ERJ open research
THE BEST IN OPEN ACCESS BASIC, TRANSLATIONAL & CLINICAL RESPIRATORY RESEARCH

Early View

Correspondence

HFNC and non-invasive ventilation: effects on alveolar recruitment-overdistention

Amandeep S. Saini, Simon Meredith, Antonio M. Esquinas, Bushra A. Mina

Please cite this article as: Saini AS, Meredith S, Esquinas AM, *et al*. HFNC and non-invasive ventilation: effects on alveolar recruitment-overdistention. *ERJ Open Res* 2022; in press (https://doi.org/10.1183/23120541.00127-2022).

HFNC and non-invasive ventilation: effects on alveolar recruitment-overdistention

Amandeep S. Saini[1], Simon Meredith[2], Antonio M. Esquinas[3], Bushra A. Mina[2]

[1]Department of Medicine, Lenox Hill Hospital/Northwell Health, New York, NY
[2]Department of Pulmonary and Critical Care Medicine, Lenox Hill Hospital/Northwell Health, New York, NY
[3]Intensive Care Unit, Hospital Morales Meseguer, Murcia, Spain

Corresponding Author:
Amandeep S. Saini, DO
Department of Medicine
Lenox Hill Hospital/Northwell Health
130 East 77th Street,
New York, NY 10075 USA
+1 (212) 434-2000
Email: asaininy@gmail.com

To the Editor

We have read with great interest a study recently published in the European Respiratory Journal Open Research that analyzed the ability of high flow nasal cannula (HFNC) and non-invasive ventilation (NIV) to induce pulmonary expansion in acute hypoxemic respiratory failure (1). We would like to congratulate the authors 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) >9.5 mL/kg predicted body weight and potentially exacerbate acute hypoxemic respiratory failure. The authors concluded that compared to NIV, HFNC contributes to lower risk of overdistention and fewer deleterious effect 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:

1. V_T and flow rate have relative proportional inter-relationships. Despite the respiratory rate and primary patient modality (mouth versus nose breathing) as possible confounders, V_T still proportionally increases to gas flow under HFNC with p-values as low as 0.001 (2, 3). As such, one can presume that higher amounts of V_T and flow rate may induce overdistention and barotrauma.
2. 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 this paper, the HFNC setting was delivered at a constant flow rate of 50 L per minute. However, previous studies considered an optimal HFNC rate of 60 L per minute, given that there were reduced indices of respiratory effort in adult patients recovering from acute hypoxemic respiratory failure (5).
3. 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 minimizes 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).
4. 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 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 and co-workers.

References

1. Artaud-Macari E, Bubenheim M, Le Bouar G, et al. High-flow oxygen therapy *versus* noninvasive ventilation: a randomised physiological crossover study of alveolar recruitment in acute respiratory failure. *ERJ Open Res*. 2021;7(4):00373-2021. Published 2021 Dec 13. doi:10.1183/23120541.00373-2021.
2. L'Her E, Nazir S, Pateau V, et al. Accuracy of noncontact surface imaging for tidal volume and respiratory rate measurements in the ICU [published online ahead of print, 2021 Apr 22]. *J Clin Monit Comput*. 2021;1-9. doi:10.1007/s10877-021-00708-x.
3. Le Moigne G, Nazir S, Pateau V, et al. Noninvasive Tidal Volume Measurements, Using a Time-of-Flight Camera, Under High-Flow Nasal Cannula-A Physiological Evaluation, in Healthy Volunteers. *Crit Care Med*. 2022;50(1):e61-e70. doi:10.1097/CCM.0000000000005183.
4. Grieco DL, Menga LS, Eleuteri D, et al. Patient self-inflicted lung injury: implications for acute hypoxemic respiratory failure and ARDS patients on non-invasive support. *Minerva Anestesiol*. 2019;85(9):1014-1023. doi:10.23736/S0375-9393.19.13418-9.
5. Delorme M, Bouchard PA, Simon M, et al. Effects of High-Flow Nasal Cannula on the Work of Breathing in Patients Recovering From Acute Respiratory Failure. *Crit Care Med*. 2017;45(12):1981-1988. doi:10.1097/CCM.0000000000002693.
6. Nishimura M. High-Flow Nasal Cannula Oxygen Therapy in Adults: Physiological Benefits, Indication, Clinical Benefits, and Adverse Effects. *Respir Care*. 2016;61(4):529-541. doi:10.4187/respcare.04577.
7. Enokidani Y, Uchiyama A, Yoshida T, et al. Effects of Ventilatory Settings on Pendelluft Phenomenon During Mechanical Ventilation. *Respir Care*. 2021;66(1):1-10. doi:10.4187/respcare.07880.