

Management of Respiratory Support

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ABSTRACT

Early recognition and referral of patients with worsening respiratory function while on conventional oxygen support therapies such as nasal cannula, simple facemask or mask with reservoir bags is important to ensure timely and safe escalation of respiratory support. Early optimization of care and involvement of Intensive Care Unit (ICU) is recommended.

Key words: COVID-19, Pneumonia, Respiratory Failure, Ventilation

Introduction

Management of viral pneumonia and respiratory failure due to 2019 corona virus disease (COVID-19) is the most important determinant of mortality. Comprehensive planning should be done in hospitals, taking into account the experience of the intensive care team, physical conditions and equipment adequacy.

Oxygen support therapy

Oxygen support therapy should be started when oxygen saturation (SpO_2) and partial arterial oxygen pressure (PaO_2) levels are below 90% and 60 mmHg, respectively. Patient mobilization in a chair during daytime and prone positioning in bed is recommended. Prone positioning provides opening and ventilation of dependent areas of the lower lobes of the lungs, where the virus is frequently located. In case of nasal congestion, patient breathing through the mouth or failure to achieve adequate oxygenation despite nasal cannula and oxygen flow of at least 6 L/min (LPM) (Fraction of inspired oxygen (FiO_2) ~44%), simple facemask should be used. When using simple facemask, oxygen flow rate should be at least 4 LPM.

If there is inadequate oxygenation using simple facemask and oxygen flow of 8 LPM (FiO_2 ~60%), non-rebreathing mask should be used

with oxygen flow of 10-15 LPM, elective intubation should be planned. The mask delivers 80-100% oxygen when its oxygen reservoir bag becomes completely inflated. It is mandatory for the patient to wear a surgical mask during low flow of supplemental oxygen therapy. Pulse oxygen saturation target levels for pregnant and non-pregnant patients are 93-94% and 90%, respectively.

High-flow nasal oxygen (HFNO) and non-invasive ventilation (NIV)

HFNO and NIV treatments are high risk procedures, due to an increase in droplet spread. These treatment methods should be carried out in isolated and negative pressure patient rooms, respecting the infection control committee recommendations and providing personal protective equipment. They are not recommended in ward-type intensive care units, as these methods are defined as aerosol generating processes. Every patient with COVID-19 infection receiving HFNO treatment should wear a surgical mask to cover his or her mouth and nose. In addition, the patient should be told to keep his or her mouth closed during oxygenation with HFNO. When performing NIV, a full face or preferably an oronasal mask should be utilized with a viral-bacterial filter. NIV masks should be cleaned daily with soap and warm water. In order to prevent the expiration air from polluting

the environment, it is more convenient to perform NIV with conventional double-circuit intensive care ventilators with viral-bacterial filters placed between each circuit and ventilator.

The success rate of HFNO and NIV treatment in viral pneumonia is about 30%. It should be noted that the most important determinant of success is patient choice. It may be thought that patients infected with COVID-19 who have undiagnosed chronic obstructive pulmonary disease (COPD) or asthma benefit more from these treatment methods. In addition, NIV can be used in patients with COPD, asthma, obesity hypoventilation syndrome, and during weaning from ventilator to facilitate extubation.

In case of hypoxemia due to ventilation/perfusion mismatch, oxygenation can be achieved with HFNO and NIV. However, it should be noted that as the shunt increases, especially exceeds 30% of the cardiac output, hypoxemia will be resistant to oxygen therapy with these methods. In this regard, patient selection and disease severity are very important indicators for HFNO and NIV success. Failure criteria are advanced age, presence of shock, vasopressor requirement, respiratory acidosis, $\text{PaO}_2/\text{FiO}_2$ ratio of <100 , SOFA and APACHE II scores of ≥ 4 and ≥ 12 points, respectively. During the HFNO or NIV application, this group of patients should be monitored closely for level of consciousness, abdominal paradox breathing and use of accessory respiratory muscles. Relatively good respiratory rate and oxygenation values in these patients can be misleading for the clinician. Especially, in patients with $\text{PaO}_2/\text{FiO}_2$ ratio of <100 , early elective intubation should be planned as shunt physiology becomes evident.

Invasive mechanical ventilation (IMV) in respiratory failure patients without ARDS

When the patient is intubated due to respiratory failure secondary to COVID-19, effective sedoanalgesia should be started (RASS score-2 and 0). Tidal volume (V_T) should be set to 6 ml/kg ideal body weight (IBW). Lung compliance and pressures should be monitored closely. Plateau pressure (P_{PLAT}) and driving pressure (ΔP), should be <30 cmH₂O and <15 cmH₂O, respectively. Minimum respiratory rate (RR) should be set. Initially, RR can be set to (patient's respiratory rate - 4)/min. Inspiratory time should be set to ≥ 1 second with patient-specific adjustment. The normal inspiratory to expiratory ratio (I:E) to start is 1:2. PEEP should be set to 3-5 cmH₂O for patients with non-acute respiratory distress syndrome (ARDS). Initially, FiO_2 should be set at 100% and should be rapidly decreased, while targeting SpO_2 about 90%. Because of the oxygen toxicity risk when FiO_2 level is $\geq 60\%$, ARDS management strategies should be considered.

A closed system should be formed and include an endotracheal tube, a closed suction system, a Heat and Moisture Exchanger (HME) with a viral-bacterial filter, a double-circuit and a separate viral-bacterial filter. (Figure 1) In case of severe ARDS, an active Heated Humidifier can be utilized to reduce resistance and mucus plugs. Unnecessary bronchodilator treatment should be avoided during IMV because of COVID-19 transmission. For inhaler treatment, use of metered-dose inhaler drugs with a chamber spacer should be preferred. The chamber spacer should be placed between the endotracheal tube and the HME. As the duration of



Figure 1. Mechanical ventilatory circuit setup for COVID-19 patient

IMV increases, the risk of complications and mortality rises. When the patient's oxygenation improves, i.e. FiO_2 is 40-50% and PEEP is <8 cmH₂O, the focus should be on rapidly weaning the patient from the ventilator.

Conclusion

In COVID-19 pandemic, management of respiratory failure is very important for morbidity and mortality. Hypoxemia should be treated promptly and SpO_2 target should be achieved by avoiding oxygen toxicity. Failure to oxygen supportive therapy can result in serious harm to the patient. If there is inadequate oxygenation with low or high flow oxygen delivering system, intubation should not be delayed. Intubation time should be decided by providing close monitoring of the respiratory drive in COVID-19 patients.

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