

Care of Burns in Scotland

National Managed Clinical Network

Paediatric Guideline

Management of Airway Burns and Inhalation Injury

Reviewed by Mr Stuart Watson, NHS Greater Glasgow and Clyde, October 2020 on behalf of COBIS

To be reviewed October 2023

NOTE

This guideline is not intended to be construed or to serve as a standard of care. Standards of care are determined on the basis of all clinical data available for an individual case and are subject to change as scientific knowledge and technology advance and patterns of care evolve. Adherence to guideline recommendations will not ensure a successful outcome in every case, nor should they be construed as including all proper methods of care or excluding other acceptable methods of care aimed at the same results. The ultimate judgement must be made by the appropriate healthcare professional(s) responsible for clinical decisions regarding a particular clinical procedure or treatment plan. This judgement should only be arrived at following discussion of the options with the patient, covering the diagnostic and treatment choices available. It is advised, however, that significant departures from the national guideline or any local guidelines derived from it should be fully documented in the patient's case notes at the time the relevant decision is taken.

A multidisciplinary team should provide the management of the child with inhalation injury. Childhood inhalation injury mandates transfer to a PICU and if associated with burns to a paediatric burns centre.

There is insufficient data to support a treatment standard or a treatment guideline for the diagnosis of inhalation injury.

Suspect inhalation injury if:-

- Exposure in an enclosed space
- Death of persons at scene
- Decreased level of consciousness, confusion
- Steam burn
- Facial burns
- Soot in mouth, nares
- Carbonaceous sputum
- Swelling, ulceration of oral mucosa or tongue (deeper examination may compromise the airway of the distressed child)
- Dyspnoea
- Hoarseness
- Drooling
- Stridor, wheeze, crepitations
- Increased work of breathing
- Oxygen saturations <94% in air (*normal saturations do not exclude the diagnosis as carboxyhaemoglobin will be misread as oxyhaemoglobin by oxygen saturation monitors*)
- Carboxyhaemoglobin >5% on co-oximetry

Consultant anaesthetic staff/ PICU staff must be informed of all inhalation injuries.

Investigations

- CXR: especially if air transfer (usually normal at baseline)
- Blood gas: co-oximetry (carboxyhaemoglobin), lactate, PaCO₂, PaO₂

Resuscitation

- Prevent ongoing burn injury
- Increase calculated fluid requirements if inhalation and burn injury present

UPPER AIRWAY BURN

No factors accurately and consistently predict the need for intubation. It is a clinical decision ie not based on laboratory data. Drooling, stridor, hoarseness, facial or neck burn or increased work of breathing mandate intubation.

- Consultant anaesthetic staff/ PICU staff must be informed of all upper airway burns
- Intubate early-oedema progresses and is worsened by fluid resuscitation
- Signs may be minimal at presentation but rapidly progress. If the child is not intubated they must be observed in an area where continuous cardiorespiratory assessment with appropriate monitors is available. Staff must be appropriately trained to recognise a child with evolving airway compromise, and facilities for intubation must be available.
- Err on the side of caution- IF IN DOUBT INTUBATE
- The child should be intubated if they need transferring between hospitals
- Senior staff experienced in intubation of the difficult airway should intubate
- Do not cut the endotracheal tube (evolving oedema can result in a cut tube being too short. The theoretical risk of increasing dead space is minor in comparison.)
- Nasal intubation is preferable (but a difficult oral intubation should not be electively changed for a nasal tube)
- The largest cuffed tube that is age appropriate should be used. Ideally this is a “microcuff tube”. The cuff should remain deflated (inflate if respiratory compliance and resistance compromises ventilation).
- If “microcuff ” tubes are unavailable then the largest age appropriate plain tube should be placed up to size 5.5, and cuffed tubes size 6.0 and above.
- Fix the tube so that it can be advanced in the first few days if necessary-once oedema has settled, suturing or stapling can be considered
- Elevate the head of the bed to 30-45° (this allows gravity drainage of oedema, and the abdominal viscera to move away from the diaphragm)

LOWER AIRWAY INJURY

Children with lower airway injury who have required intubation should be managed in a PICU. It is possible that a child has deteriorated as lower airway injury has progressed, requiring intubation after a period of observation. These children should be referred to a PICU.

Injury may not manifest until after 48 hours. Toxins produce bronchospasm, mucosal oedema, microvascular hyper-permeability, obstructive airway casts and surfactant dysfunction. Depressed epithelial integrity, loss of the mucociliary clearance mechanism, migration of upper airway secretions to the lower airway and immuno-compromise predispose to bacterial colonization and translocation. Lower airway injury may progress to the acute respiratory distress syndrome. Strategies should be targeted to minimize iatrogenic ventilator induced lung injury.

Intubation is as per upper airway thermal injury. (Caution against the use of Suxamethonium for intubation if the patient has associated burns and is >24 hours since injury. This should be regarded as a contra-indication).

