

**INDIAN ASSOCIATION OF PAEDIATRIC ANAESTHESIOLOGISTS
COVID-19 INFECTION: PAEDIATRIC ANAESTHESIA & PERIOPERATIVE CARE
ADVISORY**

Contributors

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The severe acute respiratory syndrome coronavirus 2 (COVID-19) pandemic 2020 has challenged healthcare providers (HCP) and clinicians caring for patients with this highly communicable disease, who must, at the same time, protect themselves from a potentially lethal disease. Anaesthesiologists are particularly vulnerable, being responsible for airway management, positive pressure ventilation via a facemask, endotracheal intubation and extubation, management of tracheostomised children and contact with oral secretions, all of which can cause widespread aerosolization of virus.

The Internet and social media are rife with consensus statements and advisories from societies on best practices to deal with this issue. This advisory summarizes available information and the implications for anaesthesiologists caring for children in the perioperative setting. The recommendations are to be taken as advisories and decisions made should be individualized as deemed appropriate. The recommendations may change as new advisories are released and as the situation progresses.

Symptomatology

The majority of patients with COVID-19 infection present initially with fever, and may be associated with cough and easy fatigability. Less commonly reported symptoms include palpitations, headache and diarrhea. While the majority of patients have mild symptoms and have a good prognosis, about 15% of patients may progress from days 7 to 10 to develop pneumonia, acute respiratory distress syndrome (ARDS), cardiac and renal injury, or multiorgan failure. Though the virus appears to have its most damaging clinical effects in adult patients, infection does occur in children and asymptomatic transmission of the virus from children to HCP is a significant risk. Of concern to anaesthesiologists is that children may present with minimal or no respiratory symptoms in the perioperative setting.

The World Health Organization (WHO) guideline recommends that in addition to routine standard precautions, all HCP take precautions against possible droplet and physical contact when caring for any patients with suspected or confirmed or COVID-19 infection. Additional precautions should be taken against airborne transmission when any aerosol-generating procedure (AGP) is performed *e.g.*, intubation, extubation, bronchoscopy, suctioning or cardiopulmonary resuscitation.

Education and Training in Best Practices of all Anaesthesia Personnel

Prevention is the only reliable tool available to fight COVID-19 currently. Cognitive aids like checklists are valuable to support clinical care and workflow. Context specific simulation is also a useful training aid *e.g.*, simulation sessions focused on intubation and extubation protocols performed with appropriate personal protective equipment (PPE) for anaesthesiologists and appropriate barrier techniques.

Preoperative Assessment

In addition to the standard preanaesthetic evaluation, all children should be assessed for a potential COVID-19 infection. Initial assessment should include a detailed history. Fever, sore throat, dry cough, runny nose, diarrhea are suspicious symptoms. A history of recent travel by the child or family members, history of tests recommended to close family members, symptoms in patients, family members, care givers and other contacts including a history of risk factors for a poor outcome are mandatory.

The number of attendants accompanying the child should be restricted to one caregiver per child.

Testing protocols are determined by state government policies and availability of testing kits. RT-PCR testing of nasal swabs is currently recommended. However, sensitivity for detection of COVID-19 can vary based on

how the sample was obtained, the duration from infection to testing and how the laboratory performed the test. Nasal swab results are not generally available for up to 24-48 hours and since false negative results may be obtained, all patients who undergo surgery should be considered potential COVID-19 positive or carriers, irrespective of the results of investigations. If an abdominal CT is indicated, the request must include scanning the chest as well.

General Preventive Measures

These measures must be taken while interacting with all patients

- **Social distancing.** Maintain a 1-meter distance from patients, attendant as well as colleagues, except during clinical examination.
- **Frequent hand hygiene.** (WHO 5 moments for hand hygiene) with soap and water or alcoholic hand rub.
- **Wear surgical facemask at all times.**
- **Disinfect all surfaces** in between patient consults.

