Reviewer’s report

Title: Use of esophageal balloon pressure-volume curve analysis to determine esophageal wall elastance and calibrate raw esophageal pressure: a bench experiment and clinical study

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Reviewer: Davide Chiumello

Reviewer’s report:

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Eliminating the influence of esophageal elastance on the measurement of esophageal pressure: a bench experiment and clinical study

BANE-D-17-00449

SUGGESTION: MAJOR REVISION

In the present study, Dr. Sun and coll. sought to investigate the feasibility and performance of a previously published and established calibrating procedure for esophageal pressure in a balloon with a smaller volume than previously investigated.

A bench and experimental study was designed to test the hypothesis: gas-tight glass chamber with different inner volumes and different inner pressurization were used to simulate different balloon-surrounding conditions. After progressive, intermittent inflation of the balloon, balloon and chamber pressure-volume curves were plotted; balloon transmural pressure was calculated to assess the working filling volume, and chamber elastance was estimated from the slope of the intermediate, linear section of the balloon PV curve. The clinical study was conducted on consecutive postoperative patients with delayed emergence from general anesthesia. Again, progressive, intermittent inflation of the balloon was performed, and balloon PV curves were constructed. The intermediate, linear section of the PV curve was analyzed to identify the balloon working volume, the ideal filling volume and to estimate esophageal wall elastance. The findings of the study are that the analysis of the slope of the linear, intermediate section of the balloon PV curve agreed with bench, simulated values of balloon-surrounding elastance, that the calibration procedure worked accurately even in a balloon with a volume smaller than previously investigated. Moreover, a simplified method for the estimation of esophageal elastance was proposed and validated.

The study deals with an interesting topic and was performed with rigorous methodology. Esophageal pressure measurement is being increasingly performed to estimate the contribution
of the chest wall in respiratory system physiology and to evaluate inspiratory effort. Esophageal pressure is considered to estimate pleural pressure. However, the filling volume of the esophageal balloon may significantly influence the measurement due to the elastance of the esophageal wall itself.

I have some criticism:

-the aim of the study was not clearly stated, nor it is completely understandable from the text: apparently, the main aim was to examine the relationship between the estimation of esophageal elastance from the analysis of the linear intermediate section of the PV curve, with the direct measurement of balloon-surrounding pressure. However, from the first part of the discussion, it seems that also calibration of the value of esophageal pressure by the esophageal wall pressure was an outcome, as well as the comparison of a simplified method for the estimation of esophageal elastance with the conventional one. If this is the case, it should be more clearly stated in the introduction.

-How was the number of patients included in the clinical study determined? A main outcome should be clearly stated and a sample size calculation performed on that outcome. The same consideration applies for the experimental study

-In the methods section some parts are difficult to understand for a reader who is not completely familiar with the literature cited. Please, better explain the simplified method of estimation of esophageal elastance (lines 215-218), and clearly state that the comparison of the two methods is an outcome of the study. Similarly, the correction of esophageal pressure by esophageal wall pressure seems to be different from the method previously reported by Mojoli et al (Crit care 2016; 20:98), as Pew should be the product of Ees and the balloon volume from the actual filling volume to Vmin. Please also explain how the calibrated value of esophageal pressure was calculated and that the comparison among corrected values for the different filling volumes was an outcome of the study

-As the authors disclosed in the limitation section, the patient population enrolled is composed mainly by patients without acute respiratory failure, and with presumably healthy lungs, enrolled when delayed recovery from anesthesia was expected. Please, add to table 3 the inspiratory and expiratory esophageal pressure, as well as the partitioned respiratory system, chest wall and lung elastance of the patient population. As expected, patients had a nearly-normal oxygenation; however, they were ventilated with quite elevated airway pressure (median PEEP of 9, median plateau pressure of 20: please comment

-Please, comment the fact that Mojoli et al found that the best filling volume for the Nutrivent esophageal balloon catheter displayed significant variability among patients and in the different conditions studied, while in the present study Vbest was very similar among patients.

-In Table 4 the method for the correction of esophageal pressure seems to differ from that proposed by other authors. Please, better report the correction method used. Also, the table
would be more informative if it was constructed using individual patient volumes (e.g. each patient Vmin, Vbest, Vmax) as well as fixed volumes (0.6, 0.8, 1 ml, etc) as it is now.

-Please, clarify the position of patients during the study.

-Line 83: please modify "inclined" with "linear"

Are the methods appropriate and well described?
If not, please specify what is required in your comments to the authors.

Yes

Does the work include the necessary controls?
If not, please specify which controls are required in your comments to the authors.

No

Are the conclusions drawn adequately supported by the data shown?
If not, please explain in your comments to the authors.

Yes

Are you able to assess any statistics in the manuscript or would you recommend an additional statistical review?
If an additional statistical review is recommended, please specify what aspects require further assessment in your comments to the editors.

I am able to assess the statistics

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