Mechanical ventilation strategies in severe COVID-19 based on computed tomography-guided phenotypical pattern

The novel coronavirus disease 2019 (COVID-19), a current local and global pandemic, may cause severe respiratory failure requiring mechanical ventilation. Rapid progression from initial symptom onset to respiratory failure has been described, with a median duration of 8 days. Although patients with severe disease meet criteria for acute respiratory distress syndrome (ARDS) according to the Berlin definition, the pathophysiology of COVID-19 is thought to differ, and is still poorly understood. Traditional methods of ventilation for ARDS may not be globally applicable to all cases of severe COVID-19. Currently, patients requiring invasive mechanical ventilation have high mortality rates, and many strategies are rapidly being explored to optimise this intervention.

A study by Robba *et al.*[1] based on current literature recommends that chest computed tomography (CT) be performed in all cases of severe COVID-19 to allow for clinical phenotyping. They acknowledge that this is not possible in every setting. Given limited available data, they describe five stages of COVID-19 based on evolving CT features, from pre-symptom onset to severe disease and finally dissipation. This study distinguishes three discrete phenotypes of severe COVID-19 based on CT radiographic patterns, and proposes alterations in mechanical ventilatory strategies to optimise oxygenation. Phenotype 1 shows multiple focal ground-glass opacities (GGOs) mainly in subpleural regions, phenotype 2 is marked by inhomogeneous atelectasis and peribronchial opacities, and phenotype 3 shows a patchy ARDS-like pattern. Phenotype 1 is likened to the L-type (low elastance, low recruitability, low ventilation to perfusion ratio) and phenotype 3 to the H-type (high elastance, similar to ARDS) proposed by Gattinoni *et al.*[2]

In phenotype 1, there is minimal alveolar collapse, and lung compliance is preserved. The hypoxia appears to be due to the overperfusion of areas of GGO and shunt, rather than atelectasis. The authors recommend moderate positive end-expiratory pressure (PEEP) to redistribute blood flow to non-damaged lung areas and improved shunt, rather than high PEEP or recruitment strategies, which may cause haemodynamic compromise. Prone positioning is advised against for phenotype 1. In phenotype 2, inhomogeneous atelectasis is the primary issue, and therefore high PEEP, along with lateral or prone positioning, is recommended to improve recruitment of lung units. The authors advise that phenotype 3 be managed in a manner analogous to that for traditional ARDS, as this clinical phenotype is closely related. Recruitment manoeuvres (RMs) are not recommended as routine, and are least likely to benefit phenotype 1. When RMs are required for phenotype 2 or 3, staircase techniques are advised against for COVID-19 as this has been associated with increased mortality. No data were available to inform clinical decisions regarding the use of inhaled nitric oxide.

The high incidence of micro- and macrothromboembolic events is also given significant attention. Close monitoring of clinical and laboratory parameters should be adhered to, with consideration for early anticoagulation for any of the described phenotypes, as incidence of thromboembolic events can rapidly worsen overall clinical condition.

In conclusion: severe COVID-19 may not be representative of typical ARDS and chest CT is potentially an important tool to inform clinical management decisions. Further research is required to provide additional insight and give strength to the recommendations in this paper.

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2. Gattinoni L, Chiumello D, Caironi P, et al. COVID-19 pneumonia: Different respiratory treatments for different phenotypes? Intens Care Med 2020;14:1-4. https://doi.org/10.1007/s00134-020-06033-2