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Case Report

Use of Lung Ultrasound in the Diagnosis of Patients with Suspected COVID-19

Dirk-André Clevert, MD

Professor of Radiology, Honorary Doctor (TSM-Univ.),
Section Chief, Interdisciplinary Ultrasound-Center, Department of Radiology,
University of Munich-Grosshadern Campus, Munich, Germany

Introduction

Coronavirus disease 2019 (COVID-19) is an infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). According to the World Health Organization, COVID-19 disease increases daily globally. As of the 8th of May, 2020, there have been over 3.7 million officially reported confirmed COVID-19 cases worldwide, more than 1.6 million of which are from Europe and more than 1.5 million from the Americas. United States of America had the most confirmed cases with 1,215,571, followed by Spain with 221,447, Italy with 215,858, United Kingdom with 206,719, Russia with 187,859 and Germany with 166,091. As of today, 259,474 people have deceased worldwide due to the COVID-19 pandemic [1].

The standard method of testing for COVID-19 is RT-PCR using respiratory samples from nasopharyngeal swabs. In patients with high clinical suspicion, a combination of laboratory RT-PCR and chest imaging methods including chest CT, X-ray and lung ultrasonography (LUS) may help improve COVID-19 diagnosis [2]. LUS is particularly advantageous because of its diagnostic accuracy, portability, safety, repeatability and cost-effectiveness [3]. Additionally, lung ultrasound allows the rapid assessment of the severity of COVID-19, enabling the tracking of the evolution of the disease [4]. In this report, we describe two cases on the use of LUS in the diagnosis of COVID-19.

Case 1

In our first case, a 20-year-old man developed a sore throat and unproductive cough followed by fever and dyspnea for four days. At the day of admission to the hospital the patient showed no symptoms of an increasing respiratory insufficiency. The initial oxygen saturation, by breezing normal air at the emergency room, was at 95 percent. Laboratory chemistry showed no major increased values.

According to the hospital protocol, a conventional chest X-ray and an additional lung ultrasound was performed. Chest X-ray demonstrated no typical indications of COVID-19 pneumonia (Fig 1). Ultrasound examination was performed using the mobile Samsung HM70A ultrasound system with a curved array transducer CA1-7AD and a linear transducer LA3-16AD directly at the emergency department. The ultrasound examination showed the following findings, which correlate well with chest X-ray results (Fig 2 A-D).

Using a linear transducer, no morphology changes of subpleural lesions could be detected. When the curved array transducer was used, changes of air and water contents in the lung, an indirect sign for consolidated peri-pulmonary tissues and air bronchogram sign, could not be detected. The diagnosis of lung pathologies relies on the artefacts of peri-pulmonary lesions. The presence of A-lines and absence of B-lines is an indirect sign for a healthy lung without any peripheral consolidations or pulmonary edema. The dynamic examination of the intercostal muscles showed a normal appearance during inspiration and expiration. No thickening of the pleural line with pleural line irregularity could be detected while a normal lung sliding was visible.

In summary there was no sonographic evidence for the typical appearance of COVID-19 pneumonia. Five hours later the results of the swab for SARS-CoV2 arrived, the test was negative, confirming the absence of SARS-CoV-2 infection.

