and manufacturers. In our hospital, the costs of the Ventumask and EasyVent, Ventukit, and EveCoulisse are very similar, respectively, whereas the Boussignac is the least expensive. However, based on the results of our study, the Boussignac device appears to perform more as a reservoir mask than as a CPAP device because of the low variable end-expiratory pressure, low airflow outputs, and high unadjustable F_{IO_2}. We concur with Drs Salturk and Esquinas that the impact of bench differences between CPAP devices on clinical outcomes needs to be determined in prospective trials.

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PEEP and Mechanical Ventilation: We Are Warned, We Cannot Ignore

To the Editor:

In an interesting study recently published in RESPIRATORY CARE, Natalini et al[1] analyzed in 186 subjects receiving mechanical ventilation (settings chosen by the attending physician) several potential causes of dynamic hyperinflation and intrinsic PEEP (auto-PEEP). Both intrinsic and extrinsic[2] auto-PEEP determinants as well as differences between low and high auto-PEEP cohorts (cutoff: 5 cm H_2O) were assessed. The results showed that expiratory flow limitation, the ratio between the expiratory time and the time constant of the respiratory system (T_E/τ_{RS}), the inspiratory resistance (R_{RS}), and body mass index not only were independently associated with auto-PEEP levels but also represented the strongest risk factors associated with auto-PEEP >5 cm H_2O. Surprisingly, T_E did not. The authors concluded that the ventilator settings play a marginal role in auto-PEEP generation in the absence of subjects' predisposing factors. As a clinical consequence, the authors suggested that auto-PEEP can be effectively reduced by acting on patients' respiratory mechanics impairment, with little/no additional effect obtained by breathing pattern manipulation.

We are indebted to the authors for several reasons. First, they pointed out the key role played by expiratory flow limitation in generating dynamic hyperinflation and auto-PEEP. As a matter of fact, their data show that <50% of actual auto-PEEP was accounted for by elastic and resistive properties of the respiratory system alone (comparing actual with theoretical auto-PEEP [ie, 1/maximum C_{RS} × trapped expiratory volume computed according to longest τ_{RS}]; data from Table 3). This reinforces the role of application of adequate CPAP levels to counterbalance auto-PEEP in the presence of expiratory flow limitation.[3] Second, they stressed the importance of treating patients receiving mechanical ventilation with medical therapy. In our experience, too many physicians forget that mechanical ventilation has no therapeutic role in improving patients' respiratory mechanics impairment[4]; it only equilibrates the imbalance between respiratory muscle force-generating capacity and increased respiratory work load,[4,5] providing time to recover from respiratory illness, facts that warrant concomitant bronchodilator use. Third, they suggest considering T_E/τ_{RS} ratio instead of T_E alone when setting the ventilator. In this line, we suggest that τ_{RS} should be directly measured[4] to account also for expiratory flow limitation, when present. In our opinion, few physicians recognize the relevance of setting T_E according to τ_{RS}. As a matter of fact, the breathing pattern was similar in both low and high auto-PEEP cohorts also in the present study.

This last fact is the cause of our major criticism of this worthy paper. The lack of relationship between auto-PEEP and T_E forced the authors to conclude that "manipulation of the breathing pattern might only have a negligible effect on the overall auto-PEEP value." However, this result depended mainly on the quite constant T_E imposed by the attending physicians in the face of a wide range of auto-PEEP levels.[1] To test auto-PEEP response to changing T_E, ad hoc protocols are necessary (eg, different T_E values tested in the same patient). Thus, the claim that breathing pattern manipulation has negligible effects on auto-PEEP sounds wrong and misleading and conflicts with the authors' seminal observation that T_E should be chosen according to τ_{RS}.

In conclusion, also thanks to Natalini et al,[1] enough knowledge is currently available to identify patients prone to develop significant auto-PEEP during mechanical ventilation, to treat its intrinsic causes (pharmacologically), and to prevent/attenuate its onset by manipulating the ventilator settings. We are warned, we cannot ignore…

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PEEP and Mechanical Ventilation: We Are Warned, We Cannot Ignore—Reply

In reply:

We are grateful to Dr Appendini and colleagues for their comment and appreciation.

