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EDITORIAL

Mechanical ventilation: Past and present☆

Ventilación mecánica: pasado y presente

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The epidemiological study conducted by Frutos-Vivar[1] published in this issue analyzes the evolution of programmed mechanical ventilation and the outcomes of patients admitted to Spanish intensive care units on invasive mechanical ventilation (IMV) for over 12 h or non-invasive mechanical ventilation (NIMV) for over an hour during an 18-year period. Data from 4 different cohort studies were compared and each study was separated from each other by a 6-year span. This study is unique because it collected data using the same methodology and sequenced in time from a significant number of intensive care medicine services from different Spanish territories.

The main study finding was the progressive decrease of mortality rate although the mean age was older and the severity of the patients was higher, which is consistent with the results from other epidemiological studies.[2,3] At the same time, a progressive reduction of tidal volume was seen (from 9.0 mL/kg to 6.6 mL/kg of estimated weight) accompanied by higher PEEP (from 3 cm H_2O to 6 cm H_2O) with a progressive reduction of plateau pressure (from 21 cm H_2O to 19 cm H_2O) and driving pressure (from 18 cm H_2O to 13 cm H_2O). The authors suggest that there is a correlation between the lower mortality rate reported and protective mechanical ventilation.

As the authors say, aspects not associated with protective mechanical ventilation can also certainly impact the progressive reduction of the mortality rate. Throughout the years, different changes have been introduced in the management of patients admitted to the intensive care medicine services. Among these, the protocolization of sedation, the more restrictive use of fluids, the early management of sepsis or the implementation of measures to prevent nosocomial infections.

Despite the undisputed effect of mechanical ventilation to lower the mortality rate[4] its ability to cause pulmonary damage has also been reported. Actually, the term Ventilator Induced Lung Injury (VILI) is used to define this entity.[5] Phenomena of barotrauma, volutrauma, atelectrauma, and biotrauma have been reported as mechanisms associated with the appearance of VILI in the context of non-physiological values of transpulmonary pressure due to mechanical ventilation and pleural pressure variations due to patient-respirator interactions. The use of protective ventilation with tidal volumes $\leq$6 mL/kg of ideal weight and plateau pressures $\leq$30 cm H_2O has proven to lower mortality in patients with acute respiratory distress syndrome (ARDS).[6] This effect has been associated with a reduction of VILI. However, to this day there is no specific marker to distinguish VILI from other types of pulmonary lesions, which is why the mortality associated with VILI is still unknown but might be lowered by modifying ventilatory parameters.

Since ARDS cannot be identified early on many occasions[7] to reduce the contribution from mechanical ventilation into the pulmonary lesion, it is advised to take protec-

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tive measures preventively.[8] Actually, this is the trend seen in the study conducted by Frutos-Vivar,[1] where there is a low percentage of patients with ARDS. However, we should remember the randomized trial conducted by Simonis et al.[9] in patients without ARDS that compared a protective ventilatory strategy with low tidal volumes (6 mL/kg of ideal weight) with a different strategy with intermediate tidal volumes (10 mL/kg of ideal weight) being the plateau pressure limited to 25 cm H_2O. No changes between the groups were seen in this study regarding mortality, length of hospital stay, complications or days without mechanical ventilation.

On the other hand, there is growing concern regarding patient-respirator interaction, and the potential asynchronies have to generate VILI and rise the mortality rate. The technological advances derived from engineering, mathematics or artificial intelligence offer the possibility of using proportional and adaptative dual ventilatory modalities with automated algorithms of detection and decision. These algorithms adjust ventilation much better to the patient's health status while keeping ventilatory parameters within the ranges of safety. However, there is still no evidence on its effect on the patient's progression.

In the study conducted by Frutos-Vivar[1] the use of NIMV was analyzed too as well as its growing use as first-line therapy through the years, with an overall percentage of failure of this technique sitting at around 30% (except for 2004 when it was higher) and shorter application times (median of 10 h). Although NIMV is often administered in situations of respiratory acidosis, a change in the profile of patients has been reported with a higher number of patients with heart failure, which is consistent with other publications,[10] and a lower number of patients with COPD. However, no changes in the percentage of patients with pneumonia initially treated with NIMV have been reported. Future epidemiological studies will probably change this scenario and add high-flow oxygen therapy for the management of hypoxemic respiratory failure.

Regarding variability in the programming of ventilatory parameters, another significant finding from the study conducted by Frutos-Vivar[1] is the decreased dispersion of PEEP values and tidal volume used through the years. Also, a reduced geographical variability in the programming of IMV and the use of NIMV has been reported. This may be indicative of a better adhesion by clinicians to the recommendations established by scientific societies showing a similar mortality rate at the ICU setting regardless of the territory at stake.

In conclusion, the study conducted by Frutos-Vivar[1] confirms the actual trend of programming protective mechanical ventilation with a lower progressive mortality rate and a growing use of NIMV. Epidemiological studies like this one are very interesting to know the routine clinical practice, detect changes occurred while programming ventilatory parameters, and find out about the patients' long-term outcomes.

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