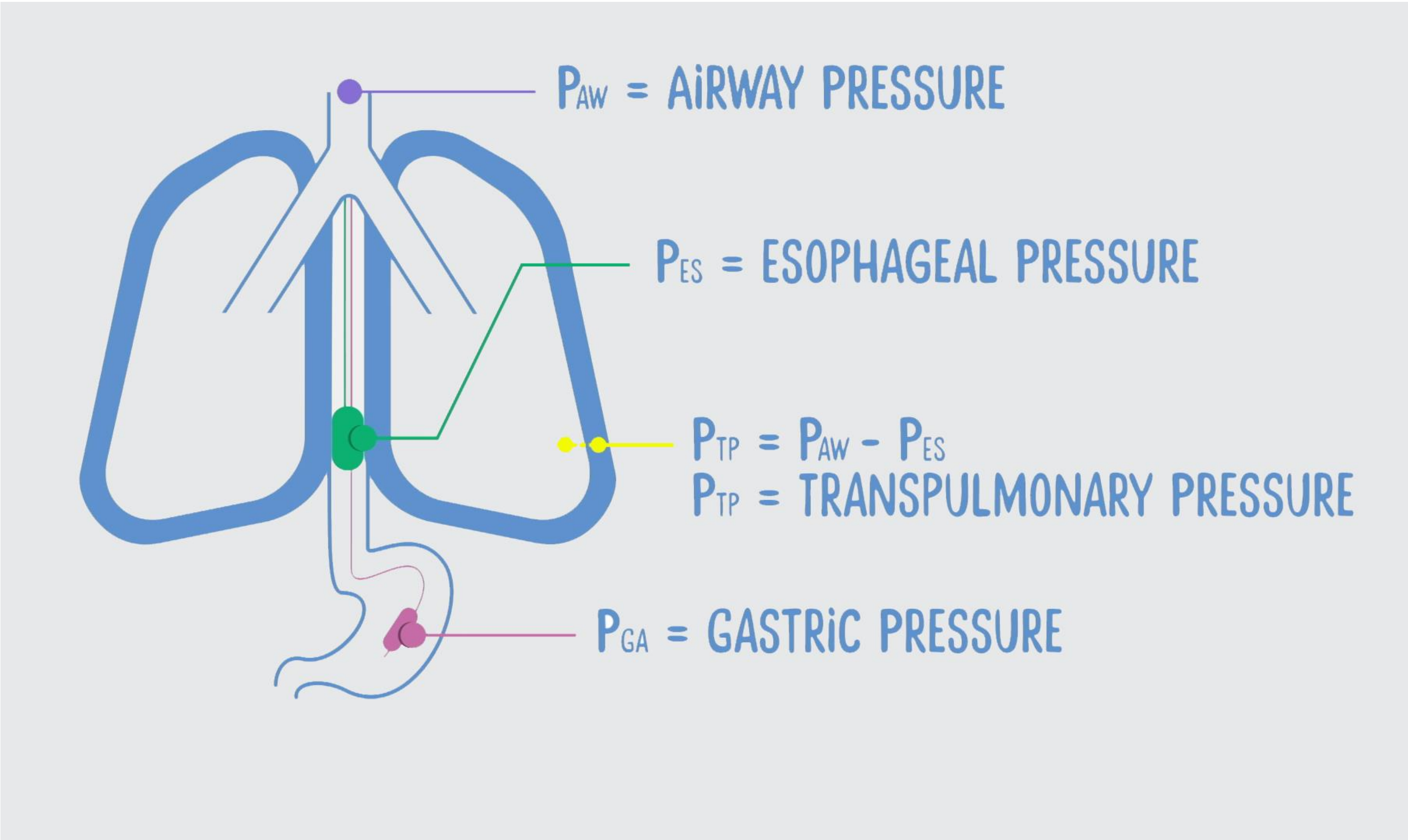

Literature List
Esophageal and Transpulmonary Pressure (Pes / Ptp)

2020

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Categories

CLIN = Clinical Study

REV = Review

Esophageal and Transpulmonary Pressure
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REV	Pham T, Telias I, Beitler,JR	**Esophageal Manometry**	*Respir. Care.* ***2020 Jun***

Abstract: The estimation of pleural pressure with esophageal manometry has been used for decades, and it has been a fertile area of physiology research in healthy subject as well as during mechanical ventilation in patients with lung injury. However, its scarce adoption in clinical practice takes its roots from the (false) ideas that it requires expertise with years of training, that the values obtained are not reliable due to technical challenges or discrepant methods of calculation, and that measurement of esophageal pressure has not proved to benefit patient outcomes. Despites these criticisms, esophageal manometry could contribute to better monitoring, optimization, and personalization of mechanical ventilation from the acute initial phase to the weaning period. This review aims to provide a comprehensive but comprehensible guide addressing the technical aspects of esophageal catheter use, its application in different clinical situations and conditions, and an update on the state of the art with recent studies on this topic and on remaining questions and ways for improvement.

