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Commentary: Measure what matters in one lung ventilation

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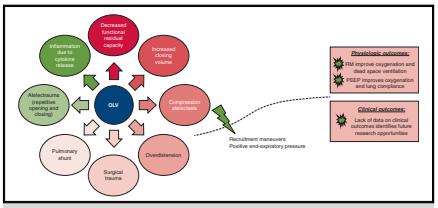

Physiological consequences of one-lung ventilation (*OLV*) and the effect of recruitment maneuvers (*RM*) and positive end-expiratory pressure (*PEEP*) on outcomes presented in the current meta-analysis.

One-lung ventilation (OLV) leads to well-described physiological changes due to intrapulmonary shunting, compressive atelectasis, decreased functional residual capacity, and increased closing capacity, overdistension, and atelectrauma.[1] The ventilation settings required to overcome these changes depend not only on the OLV physiology, but also on the underlying lung condition. Positive pressure needs to be optimal; too little or too much can create unfavorable physiology. In this issue of the *Journal*, Peel and colleagues[2] present a meta-analysis of 16 studies examining the effect of lung recruitment maneuvers (RM) and positive end-expiratory pressure (PEEP) on oxygenation, compliance, and dead space ventilation during OLV. The results are consistent with our current understanding of lung physiology. By decreasing atelectasis and closing capacity, recruitment maneuvers and PEEP produced improvement in partial arterial oxygen pressure compared with no RM/PEEP. The addition of PEEP led to a modest increase in lung compliance, and the use of RM was associated with a decrease in dead space ventilation.

How much PEEP? This study found no improvement in oxygenation with individualized PEEP compared with standard PEEP of 5 cmH_2O. This is not surprising, given the great variability in study protocols, surgical approaches, and underlying lung pathology (eg, restrictive, obstructive). During OLV in the lateral decubitus position, the elastic forces of the chest wall change (open thoracotomy); the weight of the mediastinum and abdominal contents, as well as the insufflation pressure in video-assisted thoracoscopy, are variables that affect the amount of PEEP needed. Moreover, the appropriate method of setting PEEP remains a major controversy even in more "homogenous" populations.[3] What we know is that if the aim is to improve oxygenation, some PEEP is better than no or too much PEEP.

CENTRAL MESSAGE

The meta-analysis confirms the beneficial effect of recruitment maneuvers and positive end-expiratory pressure on physiological respiratory parameters and demonstrates the lack of knowledge about patient-centered clinical outcomes.

The question is whether oxygenation and ventilation are the outcomes on which we should be focusing. We have come a long way in shifting our mindset from maximizing oxygenation and ventilation to tolerating hypoxemia and hypercapnia to mitigate lung injury.[4,5] Oxygenation, compliance, and ventilation indices are not surrogates for lung protection.[6] To provide better insight into our interventions, studies should focus on patient-centered outcomes such as survival, postoperative respiratory failure, hospital length of stay, and quality of life post-procedure, among others. The authors acknowledge this major gap in the literature of OLV and emphasize that due to the absence of clinical data, their meta-analysis summarized the commonly reported physiological outcomes.

This meta-analysis by Peel and colleagues demonstrates the beneficial effect of recruitment maneuvers and PEEP during OLV on physiological respiratory parameters. More importantly, the study demonstrates that patient-oriented clinical outcomes are largely unaddressed in the literature and identifies an important area for future research.

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Disclosures: Authors have nothing to disclose with regard to commercial support.
Received for publication March 3, 2020; accepted for publication March 4, 2020; available ahead of print March 19, 2020.

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J Thorac Cardiovasc Surg 2020;160:1123-4
0022-5223/$36.00

https://doi.org/10.1016/j.jtcvs.2020.03.031

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Commentary: To PEEP, or not to PEEP, that is no longer a question

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CENTRAL MESSAGE

The application of positive end-expiratory pressure and recruitment maneuvers during one-lung ventilation is associated with greater PaO_2, pulmonary compliance, and reduced dead space.

Intraoperative one-lung ventilation (OLV) is in demand more than ever since it was first introduced to clinical practice in November 1949.[1] Double-lumen endotracheal tubes for lung isolation are now frequently used not only for conventional thoracic surgical procedures but also for minimally invasive cardiac operations, including robotic mitral valve repairs[2] and novel transcutaneous electrophysiological interventions such as convergent maze procedure.[3] Thus, it is important to revisit the basics of the OLV and make sure that no harm is done to the patient while the proceduralist is getting better exposure.

In this issue of the *Journal*, Peel and colleagues[4] present the results of a systematic review and meta-analysis of the effect of lung recruitment and positive end-expiratory pressure (PEEP) on ventilation and oxygenation during OLV. The authors performed an extensive search of existing literature only to discover that despite a vast, worldwide use of OLV, there is a paucity of studies focused on clinical rather than surrogate outcomes of the efficacy of lung-protective ventilation strategy. Meta-analysis revealed that recruitment maneuvers and PEEP have physiologic advantages during OLV. Recruitment maneuvers increased arterial oxygen tension (PaO_2) and reduced dead space, whereas PEEP was associated with improved compliance and increased PaO_2. However, the high risk of bias related to a small sample size and heterogeneity was identified in the majority of studies. Also, not all the potential components of lung-protective ventilation strategy for OLV were amenable for the meta-analysis. Thus, the impact of tidal volume, approach to nondependent lung ventilation/PEEP application, shunt fraction, and inspiration to expiration ratio were not assessed. Most importantly, it remains unknown if "good numbers" (greater PaO_2, better compliance) were translated into better clinical outcomes (faster extubation, shorter hospital stay).

The current study was focused on the thoracic surgical population and excluded those patients who underwent cardiopulmonary bypass. However, as the lung isolation becomes more common for a broader spectrum of interventions, future studies should not omit these patients. Their number is growing, and more evidence-based

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Disclosures: Author has nothing to disclose with regard to commercial support.
Received for publication Feb 26, 2020; revisions received Feb 26, 2020; accepted for publication Feb 26, 2020; available ahead of print March 19, 2020.

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J Thorac Cardiovasc Surg 2020;160:1124-5
0022-5223/$36.00

https://doi.org/10.1016/j.jtcvs.2020.02.117