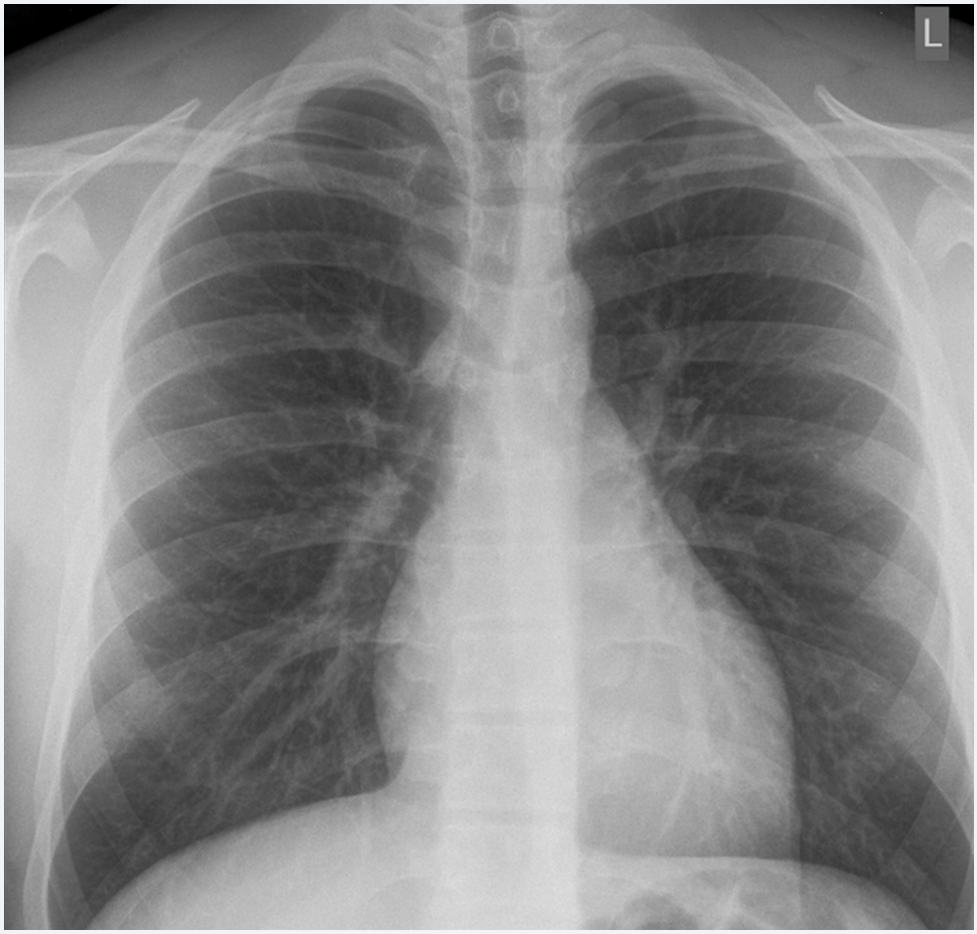

Fig 1. Conventional chest X-ray shows no reduction in transparency; no typical finding of COVID-19 pneumonia was detected.

