

Early effects of ventilatory rescue therapies on systemic and cerebral oxygenation in mechanically ventilated COVID-19 patients with acute respiratory distress syndrome: a prospective observational study

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Background: In COVID-19 patients with acute respiratory distress syndrome (ARDS), the effectiveness of ventilatory rescue strategies remains uncertain, with controversial efficacy on systemic oxygenation and no data available regarding cerebral oxygenation and hemodynamics.

Methods: This is a prospective observational study conducted at San Martino Policlinico Hospital, Genoa, Italy. We included adult COVID-19 patients who underwent at least one of the following rescue therapies: recruitment maneuvers (RMs), prone positioning (PP), inhaled nitric oxide (iNO), and extracorporeal carbon dioxide (CO₂) removal (ECCO₂R). Arterial blood gas values (oxygen saturation [SpO₂], partial pressure of oxygen [PaO₂] and of carbon dioxide [PaCO₂]) and cerebral oxygenation (rSO₂) were analyzed before (T₀) and after (T₁) the use of any of the aforementioned rescue therapies. The primary aim was to assess the early effects of different ventilatory rescue therapies on systemic and cerebral oxygenation. The secondary aim was to evaluate the correlation between systemic and cerebral oxygenation in COVID-19 patients.

Results: Forty-five rescue therapies were performed in 22 patients. The median [interquartile range] age of the population was 62 [57–69] years, and 18/22 [82%] were male. After RMs, no significant changes were observed in systemic PaO₂ and PaCO₂ values, but cerebral oxygenation decreased significantly (52 [51–54]% vs. 49 [47–50]%, $p < 0.001$). After PP, a significant increase was observed in PaO₂ (from 62 [56–71] to 82 [76–87] mmHg, $p = 0.005$) and rSO₂ (from 53 [52–54]% to 60 [59–64] %, $p = 0.005$). The use of iNO increased PaO₂ (from 65 [67–73] to 72 [67–73] mmHg, $p = 0.015$) and rSO₂ (from 53 [51–56] % to 57 [55–59]%, $p = 0.007$). The use of ECCO₂R decreased PaO₂ (from 75 [75–79] to 64 [60–70] mmHg, $p = 0.009$), with reduction of rSO₂ values (59 [56–65] % vs. 56 [53–62]%, $p = 0.002$). In the whole population, a significant relationship was found between SpO₂ and rSO₂ ($R = 0.62$, $p < 0.001$) and between PaO₂ and rSO₂ ($R = 0.54$, $p < 0.001$).

Conclusions: Rescue therapies exert specific pathophysiological mechanisms, resulting in different effects on systemic and cerebral oxygenation in critically ill COVID-19 patients with ARDS. Cerebral and systemic oxygenation are correlated. The choice of rescue strategy to be adopted should take into account both lung and brain needs.