CLIN	Beitler JR, et al.	**Effect of Titrating Positive End-Expiratory Pressure (PEEP) With an Esophageal Pressure-Guided Strategy vs an Empirical High PEEP-FiO_2 Strategy on Death and Days Free From Mechanical Ventilation Among Patients With Acute Respiratory Distress Syndrome: A Randomized Clinical Trial**	*JAMA.* ***2019 Mar***

Importance: Adjusting positive end-expiratory pressure (PEEP) to offset pleural pressure might attenuate lung injury and improve patient outcomes in acute respiratory distress syndrome (ARDS).
Objective: To determine whether PEEP titration guided by esophageal pressure (P_{ES}), an estimate of pleural pressure, was more effective than empirical high PEEP–fraction of inspired oxygen (FiO_2) in moderate to severe ARDS.
Design, Setting, and Participants: Phase 2 randomized clinical trial conducted at 14 hospitals in North America. Two hundred mechanically ventilated patients aged 16 years and older with moderate to severe ARDS (PaO_2:FiO_2 ≤200 mm Hg) were enrolled between October 31, 2012, and September 14, 2017; long-term follow-up was completed July 30, 2018.
Interventions: Participants were randomized to P_{ES}-guided PEEP (n = 102) or empirical high PEEP-FiO_2 (n = 98). All participants received low tidal volumes.
Main Outcomes and Measures: The primary outcome was a ranked composite score incorporating death and days free from mechanical ventilation among survivors through day 28. Prespecified secondary outcomes included 28-day mortality, days free from mechanical ventilation among survivors, and need for rescue therapy.
Results: Two hundred patients were enrolled (mean [SD] age, 56 [16] years; 46% female) and completed 28-day follow-up. The primary composite end point was not significantly different between treatment groups (probability of more favorable outcome with P_{ES}-guided PEEP: 49.6% [95% CI, 41.7% to 57.5%]; P = .92). At 28 days, 33 of 102 patients (32.4%) assigned to PES-guided PEEP and 30 of 98 patients (30.6%) assigned to empirical PEEP-FiO_2 died (risk difference, 1.7% [95% CI, −11.1% to 14.6%]; P = .88). Days free from mechanical ventilation among survivors was not significantly different (median [interquartile range]: 22 [15-24] vs 21 [16.5-24] days; median difference, 0 [95% CI, −1 to 2] days; P = .85). Patients assigned to P_{ES}-guided PEEP were significantly less likely to receive rescue therapy (4/102 [3.9%] vs 12/98 [12.2%]; risk difference, −8.3% [95% CI, −15.8% to −0.8%]; P = .04). None of the 7 other prespecified secondary clinical end points were significantly different. Adverse events included gross barotrauma, which occurred in 6 patients with P_{ES}-guided PEEP and 5 patients with empirical PEEP-FiO_2.
Conclusion and Relevance: Among patients with moderate to severe ARDS, P_{ES}-guided PEEP, compared with empirical high PEEP-FiO_2, resulted in no significant difference in death and days free from mechanical ventilation. These findings do not support P_{ES}-guided PEEP titration in ARDS.

REV	**Umbrello M, Chiumello, D**	**Interpretation of the transpulmonary pressure in the critically ill patient**	*Ann Transl Med.* ***2018 Oct***

Abstract: Mechanical ventilation is a life-saving procedure, which takes over the function of the respiratory muscles while buying time for healing to take place. However, it can also promote or worsen lung injury, so that careful monitoring of respiratory mechanics is suggested to titrate the level of support and avoid injurious pressures and volumes to develop. Standard monitoring includes flow, volume and airway pressure (Paw). However, Paw represents the pressure acting on the respiratory system as a whole, and does not allow to differentiate the part of pressure that is spent di distend the chest wall. Moreover, if spontaneous breathing efforts are allowed, the Paw is the sum of that applied by the ventilator and that generated by the patient. As a consequence, monitoring of Paw has significant shortcomings. Assessment of esophageal pressure (Pes), as a surrogate for pleural pressure (Ppl), may allow the clinicians to discriminate between the elastic behaviour of the lung and the chest wall, and to calculate the degree of spontaneous respiratory effort. In the present review, the characteristics and limitations of airway and transpulmonary pressure monitoring will be presented; we will highlight the different assumptions underlying the various methods for measuring transpulmonary pressure (i.e., the elastance-derived and the release-derived method, and the direct measurement), as well as the potential application of transpulmonary pressure assessment during both controlled and spontaneous/assisted mechanical ventilation in critically ill patients.

