LETTER TO THE EDITOR

Author's Response to Diaphragm Evaluation and Lung Ultrasound Score during Weaning

Vedaghosh Amara[1], Souvik Chaudhuri[2]

Keywords: Diaphragm excursion, Expiratory abdominal muscles, Lung ultrasound score.
Indian Journal of Critical Care Medicine (2022): 10.5005/jp-journals-10071-24313

We thank you for reading our research article and the observations which you have made. We are trying our best to answer the queries raised after the observations.

The objective of our study was to determine the abdominal expiratory muscle thickness as a predictor of weaning pattern, as compared to the existing ultrasound based weaning indices such as diaphragmatic excursion (DE) and diaphragmatic thickening fraction (DTF). This will be especially useful in patients where it is difficult to assess diaphragm by ultrasound (patients with surgical dressings over subcostal area). Receiver operating characteristic (ROC) curve can be plotted when two or more diagnostic tests having continuous variables (like DE, DTF, and expiratory muscle thickness) predicts a dichotomous outcome (weaning success or failure).[1] The area under the curve of the different tests with continuous variables may be compared as inherent validity of the particular diagnostic tool.[1] Although DE and abdominal expiratory muscle thickness are different from each other, whether they serve as reliable predictors of a particular binary outcome (in our study, the weaning pattern) was determined from the area under curve of the ROC, sensitivity, specificity, and diagnostic accuracy of each of the tests. Similar statistical analysis by plotting ROC has been done in other studies on weaning, where the authors have compared DTF, DE, lung ultrasound score (LUS), rapid shallow breathing index, and the slope of diaphragmatic contraction with each other to predict simple weaning.[2,3]

We completely agree that DTF is more technically challenging than DE to measure using ultrasound. However, DTF has its own proponents. A systematic review and meta-analysis of 19 studies on 1071 patients had concluded that DTF was in-fact a reliable predictor of weaning success, as the accuracy of DE was much lower.[3] Diaphragmatic thickening fraction has also been referred to as the "ejection fraction" of the diaphragm, which mirrors active contraction of the diaphragm and inspiratory effort.[4]

The measurements of both DTF and DE in the patients in our study were done during spontaneous breathing trial (SBT), when patients were on pressure support ventilation. Thus, both measurements were performed with patients' own inspiratory efforts while on uniform support levels.

In our study, we measured the abdominal muscle thickness and not thickening fraction as a predictor of successful weaning. We completely agree that muscle thickness and thickening fraction are concepts which are alike, yet unequal. That is a limitation which we have stated. However, the ultrasound measurement of the thickness of the transversus abdominis muscle has been found to strongly correlate to the electrical activity in the muscle and also to the pressure generated by the muscle during the voluntary expiratory manoeuvre.[5] Therefore, we also evaluated the transversus abdominis muscle thickness during an SBT. Thus, even though the expiratory muscle thickening fraction would have been a better index, the measurement of thickness alone is also based on the principle of increase in strength of contraction with increasing muscle thickness.

Regarding the pattern of lung ultrasound abnormalities, both interstitial and alveolar patterns are incorporated in the LUS. A score of 2 in the LUS is attributed to coalescent B lines (predominant interstitial syndrome) and a score of 3 is attributed to consolidation (alveolar syndrome).[6] In our study, we used the lung ultrasound scoring system as a measure of the extent of de-aeration due to any cause (interstitial or alveolar) to predict weaning patterns, rather than the identification of the cause of de-aeration per se.

It has been said that "weaning off mechanical ventilation: much less an art, but not yet a science."[7] We would like to conclude by saying "weaning from mechanical ventilation: much less an art, but not yet completely unraveled by science."

[1,2]Department of Critical Care Medicine, Kasturba Medical College, Manipal Academy of Higher Education (MAHE), Manipal, Karnataka, India

Corresponding Author: Souvik Chaudhuri, Department of Critical Care Medicine, Kasturba Medical College, Manipal Academy of Higher Education (MAHE), Manipal, Karnataka, India, Phone: +91 9937178620, e-mail: souvikchaudhuri1207@gmail.com

How to cite this article: Amara V, Chaudhuri S. Author's Response to Diaphragm Evaluation and Lung Ultrasound Score during Weaning. Indian J Crit Care Med 2022;26(9):1056–1057.

Source of support: Nil

Conflict of interest: None

Orcid

Vedaghosh Amara https://orcid.org/0000-0001-5296-2138
Souvik Chaudhuri https://orcid.org/0000-0001-8392-2366

References

1. Kumar R, Indrayan A. Receiver operating characteristic (ROC) curve for medical researchers. Indian Pediatr 2011;48(4):277–287. DOI: 10.1007/s13312-011-0055-4.
2. Li S, Chen Z, Yan W. Application of bedside ultrasound in predicting the outcome of weaning from mechanical ventilation in elderly

patients. BMC Pulm Med 2021;21(1):217. DOI: 10.1186/s12890-021-01605-4.
3. Banerjee A, Mehrotra G. Comparison of lung ultrasound-based weaning indices with rapid shallow breathing index: Are they helpful? Indian J Crit Care Med 2018;22(6):435–440. DOI: 10.4103/ijccm.IJCCM_331_17.
4. Llamas–Álvarez AM, Tenza–Lozano EM, Latour–Pérez J. Diaphragm and lung ultrasound to predict weaning outcome: Systematic review and meta-analysis. Chest 2017;152(6):1140–1150. DOI: 10.1016/j.chest.2017.08.028.
5. McMeeken JM, Beith ID, Newham DJ, Milligan P, Critchley DJ. The relationship between EMG and change in thickness of transversus abdominis. Clin Biomech (Bristol, Avon) 2004;19:337–342. DOI: 10.1016/j.clinbiomech.2004.01.007.
6. Bouhemad B, Mongodi S, Via G, Rouquette I. Ultrasound for "lung monitoring" of ventilated patients. Anesthesiology 2015;122(2):437–447. DOI: 10.1097/ALN.0000000000000558.
7. Navalesi P, Bruni A, Garofalo E, Biamonte E, Longhini F, Frigerio P. Weaning off mechanical ventilation: Much less an art, but not yet a science. Ann Transl Med 2019;7(Suppl. 8):S353. DOI: 10.21037/atm.2019.09.83.