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Use of lung ultrasound for diagnosis and monitoring of coronavirus disease 2019 pneumonia: A case report

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Abstract

Knowledge of lung ultrasound characteristics of coronavirus disease 2019 pneumonia might be useful for early diagnosis and clinical monitoring of patients, and lung ultrasound can help to control the spread of infection in healthcare settings. In this case report, a 36-year-old man with severe acute respiratory syndrome coronavirus 2 infection was diagnosed by reverse transcription-polymerase chain reaction testing of a nasopharyngeal swab. The lung ultrasound findings for this patient were the interstitial-alveolar damage showing bilateral, diffuse pleural line abnormalities, subpleural consolidations, white lung areas and thick, irregular vertical artifacts. When the patient recovered from the severe acute respiratory syndrome coronavirus 2 infection, lung ultrasound images showed a normal pleural line with A-lines regularly reverberating. Performing lung ultrasound at the bedside minimizes the need to move the patient, thus reducing the risk of spreading infection among healthcare staff. Lung ultrasound is useful for early diagnosis and evaluation of the severity of coronavirus disease 2019 pneumonia and for monitoring its progress over the course of the disease.

Keywords

Coronavirus disease 2019 pneumonia, severe acute respiratory syndrome coronavirus 2 infection, lung ultrasound, consolidation, white lung

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Introduction

An outbreak of the novel coronavirus disease 2019 (COVID-19) that began in Wuhan, China, in December 2019, has spread in over 200 different countries in the world. Since then (4 June 2020), the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has caused 6,416,828 people infected with 382,867 deaths (https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports/).

The SARS-CoV-2 has a coronavirus envelope, is highly infectious and can cause a variety of symptoms such as headache, dry cough, dyspnea, myalgia, fatigue and fever.[1,2] The imaging of COVID-19 pneumonia mainly involves computed tomography (CT) and chest X-ray.[3] The characteristic feature is a development of pneumonia that is seen as ground-glass opacity in the peripheric parts of the lungs as the main finding on chest CT.[4] Several studies have shown that LUS is useful for diagnosing COVID-19 pneumonia.[5–7] Moreover, advantages of LUS, such as reduced healthcare worker exposure to infected patients, repeatability during follow-up, low-cost and ease of application in limited-resource settings, makes LUS a valuable and accessible clinical tool.[7]

Case report

A 36-year-old man presented to our fever clinic on 13 February 2020 in Nanchong, Sichuan, China, with a dry cough, headache, asthenia and fever, which had started 10 days previously. He denied any recent travel, but reported a history of contact with a family member from Wuhan, China (who had not been diagnosed with SARS-CoV-2 infection), which was considered a high-risk area for COVID-19 infection by the Chinese health authorities at the time.

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The patient did not have any chronic medical problems and was a non-smoker. The physical examination revealed that body temperature of 38.2°C, respiratory rate of 20 breaths per minute, pulse of 105 beats per minute, blood pressure of 109/71 mmHg, and his oxygen saturation was 91% in room air. The thoracic CT image (Figure 1(a) and (b)) showed bilateral lesions, patchy, also confluent and ground glass with the mixed consolidation. Blood tests showed lymphocytopenia, thrombocytopenia and high levels of lactate dehydrogenase (LDH) and other inflammatory markers. A nasopharyngeal swab sample was collected and tested for SARS-CoV-2. The test result was positive. The patient was isolated and was provided with symptomatic support and antiviral treatment (recombinant human interferon, lopinavir/ritonavir oral solution, diammonium glycyrrhizinate injection and methylprednisolone).

Lung ultrasonography procedure

The ethics committee of North Sichuan Medical College approved this study. Informed consent was obtained before the LUS procedure. The LUS examinations were performed using a portable device (Mindray/UMT-500, China) with a 5-MHz convex probe. Settings were set to penetration mode with a low center frequency and a single focus zone at the level of pleura, and compound scan technology was used in the diagnosis of consolidation. In order to reduce the exposure risk, only one emergency department (ED) physician (Y.C.) entered the isolation room, observing all the standard preventive measures for respiratory, droplet and contact isolation provided by the National Health Commission of the People's Republic of China for the COVID-19 outbreak. The ultrasound probe was enclosed in a sterile, plastic probe cover. The patient was scanned in the supine position following the LUS examination method described in a previous study.[3] Each hemithorax was divided into six regions using three longitudinal lines (parasternal, anterior and posterior axillary) and two axial lines (one above the diaphragm and the other 1 cm above the nipples). The ultrasound device was sterilized in a dedicated area and put enclosed in a new sterile plastic bag at the end of the procedure.