REV	**Sahetya SK, Brower RG**	**The Promises and Problems of Transpulmonary Pressure Measurements in Acute Respiratory Distress Syndrome**	*Curr Opin Crit Care.* ***2016 Feb***

Purpose of review: The optimal strategy for assessing and preventing ventilator-induced lung injury in the acute respiratory distress syndrome (ARDS) is controversial. Recent investigative efforts have focused on personalizing ventilator settings to individual respiratory mechanics. This review examines the strengths and weaknesses of using transpulmonary pressure measurements to guide ventilator management in ARDS.

Recent findings: Recent clinical studies suggest that adjusting ventilator settings based on transpulmonary pressure measurements is feasible, may improve oxygenation, and reduce ventilator-induced lung injury.

Summary: The measurement of transpulmonary pressure relies upon esophageal manometry, which requires the acceptance of several assumptions and potential errors. Notably, this includes the ability of localized esophageal pressures to represent global pleural pressure. Recent investigations demonstrated improved oxygenation in ARDS patients when positive end-expiratory pressure was adjusted to target specific end-inspiratory or end-expiratory transpulmonary pressures. However, there are different methods for estimating transpulmonary pressure and different goals for positive end-expiratory pressure titration among recent studies. More research is needed to refine techniques for the estimation and utilization of transpulmonary pressure to guide ventilator settings in ARDS patients.

REV	Mauri T, et al.	**Esophageal and transpulmonary pressure in the clinical setting: meaning, usefulness and perspectives**	*Intensive Care Medicine 42,* ***2016 Jun***

Purpose: Esophageal pressure (Pes) is a minimally invasive advanced respiratory monitoring method with the potential to guide management of ventilation support and enhance specific diagnoses in acute respiratory failure patients. To date, the use of Pes in the clinical setting is limited, and it is often seen as a research tool only.

Methods: This is a review of the relevant technical, physiological and clinical details that support the clinical utility of Pes.

Results: After appropriately positioning of the esophageal balloon, Pes monitoring allows titration of controlled and assisted mechanical ventilation to achieve personalized protective settings and the desired level of patient effort from the acute phase through to weaning. Moreover, Pes monitoring permits accurate measurement of transmural vascular pressure and intrinsic positive end-expiratory pressure and facilitates detection of patient–ventilator asynchrony, thereby supporting specific diagnoses and interventions. Finally, some Pes-derived measures may also be obtained by monitoring electrical activity of the diaphragm.

Conclusions: Pes monitoring provides unique bedside measures for a better understanding of the pathophysiology of acute respiratory failure patients. Including Pes monitoring in the intensivist’s clinical armamentarium may enhance treatment to improve clinical outcomes.

REV	Akoumianaki E, et al.	**The Application of Esophageal Pressure Measurement in Patients with Respiratory Failure**	*Am J Respir Crit Care Med.* ***2014 Mar***

Abstract: This report summarizes current physiological and technical knowledge on esophageal pressure (Pes) measurements in patients receiving mechanical ventilation. The respiratory changes in Pes are representative of changes in pleural pressure. The difference between airway pressure (Paw) and Pes is a valid estimate of transpulmonary pressure. Pes helps determine what fraction of Paw is applied to overcome lung and chest wall elastance. Pes is usually measured via a catheter with an airfilled thin-walled latex balloon inserted nasally or orally. To validate Pes measurement, a dynamic occlusion test measures the ratio of change in Pes to change inPaw during inspiratory efforts against a closed airway. A ratio close to unity indicates that the system provides a valid measurement. Provided transpulmonary pressure is the lung-distending pressure, and that chest wall elastance may vary among individuals, a physiologically based ventilator strategy should take the transpulmonary pressure into account. For monitoring purposes, clinicians rely mostly on Paw and flow waveforms. However, these measurements may mask profound patient–ventilator asynchrony and do not allow respiratory muscle effort assessment. Pes also permits the measurement of transmural vascular pressures during both passive and active breathing. Pes measurements have enhanced our understanding of the pathophysiology of acute lung injury, patient–ventilator interaction, and weaning failure. The use of Pes for positive end-expiratory pressure titration may help improve oxygenation and compliance. Pes measurements make it feasible to individualize the level of muscle effort during mechanical ventilation and weaning. The time is now right to apply the knowledge obtained with Pes to improve the management of critically ill and ventilator-dependent patients.

