Financiación

El presente manuscrito no ha recibido financiación alguna.

Conflicto de intereses

Todos los autores reconocen no presentar conflicto de intereses en la realización del presente trabajo.

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https://doi.org/10.1016/j.medin.2019.11.001

When success means focusing on the oxygen delivery. A case of conventional management of severe hypoxemia in SARS-CoV-2

Cuando el tratamiento adecuado consiste en evaluar el aporte de oxígeno. Manejo convencional de la hipoxemia severa en un paciente con SARS-CoV-2

Dear Editor:

SARS-CoV-2 challenged ICU doctors' ability to support patients with acute respiratory insufficiency. This was due to both the unexpectedly high rate of admissions and the severity of these patients. Through this case we would like to highlight the physiology guided management of a patient with profound hypoxemia. In spite of an apparently life threatening condition this patient had a good course with conventional management guided by invasive hemodynamic monitoring.

A 46 years old male was admitted to the ICU with presumptive diagnosis of SARS-CoV-2. Respiratory symptoms had started 10 days before admission to the emergency room. Due to hypoxemia and tachypnea as well as an X-ray with bilateral infiltrates, the patient was early transferred to ICU. Support with high flow oxygen was started but escalation to invasive mechanical ventilation (MV) was required due to persistent hypoxemia. Due to a PaO_2 = 60 mmHg despite FiO_2 1 (with protective mechanical ventilation settings PEEP 10 cmH_2O, tidal volume 6 ml/kg, plateau pressure 20 cmH_2O) the patient was subjected to prone positioning therapy. The patient showed no change in respiratory mechanics during prone positioning but a slight improvement in oxygenation was observed. He completed a 16 h prone therapy session. Once in supine, oxygenation was severely deteriorated again with a PaO_2/FIO_2 < 80 mmHg hence extracorporeal membrane oxygenation (ECMO) therapy was proposed.[1] Additionally, he underwent invasive monitoring with a Swan-Ganz catheter. The patient showed moderate pulmonary hypertension (PASP 45 mmHg, PVRi 388 dyn s cm^5), cardiac index 3.5 l min^{-1} m^2 and a preserved mixed blood oxygen saturation around 75%. These data were complemented with a transthoracic echocardiogram that showed no right ventricular (RV) dysfunction (which was concordant with a pulmonary artery pulsatility index = 1.7), preserved left ventricular function and no signs of hypovolemia. Based on the preserved RV function and an adequate oxygen delivery with protective MV settings the decision of starting ECMO was postponed. Prone positioning sessions were continued up to a number of 5 and during the following days both the patient's lung function (which was more prominent in prone) as well as pulmonary hemodynamics progressively improved. The patient was extubated 2 weeks later.

During times of health services overwhelming, the selection of patients who will benefit from therapies related with a high consumption of resources should be carefully and effi-

ciently performed. In the ICU one of these therapies is ECMO. There are doubts about the long term prognosis of patients with SARS-CoV-2 who develop severe hypoxemia despite the gentlest MV. Besides this, the physiology of the patient with SARS-CoV-2 has been proposed to be different from typical ARDS[2]: (1) A high proportion of them have good compliance (Gatinnoni's phenotype L) and in consequence management with low PEEP is recommended and (2) they show a blunted pulmonary vasoconstriction. Also, at least in our experience a low rate of systemic hemodynamic involvement is seen. Such differences could affect the indications of ECMO in these patients.[3]

Respiratory ECMO is indicated to ensure oxygen delivery in patients in whom this cannot be reached under protective MV settings.[4] Other indications or goals are at least doubtful. Following this reasoning, comparing with typical ARDS, for the same arterial oxygen content, probably a lower proportion of SARS-CoV-2 patients would be subsidiaries of ECMO. A high compliance in a patient managed with relatively low PEEP could make it easier to reach safe settings including low plateau pressure, low driving pressure and tidal volume around 6 ml/kg[5]. If we put this altogether with the decreased pulmonary vascular response to hypoxia, a low prevalence of RV failure could be expected. Finally, in the absence of RV dysfunction, patients with preserved left ventricle function can maintain a cardiac output enough to keep an adequate oxygen delivery. Therefore, deciding starting ECMO based only on PaO_2 may not be adequate to cover the entire physiologic process in some patients with severe respiratory insufficiency in the context of COVID-19. This resolution should be adjusted to the current recommendations regarding the availability of resources.[6]

Another important finding of this case is the apparently low O_2 extraction which could be compatible with low systemic involvement at least at the disease stage at which the patient was. Also this could be due to the adequate sedation and the use neuromuscular blockade. In this context we would like to highlight that oxygen delivery depends essentially on cardiac output, hemoglobin concentration and SaO_2. Therefore in patients without risk of low cardiac output, taking into account SaO_2/FiO_2 instead of PaO_2/FiO_2 could be a better index when taking the decision of escalating toward therapies such as ECMO.

Finally, we would like to remark that despite the severity of the hypoxemia in this patient, he did improve with conventional therapies. Moreover, in spite of the doubts regarding the usefulness of prone positioning in the presence of good compliance, the patient's improvement was initially more evident with this approach. This could be due to a more marked dependence of pulmonary perfusion on gravity when hypoxic vasoconstriction is blunted. From this point of view prone positioning could be helpful in keeping the patient safe while waiting for the lung to heal.

In conclusion, through this case we would like to remark the importance of oxygen delivery in the management of patients with SARS-CoV-2 as this pathology could behave differently from typical ARDS. In this line of thought we recommend to be patient as long as we are able to reach the combination of protective MV settings and adequate peripheral oxygenation. This therapeutic attitude could contribute to a decrease in the necessity of more resource consuming therapies, which should be allocated following recommendations that take into account their scarcity during the pandemic, as pointed out by specific guidelines.[7]

Conflict of interest

Authors have nothing to disclosure.

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https://doi.org/10.1016/j.medin.2020.06.003
0210-5691/