LUS images

During the hospitalization, the patient conducted a total of four ultrasound examinations, which were first, fifth, tenth, and fifteenth days of admission, respectively. The LUS was performed by the same ED physician using the same ultrasound device. The specific LUS findings for this patient were the interstitial-alveolar damage showing bilateral, diffuse pleural line abnormalities, subpleural consolidations, white lung areas and thick, irregular vertical artifacts (Figure 1(c)–(h)). When the patient recovered from the SARS-CoV-2 infection, LUS images showed a normal pleural line with A-lines regularly reverberating (Figure 1(i) and (j)). Detailed report of LUS findings at each examination are shown in Table 1.

Discussion

This report describes the use of LUS in a 36-year-old man with COVID-19 pneumonia who was admitted to our hospital in Nanchong in Sichuan Province in China. Our hospital has a policy of performing serial LUS examinations on the patients with COVID-19, so we performed LUS on this patients with COVID-19 and use this as a basis for a broader discussion of the benefits of LUS. We believe that our study makes a significant contribution to the literature because LUS is a potentially very useful clinical tool for the diagnosis and management of COVID-19, but it has not been recommended by the guidelines of Clinical Management of Coronavirus Disease 2019 (WHO/2019-nCoV/clinical/2020.5). Buonsenso et al.[8] use point-of-care LUS to evaluate a patient with documented nCov-19 infection. LUS shows pleural line irregularities, thick irregular vertical artifacts and subpleural consolidations, which was consistent with ours. However, we performed ultrasound examinations on the different courses of the patient more clearly and easily show how LUS findings followed the progression of the disease. Focal B-lines are the main feature in the early stage; consolidations and areas of white lung are the main features in the progressive stage; A-lines can be found in the convalescence. In Møller-Sørensen H's study, patients with verified COVID-19 disease hospitalized at the intensive care unit and treated with mechanical ventilator and extracorporeal membrane oxygenation (ECMO) were evaluated with LUS for pulmonary changes. LUS findings represent critically ill patients with COVID-19 pneumonia. The LUS findings of our case represent the vast majority of patients with mild and moderate COVID-19 pneumonia.

The use of LUS in the evaluation of a suspected COVID-19 patient has several implications. First, LUS images can be obtained instantly at bedside by one clinician, therefore reducing the number of health workers potentially exposed to the patient. Currently, the use of traditional imaging, such as chest X-ray or CT scan, require that the patient to be moved to the radiology unit, potentially exposing several healthcare workers and other patients to the risk of SARS-CoV-2 infection.[9] While using LUS, the same evaluating clinician can do other essential tests such as blood tests, intravenous feeding and injections and respiratory support. This is a primary advantage of LUS as SARS-CoV-2 is very contagious, and reducing exposure is the most effective way to prevent infection. Second, LUS can be used to perform an initial screening of lung pathology in individuals diagnosed as positive for SARS-CoV-2 infection in order to distinguish low-risk patients from high-risk patients. Patients with negative lung images can wait for second-level imaging if clinically stable and, thereby, reduce the risk of nosocomial transmission. Third, routine use of CT scan has certain implications especially a potential high-risk of radiation.[10] While LUS has the advantages of being easy to use, reliable, radiation-free, and it can be performed repeatedly in real time. Finally, the portable devices are easier to sterilize than CT scanners and radiography equipment due to their smaller

