



Mechanical ventilation in COVID-19

La ventilación mecánica del COVID-19

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There is a painful and close relationship between COVID-19, ARDS and mechanical ventilation, so different considerations will have to be made to discuss mechanical ventilation during the COVID-19 pandemic, some of them very likely related to mortality in specific scenarios both in our country and in other latitudes. The first is the importance of sufficient and up-to-date medical knowledge in the area of acute respiratory failure, both from the physiological point of view and from the clinical experience in its recognition and management. A lot will have to be done worldwide by medical schools to improve the knowledge of this syndrome in their graduates, as well as the different hospital centers that train medical interns, residents and fellows, among others.

Similarly, technology will have to improve and become cheaper to provide quality medical consultations at a distance through different smart devices, since for now we have had to limit ourselves to seeing and talking to patients and their caregivers, through small screens, ask basic questions about the chronology of symptoms, seeking to define whether or not there is dyspnea, count the respiratory rate in one minute, know the pulse oximetry reading and heart rate in different positions with and without supplemental O₂, to sometimes have a blood pressure measurement, and to look for data of recruitment of the accessory muscles of ventilation at the level of the neck and intercostal muscles. Surely we can do better next time, much was improvised or incompletely planned in this pandemic, so proper planning is necessary before the storm.

One more aspect that corresponds to the national health systems is the correct diagnosis of the health needs of society and that this is fully satisfied, with an appropriate number of general practitioners, nurses, specialists and RRT's, etc. for the size of the population to be served and specifically meet the needs of intensive care doctors and nurses and pulmonologists, monitored intensive care beds and number of ventilators to care for critical patients.

We have as if that weren't enough the issue of semantics, of course definitions are important in medicine; If we do a little memory, we have to recognize that there has always been a debate around the name and definition of ARDS, from its original description by the Denver group and later in the American-European consensus, until reaching the Berlin conference and to further confuse, the 2003 coronavirus epidemic that spread from China to the Toronto area in Canada, coined another term that drew on the confusion and pre-existing controversy: severe acute respiratory syndrome (SARS). We must not forget that ARDS, like all syndromes in medicine, are a construct.

That is why the debate at the beginning of the pandemic whether or not severe pneumonia associated with COVID-19 was ARDS is not surprising; it was the observation of Li and Ma, some Chinese authors that COVID-19 respiratory failure occurred 8 to 12 days after first symptoms appear, unlike what was originally described in the Berlin conference that made the conclusion that these patients should not be diagnosed with «typical» ARDS.

Incredibly, in this country we use at least three names to designate the same syndrome and despite this we understand each other, although despite this, opinions were formed in favor or against whether or not this represented a classic ARDS. This certainly influenced the selection of ventilatory management strategies in more than one case, when facing an atypical pathophysiology where severe hypoxemia did not correspond to the level of lung compliance.

Additionally, an important point is the contextualized decision in each area of who to hospitalize; the routine admission of patients in respiratory failure to the emergency services and hospitalization cannot be carried out in a similar way during a pandemic with millions of cases around the world, requiring particular hospital admission protocols in which the most important is probably the most scarce, medical experience in the matter.

This variable is surely closely associated with the final outcomes both in specific institutions and in different health systems; an incalculable number of serious cases of COVID-19 had to remain at home when there was no available space in health institutions. Mexico registered a sustained excess of around 20% of general floor hospitalizations for months according to official figures.

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The following problem is in which specific area to hospitalize the cases, triage is not easy, particularly in a pandemic, in which each institution did things in the best possible way in its context, but without clear and uniform criteria and on many occasions by staff not entirely expert in the decision-making process. Tracking cases around 24 hours a day outside the ICU is similarly a major organizational issue, simply monitoring the correct compliance with the prone position protocol and use of oxygenation devices on a general ward can be a full-time activity. Traditionally and for decades, severe acute respiratory failure has been monitored and managed in ICUs and step-down units, especially for a limited number of medical specialties according to the culture of each hospital. The evaluation of complex infectious-contagious patients in an environment of pandemic fear and improvisation, cases with apparent clinical stability (silent or happy hypoxemia) for indefinite periods, with a relatively preserved pulmonary mechanics and ventilatory muscle reserve, has been a challenge for the medical community without a formal training in intensive care, especially when knowing the not uncommonly they develop acute deterioration of respiratory failure that can lead to death in a few hours in case of not initiating aggressive support, this fed by the panic of knowing the $\text{PaO}_2/\text{FiO}_2$ ratio with which the patient «opened» upon admission to hospital, when we know that in patients with ARDS with a fixed shunt, modifications in FiO_2 cause $\text{PaO}_2/\text{FiO}_2$ to fluctuate unpredictably by more than 100 mmHg.

In the best of cases, and if there is availability of ventilators and ICU beds, the routine consultation with intensive care services tends to have significant barriers and drawbacks in times of the pandemic.