Risk Categorization of Patients

For purposes of ease of operations, the following categories of patients are proposed. However, when community transmission becomes widespread every patient presenting for surgery becomes a potential asymptomatic infected case.

High Risk: Children who

1. Test +ve for COVID-19
2. Have a positive history of symptoms
3. Have suspicious signs seen on Chest imaging
4. Have a confirmed case/suspicious history with a close contact
5. Have a history of travel/residence from a COVID-19 affected zone
6. Have risk factors for a poor COVID-19 outcome

Full PPE protocols should be followed.

General Risk: All other children being considered for surgery

Universal precautions, including protection against aerosols should be followed. These consist of cap, goggles/visor, surgical mask, waterproof gown, gloves and shoe covers. In high prevalence areas, N95 mask and double gloves should be used.

Scheduling of Surgery

Elective surgery should preferably be deferred. There is evidence to show that surgery might exacerbate infection and increase morbidity. Assessing the risk of postponing surgery, versus the risk of disease progression should be considered. Children with malignancies or progressive cardiac conditions should be given such consideration.

Preparation for the Surgical Procedure

Consider a dedicated operating room (OR), ideally with negative pressure for patients with COVID-19. The majority of hospitals in India do not have negative pressure operating rooms and therefore it is not practical to recommend that they should be provided, given the financial costs involved. Air exchanges from standard operating rooms with 15 air changes per hour can clear 99% of the air borne contaminants within 20 minutes following an aerosol generating procedure (AGP) like intubation. All OR personnel (surgeons, anaesthesiologists, technicians, scrub and circulating nurses) should take adequate universal/standard precautions to protect themselves before entering the OR. Irrelevant personnel (additional nurses, technicians, residents and fellows, observers) should not be allowed inside the OR during AGPs.

- Consider excluding the following HCP from active clinical duties who are possibly at higher risk: older HCPs, those with cardiac disease, chronic respiratory disease, diabetes, recent cancer, hypertension, immunocompromised and pregnant women.
- Minimum OR staff should be present during AGPs. Those not involved for these procedures can re-enter the OR wearing a surgical facemask after a period of 20 minutes. However, they can enter the room earlier if they have full PPE and a N95 mask.
- All unnecessary equipment and trolleys should be removed from the OR. All workstation drawers and shelves should be cleared of unnecessary drugs and equipment.
- No laptops or mobile phones, personal bags or other items should be allowed in the OR. Mobile phones should be placed with the circulating personnel in the buffer zone.
- A dedicated anaesthesia machine and multiparameter monitor should be used. These can be covered with a large clear plastic drape or shield to prevent contamination of touch screens and control knobs.
- A closed anesthesia circuit is preferred, to minimize aerosol exposure. Use of Jackson Rees, semi open and open circuits should be avoided.
- Use a high quality viral filter (HME or HEPA) of appropriate size between the facemask or endotracheal tube and the anaesthesia breathing circuit. The end-tidal carbon dioxide sampling line should be placed after the viral filter. An additional viral filter should be used at the machine end of the expiratory limb of the breathing circuit.
- If an underbody warming mattress is used, cover it with a plastic drape to reduce contamination. Convective warmers should be switched off during AGPs
- The OR should be equipped with as much disposable material as possible. The team should plan and prepare the list of equipment and instruments required in the OR and store it in a sterile manner. Opening the OR doors during the procedure should be discouraged and minimized.
- All drugs and equipment should be prepared, labeled and readily available before starting an anaesthetic to reduce the need to reach into workstation drawers and anaesthesia storage shelves once the child has entered the OR or procedure room.
- An additional circulating nurse should be available in the buffer area and be responsible for delivering items from the buffer area to the OR.

