High-Flow Nasal Cannula Oxygen COVID-19 cases

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Key Conclusions

In consideration of the question of whether to use High-Flow Nasal Cannula (HFNC) oxygen in the treatment of COVID-19 pneumonia, the Surge Capacity Working Group of the Clinical Ministerial Advisory Committee is in support of this intervention as an strategy to reduce the need for mechanical ventilation in patients with respiratory failure.

The implementation of HNFC is recommended for all hospital settings, tertiary and general medical ward beds where ventilation may not be available, to ensure the oxygenation option is provided as an alternative to intubation and ventilation where available and applicable. HFNC Oxygen is considered as an alternative to intubation and ventilation, and as an alternative to CPAP. The implementation of HFNC is required to address the shortage of ICU beds and ventilation, to support the procurement of the equipment, supply of high-flow oxygen at rates of up to 60L/min (sixty liters per min), to enable the treatment of COVID-19 pneumonia in a lucid and cooperative patient that is able to maintain their airway and cooperate with awake self-proning.

Executive Summary:

The pandemic of COVID-19 is forecast to overwhelm healthcare resources – and in particular, the capacity to treat patients with respiratory failure with mechanical ventilation in the intensive care unit (ICU). High-flow nasal cannula (HFNC) is an oxygen delivery device that has the potential to be a cheaper and lower-resource alternative to mechanical ventilation in some patients. The therapy is better tolerated by patients, is less complex, requires far less supervision by trained providers, and can even be used outside of the ICU in general ward beds. Given the preliminary evidence showing that treating patients with HFNC may avoid the

need for mechanical ventilation, and in anticipation that ICU beds will likely be exhausted for months, these machines may prove to be a very cost effective way to save lives.

The procurement of devices to deliver HFNC devices is undertaken on per-high care bed, and can be used to repurpose general ward beds, to provide respiratory support to patients with confirmed COVID-19 pneumonia (2). The overall forecast of patients that need this type of treatment are anticipated to rise during the months of June – September 2020 (3). Furthermore, admission to ICU for intubation and mechanical ventilation for COVID-19 pneumonia is associated with variable, but often very high mortality(4). There is thus considerable interest in strategies that could help avoid intubation by improving oxygenation non-invasively, and that could be deployed in the non-ICU setting.

Highflow nasal cannula (HFNC) is an oxygen delivery method that is capable of supplying high inspired partial pressures of warmed and humidified oxygen. This reduces anatomic dead space, work of breathing, and respiratory rate, while increasing positive pressure, compliance, and oxygen flow. In the non-COVID setting, HFNC has been proven to avoid intubation compared to conventional oxygen devices (5-7), and there is preliminary data to suggest that it may be useful in patients with COVID pneumonia (8-10). This is an attractive strategy with potential for lower intubation rates, and better outcome, with less ICU resource utilisation and thus cost saving. Guidelines from the World Health Organisation, the Italian Thoracic Society, the Respiratory Care Committee of the Chinese Thoracic Society, The Australian and New Zealand Intensive Care Society,and a joint statement from the German Intensive Care, Anaesthesia, and Emergency Medicine Societies, as well as the joint guidelines produced by the European Society of Intensive Care Medicine and The Society of Critical Care Medicine, all recommend HFNC as a therapy for COVID-19 respiratory failure(11).

Description of HFNC:

The device consists of a flow generator (providing gas flow rates up to 60Lmin), an air-oxygen blender (that achieves escalation of the inspired oxygen fraction (FiO2) from 21% to 100%

(irrespective of flow rates), and a humidifier that saturates the gas mixture at temperature of between 31°C and 37°C (adjusted to patient comfort). To minimise condensation, the heated humidified gas is delivered via heated tubing through a widebore nasal prong. Traditional low-flow nasal cannula blow cool dry air into the nasal passages, which leads to drying of the mucosa, irritation, and epistaxis. Humidification and warming of inspired gas with HFNC markedly improve patient comfort, which leads to improved tolerance and compliance, and thus better outcomes of therapy(12).