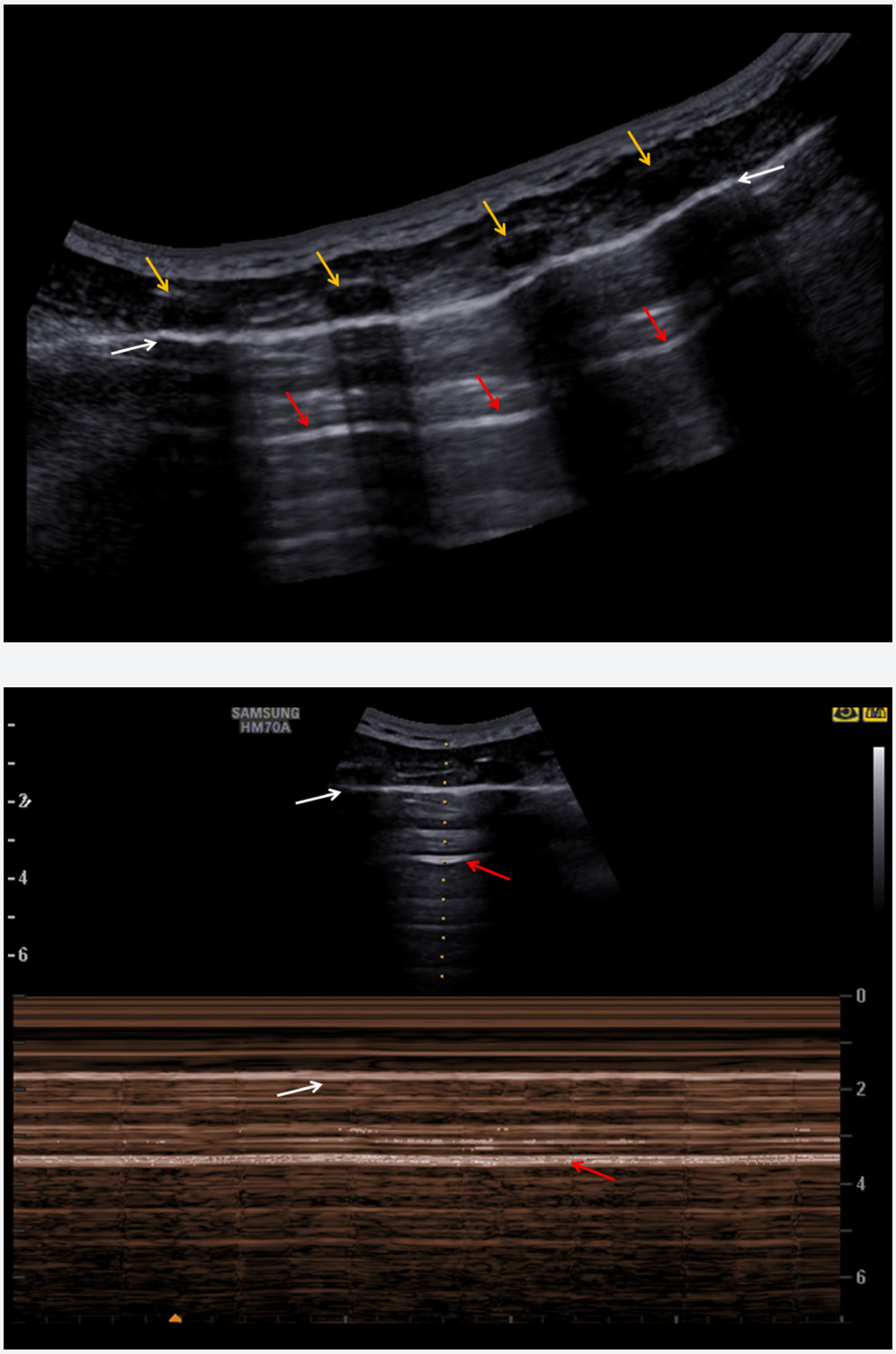

Fig 2A-B. Ultrasound image using the Samsung HM70A.

A) Panoramic view detecting chest wall and lung structures (ribs: yellow arrows, pleura: white arrows). The A-lines are the bright horizontal lines deep to the pleural line (red arrows). A-lines are a classic reverberation artefact.

B) Ultrasound image demonstrating the pleura (white arrows) and A-lines (red arrows) using a curved array transducer. The pleura and A-lines are clearly visible on M-mode as bright white lines. The distance from the skin to the pleural line equals the distance from the pleural line to the first A-line.

