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SCIENTIFIC LETTER

High flow Tracheal oxygen: assessment of diaphragmatic functionality by ultrasonography in adults during weaning from mechanical ventilation

Alto flujo de oxígeno traqueal: evaluación de la funcionalidad diafragmática mediante ultrasonografía en adultos durante el proceso de destete de la ventilación mecánica

High-flow oxygen therapy via nasal cannula (HFNC) has demonstrated physiological benefits for patients with acute hypoxemic respiratory failure, including improvements in oxygenation, increased End Expiratory Lung Volume (EELV), and reduced work of breathing.[1] Recent investigations have explored the potential of HFNC to facilitate weaning from invasive mechanical ventilation (iMV) in tracheostomized patients. However, these studies primarily focused on evaluating diaphragm functionality solely at the end of spontaneous breathing, without observing dynamic changes in Work of Breathing (WOB) throughout the entire Spontaneous Breathing (SB) period.[2–4] Therefore, we conducted a case series randomized crossover study to assess dynamic changes in inspiratory effort, measured using diaphragm ultrasound, from the initiation of SB to one hour thereafter. This study aims to evaluate the effects of High-Flow Tracheal Oxygen (HFT) versus Standard Oxygen Therapy (SOT) on inspiratory effort in tracheostomized patients during the weaning phase from iMV.

We included tracheostomized adult patients who tolerated pressure support ventilation for at least two hours, in two tertiary university hospitals in Argentina. Exclusion criteria were neuromuscular diseases, pregnancy, and individuals unable to undergo ultrasound diaphragm measurements. Ethical approval for the study was granted by the Institutional Review Board (#5093). Following the acquisition of informed consent, enrolled patients were randomly allocated to receive either HFT or SOT first, with a respiratory muscles resting period for 2 h in pressure support (Fig. 1).

The HFT strategy was administered with a flow of 60 L/min and a set temperature between 34 and 37 °C. The fraction of inspired oxygen was adjusted to achieve a SpO2 of 88% or higher. In the SOT strategy, a passive humidifier device was connected to the tracheostomy cannula. Oxygen was delivered at flow rates ranging from 2 to 15 l/min to maintain SpO2 at 88% or above.

The inspiratory effort was estimated through ultrasound assessments conducted at 5 and 60 min after iMV disconnection. Each evaluation included ultrasound measurements of diaphragmatic thickening fraction (Tfdi), diaphragmatic excursion, and Lung Ultrasound Score (LUS) to estimate lung aeration[5,6]).

The primary outcome was to compare the change in Tfdi between 5 and 60 min after SB with HFT versus SOT. As a secondary outcome, we compared diaphragmatic excursion and pulmonary aeration between 5 and 60 min in both groups.

Thirteen patients met the inclusion criteria, but three were excluded due to difficulty in obtaining ultrasound measurements. Ten patients completed the study, with a median age of 70 (IQR 64–75). Seventy percent were male (n = 7), with a median APACHE II score of 13 (IQR 10–17) and a median duration of iMV of 17 days (IQR 12–25) before inclusion. Baseline characteristics are provided in the Supplementary Material.

For the SOT strategy, the median Tfdi was 25% (IQR 13 %–36 %) at 5 min and 26% (IQR 21 %–36 %) at 60 min. During the HFT strategy, the median Tfdi was 26% (IQR 20 %–36 %) at 5 min and 27% (IQR 20 %–33 %) at 60 min. Dynamic changes in Tfdi between 5 and 60 min in both strategies showed nonsignificant differences (p = 0.4).

Diaphragmatic excursion in the SOT strategy at 5 min exhibited a median of 13 mm (IQR 11–15), increasing to 15 mm (IQR 11–22) at 60 min. In the HFT strategy, the median diaphragmatic excursion was 15 mm (IQR 13–22) at the beginning, decreasing to 14 mm (IQR 10–16) after 60 min. Dynamic changes in diaphragmatic excursion between 5 and 60 min in both strategies showed nonsignificant differences (p = 0.3).

Regarding lung aeration, the LUS score for the SOT strategy was 10 (IQR 6–21) at 5 min and 10 (IQR 6–20) at 60 min. During HFT, the median LUS score was 8 (IQR 6–17) at 5 min and 9 (IQR 7–20) at 60 min. Dynamic changes in LUS score between 5 and 60 min in both strategies showed nonsignificant differences (p = 0.4). Table 1 describes ultrasound measures.