Personal Protective Equipment (PPE)

PPE needs to be safe, sufficient and used in a manner that ensures supplies are sustainable. General principles are that it should be simple to remove after use without contaminating the user and complex systems should be avoided. Airborne precaution PPE is the minimal appropriate for airway management of patients with known or suspected COVID-19. All HCPs should familiarize themselves with the PPE available in their setup and know how to use it. A 'buddy system' (expert observer) and checklists are

recommended to ensure donning and doffing is performed correctly for maximum protection and minimal exposure. The protocol recommended for PPE are as follows:

For HIGH RISK patients:

- All personnel involved with the procedure should don PPE in the buffer room before entering the OR. PPE includes double caps, well-fitted medical protective mask (N95 or equivalent), medical goggles or face shields, medical protective clothing, boot covers, latex gloves.
- Surgeons and scrub nurses should wear disposable sterile operating clothes and sterile gloves in addition to the PPE as mentioned above.
- For regional anaesthesia and vascular access procedures, a sterile gown has to be worn by the anaesthesiologist over the PPE, after performing the surgical hand wash.

For all other patients:

- Disposable surgical gowns, surgical masks, protective eye-wear and foot covers should be used

ANAESTHESIA CONSIDERATIONS

Premedication

Premedication is highly recommended to avoid a coughing, crying and struggling child, and to reduce the risk of aerosolization and droplet contamination. Intravenous (IV) induction via a cannula secured in the ward is best, else sufficient time must be set aside for oral premedication and subsequent IV cannula placement. Nasal administration of premedication is not recommended because of the potential for high viral loads and the risk of coughing and sneezing. Ensure adequate time for the required effect of premedication to facilitate smooth child-parental separation. Avoid parental presence during induction to reduce infection risk. Encourage the child to wear a surgical facemask through transport, induction until airway management.

Before Induction

The anaesthetic plan should be clearly communicated to the anaesthesia team before the conduct of anaesthesia. An airway management rescue plan should be discussed clearly beforehand. Communication can be limited when using N95 masks and PPE gear due to muffling of one's voice. Therefore, a clear understanding or use of sign language can avoid confusion. Reiterate the infectious risk of the patient and the level of precautions required for all team members. Ensure all personnel in the OR have appropriate PPE.

Induction of Anaesthesia

Anaesthesia should not be induced in induction rooms, as the air exchange rates per hour is usually lower than in the OR. IV induction is preferred, as inhalational induction with high fresh gas flows increase exposure to respiratory droplets and aerosols. However, a smooth inhalation induction may cause less respiratory droplet exposure than placing an IV cannula in a crying and struggling child. If inhalation induction is required, the lowest possible fresh gas flow should be used while maintaining a tight facemask seal.

Precautions During Airway Management

The airway strategy (the primary plan and the rescue plans) as discussed should be followed. An anaesthesiologist experienced with handling paediatric patients should manage the airway. The aim is to secure the airway successfully at the first attempt and to minimize attempts and time. Double gloving is recommended during induction, intubation and extubation.

