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# Commentary on "Integrated ultrasound protocol in predicting weaning success and extubation failure: a prospective observational study"

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Dear Editor,

We have read the paper by Kundu *et al.* [1] with great interest. In their prospective observational study, the authors suggest an integrated ultrasound (US) protocol to assist the clinician on the weaning process. The protocol focuses the US assessment on the three main, reversible, potential causes for the extubation failure: the lung, the heart, and the diaphragm. The evaluation is done before and after the spontaneous breathing test (SBT). Two groups were created based on extubation outcome: failure and success, with the latter showing better performance and lower ICU length of stay. In conclusion, they validated the protocol as a reliable predictive tool to avoid extubation failure.

First, we absolutely agree with the authors on the need for a wide-scope ultrasound protocol, to help the clinician during the weaning.

However, some considerations should be made.

From our point of view, it is all about focusing on three clinical assessment angles (lung, heart, and diaphragm) and three assessment timings: (before, during, and after the SBT), as previous papers have shown [2]. The point is to use each of the evaluations to clarify the proper time to proceed with the patient's extubation. Through the angles, we can see the issues related to acute or chronic lung states, haemodynamic status, the cardiac potential as the "global body engine", and finally the diaphragm, as the main respiratory muscle. Thanks to the separate timings, we can pay attention to the reversible conditions, the high-risk patients (before SBT), the lung and diaphragm capacity to overcome the weaning stress and later during SBT, and the cause for failing the extubation (after the SBT). However, the protocol of Kundu *et al.* [1] did not study "during SBT" and hence missed the chance to increase the accuracy of predicting weaning failure, assessing both diaphragm and lung.

The authors evaluate the heart using the left ventricular outflow tract velocity time integral (LVOT VTI) variation, while performing a passive leg raising (PLR) before the SBT. We agree with this. However, regarding the haemodynamic state assessment before the weaning, using PLR will just give us information about the heart's responsiveness to fluids. But on the equation, we cannot forget the other side, namely the organism's tolerance (or not) to fluids. The challenge during the weaning is not in the fluid-responsive patients, but in the intolerant ones (i.e. overloaded). The latter are much harder to extubate due to right heart failure. Kundu *et al.* [1] measured the PVC, but this comprises just 50% of the cases in which it is correlated with the real haemodynamic state. Using the venous excess ultrasound score (VExUS) [3] could help dramatically in this matter. The protocol evaluates the systolic disfunction but neglects the diastolic, due to its more technically demanding nature. First, we do not consider the difficulty to be prohibitive. Sec-

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ond, neglecting the left ventricle filling pressures could be fatal during the weaning. The diastolic disfunction is one of the hidden haemodynamic causes of extubation failure, and this condition is easily overcome by using noninvasive ventilation (NIV). The protocol also lacks heart assessment after the SBT and thus misses the opportunity to identify haemodynamic conditions or reversible cardiac causes in which NIV could be helpful.

Facing the lung, alveolar (consolidations) or interstitial (water) syndrome are evaluated using LUS, and the protocol looks for pleural effusion too. This is a good decision because, in fact, the LUS delivers precious information about the lung aeration, acute condition recovery, and potential chronic states. In doing so, the clinician will know if the use of NIV is needed or not. Cut-off LUS values for success are in line with the current evidence values, and the authors also brilliantly integrate the LUS variation. Nonetheless, the modified LUS score [4] could provide deeper and wider insight.

Finally, the diaphragm: The protocol records the diaphragm thickness fraction (DTF) omitting the classical, less technically challenging diaphragm excursion (DE). We applaud that decision because the DTF is more sensitive and specific than the DE [5], and it is more related with the true muscle effort. The DTF cut-off < 26% is lower than the median average published in the current meta-analysis [6].

Further research is demanded.

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