

EIT findings during helmet noninvasive support

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Abstract

Background: Helmet Non-Invasive Ventilation (NIV) and Helmet Continuous Positive Airway Pressure (CPAP) are used for early hypoxemic respiratory failure, but a comparison among the techniques has never been made.

Methods: Fifteen patients with a $\text{PaO}_2/\text{FiO}_2 < 200$ were treated with NIV (PEEP 14 cmH₂O, Pressure support 12 cmH₂O), CPAP (PEEP 14 cmH₂O) and high-flow nasal oxygen (HFNO, 60 Lt/min) in a randomized sequence to assess the effects on tidal volume and volume distribution, with HFNO as reference standard. Each sequence lasted one hour, and the last fifteen minutes were analyzed offline.

Tidal impedance variation (Tidal Δ Z - the gas inflating the lungs during the breath cycle), the Pendelluft (expressed as % of Tidal Δ Z), the end-expiratory lung impedance (EELI), and the Tidal Δ Z/EELI were measured with electrical impedance tomography (Fluxmed, MBMED, Buenos Aires, Argentina).

Results: CPAP and NIV increased Tidal Δ Z (1775 arbitrary units [1289 - 2788] vs. 1411 [1047 - 1842] vs. 913 [781 - 1294], $p=0.003$, $p=0.015$) and EELI (5028 arbitrary units [3051 - 6738] vs. 4301 [2363 - 6358] vs. 1809 [873 - 1964], $p=0.001$, $p=0.001$) compared to HFNO, reducing the Tidal Δ Z/EELI ratio (0.34 [0.22-0.61] vs. 0.38 [0.23-0.55] vs. 0.64 [0.56-0.76], $p=0.001$, $p=0.02$) in CPAP and NIV.

CPAP and NIV decreased the pendelluft % compared to HFNO (31% [11 - 44] vs. 26% [8 - 44] vs. 55% [25 - 68] $p=0.009$, $p=0.004$), with a more prominent effect of NIV ($p=0.05$) likely consequence of PEEP and Pressure Support (Figure 1).

Conclusions: Compared to HFNO, CPAP and NIV increased Tidal Δ Z but decreased Tidal Δ Z/EELI and the pendelluft effect, commending personalized treatment to identify the better interface for each patient.

Figure 1