- Three individuals are likely to be required during induction and intubation; an intubator, an assistant and a third person to administer drugs and monitor the patient. Additional help should be available just outside the OR who can be summoned rapidly if needed.
- Preoxygenate with the minimal gas flows possible, ensure a good seal with the facemask. Inject IV fentanyl in slow, small aliquots to reduce coughing.
- Preferably use a rapid sequence induction. This may not be feasible in small children and patients with severe lung pathology as rapid severe hypoxemia may ensue. In these children, gentle positive pressure ventilation can be provided while maintaining a tight mask seal with the aim of providing just enough tidal volume to achieve chest rise.
- Use techniques that are familiar and known to work reliably across a range of patients, including when difficulty is encountered. The actual technique of airway management will differ according to local practices and availability of equipment.
- Choice of airway device: Have a lower threshold for use of a supraglottic airway device (SGA) over facemask ventilation and an even lower threshold for tracheal intubation. If using an SGA, spontaneous ventilation may be preferred to controlled ventilation, to avoid airway leak.
- Two-person two-handed mask ventilation with a “VE-grip” is recommended for mask ventilation to improve airway seal (thumbs and thenar eminences are placed on each side of the facemask and the 2nd, 3rd, 4th and 5th fingers lift the mandible towards the mask). The assistant provides bag-mask ventilation with small tidal volumes, utilizing the lowest gas flows possible.
- Ensure adequate neuromuscular blockade before tracheal intubation is attempted.
- The head end of the child should be covered following induction to minimize air borne contamination during airway instrumentation. A large plastic sheet which covers the child's face and intubators' hands can be used. Alternatively, two metal frames or screens can be inserted, one near the intubator and one further down, both covered with a single large clear plastic sheet, which serves as a protective tent over the patient. Slits in the plastic can allow introduction of the laryngoscopists' hands into the plastic tent. An “intubation box” made of clear plastic or acrylic, which sits over the patient's head and acts as a protective shield during AGP can also be used. Some practice runs are required to acquire the skills to perform intubation using these barrier devices. If feasible, the devices can be left in place for the duration of surgery, or used again during extubation. The intubation box has to undergo appropriate cleaning and disinfection after use.
- If available, video laryngoscopy is preferred, the distance between the patient and the laryngoscopist is increased along with better first-pass intubation success. If using a bougie or stylet, it should be removed with caution so as not to spray secretions on the intubating team. The outer pair of gloves worn by the laryngoscopist can be peeled off to sheath the laryngoscope blade after use.

- Cuffed endotracheal tubes are recommended to avoid air leak; the cuff should be immediately inflated after intubation of the trachea before commencing mechanical ventilation.
- Successful tracheal intubation should be confirmed by capnography and visual observation of bilateral chest rise; auscultation with a stethoscope may be difficult with the presence of barriers.
- High-flow nasal oxygen is not currently recommended during tracheal intubation.
- Where practical, single-use equipment should be used. Reusable equipment requires appropriate decontamination.
- **Management of the Unexpected Difficult Airway**
Mask ventilation may be abandoned early and a second-generation SGA should be used as an alternative between attempts at laryngoscopy for a better airway seal to minimize aerosol generation.
- **Anticipated Difficult Airway**
In the older child with a difficult airway, avoid awake fiberoptic intubation to decrease patient coughing during intubation. Flexible bronchoscopy techniques (whether oral or nasal or via a SGA conduit) are likely to be aerosol generating and therefore to be avoided as first choice. It may be prudent to call early for personnel and equipment for a surgical airway. Ensure that additional personnel who come to help are protected with PPE. Prolonged attempts at intubation may be associated with increased aerosolization.

Maintenance of Anaesthesia

After donning appropriate PPE, anaesthesiologists should continue wearing PPE during the entire case given the risk of accidental ventilator circuit disconnection, accidental extubation and unquantified aerosolization especially from airway, laparoscopic and endoscopic procedures.

Patients requiring supplementary oxygen via nasal cannula should wear a surgical mask over the tubing.

A plastic drape or sheet can be placed over the airway device and patient's head to trap any aerosolized virus.

Minimize endotracheal tube and circuit disconnection by ensuring tight connections. If the circuit needs to be disconnected, during the procedure, leave the HME filter attached to the airway device and disconnect at the elbow connection. Alternately, the endotracheal tube can be clamped prior to disconnection. Place the ventilator on standby whenever a circuit disconnection is required, such as tube repositioning. Restart mechanical ventilation only after the circuit has been reconnected.

Employ lung protective mechanical ventilation strategies by maintaining lower tidal volumes of 5-6 mL.kg⁻¹, a higher respiratory rate to maintain adequate minute ventilation and maintain peak airway pressure below 30 mmHg.

Surgical Considerations

- Surgery should be carried out with an experienced surgeon in attendance.
- Use a smoke evacuator when electrocautery is used.
- Consider avoiding laparoscopic procedures, as the risk of generating virus-carrying aerosol is supposedly higher.
- Special precautions should be taken during tracheostomy and airway endoscopic procedures because of the high risk for aerosolization.

