Received 8 November 2020

Revised 28 January 2021

Accepted 28 January 2021

Available online 31 January 2021

Keywords:

Pulmonary emphysema

Pneumothorax

COVID-19 pneumonia

ABSTRACT

In this paper, we described 2 cases with COVID-19 pneumonia, who developed pulmonary emphysema, bullae, and pneumothorax during therapy. In a 48-year-old man with mechanical ventilation, parts of ground glass opacities and consolidations transformed into emphysema and giant bulla, and bilateral pneumothorax were also observed. In a 35-year-old man, localized emphysema and pulmonary bullae were seen in subpleural area in bilateral upper lobes, where no previous lesions were presented. In conclusion, pulmonary emphysema, bullae, and pneumothorax could be complications of COVID-19. On one hand, surgical emphysema in ventilated COVID-19 patients was observed as in SARS patients. On the other hand, more serious destruction of lung parenchyma was found in COVID-19 patients.

© 2021 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/>)

Introduction

In December 2019, a severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection broke out in Wuhan, Hubei Province, China. On February 12, 2020, WHO officially named the disease caused by SARS-CoV-2 as Coronavirus Disease 2019 (COVID-19) [1]. As of September 20, COVID-19 resulted in over 30.6 million confirmed cases and 950,000 deaths worldwide [2].

Since most COVID-19 infected patients were diagnosed with pneumonia, chest CT played a central role in the diag-

nosis and management [3]. Several case series and case reports demonstrated the CT features on presentation and its temporal progressions during therapy. In COVID-19 pneumonia, ground glass opacity (GGO) and consolidation emerged from the onset, increasing in number and density, and gradually being absorbed, leaving fibrous changes at the original site [4–7]. However, only several cases who developed pulmonary bullae or pneumothorax were reported so far [8,9].

In this paper, we described 2 cases with COVID-19 pneumonia, who developed pulmonary emphysema, bullae, and pneumothorax during therapy. The purpose of this case report is to

☆ Competing Interest: The authors declare that they have no competing interests.

* Corresponding authors.

E-mail addresses: firesong@sina.com (Y. Song), suntieying@126.com (T. Sun).

<https://doi.org/10.1016/j.radcr.2021.01.055>

1930-0433/© 2021 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/>)

