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Expiratory Washout in Patients with Severe Acute Respiratory Distress Syndrome

To the Editor.—We read with interest the report by Kalfon et al. regarding the use of expiratory washout in patients with severe acute respiratory distress syndrome.1 Although interesting and stimulating, we believe that several points should be discussed.

In our opinion, the indications for the use of expiratory washout (EWO) or tracheal gas insufflation (TGI) can be summarized as situations where there is profound hypercarbia, resulting in hemodynamic or acid-base compromise, associated with high airway pressures that cannot be safely increased for fear of barotrauma (e.g., severe ARDS) and secondly wherein there are high airway pressures that cannot be reduced as a result of the contraindication of hypercarbia (e.g., lung injury in association with head injury). In our first situation, the aim of EWO is to reduce Pco2 but at the same airway pressures. In the second situation, the aim is to decrease airway pressures without allowing a resultant increase in Pco2.

In their study, Kalfon et al. have used EWO for none of the previous indications. Their findings of Pco2 decrease could easily have been reproduced by simply increasing tidal ventilation. This would have provided CO2 decrease and would have led to similar airway pressure changes, i.e., increased peak, plateau, and mean tracheal pressure. We are concerned that an uncritical reading of this paper will bias readers against TGI because of the significant increases in airway pressures associated with the mode in which EWO has been used by the authors. To most clinicians, these significant changes in airway pressure would be unacceptable.

Some of these changes in airway pressures could have been avoided by the use of pressure-controlled ventilation (PCV) rather than volume-controlled ventilation. We have recently completed a similar study of EWO, in an animal model, in which we used EWO at a flow of 6 l/min combined with PCV.2 We observed a 14% reduction in Pco2 but with no increase in peak airway pressure. Mean airway pressure increased by a nonsignificant amount as a result of intrinsic PEEP caused by EWO. We had the capability of measuring this increase in PEEP, unlike Kalfon et al., by the synchronized sup-

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In Reply.—The letters from Oppenheim and Pizov and from Findlay et al. indicate an important potential drawback of expiratory washout: auto-PEEP resulting in an increase in inspiratory plateau airway pressure, which may reintroduce a risk of lung barotrauma. Different solutions exist to overcome EWO-induced auto-PEEP. As suggested by Findlay et al., one is to deliver EWO during pressure-controlled ventilation. In such circumstances, because EWO-induced increase in airway pressure automatically results in a decrease in the tidal volume, the lack of EWO-induced auto-PEEP is associated with a reduction in the efficiency of EWO on CO₂ elimination. In Findlay’s study, a 6 l/min EWO flow delivered during pressure-controlled ventilation was associated with a modest reduction in Pao₂ (−14%). As a consequence, this technique for counteracting EWO-induced auto-PEEP appears to have serious limitations. It is more simple and efficient to reduce the PEEP level. In a recent study, we could demonstrate in a series of patients with ARDS that inspiratory plateau airway pressure, mean airway pressure, and consequently arterial oxygenation and pulmonary shunt could be maintained constant when the PEEP level was reduced of an amount equal to EWO-induced auto-PEEP. In this study wherein a 15 l/min EWO flow was used, Pao₂ could be reduced by 26% if compared with control values without EWO.

As emphasized by Findlay et al., it is technically possible to measure EWO-induced auto-PEEP by synchronizing suppression of EWO and occlusion of the expiratory valve. This technical option, already present in prototypes, should be available on any medical device providing EWO and should be considered as a critical element of safety. Findlay et al. have outlined an important limitation of our study, although the indication for EWO was unquestionable—severe ARDS with lung hyperdensities involving 50% of the lung parenchyma, low respiratory compliance, and profound hypercarbia with acid-base compromise resulting in increased pulmonary artery pressure—the technical conditions of EWO administration were not optimized. EWO-induced auto-PEEP should have been counterbalanced by a concomitant reduction in PEEP, a technique that does not compromise CO₂ elimination and arterial oxygenation. We agree with Findlay et al. that our study should not bias intensivists against the use of EWO in patients with severe ARDS.

Another solution proposed by Oppenheim and Pizov to limit the auto-PEEP resulting from tracheal gas insufflation is to replace oxygen by helium. In an interesting study, these authors have demonstrated that helium is more effective than oxygen for improving CO₂ elimination and limiting auto-PEEP. However, helium does not totally avoid the increase in peak inspiratory airway pressure and therefore appears less effective than decreasing PEEP. In addition, its high cost and the risk of decreasing Fio₂ and worsening arterial oxygenation in patients with ARDS render problematic its routine use in clinical practice.

Although we agree that EWO is a peculiar mode of tracheal gas insufflation, we think that it should be clearly individualized from a semantic point of view. The administration of an intratracheal gas flow during inspiration—inspiratory bypass—increases tidal volume and therefore cannot be considered as a new mode of CO₂ elimination. In contrast, EWO that removes the carbon dioxide-laden gas occupying the instrumental dead space without inducing major changes in tidal volume appears as an original technique for enhancing CO₂ clearance in patients treated by permissive hypercapnia. In our opinion, EWO rather than inspiratory bypass or continuous tracheal gas insufflation could be clinically used in the near future if technical problems related to the measurement of auto-PEEP are solved by manufacturers of ICU ventilators.

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