LETTER TO THE EDITOR

Rebreathing of carbon dioxide during non-invasive ventilation. Is PEEP the final solution?

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Key Words: non-invasive ventilation; PEEP; rebreathing; COPD; mechanical ventilation

Dear Editor,

We have read the article published by Al Hussain and Vines [1] with keen interest. This was a simulated experiment on healthy volunteers examining the effect of varying levels of positive end-expiratory pressure (PEEP) on the level of rebreathing of carbon dioxide (CO₂) during non-invasive ventilation (NIV) with a dual limb critical care ventilator [1].

The authors mentioned in the limitations that the results may be different for those with an elevated baseline partial pressure of alveolar CO₂. The indications for NIV as mentioned in the introduction of the article were chronic obstructive pulmonary disease (COPD) or type 1 respiratory failure like acute respiratory distress syndrome (ARDS) or pulmonary edema [2]. But these conditions require specific PEEP settings, for example in COPD to counter auto-PEEP or in ARDS according to the level of hypoxia. Thus, the absence of or low PEEP in an NIV setting in these cases would be unlikely.

The authors also mentioned in the limitations that the sample size was small but statistically significant. In the article, it was not clear what the primary objective was or if any sample size was calculated based on that. Thus, it would perhaps be better to comment only on clinical significance instead of statistical significance in such a study. It might be possible that the results, even though statistically significant, may not have a clinically significant effect and a future study with blood gas parameters, if feasible, in real patients may be formulated. The authors also commented that due to the short duration of the experiment any possible effects of CO₂ rebreathing on respiratory rate and tidal volume were not observed and were similar at all PEEP levels. Thus, it would have been better to have longer experiments to allow such changes to be observed while keeping in mind the ethical issues of subjecting healthy volunteers to potential CO₂ rebreathing and its effects [3].

A few observations regarding the methodology are as follows. Mask fit is an important component of effective ventilation during NIV. Although the authors excluded facial deformity, they could have commented on the presence or absence of a beard in the inclusion or exclusion criteria, which is a more practical clinical problem in such patients (as evident in the lightly bearded volunteer in Figure 1 of the article). This study was conducted as a crossover randomized controlled trial where each volunteer experiences four different masks at different PEEP levels. The main concern with such trials is the “washout period” where each volunteer experiences four different masks at different PEEP levels. The authors mentioned in the limitations that the results may be different for those with an elevated baseline partial pressure of alveolar CO₂. The indications for NIV as mentioned in the introduction of the article were chronic obstructive pulmonary disease (COPD) or type 1 respiratory failure like acute respiratory distress syndrome (ARDS) or pulmonary edema [2]. But these conditions require specific PEEP settings, for example in COPD to counter auto-PEEP or in ARDS according to the level of hypoxia. Thus, the absence of or low PEEP in an NIV setting in these cases would be unlikely.

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In the discussion, the authors tried to bring out the relation between mask leak and CO₂ clearance during NIV. The results showed higher mask leaks at higher PEEP levels. But there was no difference in ventilation, which seems unlikely if the leak was significantly more in higher PEEP groups. The authors could have commented on any possible leak compensation feature of the ventilator in this case. Also, as the authors have themselves pointed out, mask leak can affect the CO₂ washout, so comparing the results between different PEEP levels in such a situation, again, becomes unreliable. The authors, towards the end, based their conclusions on the assumption that mask leak is a desirable mechanism of CO₂ clearance in NIV. But in critical care ventilators, a good seal with no or minimal leak is essential for effective ventilation, PEEP maintenance, as well for CO₂ clearance [6]. This correlation between mask leak and CO₂ clearance appears to be not satisfactorily conveyed.

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