Editorial

Mechanical ventilation during lobectomy: is this lung behaving as a "baby"?

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The annual number of lobectomies substantially increased over the last decade (1). With such increase in the volume of lobectomies it became important to develop guidelines to help establish the optimum intra and postoperative care of these patients. One of the specific areas in need for standardization of care based on the best available evidence is that of mechanical ventilation. The clinical practice guidelines published in the current issue of the *Journal of Thoracic Disease* constitute a great attempt to provide this much needed guidance (2).

During surgery, the operated side is typically collapsed, either via double lumen endotracheal intubation, a bronchial blocker, or iatrogenic induction of pneumothorax in cases of non-intubated thoracoscopic lobectomies (3). There are multiple ventilation challenges in these patients such as the single lung ventilation and the lateral position of the patient during surgery (ventilated lung in the dependent position) that may require a unique approach. Both the non-ventilated lung and the ventilated one are prone to injury through various different mechanisms. But the main stem of lung injury during single-lung ventilation is the hyperoxia and lung overdistention generated by the anesthesia team in an effort to compensate for the collapsed lung.

Reviewing the recommendations arising from the guidelines one cannot help but notice the similarities between the acute respiratory distress syndrome (ARDS) mechanical ventilation management recommendations and mechanical ventilation management recommendations in lobectomy patients (2,4). Both emphasize the importance of lung-protective ventilation with small tidal volumes as in both instances the portions of the lungs accessible for ventilation are smaller than normal. In the case of ARDS, the portions of the lung accessible for ventilation are heterogeneously scattered through both lungs. These healthy alveoli have been referred to as the "baby lung" (5). During lobectomy, the non-operable lung receives all ventilation and most perfusion, and becomes the "baby lung" requiring a more gentle ventilation strategy. In both cases, the overall compliance of the lungs will decrease. In the case of ARDS, due to the heterogeneous fluid-filled alveoli and basal atelectasis. And in the case of lobectomies due to the collapse of one lung and potential atelectasis of segments of the contralateral lung due to its dependent location during surgery. Another parallel of mechanical ventilation recommendations for ARDS and those for lobectomies is the use of hypercapnia with slightly different nomenclature, "permissive hypercapnia" in cases of ARDS and "therapeutic hypercapnia" in cases of lobectomy. Regardless the differences in semantics, the concept is the same. Hypercapnia is primarily allowed in order to maintain low tidal volumes and airway pressures, and it may additionally have a protective anti-inflammatory role (6). The only cases in which hypercapnia should be avoided is in patients with pulmonary hypertension, cardiac arrhythmia and increased intracranial pressure. Similarly, minimizing inspired oxygen and applying positive end expiratory pressure (PEEP) to avoid atelectasis and maintain lung recruitment is recommended in both clinical scenarios. It is imperative to open the lung and keep it open. Adjuvant therapies such as nebulized steroids, sivelestat and

ulinastatin have also been examined in patients with ARDS but only with variable success (7-9).

This begs the questions: should our mechanical ventilation strategy for patients undergoing lobectomy mirror that of patients with ARDS?

There are hundreds of studies examining the various roles of mechanical ventilation and other means to improve outcomes in ARDS compared to only 51 small studies on mechanical ventilation in lobectomy patients (10). However, the advantage that the latter has is the homogeneity of the patient population making results more generalizable. To the contrary of patients with ARDS where the pathology may be heterogenous with various degrees of involvement and various etiologies (both pulmonary and extra pulmonary), patients undergoing lobectomies undergo a similar process to collapse the lung (except for those performed without endotracheal intubation). This raises hope for more solid evidence to support or refute the current guidelines with larger randomized trials. This evidence is needed to avoid having standards of care based on untested assumptions. Using ARDS trials as an example, several ventilatory approaches that were thought to be beneficial initially were later on shown to have no difference or even be harmful in certain instances (11,12). Studies should focus on meaningful outcomes to demonstrate the effectiveness of each intervention and avoid surrogate outcomes as oxygen saturation and cytokine levels. Again, learning from prior ARDS trials, these markers may not correlate with more meaningful outcomes as mortality and morbidity (13).

It's an exciting time to investigate in depth our strategies for mechanical ventilation of patients undergoing lobectomy and we may or not see a divergence from the ARDS mechanical ventilation approach. Based on the available evidence patients undergoing lobectomy should be managed similarly to ARDS patients with low tidal volumes, therapeutic hypercapnia, low inspired oxygen, and PEEP. We strongly agree with the goals of mechanical ventilation stated by the authors in the current practice guidelines: provide adequate oxygenation, provide adequate ventilation (maintaining non-toxic levels of carbon dioxide), and do so in a manner that prevents intra and post-operative lung dysfunction.

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Footnote

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References

1. Ceppa DP, Kosinski AS, Berry MF, et al. Thoracoscopic lobectomy has increasing benefit in patients with poor pulmonary function: a Society of Thoracic Surgeons Database analysis. Ann Surg 2012;256:487-93.
2. Gao S, Zhang Z, Brunelli A, et al. The Society for Translational Medicine: clinical practice guidelines for mechanical ventilation management for patients undergoing lobectomy. J Thorac Dis 2017;9:3246-54.
3. Wu CY, Chen JS, Lin YS, et al. Feasibility and safety of nonintubated thoracoscopic lobectomy for geriatric lung cancer patients. Ann Thorac Surg 2013;95:405-11.
4. Fan E, Del Sorbo L, Goligher EC, et al. An Official American Thoracic Society/European Society of Intensive Care Medicine/Society of Critical Care Medicine Clinical Practice Guideline: Mechanical Ventilation in Adult Patients with Acute Respiratory Distress Syndrome. Am J Respir Crit Care Med 2017;195:1253-63.
5. Gattinoni L, Pesenti A. The concept of "baby lung". Intensive Care Med 2005;31:776-84.
6. Nichol AD, O'Cronin DF, Naughton F, et al. Hypercapnic acidosis reduces oxidative reactions in endotoxin-induced lung injury. Anesthesiology 2010;113:116-25.
7. Artigas A, Camprubí-Rimblas M, Tantinyà N, et al. Inhalation therapies in acute respiratory distress syndrome. Ann Transl Med 2017;5:293.
8. Pu S, Wang D, Liu D, et al. Effect of sivelestat sodium in patients with acute lung injury or acute respiratory distress syndrome: a meta-analysis of randomized controlled trials. BMC Pulm Med 2017;17:148.
9. Leng YX, Yang SG, Song YH, et al. Ulinastatin for acute lung injury and acute respiratory distress syndrome: A systematic review and meta-analysis. World J Crit Care Med 2014;3:34-41.
10. Fan E, Brodie D, Slutsky AS. Acute Respiratory Distress Syndrome: Advances in Diagnosis and Treatment. JAMA 2018;319:698-710.
11. Ferguson ND, Cook DJ, Guyatt GH, et al. High-frequency oscillation in early acute respiratory distress syndrome. N Engl J Med 2013;368:795-805.

12. Jain SV, Kollisch-Singule M, Sadowitz B, et al. The 30-year evolution of airway pressure release ventilation (APRV). Intensive Care Med Exp 2016;4:11.
13. Acute Respiratory Distress Syndrome Network, Brower RG, Matthay MA, et al. Ventilation with lower tidal volumes as compared with traditional tidal volumes for acute lung injury and the acute respiratory distress syndrome. N Engl J Med 2000;342:1301-8.

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