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Noninvasive Ventilation for *De Novo* Respiratory Failure: Impact of Ventilator Setting Adjustments

To the Editor:

One of the main aims of partial ventilatory support is to adequately unload the respiratory muscles. On one hand, overassistance may cause diaphragmatic dysfunction (1) and asynchrony (2); on the other hand, excessive inspiratory effort associated with insufficient amounts of assistance may lead to respiratory distress and expose the patient to the risk of self-inflicted lung injury (3). During noninvasive ventilation (NIV) for acute respiratory failure, pressure support level adjustment is therefore likely to influence the outcome. Especially, it is expected that an amount of assistance insufficient to reverse respiratory distress would lead to NIV failure and precipitate intubation. However, adjusting the amount of assistance in clinical practice remains a challenge. In fact, measuring the amount of respiratory effort requires the use of an esophageal catheter (4, 5) that cannot be routinely used during NIV.

We read with great interest the report of Tonelli and colleagues on a series of 30 patients during a 24-hour NIV trial for *de novo* acute hypoxemic respiratory failure in whom an esophageal catheter had been inserted (6). All patients exhibited an excessive inspiratory effort upon NIV initiation, with a median esophageal pressure swing (ΔPes) as high as 33 (interquartile range [IQR], 24–39) cm H_2O in the NIV success group and 38 (IQR, 32–42) cm H_2O in the NIV failure group ($P = 0.1$). After 2 hours of NIV, the patients who succeeded the NIV trial had dramatically decreased their respiratory effort. Thus, their ΔPes became significantly lower than those of patients who failed the NIV attempt (11 [IQR, 8–15] vs. 31.5 [IQR, 30–36] cm H_2O; $P < 0.001$). The authors concluded that the magnitude of respiratory effort relief within the first 2 hours of NIV was therefore an accurate predictor of NIV outcome.

As the respiratory effort is significantly influenced by the amount of assistance, however, such a conclusion may rely on an interpretation bias, and further details about the ventilator's setting adjustments are needed to support it. In fact, for a comparable respiratory effort at baseline, the positive end-expiratory pressure (PEEP) and pressure support levels did not significantly differ between the NIV success and failure groups (8 [IQR, 6–10] vs. 8 [IQR, 7.5–10] cm H_2O and 11 [IQR, 10–14] vs. 11 [IQR, 10–12] cm H_2O, respectively; $P > 0.0.5$ for both comparisons), suggesting a comparable ventilatory demand. The authors did not report subsequent changes in respiratory support. After 2 hours of NIV, however, the magnitude of the difference in dynamic transpulmonary pressure, when compared with that of ΔPes, suggests different ventilator setting adjustments between patients who succeeded or failed the NIV attempt (30.5 [IQR, 28–43.5] vs. 39.5 [IQR, 37.5–42.3] cm H_2O; $P = 0.04$). If so, the following interpretation could rather be found: in patients with *de novo* acute hypoxemic respiratory failure, NIV may avoid early intubation when the amount of assistance is properly adjusted in a manner that allows a significant decrease in respiratory effort. Could the authors report the PEEP and pressure support levels after 2 hours of NIV to further assess this alternative conclusion? ■

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Should We Monitor Pulsus Paradoxus via Pulse Oximetry in Patients with COVID-19 and Acute Respiratory Failure?

To the Editor:

We read with interest the study by Tonelli and colleagues (1), in which they assessed the inspiratory effort of 30 patients with *de novo* respiratory failure. The inspiratory effort was quantified by measuring the respiratory swings in esophageal pressure (ΔPes). Their findings suggest that the lack of inspiratory effort relief within the first 2 hours of noninvasive ventilation (NIV) is an early and accurate predictor of NIV failure at 24 hours. In practice, patients in whom ΔPes does not decrease by >10 cm H_2O after initiating NIV finally require tracheal intubation.

We agree with Tonelli and colleagues (1) that there is a need for an early robust predictor of NIV failure to avoid intubation delay. Such delay may lead to self-inflicted acute lung injury (2). Indeed, persistently strong spontaneous inspiratory efforts simultaneously increase tissue stresses and raise pulmonary transvascular pressures, vascular flows, and fluid leakage (2, 3). This phenomenon has recently been advocated to explain, at least in part, the rapid deterioration of lung function in patients with coronavirus disease (COVID-19) (3).

The study by Tonelli and colleagues (1) suggests that ΔPes may be a robust predictor of NIV failure and may help clinicians in the decision-making process of tracheal intubation. However, we are concerned by the fact that esophageal probes are rarely used and often poorly tolerated in spontaneously breathing patients with acute respiratory failure. Therefore, although Tonelli's findings make a lot of sense from a physiologic standpoint, we are afraid that the clinical applicability of their esophageal tonometry approach may be limited.

Respiratory swings in pleural pressure induce swings in the arterial pulse, which are known as the pulsus paradoxus. A pulsus paradoxus is classically observed during asthma crisis, and its magnitude is known to reflect the severity of the attack. Cyclic respiratory changes in the arterial pulse are reflected by proportional changes in the pulse oximetry waveform (4). We are well aware that the magnitude of the respiratory swings in the pulse oximetry waveform (also known as the Pleth Variability Index [PVI]) is dependent on volume status and may significantly increase during surgical bleeding (5). However, in patients with acute respiratory failure, PVI depends almost exclusively on the magnitude of changes in pleural pressure (i.e., on the respiratory effort). In this respect, PVI has been proposed to assess the expiratory effort in patients with airway obstruction (6). We believe it may also be used to assess the inspiratory effort during acute respiratory failure related to bacterial or viral pneumonia. All hypoxemic inpatients with COVID-19 are monitored with a pulse oximeter that, in addition to oxygen saturation, could be used to quantify their pulsus paradoxus or PVI (Figure 1). In other words, PVI monitoring may constitute an elegant and practical alternative to the quantification of ΔPes and assist clinicians in the timing of tracheal intubation. Studies are needed to confirm this hypothesis and to clarify which PVI cutoff value would correspond to the best discriminative value of 10 cm H_2O reported by Tonelli and colleagues (1) for ΔPes. ■

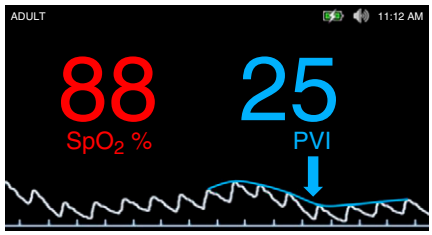

Figure 1. Modern pulse oximeters enable the monitoring of the respiratory pleth variability (pulsus paradoxus or Pleth Variability Index). PVI = Pleth Variability Index; Sp_{O_2} = oxygen saturation as measured by pulse oximetry.

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