Pulmonary Ultrasonography
Staying Within the Lines Prevents Us Finding Something Better on the Other Side

To the Editor:
The article by Bataille et al1 in CHEST (December 2014) represents a significant advancement in the field, not least because it demonstrates that lung ultrasonography (LUS) has serious limitations in patients with acute respiratory failure and that thoracic ultrasonography (TUS), which includes echocardiography, is preferable. Nevertheless, even if we consider Descartes’ observation that perfect numbers, like perfect men, are very rare, we wonder what numerical grounds there are for claiming that TUS could disambiguate cases of hemodynamic pulmonary edema and pneumonia.1 Is this conundrum solved with the aid of careful physical examination?

Although we agree that “the bedside use of artificial intelligence methods in this setting could pave the way for the development of new clinically relevant integrative diagnostic models,”1 we respectfully emphasize that overreliance on such tools could undermine quick clinical decisions in emergency scenarios. Indeed, artificial intelligence feedback, yielded by software programmed using information from very human, and therefore potentially fallacious, subjects, is no substitute for easy-to-use and reliable diagnostic tools in the hands of comprehensively trained experts.

Likewise, we agree that the statistical approach adopted, partial least-squares regression, was appropriate, particularly because 7% of pulmonary and 10% of cardiac ultrasonographic data were missing at the recording time. However, focusing more on the core of the study, we would like to highlight some of the authors’ statements and make a few respectful remarks and queries of our own:

1. First and foremost, we strongly agree with the authors’ statement emphasizing the weakness/unreliability of using an increase in LUS B-lines2,3 for diagnostic purposes: “Of note, the exclusive use of LUS patterns to detect cardiac edema (B profile) was highly unreliable because B lines were also detected in 33% of pneumonia cases (ie, false-positive diagnosis) and absent in 37% of cardiogenic edema cases (ie, false-negative diagnosis).”1

2. The finding that fewer patients with cardiogenic edema (22 of 34, 65%) were correctly diagnosed by LUS than by TUS (32 of 34, 94%) is to be expected, as the latter technique includes echocardiography, undoubtedly the most appropriate option for a cardiologic diagnosis.4,5 However, the authors’ finding that 51 of 77 patients with pneumonia (66%) were correctly diagnosed by LUS and 64 of 77 (83%) by TUS is not so intuitive, and we wonder whether the authors can explain why this should be so.

3. We would also be interested to learn whether there were any comorbidities present in this series, and what effect this would have on the findings (aside from complicating the statistical analysis, of course).

We hope that the authors of this excellent study, steadfastly aimed at improving best clinical practice, will enlighten us. After all, “In questions of science the authority of a thousand is not worth the humble reasoning of a single individual” (Galileo Galilei).

Guglielmo M. Trovato, MD
Catania, Italy

Marco Sperandeo, MD
San Giovanni Rotondo, Italy

References

Response

To the Editor:

I am very grateful to Drs Trovato and Sperandeo for their comments on our article published in CHEST.

We strongly agree that the integrative use of thoracic ultrasonography (TUS) holds the promise of improving acute respiratory failure (ARF) diagnosis and management. Nevertheless, to do so we need to first address some underpinning conceptual and methodologic issues.

First, we must explore innovative ways to usefully combine and interpret the clinical and ultrasound data recorded during ARF. A starting point is to independently assess the diagnostic value of clinical and ultrasound data before investigating an integrative analysis of the whole dataset. In the meantime, we strongly recommend that TUS be used as a complementary tool, designed to complete the physical examination and standard of care diagnosis procedures. To rely solely on TUS for the differential diagnosis of severe ARF is hazardous and could induce hasty and inappropriate therapeutic decisions. Second, we must develop fast and reliable analysis methods to interpret the high-dimensional and multimodal data recorded at the patient’s bedside. To address this issue, we proposed and validated a new supervised learning machine classifier, by combining random ensembles of predictors. Our aim is not to substitute medical reasoning with an abusive use of artificial intelligence techniques, but to demonstrate that previously described alternative binary classification methods could constitute an oversimplification.

Unlike those of previous studies, which have suggested that an exclusive lung ultrasonography assessment could be used to estimate a patient’s respiratory and hemodynamic status, our findings highlight the pivotal place of echocardiography in the diagnosis and management of severe ARF to “disambiguate cases of hemodynamic pulmonary edema and pneumonia.” In fact, the use of supervised learning machine methods allowed us to demonstrate that left ventricular telediastolic pressure estimation has an additional value for the diagnosis of hemodynamic pulmonary edema and pneumonia (ie, high and low levels, respectively [e-Table 1, PLS Component 1, in our published article]). This critical point has been discussed in a study that explored the meaning of B-lines in a large cohort of patients with dyspnea. Interestingly, despite the fact that the authors identified a greater number of B-lines in dyspeptic patients compared with control subjects, they did not find any specific feature or cutoff criterion that could allow discrimination between acute hemodynamic pulmonary edema and noncardiogenic causes of dyspnea.

A fast-growing body of evidence suggests that TUS provides physicians with an easy, rapid, and reliable evaluation of lung and heart interactions and its variations at the bedside. However, as suggested by Trovato and Sperandeo, TUS is not a shortcut for a broader medical reasoning and can be unreliable if not used jointly with a thorough clinical assessment.

Stein Silva, MD, PhD Toulouse, France

AFFILIATIONS: From the Critical Care Unit, CHU Purpan, INSERM U825.

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CORRESPONDENCE TO: Stein Silva, MD, PhD, Critical Care Unit, CHU Purpan, INSERM U825, 31059 Toulouse Cedex 3, France; e-mail: silvastein@me.com

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