Review Article

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COVID 19 Severe Acute Respiratory tract infection and Pneumonia: Recommendations for Oxygen Therapy in a Resource Limited setting

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Abstract

This article reviews the WHO and CDC guidelines of oxygen therapy for COVID-19 infected patients keeping in view the resource limited constraints of a healthcare system.

Early recognition of patients with worsening respiratory function while on conventional oxygen therapies, such as simple face masks or masks with reservoir bags and referral to a tertiary care center for advanced oxygen therapy and mechanical ventilation is important to ensure the timely and safe escalation of respiratory support. Early optimisation of care and involvement of medical care Unit is suggested. In patients with COVID-19 there is the potential for a worsening of hypoxemia and an increased need for high flow oxygen and intensive care management so close monitoring is advised. The resource limitations are oxygen supply or availability of oxygen delivery devices, personal protective equipment for the staff, proper donning and doffing areas dedicated for suspected and confirmed covid positive patients. The idea of writing this review article was to ensure safe and economical management of these patients in a resource constrained setting using minimum possible measures.

In the mild and moderate stages of disease, normal oxygen supportive measures (facemask oxygen) could also be advantageous. Supplemental oxygen therapy is immediately needed for patients with respiratory distress, hypoxemia or shock with a target SpO_2 >94% as recommended by the WHO. Patients may still have increased work of breathing or hypoxemia even when oxygen is delivered via a mask with reservoir bag (flow rates of 10–15 L/min, which is usually the minimum flow required to take care of bag inflation; FiO_2 0.60–0.95).

Keywords: COVID-19 Severe Acute Respiratory Infection (SARI) and Pneumonia, oxygen therapy, resource limited setting.

Introduction

Corona virus disease (Covid-19) caused by Severe Acute Respiratory Syndrome-Corona Virus-2 (SARS-CoV-2), is a single-stranded ribonucleic acid (RNA) encapsulated corona virus and is highly contagious. Transmission is assumed to be predominantly by droplet spread (i.e. relatively large particles that settle in the air), aerosol generation and direct contact with the patient. There is still no specific antiviral treatment for COVID-19 infection, only supportive therapies including respiratory care and oxygen supplementation for affected patients, especially in more severe cases.

Suspect and confirm diagnosis of COVID-19 infection

Clinical diagnosis, antibody test or if available by laboratory (RT-PCR). Start infection prevention

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and control (IPC) measures.[1] Put a simple surgical face mask on the patient. This prevents spread of the virus to staff and other patients.

Consider IPC issues of staff personal protection equipment (PPE), medical equipment and COVID-19 hospital areas.[4]

Suspect pneumonia and confirm need for oxygen[2]

Any patient with fever or suspected respiratory infection, with one of the following signs: Respiratory rate >22 breaths/min; severe respiratory distress; altered mental status or SpO_2 ≤90% on room air.

Pediatric patients with cough or difficulty in breathing and a minimum of one among the following signs: central cyanosis or SpO_2 <90%; severe respiratory distress (e.g; stridor, grunting, chest indrawing).

In neonates signs of pneumonia with other classical symptoms: Inability to breast feed or drink, lethargy or unconsciousness or convulsions with other signs of pneumonia may be present: chest indrawing, faster breathing rate (in breaths/min): <2 months ≥60; 2–11 months ≥50;1–5 years ≥40.

Confirm hypoxia with pulse oximeter[2]

Oxygen therapy to be started if SpO_2 <90%. oxygen delivery device preferred: Nasal cannula (prongs) or nasal catheter or face mask.

Nasal prongs recommended for child <5 years. Simple face mask/hudson's mask is preferred over nasal prongs or any other type of oxygen face mask. This limits aerosol generation and therefore prevents viral load and spread to the medical staff and other patients.

Oxygen flow needs to be adjusted to target SpO_2 >90% adults & children. And if there are signs of multi-organ failure including shock or alteration of mental status SpO_2 >94% is recommended.

In pregnant patients as per the WHO guidelines target SpO_2 >92–95% in all the three trimisters.

If oxygen saturation of >90% cannot be achieved, or if SpO_2 <90% despite using the high concentration oxygen devices viz; non-rebreathing mask(NRM) at high flow of O_2(10-15 litres) or oxygen hood in pediatric patients (FiO_2 of 80-90%) suspect Acute Respiratory Distress Syndrome(ARDS). Consider nursing the patient in prone position in periodic intervals. This may improve the ventilation and oxygenation of the patients and avoid the need for mechanical ventilation.[3] If the oxygen saturation does not improve further, advanced oxygen therapy and mechanical ventilation may be required. If possible these patients should be shifted to ICU'S as soon as possible for management of intubation and ventilation as these are high aerosol generating procedures and would require proper PPE'S to be worn by the medical staff. Timely decision of enhancing the oxygen support while monitoring the blood gases and other vital parameters including urine output are paramount for the patient management.

Oxygen delivery devices[4]

Titrate O_2 flow with SpO_2.