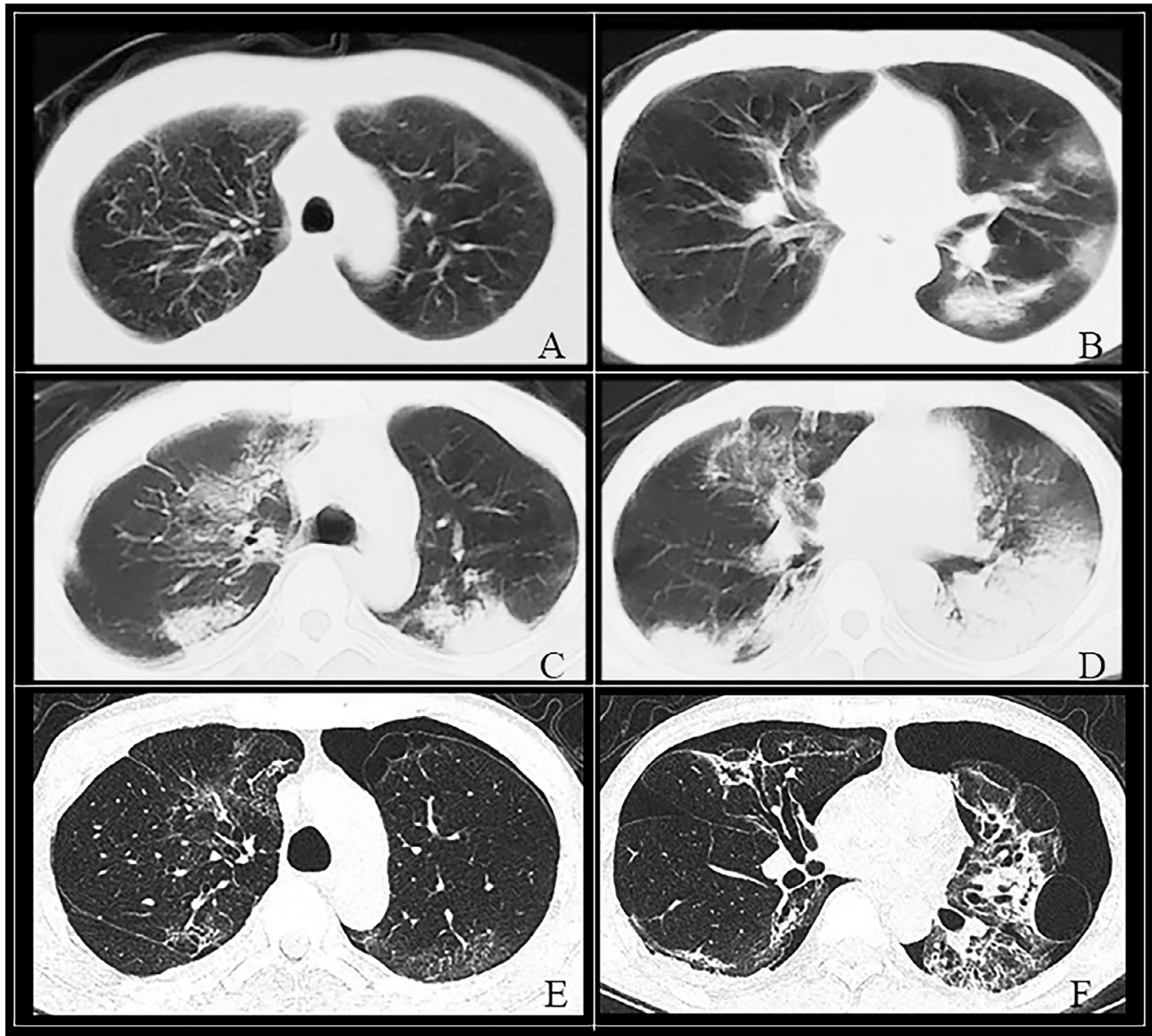


Fig. 1 – Chest CT images of a 48-year-old man with COVID-19. (A-B) Initial CT images showed multiple ground-glass opacities (GGOs) in peripheral area in bilateral lungs. (C-D) Images obtained on day 15 showed that GGOs increased in extent and density, progressing into multiple consolidations. (E-F) On day 45, parts of GGOs and consolidations transformed into emphysema and giant bulla, and bilateral pneumothorax were also observed.

share our experience in temporal progressions of COVID-19 on CT and alert the clinicians with this clinical situation.

Case 1

A 48-year-old man from Wuhan (the epicenter of the COVID-19 outbreak) presented to local hospital with fever and cough for 5 days. After 15 days' supportive treatment, the clinical symptoms deteriorated and the patient was transferred to our ward in Tongji hospital, Wuhan.

On admission to our ward, real-time reverse transcriptase-polymerase chain reaction (rRT-PCR) result for SARS-CoV-2

was positive in oropharyngeal swabs. Screening was positive for influenza A. Therefore, he received supportive treatment for COVID-19 and Tamiflu for influenza A. On day 17 from onset, the patient developed left chest pain during inhalation, and subsequent follow-up chest CT revealed bilateral pneumothorax. High-flow nasal cannula oxygen therapy was initiated, and closed thoracic drainage was performed, until the last follow-up CT scan. No assisted respiration via noninvasive ventilator was given to this patient.

From onset to the last follow-up CT scan, the CT images showed a serial transformations of pulmonary lesions. The initial chest CT showed ground-glass opacities (GGOs) and patchy consolidations in bilateral lungs, predominantly affecting the subpleural area (Figs. 1A and B). On day 15, the

