Editorial

# The Acute Respiratory Distress Syndrome ventilatory management is still a complicated picture

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The Acute Respiratory Distress Syndrome (ARDS) is a clinical syndrome characterized by a refractory hypoxemia due to inflammatory pulmonary edema associated with a variety of clinical conditions (1). Accordingly, to the recent Berlin definition, the ARDS is defined as an acute respiratory failure with an arterial oxygen pressure ($PaO_2$)/fraction of inspired oxygen ($FiO_2$) ratio lower than 300 mmHg (2). In a large international observational study enrolling all patients admitted in 207 intensive care units, during a 4 weeks period, 23% of the patients required mechanical ventilation and ARDS was presented in 10% of these patients (3). The reported intensive care and hospital mortality were 35% and 40% respectively (3). The main supportive treatment is the invasive mechanical ventilation with low tidal volume and positive end-expiratory pressure (PEEP) levels according to the severity of hypoxemia and the use of adjunctive measures such as the prone position, the neuromuscular block and extracorporeal membrane oxygenation (ECMO) (4,5). However, the use of this ventilatory strategy in ARDS patients is still not commonly applied (3). In the current issue Liu *et al.* in a prospective observational study in 20 Chinese intensive care units, wanted to take a photo about the practice of the diagnosis, management and outcome of ARDS patients (6). In the one-month period of study, 1,814 patients were admitted in the intensive care unit and ARDS was found in 147 (8%) of these patients according to the Berlin definition. The intensive care and hospital mortality were 32% and 34% respectively. However, the hospital mortality was up to 60% in severe ARDS patients. Ninety-four (75%) patients received protective mechanical ventilation with low tidal volume and plateau with a mean PEEP level of 10 $cmH_2O$. Recruitment maneuvers and prone position were respectively applied in 34% and 3% of the population.

The overall prevalence of ARDS and the number of ARDS for every one intensive care bed were similar to Bellani *et al.* data (0.3 *vs.* 0.36 cases for intensive care bed). However, the number of cases were significantly lower, almost the half, compared to those reported for United States and Australia (5.5 and 6.8 cases for intensive care bed). These data could be due to the possible difference in the intensive care resources and to the difficulty for a correct diagnosis of the ARDS in the clinical practice (3,7,8).

In an attempt to decrease the damage due to the ventilator induced lung injury (VILI), the lung protective ventilation strategy has been suggested and changed throughout the years (9,10). Although the mortality, without any doubt, and the barotrauma were significantly reduced in the years, they still ranged between 30–50% and 5–8% in ARDS patients (3,11). In the present study the intensive care mortality rate was in line with the previous studies (3) and higher the severity of ARDS was (defined according to the $PaO_2/FiO_2$ ratio), higher the mortality was. Interestingly, although the APACHE score was not different among the different classes of ARDS (mild, moderate and severe) and mortality rate in severe ARDS reached 56%, significantly higher compared to patients with similar severity (38–48%) (3).

In order to explain these findings, we have to analyze the ventilatory setting (tidal volume, driving pressure, PEEP) and the use of adjuvant measures (prone positions and recruitment maneuver) in these studies. Concerning the ventilatory setting, the first points to be elucidated are tidal volume and driving pressure that can significantly modulate the VILI. The applied tidal volume was 8 mL/kg of predicted body weight resulting in an airway plateau pressure within 17 to 20 $cmH_2O$. The associated driving pressure (plateau pressure minus the PEEP) ranged from 8 up to 21.5 $cmH_2O$. Although the applied tidal volume was similar among mild and severe classes of ARDS, the driving pressure was significantly higher in the severe compared to mild and moderate ARDS. This data, confirm, once again, that the tidal volume based on ideal body weight, is a no sense from a physiological point of view and it is an oversimplification (12). Ideally the size of baby lung and not only the body weight should be considered in selecting the adequate tidal volume. On the contrary, a low tidal volume based on ideal body weight, in presence of severe ARDS could promote overstress/overstrain (13). Consequently, in clinical practice it should be considered, in addition to tidal volume based on ideal body weight, the driving pressure which is related to the size of baby lung (12). However, in cases of alteration in the chest wall elastance, for example increase in the intraabdominal pressure, the simple airway driving pressure could not reflect the lung condition (14,15) and transpulmonary pressure should be measured (4,16,17). The last but not the least point is the PEEP. A relatively low level of PEEP (i.e., 10 $cmH_2O$ in the most severe ARDS) was applied, while according to clinical data and international recommendations, up to 15 $cmH_2O$ should have been used (5,18). The use of this relatively low PEEP should be reflected by the requirements of very high level of oxygen fraction (90%) in order to insure adequate gas exchange.

Among the applied adjuvant measures the prone position was used in lower than 10% of the population without any difference according to the severity of ARDS with an average application of 8.5 hours every day. Unfortunately, there were several missing data such as the number of days of pronation and the associated complications. The use of prone position, as demonstrated in several randomized controlled studies and meta-analysis clearly showed a positive effect on the outcome (19) and should be applied in severe ARDS patients for longer period of time (15–20 hours) (20). However currently the use of prone position in daily clinical practice has been reported between 6–8% (3,21). In a recent observational study, Guerin *et al.* reported the use of prone position between 9–13%, but with a significant difference among the mild, moderate and severe ARDS (5.9%, 10.3% and 32.9%) (22).

On the contrary, the recruitment maneuvers despite of the quality of the current evidence is low and there is not a definitive conclusion on the outcome (22), has been applied in 35% of the population.

Thus, to decrease the mortality rate in the most severe ARDS it should be suggested to apply a ventilatory setting more based on the pathophysiology of the ARDS and a wider use of prone position.

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## Footnote

*Conflicts of Interest:* The authors have no conflicts of interest to declare.

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