Dräger

	Talmor DS, Fessler HE	Are Esophageal Pressure Measurements Important in Clinical Decision-Making in Mechanically Ventilated Patients?	Respir Care. **2010 Feb**

Abstract: Low-tidal-volume ventilation strategies are clearly beneficial in patients with acute lung injury and acute respiratory distress syndrome, but the optimal level of applied positive end-expiratory pressure (PEEP) is uncertain. In patients with high pleural pressure on conventional ventilator settings, under-inflation may lead to atelectasis, hypoxemia, and exacerbation of lung injury through "atelectrauma." In such patients, raising PEEP to maintain a positive transpulmonary pressure might improve aeration and oxygenation without causing over-distention. Conversely, in patients with low pleural pressure, maintaining a low PEEP would keep transpulmonary pressure low, avoiding over-distention and consequent "volutrauma." Thus, the currently recommended strategy of setting PEEP without regard to transpulmonary pressure is predicted to benefit some patients while harming others. Recently the use of esophageal manometry to identify the optimal ventilator settings, avoiding both under-inflation and over-inflation, was proposed. This method shows promise but awaits larger clinical trials to assess its impact on clinical outcomes.

CLIN	Talmor D, et al.	Mechanical Ventilation Guided by Esophageal Pressure in Acute Lung Injury	N Engl J Med. **2008 Nov**

Background: Survival of patients with acute lung injury or the acute respiratory distress syndrome (ARDS) has been improved by ventilation with small tidal volumes and the use of positive end-expiratory pressure (PEEP); however, the optimal level of PEEP has been difficult to determine. In this pilot study, we estimated transpulmonary pressure with the use of esophageal balloon catheters. We reasoned that the use of pleural-pressure measurements, despite the technical limitations to the accuracy of such measurements, would enable us to find a PEEP value that could maintain oxygenation while preventing lung injury due to repeated alveolar collapse or overdistention.

Methods: We randomly assigned patients with acute lung injury or ARDS to undergo mechanical ventilation with PEEP adjusted according to measurements of esophageal pressure (the esophageal-pressure–guided group) or according to the Acute Respiratory Distress Syndrome Network standard-of-care recommendations (the control group). The primary end point was improvement in oxygenation. The secondary end points included respiratory-system compliance and patient outcomes.

Results: The study reached its stopping criterion and was terminated after 61 patients had been enrolled. The ratio of the partial pressure of arterial oxygen to the fraction of inspired oxygen at 72 hours was 88 mm Hg higher in the esophageal-pressure–guided group than in the control group (95% confidence interval, 78.1 to 98.3; P=0.002). This effect was persistent over the entire follow-up time (at 24, 48, and 72 hours; P=0.001 by repeated-measures analysis of variance). Respiratory-system compliance was also significantly better at 24, 48, and 72 hours in the esophageal-pressure–guided group (P=0.01 by repeated-measures analysis of variance).

Conclusions: As compared with the current standard of care, a ventilator strategy using esophageal pressures to estimate the transpulmonary pressure significantly improves oxygenation and compliance. Multicenter clinical trials are needed to determine whether this approach should be widely adopted.

REV	**Gattinoni L, et al.**	**Bench-to-bedside Review: Chest Wall Elastance in Acute Lung injury/acute Respiratory Distress Syndrome Patients**	*Crit Care.* ***2004 Oct***

Abstract: The importance of chest wall elastance in characterizing acute lung injury/acute respiratory distress syndrome patients and in setting mechanical ventilation is increasingly recognized. Nearly 30% of patients admitted to a general intensive care unit have an abnormal high intra-abdominal pressure (due to ascites, bowel edema, ileus), which leads to an increase in the chest wall elastance. At a given applied airway pressure, the pleural pressure increases according to (in the static condition) the equation: pleural pressure = airway pressure x (chest wall elastance/total respiratory system elastance). Consequently, for a given applied pressure, the increase in pleural pressure implies a decrease in transpulmonary pressure (airway pressure - pleural pressure), which is the distending force of the lung, implies a decrease of the strain and of ventilator-induced lung injury, implies the need to use a higher airway pressure during the recruitment maneuvers to reach a sufficient transpulmonary opening pressure, implies hemodynamic risk due to the reductions in venous return and heart size, and implies a possible increase of lung edema, partially due to the reduced edema clearance. It is always important in the most critically ill patients to assess the intra-abdominal pressure and the chest wall elastance.