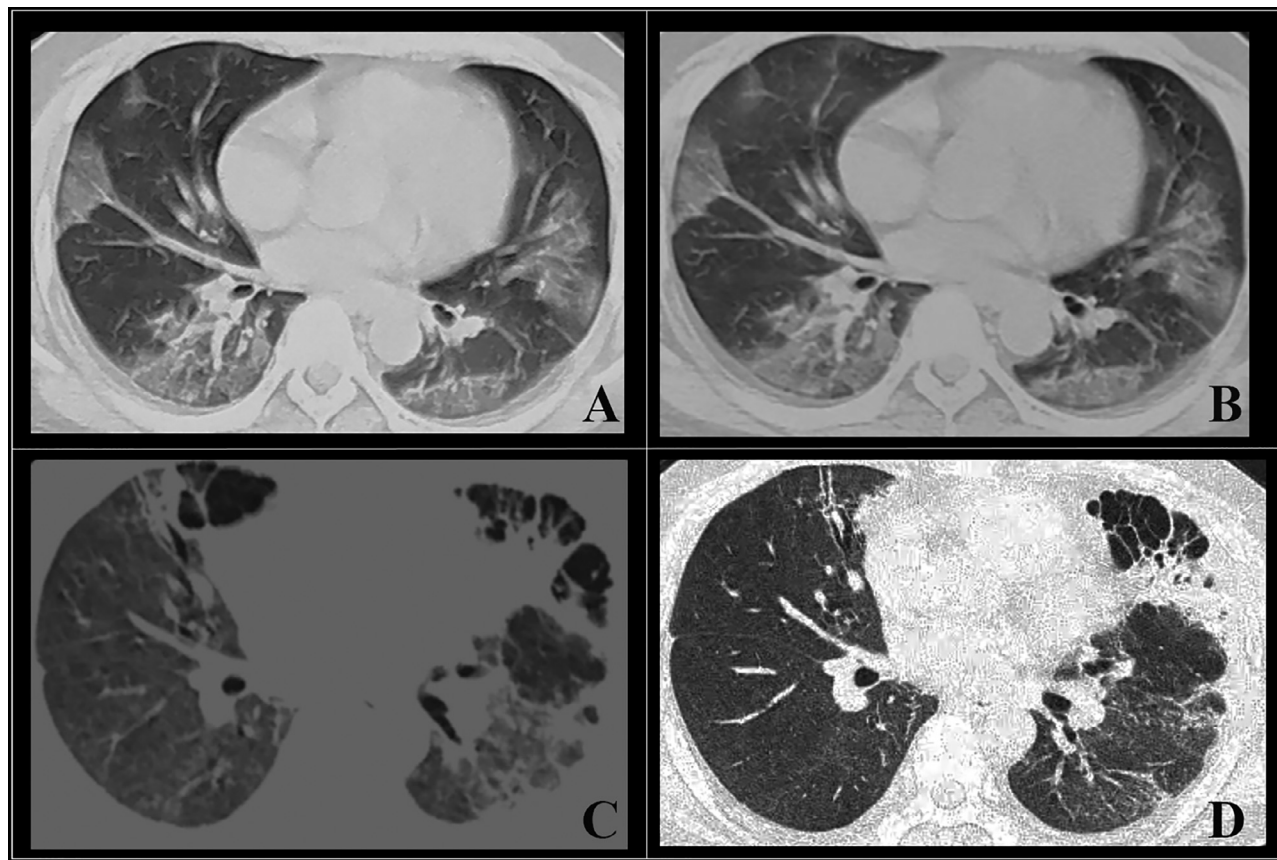


Fig. 2 – Chest CT images in a 35-year-old man with COVID-19. A. Initial chest CT image on admission showed multiple peripheral GGOs and patchy consolidations in both lungs. (B–D) Follow-up CT images obtained on day 12, 24, and 32, showed localized emphysema and pulmonary bullae in subpleural area in bilateral upper lobes, where no previous lesions were present.

lesions increased both in extent and density and progressed to multiple consolidations, from peripheral to central area (Figs. 1C and D). Subsequently, parts of GGOs and consolidations transformed into emphysema and giant bulla, and bilateral pneumothorax were also observed (Figs. 1E and F).

Case 2

A 35-year-old man from Wuhan was admitted to local hospital due to fever, cough, and dyspnea. On admission, a diagnosis of COVID-19 pneumonia, acute respiratory distress syndrome, type I respiratory failure and hypoproteinemia was made. Emergency measures were taken, and the patient was treated with antiviral (ganciclovir, oseltamivir) and anti-inflammatory medication (meropenem, linezolid), with supportive care for 35 days in local hospital. On day 36 from onset, the patient was transferred to our ward in Tongji hospital, Wuhan.

Initial chest CT on admission showed multiple peripheral GGOs and patchy consolidations in both lungs, which did not spare the subpleural regions (Fig. 2A). On images obtained on day 12 (Fig. 2B), day 24 (Fig. 2C), and day 32 (Fig. 2D), localized emphysema and pulmonary bullae were seen in subpleural

area in bilateral upper lobes, where no previous lesions were presented.

