To the Editor:
The article by Volpicelli et al.1 aimed to assess the possible role of B-lines by lung ultrasound (LUS) alone or in combination with left ventricular ejection fraction (LVEF) in predicting high or low levels of pulmonary artery occlusion pressure (PAOP) and extravascular lung water (EVLW). The multicenter study comprises the evaluation of critically ill patients from different clinical settings and conditions predisposing to hemodynamic instability. Notwithstanding these valuable aspects, the study in our view did not add any useful information on the role of LUS in the clinical management of these patients. Data indeed appear to fail in demonstrating any usefulness of A- and B-patterns alone in detecting high PAOP, as sensitivity and specificity of these methods achieve considerable values only when LVEF, a widely recognized and used index of cardiac performance, is added to the model. As per authors’ conclusions, “only the combination of the A-pattern at LUS and the normal LVEF estimated by focused cardiac ultrasound reliably indicates low PAOP,” meaning that this point represents the most important finding of the study. In this context, it is our opinion that many issues need to be addressed. The authors did not clearly state why LVEF was used, namely the rationale of combining LUS findings with a measure of systolic function. Considering the variety of clinical conditions reported, LVEF cannot indeed be supposed to be affected in any case and is therefore neither a valuable nor a sensitive predictor of hemodynamic instability in any given patient. This consideration also leads us to underline the need of including LVEF data in the article, as well as of detailing the conditions of patients whose evaluation of LVEF and LUS pattern was associated with high predictive values for PAOP assessment. The absence of any improvement of accuracy in predicting EVLW by combining LVEF and A-pattern further supports the hypothesis that LVEF cannot be chosen as a target tool to assess hemodynamic state in the particular population studied.

As far as LUS findings, the article did not accurately describe how patients were studied (supine or seated position), the clinical setting (dyspneic patients?), potentially increasing the detection of LUS artifacts, as well as the possible underlying mechanisms. Indeed, the authors did not provide any explanations on possible related mechanisms associated with the high prevalence of A-pattern and high PAOP in chronic heart disease patients, whereas B-pattern was mostly found in combination with high PAOP in patients with normal cardiac function (mostly sepsis and pulmonary failure).1 Is the study showing that lung fluid is increased in the setting of sepsis and acute pulmonary failure regardless of the underlying disease? If this is the case, which are the EVLW values in this group of patients? Also, which kind of interstitial syndrome, whose detection through B-lines is advocated throughout the article, are the authors referring to in the study, and particularly in this patient group?1

With no answers to these questions, we wonder how the conclusion of using LUS in the first approach of patients requiring fluid resuscitation could be driven by the present data. We therefore claim the need for emphasizing the useful but limited power of LUS in the evaluation of critically ill patients, having no study been performed to actually validate the aforementioned ultrasound signs as pathophysiologically associated with any of the disease causing hemodynamic instability.
Competing Interests
The authors declare no competing interests.

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References

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In Reply:
We thank you and readers for the great opportunity to extend the discussion on our study.1 We answer point-by-point to the three letters.

To Dr. Foti et al.
First, the “B-pattern” is not a new terminology. It is a recommended terminology agreed on by the main international experts and represents a standard definition worldwide.2 Regarding the “A-pattern,” there is no confusion with A-lines that are meaningless and never considered for hemodynamic assessment.

Second, regarding the number of cases, we here confirm the conclusions and also the limitations already reported in our article.1 We reiterate that the correlation with pulmonary artery occlusion pressure (PAOP) was not satisfactory, which represents the first interesting finding of our study and is reflected even in the title of our article. Indeed, pulmonary congestion and PAOP may be independent, which opens new perspectives about the usefulness of B-lines and is worthy of further investigation in future studies. Regarding extravascular lung water (EVLW), the combination of A-pattern and EVLW greater than 10 ml/Kg was found in 1 of 32 patients and not 3 as is superficially reported in the letter. This unique patient had an EVLW level of only 1 point above the threshold (11 ml/kg). However, the cutoff chosen may be crucial because there is no perfect consensus on the abnormal value of EVLW. Extending the study population and testing different cutoff values may help to assess the real relation between B-lines and EVLW calculated by the PiCCO technology. Thus, we reiterate that the absence of B-lines may safely guide fluid resuscitation in critically ill patients, whereas the possible appearance of B-lines during fluid administration demands discontinuance. This principle, more authoritatively evidenced by previous studies, is further supported by our data.3,4 However, 4 of 32 cases showed a combination of diffuse B-lines and EVLW less than 10 ml/kg. This is not surprising because the phenomenon of B-lines is not only linked to pulmonary congestion but also to acute respiratory distress syndrome and infections, which represent more complex pulmonary conditions. Avoiding fluid overload in these patients is safe in any case. When the B-pattern is detected, our suggestion is to avoid or consider more carefully the fluid administration by relying on adjunctive tools. Of course, fluids are better guided once invasive monitoring is established, which is clearly reported and continuously repeated in clear words in our article. We leave to the judicious opinion of Foti et al. but especially of anyone else who really faces complex emergency situations at bedside, whether this potential is useful or not. Indeed, B-lines cannot be used to predict fluid responsiveness but only the lung tolerance to fluid administration. However, even when we have the possibility to use more advanced tools for hemodynamic monitoring, like usually happens once the patient is admitted to the intensive care unit (ICU), B-lines assessment still maintains its importance because it is the only bedside tool that allows a safe direct insight into the lung.5

Finally, we do not understand why Foti et al. extrapolated some sentences from our article and interposed their words to change the original meaning. We did not write that “even” the combination with left ventricular ejection fraction (LVEF) did not improve the accuracy of lung ultrasound. Foti et al. will understand that if they add the word “even,” the meaning of our sentence totally changes. What is true is that, in the EVLW group, LVEF did not increase the performance of lung ultrasound, simply because it was sufficiently accurate by itself.

To Dr. Melillo
First, our article does not “advocate the usefulness of B-line counts” because we did not count B-lines, which is clearly explained in the method.1 We used a very basic and simple dichotomous method.

Second, Dr. Melillo writes that “experience dictates” that “B-lines are poorly reproducible.” Exactly the opposite is true. A large body of scientific evidence dictates that B-lines are highly reproducible and easy-to-learn by operators with different skill and expertise. Agricola et al. obtained intraclass correlation coefficient of 3.1 and 4.4% on 280 scans performed by two operators.4 Boussuges et al.5 obtained intraclass correlation coefficient less than 5% on 1,890 scans performed by two operators. Fagenholz et al.7 obtained “excellent agreement” on 308 scans. Jambrik et al.8 obtained intraclass correlation coefficient of 5.1 and 7.4% on 560 scans performed by two operators. Liteplo et al.9 obtained intraclass correlation coefficient of 0.82 on 800 scans performed by several operators with different skills.