Clinical Practice Recommendations for Anaesthesia and N.O.R.A in Pediatric Patients during COVID-19 Pandemia

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This document has been elaborated in order to support anaesthesiologists in the perioperative management of children with suspected or confirmed SARS - COV2 infection. This virus is part of the Coronavirus family which also comprises the viruses causing SARS (SARS-COV) e MERS (MERS-COV) [1].

The SARS-COV2 virus causes a mainly respiratory disease named COVID-19, is highly transmissible via droplets and causes severe illness in elder adult patients with comorbidities [2]. The spread of the COVID-19 has provided new epidemiological insights and the pediatric population has been identified as susceptible to infection too[3]. As for other respiratory diseases, children with congenital cardiac disease, bronchial hypoplasia, respiratory tract malformations and malnutrition are at higher risk to develop more severe clinical symptoms [4] .

The presence of viral nucleic acid (RT-PCR protocol) in nasopharygeal swabs, blood or feces confirms the clinical diagnosis.

Clinical Symptoms of COVID-19 in children

An ad hoc expert comitee has defined the following disease stages:

1. Asyptomatic infection
2. Acute upper respiratory tract infection without radiological signs of peumonia or sepsis (**WHO stage I**).
3. Mild pneumonia with respiratory symptoms (cough, nasal congestion) and fever (<37,5-37,8°C). Thorax X-ray not suggestive for moderate-severe pneumonia (**WHO stage II**).
4. Moderate to severe pneumonia characterized by: RR ≥ 70/min (<1 y); RR≥50/min (≥1 y) not due to fever or crying, SpO_2 < 92%. Presence of clinical signs of hypoxia: nasal flaring, respiratory

retractions, intermittent apnoea, cianosis (**WHO stage III**). Diagnosis is based on clinical symptoms. Radiological exams are indicated to identify or exclude complications.

5. Critical cases:
   - Respiratory distress (**WHO stage IV**: oxygenation is maintained with BiLevel NIV, CPAP, mechanical ventilation).
   - Sepsis (**WHO stage V**: suspected or confirmed infection with ≥2 signs of SIRS, one of which has to be alteration of body temperature or leucocyte count.
   - Multiorgan disease (MOD) (**WHO stage VI:** hypotension with two of the following symptoms: altered mental state, tachycardia or bradycardia (<90 bpm or > 160 neonates; <70 bpm or > 150 bpm children), capillary refill >2sec, petechia or purple rash; increased lactate; oliguria; hypothermia [<35°C]).

Specific Aims and Field of Application

- to identify children with suspected or confirmed infection and neonates from COVID-19 positive mothers scheduled for surgery or procedures requiring anesthesia
- to define criteria of urgency and postponement of surgery or procedures[6]
- to define the context: Operating Theatre or N.O.R.A (flow-chart)
- prevention of transmission from the caregiver to the child and viceversa
- to put in practice procedures to minimise airborne viral spreading during airway management
- to plan a dedicated perioperative pathway (COVID operating theatre)

Anaesthesiologic Management of the Pediatric Patient scheduled for Surgery

We here describe the scenario of a child identified as supected, probable or confirmed case (according to the comunication Nr. 6360 dated 27.02.2020 of the Italian Ministery of Health) scheduled for urgent or emergency surgery. The surgeon and the anesthesiologist together will define the risks and benefits of the planned procedure and the patient should be accompanied by only one caregiver (Civil Code, art.314, paragraph 1)[7].

Preoperative Evaluation

- Preoperative laboratory testing according to the SARNePI recommendations, [8]
- Most children with COVID-19 have high erythrocyte sedimentation rate and C- reactive protein with normal procalcitonine (PCT). PCT may be high when typical COVID-19 signs are present in the CT scan[9]. White blood cell count initially may be normal or reduced: in severe cases D-dimers might progressively increase while lymphocytes decrease[10].

Airway Management

- Airway should be managed by the most experienced member of the team
- Spontaneous breathing or airway secured by second generation supraglottic devices should be prefered for procedural sedation in order to minimize aerosolization of secretions.
- If endotracheal intubation is required, use rapid sequence induction (full dose muscle relaxant) and videolaryngoscope[11].
- Maintain an adequate level of sedation and analgesia at the end of surgery (e.g. low dose remifentanyl infusion) so that controlled extubation can be performed minimizing the risk of laryngospasm.

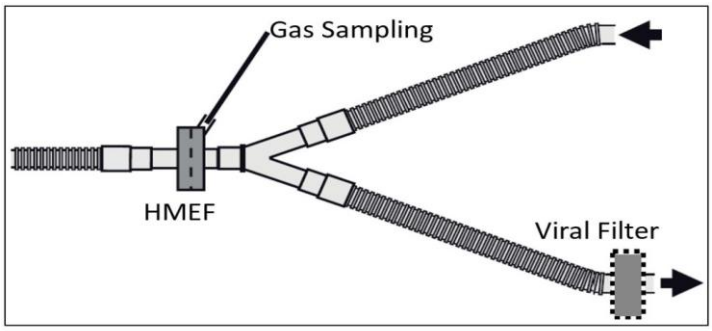
Protected Perioperative Pathway

The patient should be transported to the OT applying appropriate measures to avoid spreading of the infection and limiting personnel and caregivers involved.