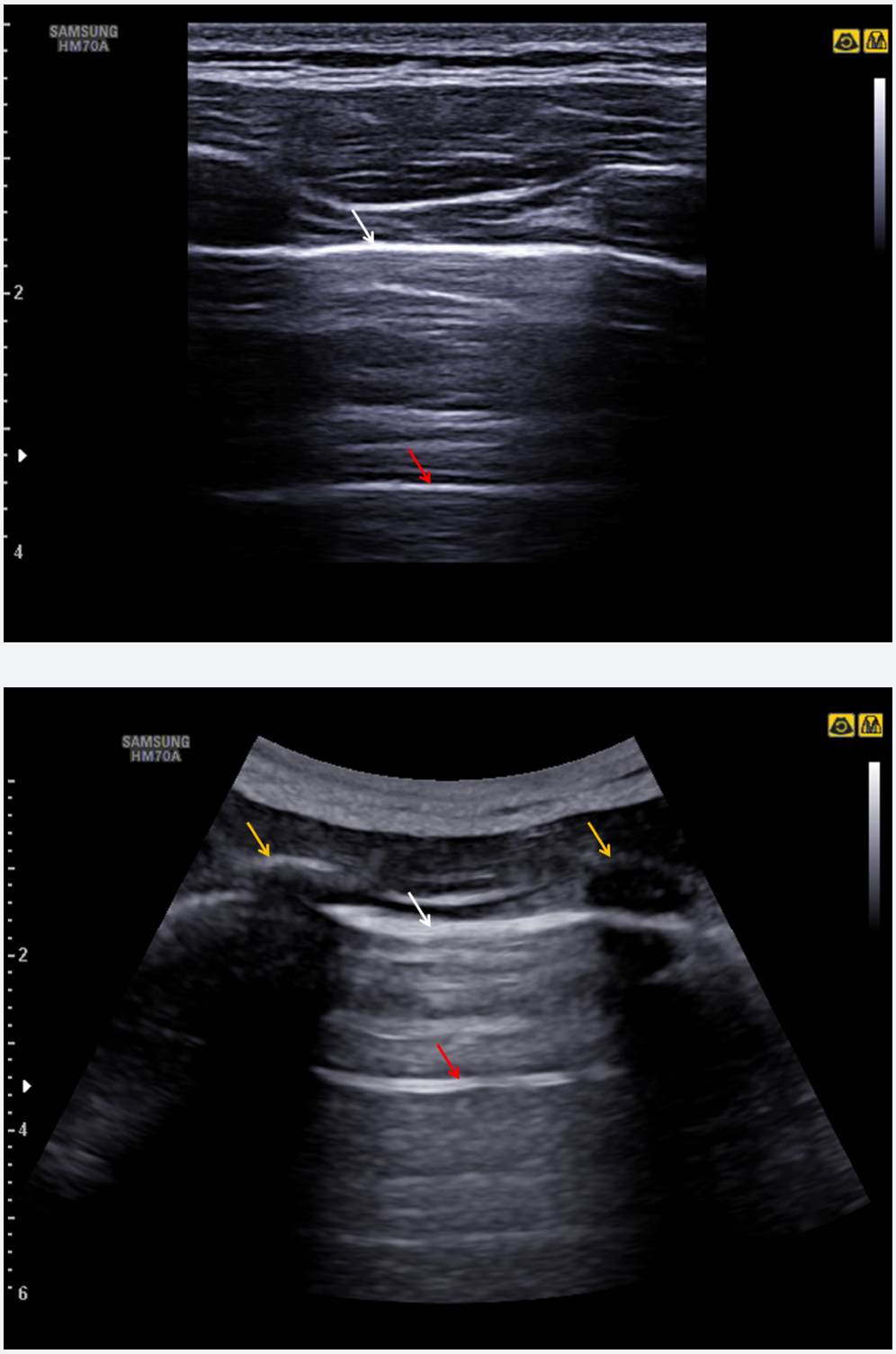

Fig 2C-D. Ultrasound image using the Samsung HM70A.

C) Detection of pleura (white arrow) and the A-lines (red arrow) using a high-frequency linear transducer. The finding is fitting with no consolidations of the lungs. The presence of A-lines is an indirect sign of a healthy lung without any peripheral consolidations or pulmonary edema.

D) Detection of the ribs (yellow arrows), pleura (white arrow) and the A-lines (red arrow) using a curved array transducer. The finding is fitting with no peripheral consolidations or pulmonary edema.

Case 2

In our second case, a 69-year-old man who developed a sore throat and unproductive cough followed by fever and dyspnea over one week was admitted to the hospital. On the day of admission, the patient demonstrated symptoms of increasing respiratory insufficiency. The initial oxygen saturation, through unassisted breathing in the emergency room, was only 80 percent. Laboratory chemistry showed increased values for CRP (11.6 mg/dl, N <0.5), leucocytes (17.4 G/l), as well as D-dimer (20.9 µg/ml, N <0.5) and LDH (1021 U/l, N<249).

According to the hospital protocol, an HR-CT examination of the lungs was performed. The lung CT showed a mixed finding of COVID-19 pneumonia with typical triangular, subpleural ground-glass opacity (GGO) and consolidations on the one hand, and on the other hand, additional congestion of the lungs. Additionally, a pneumothorax was detected which was directly treated with drainage. The follow-up examination demonstrated a slight dehiscence on the left side (Fig 3). With increasing respiratory insufficiency (pO2 48 mmHg under insufflation of 12 litres O2 via oxygen mask with reservoir bag), the indication for intubation was given and the patient was transferred to the intensive care unit (ICU).

The follow-up examination was performed the following day at the ICU using a conventional chest X-ray (Fig 4) and a mobile Samsung HM70A ultrasound system with a curved array transducer CA1-7AD and a linear transducer LA3-16AD. The ultrasound examination demonstrated the following findings, which correlate well with the initial lung CT (Fig 5-6). The swab-testing for SARS-CoV-2 was positive in this case.