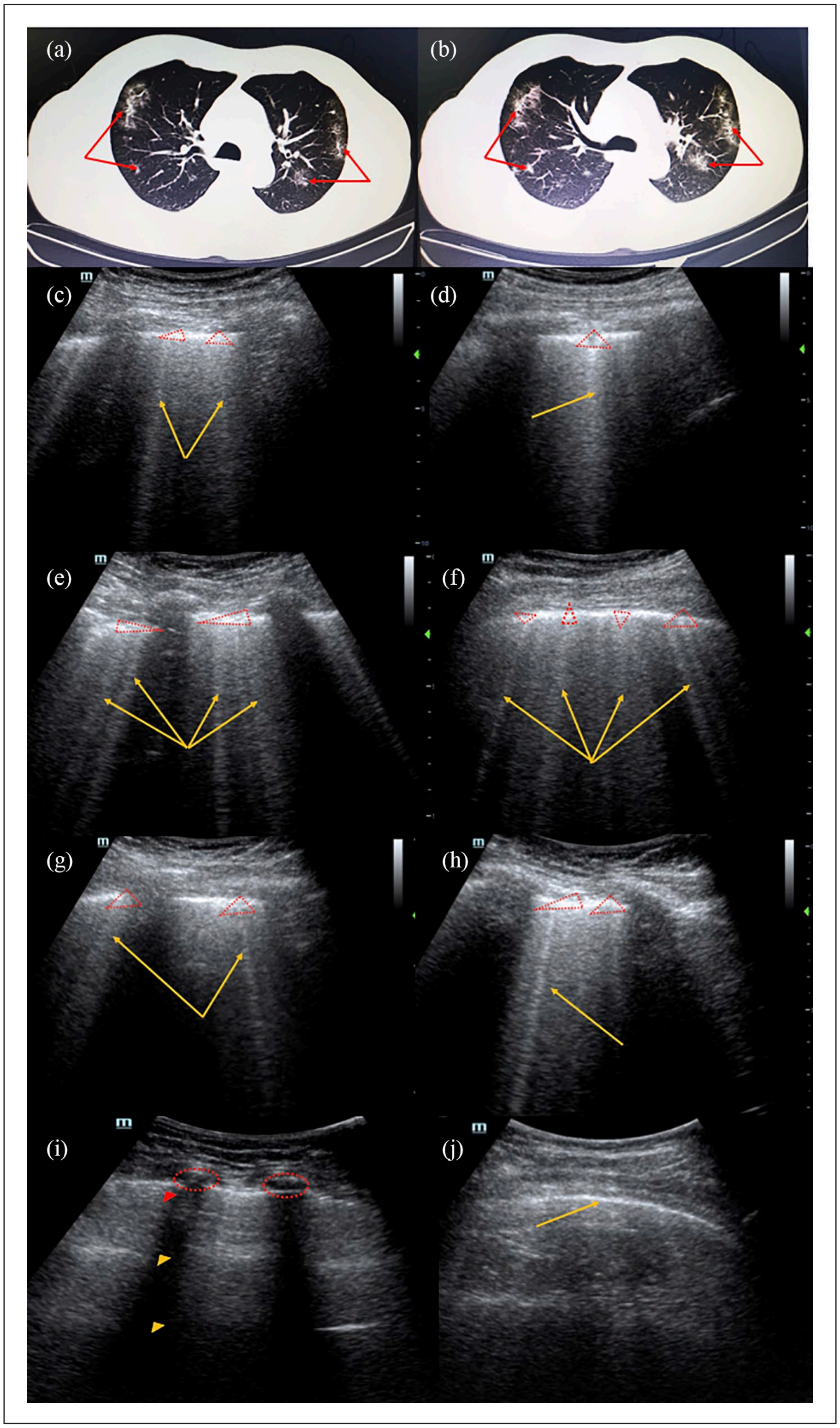

Figure 1. ((a) and (b)) Chest CT images of this patient showed multiple ground-glass opacities in both lungs, mainly in the subpleural areas (red arrows). The patient's lung ultrasound (LUS) images during the hospitalization. ((c) and (d)) The pleural line is interrupted by some visible small consolidations (red triangle) and thick irregular vertical artifacts (yellow arrows) on the first day. ((e) and (f)) There were more visible small consolidations, thick irregular vertical artifacts and areas of white lung (yellow arrows) with the progress of the disease on the fifth day. ((g) and (h)) Less small consolidations, thick irregular vertical artifacts and areas of white lung were observed with the improvement of disease on the tenth day. After recovery from COVID-19 pneumonia on the fifteenth day, (i) LUS shows normal images, the bat sign: the ribs (red circle) and the pleural line (red triangle) outline a silhouette reminiscent of a bat and the A-line: inside the merlin space, a repetition of the pleural line is seen (yellow triangle), occurring at a standardized distance from skin to pleural line. (j) Slide normal pleural line.