Nasal prongs O_2 1 – 5 L/min → FiO_2 28%–40% child and adult

Nasopharyngeal catheter O_2 1 – 2 L/min → FiO_2 45%–60% infant and child

Oxygen face mask O_2 6 – 10 L/min → FiO_2 44%–60% child and adult

Venturi oxygen face mask O_2 4 – 15 L/min → Fi O_2 24%–60% (for Venturi O_2 flow rate FiO_2 device specific)

Oxygen face mask reservoir bag O_2 10–15 L/min → FiO_2 60%–95%

Caution

Aerosol generation with droplet spread using open high flow oxygen devices is responsible for most of the contamination and spread of corona virus infection. Simple surgical face mask over nasal prongs is preferable.

Humidification and nebulisation should be avoided as much as possible: Viral spread and equipment may be contaminated being one more aerosol generating procedure.

While HFNO (High frequency Nasal Oxygenation carries a small risk of aerosol generation, it is considered a recommended therapy for hypoxia associated with COVID-19, as long as the staff are wearing optimal PPE. The risk of airborne spread and transmission to the medical staff is considered low when optimal PPE's with and other infection control precautions including donning and doffing are done properly.

Resource limitations: Oxygen supply and availability of oxygen delivery devices.

Assessment of oxygen delivery devices and monitor oxygen supply.

Disinfection of oxygen delivery devices viz; nasal prongs, catheters and face masks.

Infection prevention and control (IPC) measures and policies as per the local protocol of the hospital for contaminated medical equipment.[5]

Oxygen supply[4]

Cylinders may not easily be refilled. Infection prevention and control (IPC) measures if cylinder is at the bedside.

If bulk supply of oxygen is not available then alternate methods may be devised and modified as per the local needs and demand.

Oxygen concentrators produce 4–10 L/min of O_2 and can serve as an important alternative to cylinders in a resource constrained setting.

Decontamination and Disinfection[5,6]

Cleaning of oxygen delivery devices or any surface of secretions and mucus. Disinfect with 70% (ethyl or isopropyl) alcohol or soak in 0.1% sodium hypochlorite solution (1000 ppm available chlorine) for 30 minutes.

Preparation of 0.1% sodium hypochlorite solution[4]

5% sodium hypochlorite contains 50,000 ppm available chlorine, and the dilution contains 1000 ppm. Household bleach to be diluted usually 5% = 5g sodium hypochlorite /100 ml 1:50 with tap water. One measure of bleach to be added to 49 measures of tap water.

Check the concentration of sodium hypochlorite on label (in g/100 ml) and dilute accordingly. For example: 2.5% sodium hypochlorite bleach contains 2.5g sodium hypochlorite /100 ml. add 24 measures tap water to 1 measure of bleach. 4.2% sodium hypochlorite bleach equals 4.2g sodium hypochlorite /100 ml. One measure of bleach is added to 41 measures of tap water. All the dilutions contain 1000 ppm available as chlorine.

A container of solution is to be prepared in a well ventilated place. Store covered, cool and shaded. Discard at 24 hours. Avoid direct contact with eyes and do not mix this solution with detergents.

Thoroughly rinse the oxygen delivery devices before reusing again.

Oxygen Therapy with Resource Limited Conditions

COVID-19 Severe Acute Respiratory Infection and Pneumonia

Key Points

Suspect and Confirm Diagnosis of COVID-19 infection

- Diagnose clinically or by laboratory test
- Simple surgical face mask to be used
- Start infection prevention and control (IPC) measures
- Consider personal protection (PPE) for the medical staff, disinfect medical equipment and designate a dedicated Covid-19 hospital area

Suspect Severe Pneumonia and Confirm Need for Oxygen

- Respiratory signs and symptoms
- Adult or adolescent SpO_2 ≤90%
- Child SpO_2 as per the age

Confirm Hypoxia Pulse Oximeter

- Start oxygen therapy if SpO_2 <90%
- Nasal cannula (prongs) or nasal catheter or face mask
- Nasal prongs for child < 5 years
- Adjust O_2 flow to target SpO_2 >90%
- Try prone position with pillow under the chest
- If SpO_2 not increasing or <90%-Advanced oxygen/Ventilatory support

Resource Limitations

- Availability of oxygen delivery devices and oxygen supply
- Assessment and monitoring of oxygen supply
- Consider disinfection of oxygen delivery devices

Decontamination and Disinfection

- Physical and mechanical cleaning of equipment
- 0.1% sodium hypochlorite solution to be used for 30 minutes

Caution

- Surgical face mask preferred over prongs for the risk of contamination.
- Risk of droplet spread with high flow O_2 from all devices
- Humidification and nebulisation to be avoided

Oxygen Delivery Devices

- Nasal prongs O_2 1–5 L/min
- Nasal catheter O_2 1–2 L/min (infant & child)
- Oxygen face mask O_2 6–10 L/min PPP
- Face mask reservoir bag O_2 10-15 L/min (Make sure reservoir bag inflates)
- Venturi oxygen face mask O_2 4–15 L/min (O_2 flow rate device specific)

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