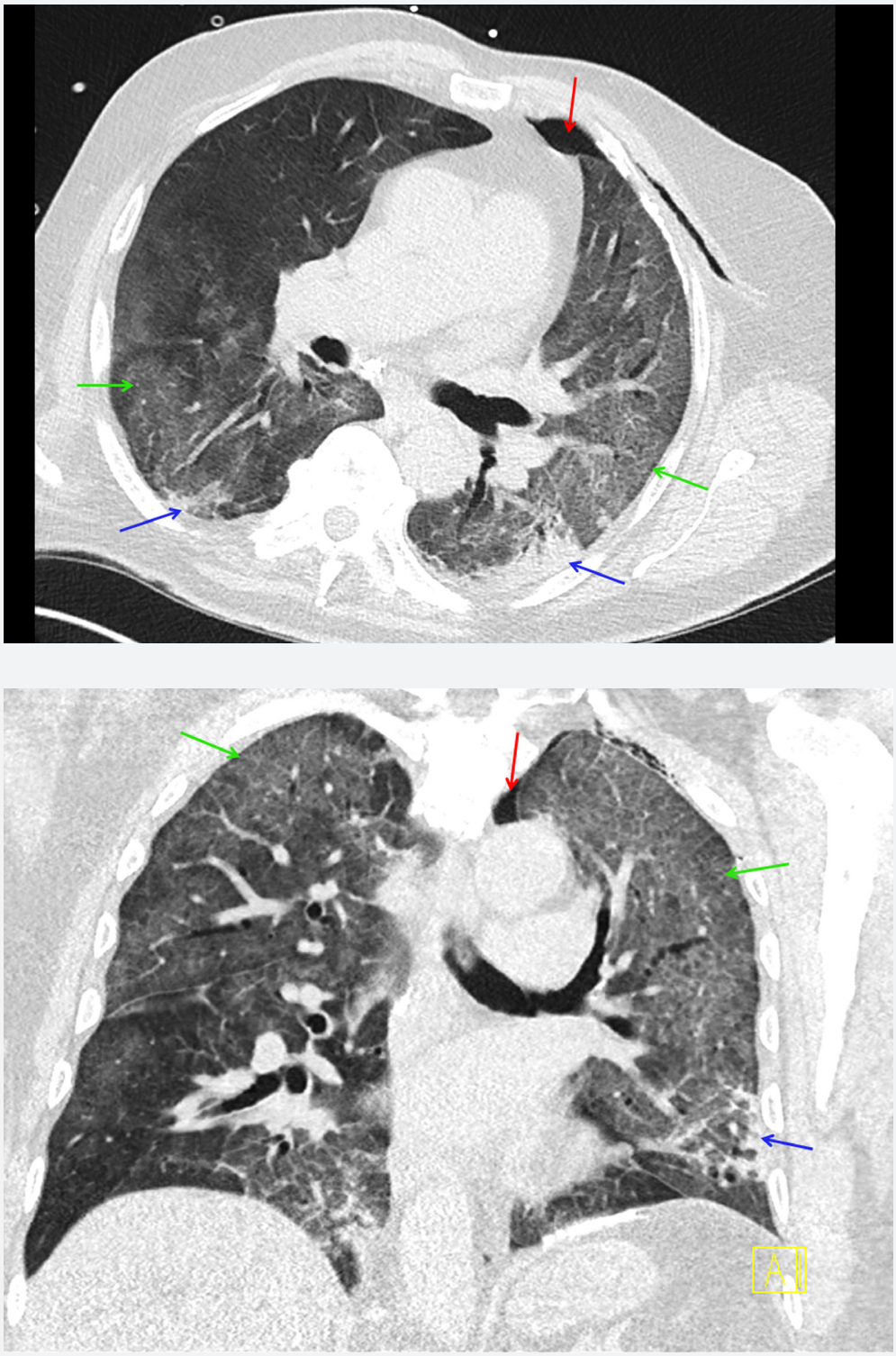

Fig 3. CT images of a 69-year-old patient with suspected COVID-19.

A) Axial or B) Coronal lung CT shows a mixed finding of COVID-19 pneumonia with typical triangular, subpleural ground-glass opacity (GGO, green arrows) and consolidations (blue arrows) and additional congestion of the lungs. Furthermore, a pneumothorax was detected and directly treated with drainage. Follow-up examination demonstrated a slight dehiscence on the left side (red arrow).

