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ELMO: an innovative interface for noninvasive ventilation

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During the COVID-19 pandemic, many patients were admitted to ICUs due to acute hypoxemic respiratory failure (AHRF) and required either noninvasive or invasive ventilatory support. The mortality rate of those patients was high in many regions.[1,2] Patients with severe disease, ICU overburden, and lack of equipment, including ventilators capable of offering safe and efficient mechanical ventilation, might have contributed to excessive mortality.[3]

In this scenario, a multidisciplinary task force in the state of Ceará, Brazil, developed a new interface for applying noninvasive ventilation (NIV). It has been designated ELMO. The results of a preliminary study that assessed feasibility, acute response, and adverse effects of the use of ELMO are published in this issue of the Brazilian Journal of Pulmonology.[4]

ELMO is a helmet-type interface that allows the application of CPAP = 8-15 cmH_2O, with a FIO_2 up to 100%. Positive pressure is generated by two compressed air flow meters (up to 30 L/min each) and a PEEP valve coupled to an air outlet. A total gas flow higher than 40 L/min is sufficient to avoid CO_2 rebreathing.[4] ELMO allows applying NIV without a ventilator, which is a significant advantage, especially during the COVID-19 pandemic, when the number of available ventilators was not nearly enough in some regions.[5]

The results of this preliminary study showed that applying CPAP with ELMO (ELMOcpap) is feasible. Only one patient out of ten (10%) did not tolerate ELMOcpap and used it for less than 40 min. The median number of days using ELMOcpap was 2 (IQR: 1-5 days), with a median of 310 min of daily use (IQR: 60-1,230 min). During ELMOcpap use, patients remained comfortable, and neither sedatives nor analgesics were needed. ELMOcpap was associated with increases in PaO_2, SaO_2, and PaO_2/FiO_2, as well as with Borg dyspnea score reduction. CO_2 rebreathing was not detected. Only mild side effects were observed: cough, dry mouth, eye irritation, regurgitation, and cervical/armpit discomfort.[4] The success rate of ELMOcpap was 60%, a result that is similar to those found in other studies that applied NIV in patients with AHRF due to COVID-19.[6] Four patients failed: one did not tolerate the interface and received conventional oxygen therapy, and three had their respiratory condition worsened and were intubated. Among these three patients, two died.[4]

The efficacy of helmet NIV in AHRF has previously been demonstrated in a network meta-analysis that included randomized clinical trials that compared high-flow nasal oxygen (HFNO), face mask NIV, helmet NIV, and standard oxygen therapy.[7] Those authors showed that NIV applied with helmet was associated with a lower risk of tracheal intubation and death when compared with the other three options. The following factors might explain the better results with helmet NIV: 1. better tolerance for helmet interface minimizes interruptions in therapy and may increase its effectiveness; and 2. helmet interface decreases leaks and may be more effective in delivering higher levels of PEEP, increasing alveolar recruitment and oxygenation.[8] The ELMO interface was well tolerated and allowed the application of PEEP levels from 8 to 12 cmH_2O, showing that it can be effective in treating AHRF.[4] However, those results are preliminary, and further studies are necessary to determine the actual role of ELMOcpap in treating AHRF.

In patients with AHRF due to COVID-19 in particular, the effectiveness of treatment with helmet NIV has been demonstrated. A randomized clinical trial[9] that included patients with COVID-19 with moderate to severe AHRF (PaO_2/FIO_2 < 200 mmHg) showed that treatment with helmet NIV, when compared with HFNO, improved oxygenation, reduced dyspnea, reduced the rate of endotracheal intubation (OR = 0.41; 95% CI: 0.18-0.89; p = 0.03), and increased the number of days free from invasive mechanical ventilation at 28 days: median = 28 days (IQR: 13-28 days) vs. 25 days (IQR: 4-28 days); p = 0.04. Despite these better outcomes, helmet NIV neither reduced ICU mortality nor hospital mortality when compared with HFNO.[9]

An important limitation of NIV in patients with AHRF is the mortality rate among those who failed and were intubated, which is usually higher than those who are intubated without previously receiving NIV.[8,10] In line with those findings, in that study,[4] among the four patients who failed NIV treatment, two died (50%). The main hypothesis to explain the higher mortality in patients who are intubated after receiving NIV first is the delay in intubation. This delay might be associated with cardiac ischemic events, respiratory muscle fatigue, and complications of emergency intubation, which are factors that can worsen patient outcomes.[8,10] To reduce NIV failure rates, studies to identify high risk patients and to establish objective parameters to indicate intubation are needed.

Innovative initiatives capable of effectively and safely increasing the treatment of critically ill patients are extremely important and, in Brazil, are still few and far between. Therefore, the remarkable development of ELMOcpap should be regarded as an example of how to face an adverse and catastrophic event, the COVID-19 pandemic, in a creative and ingenious way.

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AUTHOR CONTRIBUTIONS

All authors participated in the drafting and revision of the manuscript, as well as in the approval of the final version.

CONFLICT OF INTEREST

None declared.

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