The application of HFT during the weaning phase from iMV did not significantly alter inspiratory effort, diaphragmatic excursion, or lung aeration compared to SOT. Previous studies assessing the impact of HFT on inspiratory effort similarly failed to demonstrate an improvement in diaphragm functionality.[7,8] Improvements were limited to the SpO2/FIO2 ratio, a mild increase in positive end-expiratory pressure (PEEP), and a reduction in respiratory rate. These benefits appear to be flow-dependent, manifesting when applying flow rates exceeding 40 L/min.[9] The

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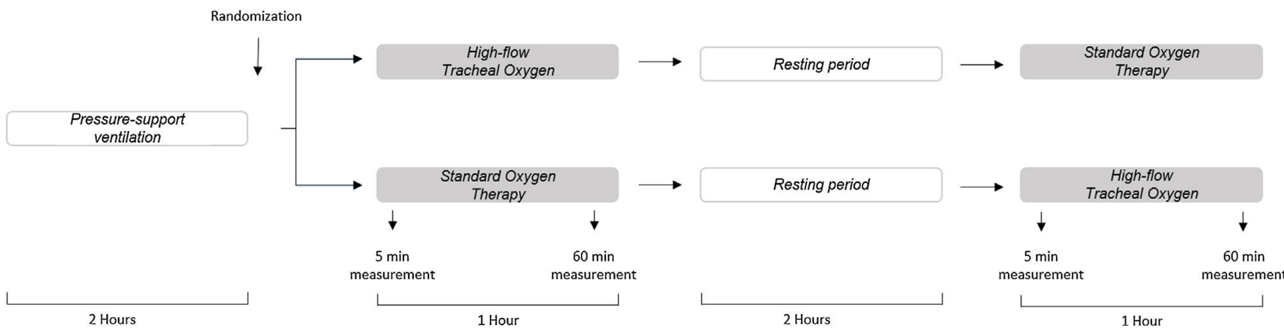

Figure 1 Flow chart of the study design.

Table 1 Ultrasound measured.

	Initial measurement (5 min)	Final measurement (60 min)	Temporary changes (60−5 min)
HFT strategy			
Diaphragm excursion mm (SD)	16.6 (7.02)	15.3 (7.44)	−1.38 (8.32)
Tfdi % (SD)	0.33 (0.25)	0.29 (0.12)	−0.04 (0.31)
LUS score (point)	10.8 (7.19)	12.6 (9.18)	−1.80 (2.97)
SOT strategy			
Diaphragm excursion mm (SD)	14.6 (7.75)	16.5 (7.43)	1.89 (5.04)
Tfdi % (SD)	0.26 (0.14)	0.32 (0.18)	0.06 (0.12)
LUS score (point)	12.0 (8.08)	13.1 (9.64)	−0.44 (4.16)

HFT: High-Flow Tracheal Oxygen; SOT: Standard Oxygen Therapy; Tfdi: Diaphragmatic Thickening Fraction; LUS: Lung Ultrasound Score.

absence of substantial benefits with HFT may be attributed to several factors. Firstly, the direct entry of inspiratory flow into the trachea bypasses the oropharyngeal dead space, diminishing potential effects. Secondly, the absence of glottic closure with the tracheal tube eliminates a crucial factor in maintaining PEEP.[10] Lastly, the direction of inspiratory flow from the HFT tracheal device may not sufficiently increase expiratory resistances, resulting in a loss of the potential PEEP effect.

Several limitations of this study include the small sample size, which reduces statistical power. Secondly, we did not evaluate blood gas analyses, as existing literature indicates that HFT could improve arterial partial pressure of oxygen without affecting pCO2(3) Finally, the lack of blinding among investigators could potentially introduce bias in ultrasound measurements in both modalities.

The strength of this study lies in describing the temporal changes in diaphragmatic functionality over 60 min, contrasting with other studies that evaluated shorter periods.[8] This approach offers dynamic insights into both diaphragm functionality over time and its muscular tolerance during the weaning process from iMV, providing a comprehensive understanding of the diaphragmatic response throughout the entire duration, rather than at a specific moment.

In our population, the application of HFT during the weaning phase of iMV did not generate significant changes in inspiratory effort, in comparison to SOT. However, this preliminary finding could inform future investigations evaluating the impact of HFT in tracheostomized patients with prolonged mechanical ventilation.

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Declaration of generative AI and AI-assisted technologies in the writing process:

Throughout the preparation of this work, the authors utilised ChatGPT 3.5 to enhance writing quality and conciseness. Subsequently, the authors thoroughly reviewed and edited the content as necessary, assuming full responsibility for the publication's content.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.medine.2024.06.006.

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Reasons for refusal of admission to the ICU in oncological population and their association with 6-month mortality

Motivos de rechazo de ingreso en UCI en población oncológica y su asociación con la mortalidad a seis meses

The incorporation of innovation, both technological and pharmacological, into the world of medicine has substantially modified the diagnostic and therapeutic processes for so many diseases.

With the development of new molecules, the prognosis of many neoplasms has drastically changed in recent years, showing an increase in survival. This situation poses a challenge when considering the admission of these patients to intensive care units. It is necessary to avoid grouping all cancer patients into a single category and start individualizing treatment.[1]

Regardless of the reason for ICU admission, this subgroup of patients can benefit from the creation of multidisciplinary teams for their management. This involves strengthening ties among different specialties involved in both the acute process at the ICU setting and their subsequent follow-up in conventional hospitalization wards. Indeed, a growing trend is management by multiple professionals in wards, with close monitoring through alert systems.[2]

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