Emergence and Extubation

- Administer anti-emetics to minimize vomiting.
- Limit the number of personnel in the OR during extubation to the anaesthesiologist, an assistant and a nurse.
- Perform suctioning when the child is deep to minimize coughing and risk of laryngospasm. Use a closed in-line suction if available to minimize aerosolization during tracheal tube suctioning.
- Consider removal of the SGA and endotracheal tube when deep, or use techniques that minimize coughing and bucking during emergence such as total intravenous anaesthesia, dexmedetomidine or administration of lignocaine or opioids at emergence. This needs to be balanced against adverse impact on the respiratory drive, neuromuscular function and haemodynamics.
- All airway devices should be removed from the patient in the OR and not in the recovery area.
- The convective warmer can be turned off during extubation, and restarted once the facemask (oxygen mask/ surgical facemask) is on the patient. If supplemental oxygen is required, use a simple facemask with low oxygen flows.
- Consider bypassing the Post Anesthesia Care Unit (PACU). Observe the child in the OR till considered safe to transfer directly to the ward. This minimizes exposing the infected patient to other HCP and other patients.

Patient Transport

- Designate an isolated COVID-19 holding/recovery area.
- All children transported to and from the OR should wear a surgical facemask.
- Consider dedicated hallways and patient transport routes for COVID-19 patients to prevent cross infection.
- Mechanically ventilated children with COVID-19 should be transported with HME filters on the patient end of the Y-piece and on the expiratory limb tubing at the ventilator end. If a transport ventilator is not available, a HME filter should be connected to the tracheal tube during transport. A transparent plastic sheet should be used to cover the head end of the patient.

Doffing PPE & Disinfection of the OR

- Following correct procedure for doffing is extremely important, as the outer surfaces of protective gear will be loaded with infective material. Clearly mark area for doffing, and ensure that all users follow protocol.
- Ensure adequate air exchange and filtration time of the OR before cleaning and preparing for the next case.
- Coronaviruses can remain infectious on inanimate surfaces for up to 9 days, and all surfaces and equipment used should be carefully disinfected with a minimum of 70% ethanol for small surfaces or 1% sodium hypochlorite for larger surfaces.

Recommendations for CPR in Suspected and Confirmed COVID-19 Patients

Resuscitations carry added risk to HCPs since the administration of CPR involves performing numerous aerosol-generating procedures, which include chest compressions, positive pressure ventilation, and establishment of an advanced airway. Resuscitation efforts also require numerous providers to work in close proximity to one another and the patient. While the algorithms for BLS and Advanced Life Support remain the same, the following modifications are suggested while resuscitating suspected or confirmed COVID -19 patients.

- Before entering the scene, all rescuers should don PPE.
- Limit personnel on the scene to only those essential for patient care.
- Consider replacing manual chest compressions with mechanical CPR devices (for adolescents) to reduce the number of rescuers required.
- Use oxygenation and ventilation strategies with lower aerosolization risk.
- Attach a HME filter, if available, to any manual or mechanical ventilation device before administering any breaths.
- Early insertion of a SGA (second generation) to enable ventilation is preferred to ventilation with a facemask as it causes less aerosol spread. Early tracheal intubation with a cuffed endotracheal tube is recommended. Video laryngoscopy should be considered, if available.
- Consider age, comorbidities and severity of illness in determining the appropriateness of resuscitation and balance the likelihood of success against the risk to rescuers.

Further Reading

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- Interim Guidance for Basic and Advanced Life Support in Adults, Children, and Neonates with Suspected or Confirmed COVID-19. 10.1161/CIRCULATIONAHA.120.047463
National Centre for Disease Control – India (Access the latest government notifications and advisories and readymade signages): <https://ncdc.gov.in/index4.php?lang=1&level=0&linkid=127&lid=4328>