LETTERS TO THE EDITOR

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Is it a high time for a consensus on quantitative lung ultrasound approach?

We read with interest the Letter from Bacariza *et al.* commenting our paper focusing on the role of lung ultrasound (LUS) Score in predicting outcomes in COVID-19 respiratory failure.[1, 2]

This letter is greatly appreciated since it offers a precious opportunity to clarify some issues of our paper, and to discuss some still debated aspects regarding LUS Score.

Over the last decades, LUS has emerged as a new imaging tool for the lungs, being initially applied with a qualitative approach to aid diagnosis and management of respiratory diseases. In the last decade, studies correlating LUS to lung tissue density led to develop a quantitative approach to grade lung aeration and quantify disease severity.

We agree with Bacariza *et al.* that the proposed modified LUS Score may improve LUS-based aeration assessment focusing on the alveolar rather than interstitial involvement of the disease;[3] however, more evidence is needed, and no consensus or recommendations are still available on this specific issue. Furthermore, also consensus and recommendations focusing on the most appropriate probe (linear, curvilinear or microconvex), and the proper knobology setting for appropriate image acquisition and subsequent most accurate LUS Score assessment are lacking.

Bacariza *et al.* question why in our cohort, despite the median number of involved areas was higher in patients who avoided intubation with high-flow nasal oxygen (HFNO) than those who avoided intubation with helmet noninvasive ventilation (NIV), median LUS Score was quite similar (6 *vs.* 4 and 9 *vs.* 8, respectively). Possible explanations for this phenomenon could be the following: 1) decision to start HFNO or NIMV was upon treating clinicians blind to the decision to perform LUS, and this is not a randomized study; 2) reviewing our raw data, we have found that patients treated with NIV had worst scores in the posterior regions with a more focal involvement in the gravity dependent areas; differently, in patients treated with HFNO the involvement was multifocal with lower scores in the posterior regions. This is consistent with the mechanism of action of positive end-expiratory pressure, which may cause gas shift from non-dependent to dependent areas during inspiratory effort. However, this is far behind the scope of the study and needs a more complex physiologic design to be eventually confirmed.

However, this issue enhances a further open question about what information overall LUS may yield. In fact, on the base of available evidence, Italian Society of Anesthesia, Analgesia, Resuscitation, and Intensive Care Consensus on lung ultrasound in critically ill COVID-19 patients state that a high overall LUS Score and/or a high score in the gravity dependent areas correlate with worsening outcomes.[4] Therefore, we should probably consider the median or the worst regional LUS Score rather than the overall score. Furthermore, same scores may yield different information whether in case of normal or low compliance. In the latter, LUS Score has been found to be related to the percentage of non-aerated, poorly aerated, and well aerated tissue in CT-based quantitative analysis, being likely proportional to the residual lung volume available for tidal ventilation.[5]

LUS Score reaches its maximum effectiveness when properly driven by clinics and integrated with physiological parameters in a multimodal monitoring tool. In this perspective, it is a high time for a consensus to clarify what score should be used depending on clinical setting, and how it should be obtained.

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