Monitoring

The requirement for invasive lines can be discussed with the retrieval team. The retrieval team can site lines as indicated if the referring hospital are unable to gain access.

- Arterial line
- Central venous (ideally continuous SVO₂ monitoring)
- End tidal CO₂ monitoring

Carbon monoxide

- 100% humidified oxygen until CO levels <10%
- No place for routine use of hyperbaric oxygen therapy

Cyanide toxicity

Cyanide toxicity is uncommon. Cyanide levels are not routinely performed by hospital biochemistry services, and have to be sent to reference laboratories. For this reason they cannot be used to influence management. The routine use of antidotes is not recommended as they have significant side effects. Priority should be given to stabilising the airway. The use of Cyanide antidotes should be discussed with a PICU consultant. Therapy will be influenced by local availability of antidotes.

Suspect Cyanide poisoning if:-

- Lactate remains elevated despite adequate resuscitation
- High mixed venous oxygen saturation
- Low arterial venous oxygen difference

Bronchoscopy

It is expected that the child will already be on a PICU. Bronchoscopy should not be performed by the referring hospital unless it is to assist an emergency intubation, or because the child cannot be ventilated after being intubated.

- Only appropriately trained personnel should perform bronchoscopy.
- Consider after intubation to support diagnosis and obtain baseline microbiology specimens
- As required for bronchial toilet and removal of airway secretions and casts.
- To obtain microbiology specimens if chest infection is not improving on therapy targeted at blind bronchial alveolar lavage cultures.
- Prior to extubation if concerns from earlier bronchoscopy.
- MLB if child fails extubation.

Sterile Blind Bronchial Alveolar Lavage

- Days 2 and 3 to obtain microbiology specimens.
- Thereafter on clinical suspicion of lower airway infection
- To confirm treatment success at end of antibiotic course
- Daily if adopting the Shriners bronchial toilet schedule (see later)

Tracheostomy

- Emergency airway
- Elective – currently no evidence of benefit. Consider in individual cases of protracted intubation.

Ventilation

These patients are at risk of ARDS and iatrogenic ventilator induced lung injury. The standard of care for mechanical ventilation in inhalation injury has not been established. Lung protective strategies should be adopted

- Permissive hypercarbia (pH>7.2-bicarbonate if necessary)
- PEEP 10-12, Tidal volumes max 10ml/kg, Peak inspiratory pressure < 30cmH₂O
- Humidified oxygen, FiO₂< 70% (accept SaO₂ >92%)
- Proning, rotation
- HFOV
- Consider nitric oxide

Bronchial Toilet

4 hourly physiotherapy is the mainstay of bronchial toilet. Salbutamol nebulisers should be used to treat bronchospasm.

There is animal model evidence for the use of nebulised heparin and nebulised N-acetylcysteine. Whilst it is standard practice in some paediatric burn's centres, it's routine use cannot be recommended. The following is the Shriners policy, which can be adopted at the discretion of the PICU consultant.

- 4 Hourly chest physiotherapy (half an hour after N-acetylcysteine)
- 2 hourly turning
- 6 hourly proning
- Nebulise 3ml 20% N-acetylcysteine with Salbutamol (2.5mg < 5 years of age, 5mg>5 years of age) 4 hourly
- Nebulise 5000 units Heparin with 3ml normal saline every 4 hours (alternate with N-acetylcysteine ie nebulisers every 2 hours)
- Suction as needed
- Bronchoscopy may needed to assist with bronchial toilet. (send specimens for microscopy, culture and sensitivity whenever bronchoscopy is performed).
- Daily bronchial alveolar lavage
- Monitor coagulation profile daily whilst on nebulised Heparin
- Antibiotics for proven infection-Narrow spectrum and targeted where possible. Limit to 1-week intravenous. Confirm clearance with BAL specimens.

Weaning and Extubation

- Minimal or no inotropic requirement
- T-piece or Swedish nose to assess suitability for extubation
- Leak past ETT at 20cmH₂O- if not, course of steroids
- MLB pre extubation if previous findings warrant- if not MLB for any child that has to be reintubated
- Post extubation stridor can be treated with adrenaline nebulisers
- Consider non-invasive ventilation as an option to reintubation.

ECMO

- Should be considered in any patient failing conventional ventilation
- Debridement and grafting should ideally be done before commencing ECMO

Miscellaneous

- Steroids: No indication for routine use. Limit to bronchospasm, and peri-extubation. Consider use in ARDS.
- Bronchial alveolar lavage with Sodium Bicarbonate solution 1.26% 3- 5ml until return solution is clear of soot is practiced in some units. This may also neutralise acid toxins. There is no evidence to support this anecdotal practice.
- Naso-gastric tube and commence feeds at outset. If not tolerated early passage of Nasos -jejunal tube
- Dietetic support to optimise nutrition
- Consider peritoneal drain if ascites is compromising ventilation