BRIEF COMMUNICATION

# Pulmonary Vascular Permeability Indices: Fine Prints of Lung Protection?

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To the Editor,

The domain of lung-protective strategies continues to be actively researched with the aim of an improved understanding of the underlying pathophysiology and the prevention and management of pulmonary complications. It is noteworthy that pulmonary edema constitutes the commonest complication in critically ill patients accounting for mortality of 12 and 30% following cardiogenic and noncardiogenic causes, respectively.[1,2] Albeit challenging, a sound characterization and differentiation of the cardiogenic and noncardiogenic (essentially acute respiratory distress syndrome, i.e., ARDS) pulmonary edema is of paramount importance for the subsequent management.

The current era is witnessing a transition from the relatively subjective to more objective modalities of pulmonary edema diagnosis. Chest auscultation was the most preliminary method, which slowly progressed to roentgenography, lung ultrasound, and the most recent technique of transpulmonary thermodilution (TPTD). The current concept of TPTD-based measurement of extravascular lung water (EVLW) promises to guide in the diagnosis and follow-up of the edema treatment regimen. Considering the fact that TPTD measures a wide range of volumes (which could serve as surrogates of the preload), it presents the potential of providing an estimate of the capillary permeability by computation of the pulmonary vascular permeability indices (PVPIs). The PVPI is defined as the ratio of the fluid extravasated in the interstitial space to that present in the pulmonary vasculature.[3,4] Pulmonary vascular permeability indices have been demonstrated to be higher in ARDS compared to cardiogenic pulmonary edema, which can be explained on the basis of an increased hydrostatic pressure as a cause of cardiogenic pulmonary edema in sharp contrast to the noncardiogenic pulmonary edema, which is largely attributed to an enhanced capillary permeability.

The recent literature elucidates that a PVPI of less than 2 indicates normal pulmonary permeability and more than 3 is suggestive of increased pulmonary permeability.[3,4] Pulmonary vascular permeability indices assist in the establishment of the type and quantification of pulmonary edema, staging, monitoring progression, and assessing the response to the therapeutic interventions. The clinical use of TPTD measurements can extend to the fluid management in critically ill patients to avoid circulatory overload, weaning from mechanical ventilation, monitoring ventilatory strategies and recruitment maneuvers during one-lung ventilation, fluid management in burn patients, early detection of graft dysfunction in lung transplant patients, and reperfusion pulmonary edema following pulmonary endarterectomy, thereby serving as an appropriate prognostic tool.[5–7]

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Although TPTD is a promising novel technique, it does present certain inherent limitations. First, it requires central venous catheterization and arterial cannulation with the necessary infrastructure and therefore patient selection is important owing to the cost and associated complications. Second, it may underestimate EVLW in pulmonary embolism or overestimate in background of a large pleural effusion or lung resection.[8] Moreover, the TPTD estimations are unreliable in setting of arrhythmias or circulatory assistance. Finally, although the initial literature outlines a PVPI of less than 2 as normal, further studies are required for more robust values across diverse clinical settings and the associated cutoff values for the formal characterization of the leaky lungs.[4,5]

To conclude, TPTD can prove pivotal with regards to the pulmonary protection in the critically ill patients. Interestingly, the most recent Berlin diagnostic ARDS definition fails to take into account the concept of increased vascular permeability and the aforementioned discussion highlights that the inclusion of PVPI could add to the objective value of the diagnostic criterion. All in all, PVPIs definitely constitute novel management clinical and research targets of the ongoing endeavors of lung protection across the wide gamut of predisposed scenarios.

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