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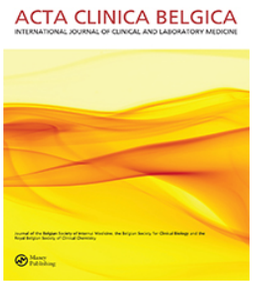

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# COVID-19 pandemic: overview of protective-ventilation strategy in ARDS patients

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REVIEW



# COVID-19 pandemic: overview of protective-ventilation strategy in ARDS patients

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**ABSTRACT**

**Objectives**: In the context of COVID-19 pandemic, the aim of this manuscript is to provide a standard of care of patients with ARDS for non-emergency medicine trained physicians who are not customary with mechanical ventilation.

**Methods**: We conducted a systematic review of the literature to investigate the best practice recommendations regarding the mechanical ventilation of patients with ARDS.

**Conclusion**: We summarized the principal strategies for lung-protective ventilation of patients with ARDS. This focus is particularly addressed to physicians who are not experienced in the invasive respiratory management of ARDS patients. Nevertheless, it remains fundamental to acknowledge that new insights concerning this quickly spreading illness become available on a regular base.

**KEYWORDS**

COVID-19; acute respiratory distress syndrome; SARS-CoV-2; mechanical ventilation; protective ventilation

## Introduction

Last night, we experienced in our intensive care unit (ICU) the first admission of a patient tested positive for COVID-19 and treated with mechanical ventilation for severe acute respiratory distress syndrome (ARDS) (Figure 1). In this short communication, we describe the principal recommendations for the ventilatory management of patients with ARDS. In the context of COVID-19 pandemic, the aim of this manuscript is to provide a standard of care of patients with ARDS for non-emergency medicine-trained physicians who are not customary with mechanical ventilation.

## Description

Using the Berlin definition, ARDS represents the most serious form of acute lung injury characterized by the acute onset of hypoxemia (≤7 days, PaO2/FiO2 ≤ 300 mmHg) and bilateral pulmonary infiltrates without evidence of cardiac failure in a mechanically ventilated patient with a positive end-expiratory pressure (PEEP) of at least 5 $cmH_2O$ [1].

First of all, a low tidal volume of around 6 mL/kg of predicted body weight (PBW) is recommended to avoid barotrauma and volutrauma [2,3]. The PBW may be calculated as follows: X + 0,91 × (height in centimeters − 152,4) (X = 50 and 45,5 for men and women, respectively) [4]. Also, a lung-protective strategy with a limited plateau pressure has been validated to reduce barotrauma. In this regard, a strict monitoring of the plateau pressure (Pplat) at end-inspiratory pause (0.2–0.5 seconds) is warranted, and should not exceed 30 $cmH_2O$ [5]. Likewise, the level of Pplat depends on PEEP settings. A PEEP value above 5 $cmH_2O$ is part of the ventilation settings for the management of patients presenting with ARDS [6]. The use of higher levels of PEEP should be restricted to moderate (100< PaO2/FiO2 ≤ 200 mmHg) or severe (PaO2/FiO2 ≤ 100 mmHg) ARDS, except in cases of hemodynamic instability [7]. Both mechanical ventilation at lower tidal volume and limited Pplat have shown a significant decrease in mortality. Therefore, the choice of volume ventilation modes may help to monitor Pplat [5,8]. Administration of neuromuscular blocking agents (NMBA) for no more than 48 hours may help to improve oxygenation and reduce mortality at the precocious phase (≤48 hours) of moderate to severe ARDS [9]. Indeed, paralysis induced by NMDA infusion facilitates lung-protective ventilation by improving ventilator adaptation and allowing reduction of the tidal volume and the Pplat. Daily monitoring is required to confirm expected outcomes and to assess the potential to stop neuromuscular blockade within 2 days [10]. In addition, critically ill patients (PaO2/FiO2 ≤ 150 mmHg) are candidates for prone position to improve oxygenation and reduce mortality. This strategy has been validated to facilitate gas exchange by making lung aeration more homogeneous. The prone ventilation should be maintained for 12 to 16 consecutive hours. Of note, this procedure should be restricted to healthcare operators that are skilled in its practice. Experienced staffs with specific protocols are necessary to ensure technical ability and to avoid potential complications [11–13]. Several alveolar