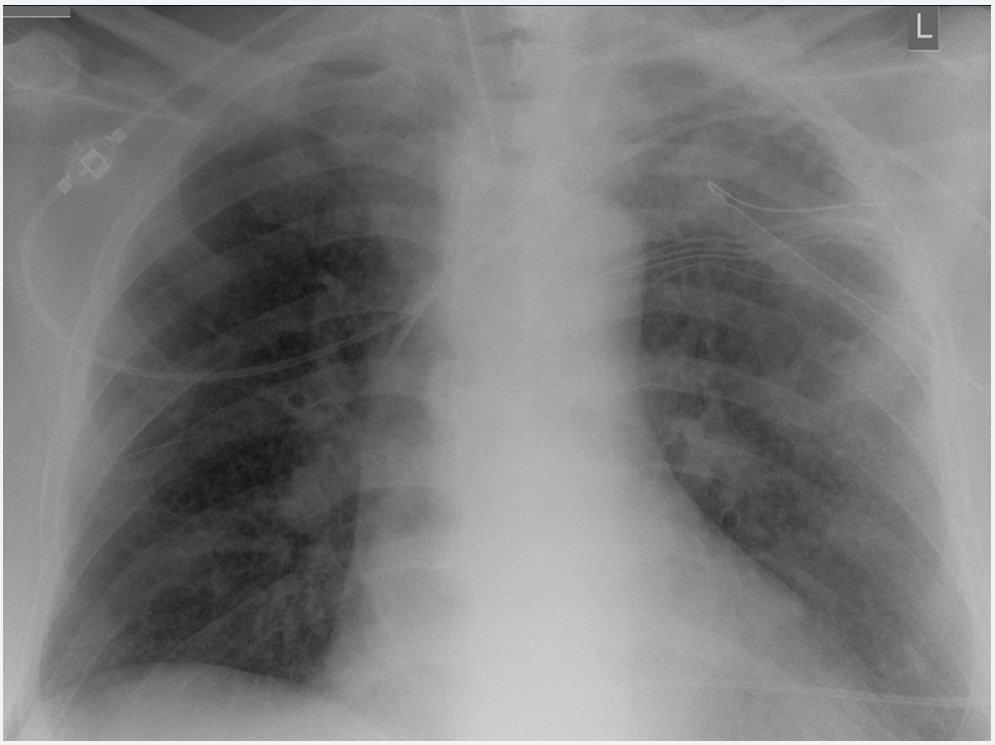

Fig 4. Conventional chest X-ray demonstrates a bipulmonary reduction in transparency, most likely from known atypical infiltrates from COVID-19. No evidence of pneumothorax is detected in this imaging plane.