The similar expiratory time used in patients with high and low auto-PEEP levels does not diminish the lack of relationship between auto-PEEP and expiratory time (if anything, it made the statistical analysis more consistent).

We definitely believe that the ventilator settings could have been improved in some subjects enrolled in the study. Namely, expiratory time should be increased in patients with significant levels of auto-PEEP. Our findings suggest that such an increase should be proportional to the time constant of the respiratory system.

Therefore, we agree with Appendini and colleagues that in some cases, breathing pattern manipulation (ie, the decrease of breathing frequency and/or inspiratory time) could be advisable in mechanically ventilated patients with auto-PEEP.

On the other hand, we should always keep in mind that expiratory time can be set only in patients undergoing controlled ventilation, whereas it cannot be imposed during any modality of assisted ventilation, when expiration is ended by patient inspiratory triggering. On the contrary, medical therapy and patient position can effectively reduce auto-PEEP both during controlled and during assisted ventilation and therefore play a fundamental role in clinical practice, in particular during weaning from mechanical ventilation.

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Transcutaneous Carbon Dioxide in the Management of Noninvasive Ventilation

To the Editor:

Respiratory monitoring during noninvasive mechanical ventilation (NIV) allows evaluation of its efficiency and prevention of any delay in the initiation of invasive mechanical ventilation and the occurrence of related complications. The measurement of breathing frequency, pulse oximetry, arterial blood gas analysis, and capnography are commonly employed methods for this purpose. Direct monitoring of P_{CO_2} is particularly important in the management of patients with hypercapnic respiratory failure. Direct measurement of arterial P_{aCO_2} using arterial blood gas analysis is the accepted standard method; however, the inability of this method to provide continuous monitoring and its invasive nature have spurred research for an alternative method.[1] The studies have focused on end-tidal P_{CO_2} and transcutaneous measurement of P_{CO_2} (P_{tcCO_2}) due to their ability to provide continuous monitoring and their noninvasive nature. P_{tcCO_2} is especially used to evaluate alveolar ventilation in patients with nocturnal hypoventilation receiving NIV in the home setting. The studies demonstrated the correlation between P_{tcCO_2} and P_{aCO_2} values.[2]

In the study titled "What is the potential role of transcutaneous carbon dioxide in guiding acute noninvasive ventilation?" Van Oppen et al[3] evaluated the correlations between $P_{tcCO_2} - P_{aCO_2}$ and arterial pH-calculated transcutaneous pH and the relationship of the 2 methods with the pain scores in 9 subjects undergoing NIV due to hypercapnic respiratory failure. The study measurements were performed with 4-h intervals in the first 12 h after the initiation of NIV.

According to Bland-Altman analysis, transcutaneous pH was, in general, consistent with arterial pH; however, this relationship was weaker in the case of severe acidosis, as evidenced by the pH value measured, <7.30. A similar relationship was found between P_{tcCO_2} and P_{aCO_2}. This relationship was weaker in the case of severe acidosis when P_{aCO_2} was >65 mm Hg. They suggested that NIV could be guided using bicarbonate and pH values predicted using the algorithms, and this approach would also reduce the number of blood samplings for arterial blood gas analysis. The utility of this method only when pH is not <7.30 and in the presence of pure respiratory acidosis, which is not accompanied by metabolic acidosis, may limit its use in clinical practice. However, the predicted values when baseline bicarbonate is measured >34.0 mmol/L do not reflect the actual values, and this necessitates the use of further algorithms.

As the secondary outcome measure of the study, pain score was significantly lower compared with arterial blood sampling during transcutaneous monitoring. There are also studies suggesting that the correlation between P_{tcCO_2} and P_{aCO_2} in subjects undergoing NIV is suboptimal and that P_{tcCO_2} cannot substitute for P_{aCO_2}.[4] Although P_{tcCO_2} monitoring is a noninvasive method and seems to be superior in showing the efficiency of treatment, more studies with a larger number of cases are required to establish its place in cases with acute respiratory failure.

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