The next topic of cardinal importance is that related to intubation and if its indications or timing are the same or should be adjusted when dealing with a respiratory failure of different characteristics, voices having arisen in both directions, avoiding it as much as possible given the high mortality associated with mechanical ventilation or proceeding with it early before exhibiting signs of overt failure; again an aspect in which judgment and experience counts.

The rationale in support of prompt intubation and invasive ventilation was based on one hand in fear around potential aerosolization from managing patients either with masks and non-invasive ventilation (NIV) or high flow nasal oxygen. One of the highest rates of health personnel infected with SARS-CoV-2 in the world is precisely that of Mexico; in such a way that personally I was against the use of these modalities of mechanical ventilation for a good number of months, until the evidence, the overwhelming number of cases in the first peak of the pandemic and a shortage of equipment, made me reconsider and change opinion as

well as did many colleagues too. Taking into account the definition of the Surviving Sepsis Campaign Guidelines on the management of adults with coronavirus disease 2019 (COVID-19) in the ICU of the SCCM, it may be the decision of the attending physician himself who modifies the status of a patient from serious to critical stage by simply indicating mechanical ventilation; in practice this is done in many cases through a clinical impression, pulse oximetry and an abnormal radiological image, which may be sufficient for physicians familiar with respiratory failure, but not necessarily with other specialties whose area of expertise is far away. These definitions poorly separate both categories of severity of the disease and do not contribute significantly to help the clinician in the stratification process, however this is what we have.

A subsequent concern was the description of the interesting patient self-inflicted lung injury (P-SILI) from spontaneous breathing at a supranormal tidal volume and generated by very high transalveolar pressures ($> -15 \text{ cmH}_2\text{O}$) from a combination of high respiratory drive, maintained respiratory muscle strength and close to normal lung volumes, which theoretically could be limited by applying timely controlled mechanical ventilation with heavy sedation and neuromuscular blocking agents (NMBA).

A controversial point is the recent trend supported by many to liberalize the level of the mechanical tidal volume used in severe pneumonic forms of COVID-19, based on the observation that this attenuate patient dyspnea, forgetting the role that correct sedation and neuromuscular relaxation have on this aspect and asynchrony, what is known to be a harmful alveolar issue related with bad outcomes, especially when this asynchrony is severe and persistent, which is associated with failure in the spontaneous ventilation test, time on mechanical ventilation, development of ventilator-associated pneumonia, organ dysfunction, and increased mortality and ICU stay. In the event of persistent ventilator dyssynchrony or the need for ongoing deep sedation, prone ventilation, or persistently high plateau pressures (severe ARDS), some guidelines suggest using a continuous NMBA infusion for up to 48 hours to achieve protective lung ventilation goals, something to take seriously.

On the other hand some opinions to titrate the PEEP level outside of known standards deserve mention. The correct application of PEEP constitutes one of the most significant advances in the management of ARDS since its original description and its titration has always been an interesting and complex topic, since it touches on physiological and pathophysiological bases applied to the clinic. There are many methods of titrating it, but the ARDSnet table is a practical and reliable simplification whose merit is to standardize criteria throughout the

world. The SCCM issued a vague recommendation in this pandemic regarding the preference to select a «high» level of PEEP (> 10 cmH₂O), over one low in severe COVID-19 associated ARDS. I am not sure that a positive pressure of 10 cmH₂O is the best definition of these limits in the ventilatory management of severe ARDS. As a consequence, some authors recommended not to rely on it in most COVID-19 cases; optimum PEEP is still of paramount importance.

The reader is probably waiting for a strong recommendation on how to approach ventilatory management in these cases, especially which ventilatory mode to select; I am more and more convinced that it is generally an irrelevant point, since we can achieve almost the same with many ventilatory modes if we pay attention to the details, particularly with current technology. A distinctive characteristic of young fellows is to change ventilatory mode each shift, not always with sufficiently deep and thoughtful bases, but with the spirit of trying what they believe is best for the patient; learning mechanical ventilation is a long road.

Respiratory physiology in the critically ill who is intubated and started on mechanical ventilation is a complex matter and we can hardly predict the particular

answer to the change of a single parameter in the machine which in turn induces countless reflex and physiological compensatory responses. The answer can be found by standing at the bedside and observing with extreme care the details that modern monitoring provides in this context; the old trial and error is still more valid than ever.

Thus, we can conclude that mechanical ventilation in seriously ill patients with COVID-19 is a core issue that goes beyond the simple selection of a specific ventilatory mode and has more to do with a deep knowledge of respiratory physiology, hemodynamics, experience and common sense in a professional teamwork environment. Carrying it out correctly, avoiding complications is a rare art that every medical professional involved in the care of the critically ill must seek and cultivate with dedication and passion for fine details, achieving it will have as an invaluable gift the gratitude of patients and their families, one of the best rewards a physician can enjoy.

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