- Premedication, oral or nasal, is recommended to make separation from the parent less traumatic.
- the team which will prepare the OT should use transparent drapes to protect the anesthesia equipment (ventilator, infusion pumps, videolaryngoscope)
- after emergence from anesthesia the patient will complete postoperative recovery preferably in the OT until ready to be transferred to the ward.

Mechanical Ventilator Set-Up

- use HMEF filters(Heat and moisture exchange filters)
- use a filter with appropriate dead space. Pediatric filters usually have 10ml dead space for a minimum tidal volume of 30ml (patient weight 5kg)
- put a filter with VFE (viral filtration efficiency) 99.9% on the expiratory branch of the anaesthesia circuit
- if the VFE of the HMF filter is not high enough , a 0.2µ filter (epidural cathether filter) can be inserted before the water trap of the gas-sampling line.



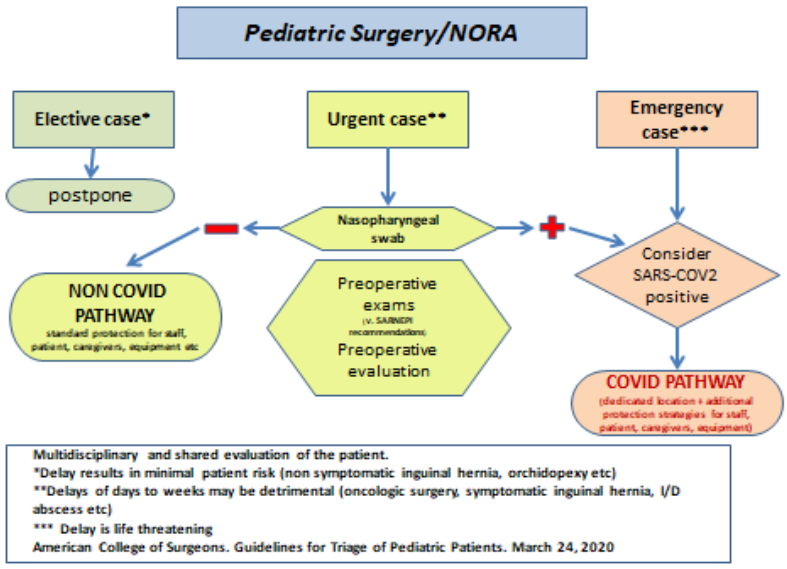
Preferred Filter Configuration
VFE > 99.99% for each filter. Gas sampling on machine side of filter. (Courtesy Draeger Medical)

Anesthesia/ NORA for suspected/probable or confirmed COVID-19

- Consider only urgent surgery and procedures that cannot be delayed.
- Use PPE for self-protection and protection of the patient according to your institutional protocol.
- Use a dedicated Operation theatre/ radiological suite (institutional protocol)
- Limit the members of staff in the OT/radiological suite
- Use a checklist to prepare the OT and equipment.
- Use transparent plastic drapes to avoid contamination of staff and equipment

	Anaesthesia	NORA
Preoperative assessment	- Laboratory tests (SARNePI recommendations) - Nasopharyngeal swab - Anesthesiologic evaluation	- Laboratory tests (SARNePI recommendations) - Nasopharyngeal swab - Anesthesiologic evaluation
Premedication	- recommended to avoid agitation and to facilitate separation from parents. Prefer oral or iv route. Nasal route only in negative cases. - consider Salbutamol puffs with spacer for patients with respiratory symptoms or in therapy with broncodilators in the last year	- Recommended to avoid agitation and to facilitate separation from parents. Prefer oral or iv route. Nasal route only in negative cases.
Induction	- prefer iv to inhalatory induction - preoxygenation (0.2l/min/kg) - limit/avoid manual ventilation - antiviral filters between the patient airway and equipment used for manual/mechanical ventilation	- Prefer iv to inhalatory sedation. - Antiviral filters between the patient airway and equipment used for manual/mechanical ventilation
Airway management	- provided by the most experienced team member - avoid aerosolization - immediate availability of all devices necessary for difficult airway management - ETT o LMA can be used	- Prefer spontaneous breathing and administer low flow oxygen (0.2l/kg/min) if necessary
Emergence	- avoid agitation, delirium, cough, nausea and vomiting	
Postoperative Analgesia	- provide good pain control in order to avoid agitation and crying	
Trasfer	- postoperative recovery in the OT - safe transfer to a dedicated ward	- safe transfer to a dedicated ward or recovery area before discharge

Flow-Chart


Pediatric Surgery/NORA
Elective case*
Urgent case**
Emergency case***
postpone
Nasopharyngeal swab
NON COVID PATHWAY
standard protection for staff, patient, caregivers, equipment etc
Preoperative exams
(v. SARNEPI recommendations)
Preoperative evaluation
Consider SARS-COV2 positive
COVID PATHWAY
(dedicated location + additional protection strategies for staff, patient, caregivers, equipment)
Multidisciplinary and shared evaluation of the patient.
*Delay results in minimal patient risk (non symptomatic inguinal hernia, orchidopexy etc)
**Delays of days to weeks may be detrimental (oncologic surgery, symptomatic inguinal hernia, I/D abscess etc)
*** Delay is life threatening
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