Table 1. LUS images at each examination.

Implementation time	LUS findings
The first day of admission (early stage of the disease)	Thickened pleural line with a small amount of B-line
The fifth day of admission (progression stage)	A large number of discrete B-lines, more visible small consolidations and areas of white lung
The tenth day of admission (early recovery)	Confluent B-lines, less small consolidations and less areas of white lung
The fifteenth day of admission (late recovery)	Lung ultrasound shows normal images, the bat sign and the A-lines

LUS: lung ultrasound.

surface area. In case of a massive spread of this pandemic, traditional imaging is much more difficult to perform than LUS. We therefore recommend that clinicians working in countries affected by the COVID-19 pandemic use and further evaluate the role of LUS in patients with COVID-19 pneumonia.

Conclusion

The LUS images of patients with COVID-19 pneumonia are quite characteristic. Performing LUS at the bedside minimizes the need to move patients within the hospital, thus reducing the risk of transmitting infection. LUS might be useful for early detection and evaluation of severity of COVID-19 pneumonia.

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Author contributions

Y.Y. and D.Y. were involved in conceptualization; Y.C. and Y.G. were involved in data curation; Y.Y. was involved in formal analysis, funding acquisition, investigation, and writing—review and editing; Y.Y. and Y.C. were involved in project administration; and D.Y. was involved in writing—original draft.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical approval

All procedures performed in this case involving the patient were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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Informed consent and consent for publication

Informed consent was obtained from the patient included in the study. Written informed consent was obtained from the patient for publication of this case report and accompanying images.

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References

1. Møller-Sørensen H, Gjedsted J, Lind Jørgensen V, et al. COVID-19 assessment with bedside lung ultrasound in a population of intensive care patients treated with mechanical ventilation and ECMO. *Diagnostics* 2020; 10(7): 447.
2. Zhao W, Zhong Z, Xie X, et al. Relation between chest CT findings and clinical conditions of coronavirus disease (COVID-19) pneumonia: a multicenter study. *AJR Am J Roentgenol* 2020; 214(5): 1072–1077.
3. Soldati G, Demi M, Smargiassi A, et al. The role of ultrasound lung artifacts in the diagnosis of respiratory diseases. *Expert Rev Respir Med* 2019; 13(2): 163–172.
4. Li Y and Xia L. Coronavirus disease 2019 (COVID-19): role of chest CT in diagnosis and management. *AJR Am J Roentgenol* 2020; 214(6): 1280–1286.
5. Manivel V, Lesnewski A, Shamim S, et al. CLUE: COVID-19 lung ultrasound in emergency department. *Emerg Med Australas* 2020; 32(4): 694–696.
6. Mohamed MFH, Al-Shokri S, Yousaf Z, et al. Frequency of abnormalities detected by point-of-care lung ultrasound in symptomatic COVID-19 patients: systematic review and meta-analysis. *Am J Trop Med Hyg* 2020; 103(2): 815–821.
7. Yu X, Zhai Z, Zhao Y, et al. Performance of lung ultrasound in detecting peri-operative atelectasis after general anesthesia. *Ultrasound Med Biol* 2016; 42(12): 2775–2784.
8. Buonsenso D, Piano A, Raffaelli F, et al. Point-of-care lung ultrasound findings in novel coronavirus disease-19 pneumonia: a case report and potential applications during COVID-19 outbreak. *Eur Rev Med Pharmacol Sci* 2020; 24(5): 2776–2780.
9. Zhou F, Yu T, Du R, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. *Lancet* 2020; 395(10229): 1054–1062.
10. Tung-Chen Y, Martí de, Gracia M, Díez-Tascón A, et al. Correlation between chest computed tomography and lung ultrasonography in patients with coronavirus disease 2019 (COVID-19). *Ultrasound Med Biol*. Epub ahead of print 13 May 2020. DOI: 10.1016/j.ultrasmedbio.2020.07.003.