Discussion

More than 100 critically ill patients with COVID-19 had been treated in our ward, among which 2 cases presented with pulmonary emphysema, bullae and pneumothorax during therapy. In contrast with severe acute respiratory syndrome (SARS) pandemic in 2003, COVID-19 has a much lower incidence of pneumothorax, which was reported 12%–34% in mechanically ventilated SARS patients [5,10]. However, there existed obvious differences between the 2 cases.

For case 1, the patient was diagnosed with both COVID-19 pneumonia and influenza A, and no mechanical ventilation was used. The bullae were presented within the GGOs and consolidations, and serial CT images demonstrated this transformation. Recent pathological reports of COVID-19 revealed various damages in the alveolar structure, with minor serous exudation and fibrin exudation [11]. The bullae could be related to massive damages in the alveolar structure and subse-

quent fibrous changes, further resulting in the development of pneumothorax.

For case 2, assisted respiration via noninvasive ventilator was given to treat acute respiratory distress syndrome. Localized emphysema and pulmonary bullae appeared in subpleural sparing in bilateral upper lobes, where no previous lesions were present. This was similar to the surgical emphysema in mechanically ventilated SARS patients [9,10]. Therefore, the use of ventilator may play an important role in the process.

In conclusion, we described 2 COVID-19 cases with rare CT findings during therapy, suggesting that pulmonary emphysema, bullae, and pneumothorax could be complications of COVID-19. On one hand, surgical emphysema in ventilated COVID-19 patients was observed as in SARS patients. On the other hand, more serious destruction of lung parenchyma was found in COVID-19 patients.

Availability of data and material

Not applicable.

Code availability

Not applicable.

Patient consent statement

A written consent was obtained from the patient for publication of this case.

REFERENCES

- [1] World Health Organization. WHO Director-General's remarks at the media briefing on 2019-nCoV on 11 February 2020. 2020. Available at <https://www.who.int/dg/speeches/detail/who-director-general-s-remarks-at-the-media-briefing-on-2019-ncov-on-11-february-2020>. Published February 11, 2020.
- [2] WHO. Available at <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports/>. (Accessed April 12, 2020).
- [3] Zu ZY, Jiang MD, Peng P, Chen W, Ni QQ, Lu GM. Coronavirus disease 2019 (COVID-19): a perspective from China. *Radiology* 2020;296:E15–25.
- [4] Li M, Lei P, Zeng B, Li Z, Yu P, Fan B. Coronavirus disease (COVID-19): spectrum of CT findings and temporal progression of the disease. *Acad Radiol* 2020;27:603–8.
- [5] Wang Y, Dong C, Hu Y, Li C, Ren Q, Zhang X. Temporal changes of CT findings in 90 patients with COVID-19 Pneumonia: a longitudinal study. *Radiology* 2020;296:E55–64.
- [6] Wang Y, Dong C, Hu Y, Li C, Ren Q, Zhang X. Temporal changes of CT findings in 90 patients with COVID-19 Pneumonia: a longitudinal study. *Radiology* 2020;27:603–8.
- [7] Chen H, Ai L, Lu H, Li H. Clinical and imaging features of COVID-19. *Radiol Infect Dis* 2020.
- [8] Sun R, Liu H, Wang X. Mediastinal emphysema, giant bulla, and pneumothorax developed during the course of COVID-19 pneumonia. *Korean J Radiol* 2020;21:541–4.
- [9] Hussain A, Noorani A, Deshpande R, John L, Baghai M, Wendler O. Management of pneumothorax in mechanically ventilated COVID-19 patients: early experience. *Interact Cardiovasc Thorac Surg* 2020;31:540–3.
- [10] Kao H-K, Wang J-H, Sung C-S, Huang Y-C, Lien T-C. Pneumothorax and mortality in the mechanically ventilated SARS patients: a prospective clinical study. *Crit Care* 2005;9:R440–5.
- [11] Yao XH, Li TY, He ZC, Ping YF, Liu HW, Yu SC. [A pathological report of three COVID-19 cases by minimally invasive autopsies]. *Zhonghua Bing Li Xue Za Zhi* 2020;49:E009.