Advantages of HFNC:

• Can be implemented and managed by non-ICU specialists.

• Does not require invasive monitoring or addresses the health care worker patient-to-nurse ratios.

• Can be combined with awake self-proning (another strategy shown to improve oxygenation in COVID-19 pneumonia)(1).

• May reduce the need for invasive ventilation in COVID-19 pneumonia

Protocol for stepwise escalation of oxygen therapy and HFNC in COVID-19 pneumonia:

Category Clinical status Suggested action:

Throughout the process consider the clinical presentation of the patient, including ability to maintain airway, orientation and ability to maintain the breathing work effort (avoid exhaustion). Consider awake self-proning to enable lung recruitment*, and ensure regular review by clinicians to monitor the patient progress**.

- GREEN RR ≥ 30bpm with SpO2 ≤ 92% Administer Oxygen via either nasal cannula (2-4L/min) or by 40% face mask. If SpO2 rises to >93%, observe and monitor.
- YELLOW RR ≥ 30bpm with SpO2 ≤ 92% on FiO2 ≥ 40% Start Oxygen 15L/min via rebreather face mask, consider for early intervention and transition to HFNC Oxygen.
- RED RR ≥ 30bpm with SpO2 ≤ 92% on 15L/min or HFNC and/or patient confused/ obtunded, rising FiO2 needs, significant clinical decline. Urgent review by ICU with preparation for intubation.

* Awake early self-proning is another strategy that has been employed to improve oxygenation and prevent or delay intubation. This should be instituted when oxygen requirements are escalated to 15L/min via non-rebreather face mask or HFNC.

** The decision to initiate HFNO in confirmed COVID-19 patients should be based on clinical judgement, but is indicated in the hypoxic, awake patient who is able to comply with proning instructions.

It is strongly advocated to initiate early discussions with ICU team on-call to ascertain ceilings of treatment at presentation in order to avoid inappropriate escalation of ventilatory support. There should be a low threshold for intubation where there is clinical decline (which may include a rising oxygen requirement, consistently or rapid increase in respiratory rate or exhaustion).

- Use minimum oxygen flow necessary to maintain SpO2 > 88% - 94% as lower flow rates (for example under 35 L/min) may have less aerosolization. In attempt to minimize flow, titrate FiO2 to maximum support prior to increasing flow greater than 35L/min.
- Ensure proper size and fit of nasal cannula.
- Once HFNC has been initiated, the patient needs to be assessed after one and after three hours to determine if patient needs to be intubated. Patients should be monitored with continuous pulse oximetry for early identification of rapid deterioration.
- If tolerated, a surgical face mask should also be placed on the patient at all times to reduce the bioaerosolisation of infected materials due to the high gas flow and nosocomial transmission (13, 14). Dispersion studies have shown that, compared to oxygen therapy with a mask, the utilization of HFNC does not increase either dispersion or microbiological contamination into the environment; the patient being able to wear a surgical mask above HFNC in order to reduce the aerosol transmission during coughing or sneezing represents an additional benefit.

PPE and other considerations

• Appropriate administrative controls, optimal ventilation, and PPE (including N95 masks) to be worn by the staff and patient to reduce nosocomial infections.

• Medical engineering consultation required about oxygen supply at individual hospitals including number of HFNC units that can be supported. The high flow of oxygen exceeds the requirements for routine general ward beds (4-15l/min), and for ICU or ventilated patients (30l/min).

Cost analysis

Preliminary local data suggest that patients with COVID-19 pneumonia requiring HFNC occupy the resource for a median of around 7 days. The cost of the HFNC instrument range between R45,000 – R60,000 on the South African market. A single HFNC machine therefore has the potential to treat ~4 patients a month for between R1000 and R2000 per patient (consumables only). Even a modest reduction in the need for ICU admission and ventilation will offset the cost of implementing HFNC Oxygen therapy

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