The Role of Lung Ultrasound in Low-Resource Settings During the Coronavirus (SARS-CoV-2) Pandemic

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Lung ultrasound (LUS) has proven to be a helpful diagnostic tool for evaluating lung involvement in respiratory pathologies. The usage of this imaging technique became even more widespread during the SARS-CoV-2 pandemic. The latest generation ultrasound scanners are conveniently portable and this permits ultrasound examinations to be performed even in extreme environments where no other diagnostic tool is available. Our team has developed the first guide that assists the clinician while operating in low-resource settings, in managing a SARS-CoV-2 patient based on the clinical examination and the LUS findings.

Key Words—Covid-19; evacuation; humanitarian; lung ultrasound; migration

Received May 5, 2021, from the Emergency Medicine Unit and Emergency Medicine Postgraduate Training Program, IRCCS Policlinico San Matteo University Hospital, University of Pavia, Pavia (G.C., G.S., S.P.); Italian Red Cross, Rome, Italy (A.N.); and Medical Graduate, University of Pavia, Pavia, Italy (R.R.). Manuscript accepted for publication May 6, 2021.

The authors state that they have no conflicts of interest.

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doi:10.1002/jum.15755

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The Italian Red Cross medical team has the duty to provide first aid to whom that requires such, follow-up SARS-Cov-2 patients onboard, and decide whether a patient needs an urgent medical evacuation. Neither laboratory test nor imaging diagnostic tool was available onboard.

Our staff brought onboard a handheld Clarius C3 ultrasound scanner (Clarius Mobile Health, 130–2985 Virtual Way, Vancouver, BC, V5M 4X7 Canada) that works with a rechargeable battery and transmits the image directly to a smartphone through a wireless connection.

We conducted constant follow-up of SARS-Cov-2 patients, and we performed LUS on each individual who presented any respiratory symptom.

The lung involvement was quantified with the score we routinely use in our Emergency Department: we perform a 12-pulmonary windows approach: it is faster than other proposed approaches, but nonetheless provides a comprehensive evaluation of the lung involvement. The ultrasound scanner probe is placed on the intercostal spaces and acoustic artifacts are examined: A-lines suggest an aerated lung portion, whereas multiple B-lines suggest a decreased aeration of the scanned lung segment (Figure 1).

**Figure 1.** Acoustic artifacts in lung ultrasound: A-lines (horizontal artifacts indicated by the green arrows) are the reverberation of the pleural line and suggest that the lung is aerated. B-lines are vertical artifacts (indicated by the red arrows) that suggest a progressive decrease of lung aeration as the number of B-lines increases.

**Figure 2.** This flowchart guides the clinician in deciding when a patient should be evacuated, according to the patient's symptoms and LUS findings.
We elaborated a flowchart, based on our experience, that guides the clinician in the decision-making process (Figure 2).

When should I plan a medical evacuation for a patient? This decision is based on the evidence that a high lung ultrasound score is predictive of a clinical worsening of the patient.

Several studies confirmed that the presence of a B pattern in multiple acoustic windows is related to a worsening of the clinical condition of a patient with Covid-19. These patients are candidate for oxygen therapy and medical evacuation when the oxygen supply is limited or unavailable.

The role of ultrasound in the evaluation of the pulmonary involvement in patients with Covid-19 pneumonia has been discussed in multiple studies but it gains even more importance if it is the only imaging technique available to the clinician.

Acknowledgment

Open Access Funding provided by Universita degli Studi di Pavia within the CRUI-CARE Agreement [Correction added on May 18, 2022, after first online publication: CRUI funding statement has been added.]

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