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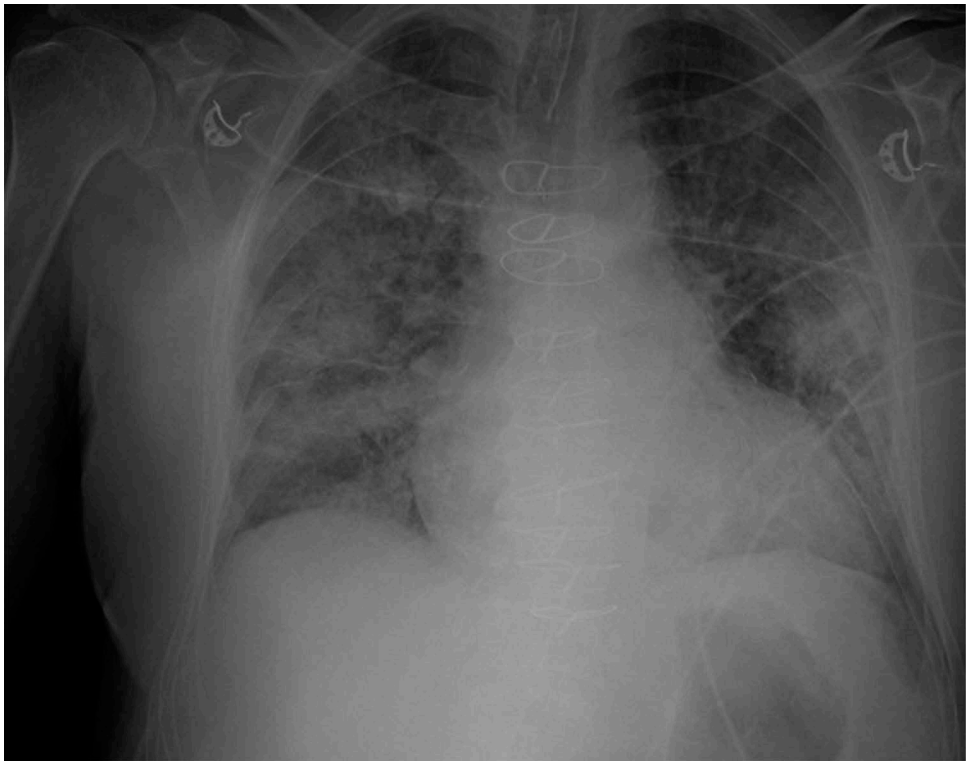

Figure 1. Chest radiograph findings of ARDS showing bilateral diffuse infiltrates in a patient tested positive for COVID-19 with severe hypoxemia (PaO2/FiO2 ratio ≤100 mmHg).

recruitment maneuvers have been described in the literature. The purpose of these maneuvers is to improve gas exchange, arterial blood oxygenation and lung compliance by reducing ventilator-induced lung injury (VILI), favored by repetitive opening and closing of unstable lung units. However, available data are not sufficient to recommend the routine use of these maneuvers in ARDS patients [14,15]. Moreover, most recent guidelines for the management of ARDS suggest the use of inhaled nitric oxide (iNO) in patients with severe hypoxemia (PaO2/FiO2 ≤ 100 mmHg) when protective ventilator settings and prone ventilation remain insufficient. Nevertheless, we cannot support the routine use of iNO in COVID-19 given the lack of information on its benefit for the sickest of these patients. As a last resort, the use of veno-venous extracorporeal membrane oxygenation (ECMO) may also be considered in the setting of severe respiratory failure (PaO2/FiO2 < 80 mmHg) despite optimal protective ventilation strategies [16].

Finally, it remains fundamental to acknowledge that new insights concerning this quickly spreading illness become available on a regular base. Last month, the Surviving Sepsis Campaign (SSC) COVID-19 committee provided recommendations for the management of critically ill patients with SARS-CoV-2 infection. The SSC guidelines suggest that $SPO_2$ should be maintained between 92% and 96% in the case of hypoxemic respiratory failure requiring mechanical ventilation [17]. Interestingly, L. Gattinoni and colleagues recently hypothesize that COVID-19 pneumonia is a non-uniform condition with different phenotypes, based on clinical experiences shared between frontline ICU workers [18]. This statement may influence strategy on ventilatory management and therapeutic approaches. For all these reasons, we would like to emphasize that mechanical ventilation of the COVID-19 patients has proven to be very challenging. Accordingly, experienced operators (i.e. intensivists, anesthesiologists) have to be consulted as soon as possible during the course of the disease, particularly to reduce cross-contamination during endotracheal intubation and to improve the chances of success during the ventilatory support.

## Conclusion

We summarized the essential recommendations regarding lung-protective mechanical ventilation in patients with ARDS. In the context of COVID-19 pandemic, this focus is particularly addressed to physicians who are not experienced in the invasive respiratory management of ARDS patients.

## Disclosure statement

The authors declare that they have no conflict of interest.

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## Ethical approval

This article does not contain any studies with human participants or animals performed by any of the authors.

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