



High-flow nasal cannula and noninvasive ventilation: effects on alveolar recruitment and overdistension

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To the Editor:

We have read with great interest a study recently published in *ERJ Open Research* that analysed the ability of high-flow nasal cannula (HFNC) and noninvasive ventilation (NIV) to induce pulmonary expansion in acute hypoxaemic respiratory failure [1]. We would like to congratulate ARTAUD-MACARI *et al.* [1] for their interesting observation using end-expiratory electrical lung impedance as a measuring tool. NIV certainly affects both dependent and non-dependent lung regions, which could increase tidal volume (V_T) to >9.5 mL per kg predicted body weight and potentially exacerbate acute hypoxaemic respiratory failure. The authors concluded that, compared to NIV, HFNC contributes to lower risk of overdistension and fewer deleterious effects on global and regional V_T , because the end-expiratory electrical lung impedance does not increase in non-dependent regions. Other studies, however, argue that HFNC may have similar negative effects to NIV, supported by four well-known determinants, as follows.

First, V_T and flow rate have relative proportional inter-relationships. Despite the respiratory rate and primary patient modality (mouth *versus* nose breathing) being possible confounders, V_T still increases proportionally with gas flow under HFNC, with p-values as low as 0.001 [2, 3]. As such, one can presume that higher levels of V_T and flow rate may induce overdistension and barotrauma.

Secondly, while HFNC could have a protective effect compared to NIV, the negative swings in pleural pressure secondary to spontaneous inspiratory efforts can contribute to patient self-inflicted lung injury [4]. In the study by ARTAUD-MACARI *et al.* [1], the HFNC setting was delivered at a constant flow rate of 50 L·min⁻¹. However, previous studies considered an optimal HFNC rate of 60 L·min⁻¹, given that there were reduced indices of respiratory effort in adult patients recovering from acute hypoxaemic respiratory failure [5].

Thirdly, during spontaneous breathing, both the V_T and inspiratory flow vary, and when HFNC flow is less than patient inspiratory flow, the patient will inspire atmospheric air. Alternatively, when HFNC flow is sufficiently high, the absolute humidity of inspired gas is unlikely to be a problem. Conditioning of the gas minimises airway constriction, reduces work of breathing, improves mucociliary function, facilitates secretion clearance and decreases the incidence of atelectasis, thereby improving the ventilation/perfusion ratio and overall oxygenation [6].

Finally, the Pendelluft phenomenon also has an effect on V_T . The phenomenon is defined as the displacement of gas from a more recruited non-dependent lung region to a less recruited dependent lung region. Gas flow from the dependent to the non-dependent region is essential in Pendelluft, but the severity of this phenomenon is not always proportional to gas flow. The severity increases as differences in plateau pressure levels increase between the non-dependent and dependent regions, and is amplified by differences in their lung mechanics [7].

Flow rate, negative pleural pressure swing, spontaneous inspiratory effort and the Pendelluft phenomenon are important determinants in HFNC complications. We are not fully convinced that HFNC has a greater protective effect compared to NIV relative to lung injury, and suggest that more research is needed to confirm the findings reported by ARTAUD-MACARI *et al.* [1].



Shareable abstract (@ERSpublications)

Both high-flow nasal cannula and noninvasive ventilation are subject to pulmonary complications
<https://bit.ly/3jFCSG9>

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