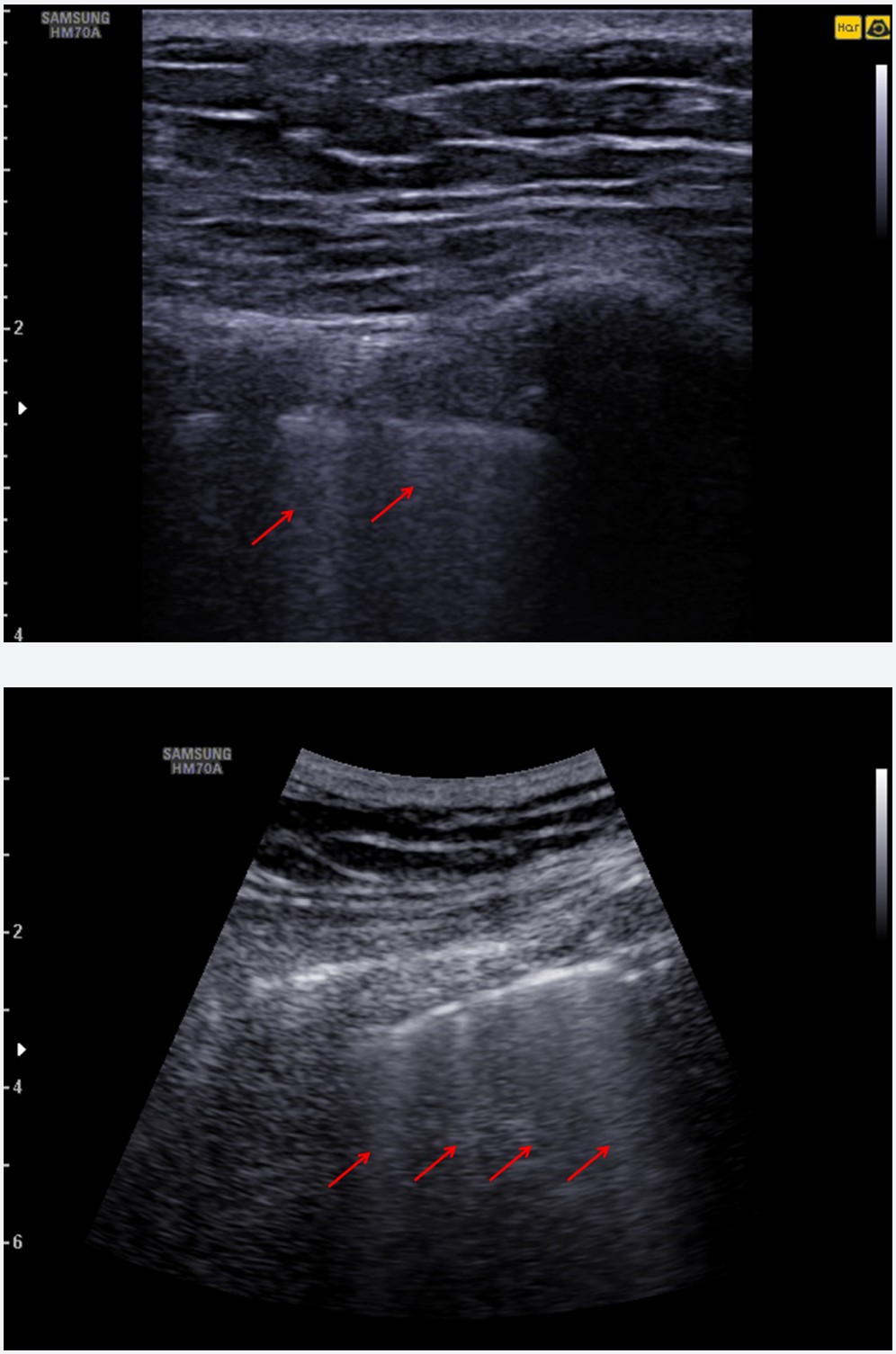

Fig 5A-B. Lung ultrasound using the Samsung HM70A.

A) B-lines (red arrows) were demonstrated using a high-frequency linear transducer. This finding is fitting with consolidations of the lungs.

B) Multiple B-lines (red arrows) were demonstrated using a curved array transducer. This finding is fitting with severe consolidations of the lungs.

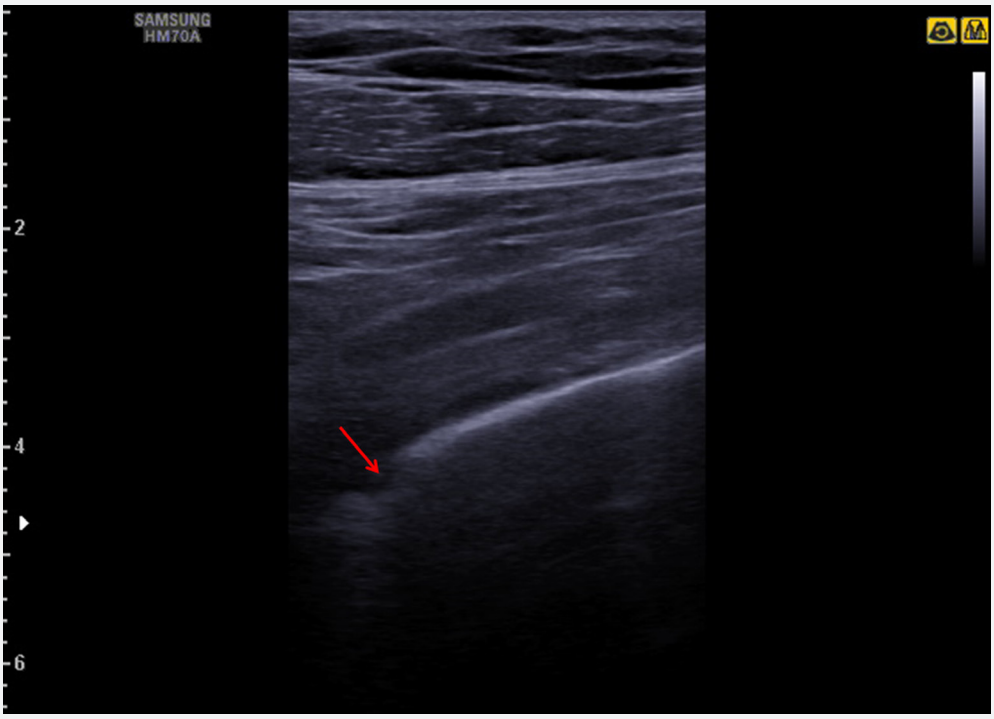

Fig 5C. Lung ultrasound using the Samsung HM70A. Thickening and irregularity of the pleural line (red arrow) was demonstrated using a high-frequency linear transducer.

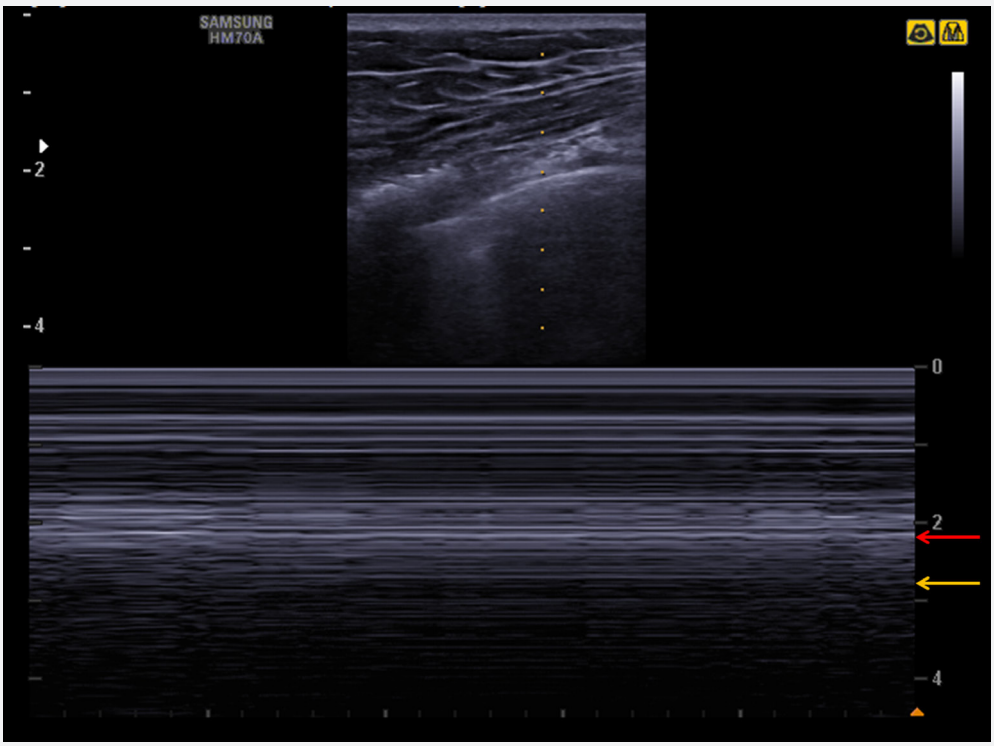

Fig 6. Lung ultrasound using the Samsung HM70A. During the follow-up examination, the pneumothorax was still visible. As seen in M-Mode, the delimitation of the pleura (red arrow) and the stratosphere sign (yellow arrow) is an indication that the pneumothorax still existed.

References

[1] World Health Organization; Coronavirus disease (COVID-2019) situation report 109.

[2] Lomoro P, Verde F, Zerboni F, Simonetti I, Borghi C, Fachinetti C, Natalizi A, Martegani A. COVID-19 pneumonia manifestations at the admission on chest ultrasound, radiographs, and CT: single-center study and comprehensive radiologic literature review. Eur J Radiol Open. 2020;7:100231.

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[4] Soldati G, Smargiassi A, Inchingolo R, Buonsenso D, Perrone T, Briganti DF, Perlini S, Torri E, Mariani A, Mossolani EE, Tursi F, Mento F, Demi L. Is There a Role for Lung Ultrasound During the COVID-19 Pandemic? J Ultrasound Med. 2020 Mar 20.

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