Care of Burns in Scotland
National Managed Clinical Network

Guideline for Inhalation Injury in Burns Patients

ADULT GUIDELINE

Reviewed by Murray Geddes, March 2021;

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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.

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Guideline for Inhalation Injury

Inhalational injury comprises a spectrum of airway injury caused by thermal and toxic damage to respiratory tract mucosa from both the heat of the burn and exposure to gases and chemicals in smoke. Whilst traditionally seen as separate entities ('airway burn vs. smoke inhalation') the airway damage seen in patients with burn injuries tends to be of mixed aetiology and is best treated as such. Thermal damage to the deeper tracheobronchial tree is unusual outside of steam inhalation. Inhalational injury rarely occurs in the absence of facial burns except in very specific scenarios (such as inhaled hot foods, direct application of heat to airway, etc.). A pattern of predominantly toxic injury is seen more commonly following fires in enclosed spaces: smoke contains high levels of CO, CO_2, particulate matter and other chemicals. Whilst cyanide poisoning is no longer as common in the developed world as it used to be, it is still seen, especially if the fire involves synthetic furnishings (particularly polyurethanes and polyvinyls) and a high index of suspicion needs to be maintained. Toxic inhalation injury causes decreased conscious level at the time of the injury and subsequently causes lung injury and worsens the inflammatory consequences of burns. The combination of inhalational injury and burns increases mortality compared to burn injury alone.

Initial symptoms of inhalational injury include voice changes and hoarseness which may progress of stridor and airway obstruction.

Diagnosis

Inhalational injury should be suspected in a patient presenting with facial, perioral or nasal burns. Toxic injury should be suspected in fire victims who have a history of altered level of consciousness or were rescued from a fire in an enclosed space.

Voice changes, hoarseness and stridor should be regarded as indicating an upper airway injury and lead to further examination and intervention. Upper airway injury presents a significant management challenge and a patient with suspected upper airway burn should be immediately referred for intensive care or anaesthetic review.

All burn patients should have an arterial or venous blood sample analysed for carboxyhaemoglobin. Smoke inhalation should be diagnosed by the presence of an elevated carboxyhaemoglobin level: greater than 10% of total Haemoglobin is diagnostic. Routine bronchoscopy for the diagnosis of treatment is not recommended as there is not prospective study that demonstrates benefit. Although a retrospective study of a national database suggested a possible benefit of bronchoscopy, it did not show a significant mortality benefit. A well-designed prospective study is required before routine bronchoscopy can be recommended as a standard of care.

Treatment

Inhalational injury should be managed by clinician experienced in the management of difficult airways such as senior anaesthetic, critical care or emergency department doctors.

Unless there is a good reason not to, the airway should be rapidly secured with an uncut endotracheal tube. This should be the default prior to transfer to a burns unit. There is no single approach to intubation that can be recommended for all patients; choice will depend upon the clinical experience and skills of the clinician and the nature of the injury. Suxamethonium or Rocuronium are acceptable paralytic agents although Suxamethonium has the potential to cause a dangerous hyperkalaemic response if administered after 72 hours.

All patients should receive humidified high flow oxygen or be ventilated on 100% oxygen until the carboxyhaemoglobin is less than 10% of total Haemoglobin. Hyperbaric oxygen is impractical in the vast majority of cases. The administration of cyanide antidotes should be considered if the patient has suggestive clinical features such as:

1. History of fire in an enclosed space
2. Altered level of consciousness
3. Cardiovascular compromise out of keeping with the rest of their injury, particularly unexplained hypotension
4. High serum lactate level (especially above 10 mmol/l)

Hydroxocobalamin [Cyanokit ®] is the current first-line treatment in moderate-to-severe cyanide poisoning in the UK given its favourable safety profile compared to other agents.

All inhalational injury victims should receive routine thromboprophylaxis according to local hospital protocols.

All inhalational injury patients requiring invasive ventilation should be ventilated according to standard lung protection strategies.

Other treatment modalities:

Nebulised heparin

The evidence for administration of nebulised heparin is poor. Several studies using retrospective controls suggest both reduction in days ventilated and improvement in mortality. There has only been a single prospective and blinded trial. This does suggest a mortality benefit (RR 0.74, CI 0.55 – 0.99) although the numbers were small at 50 patients per group.

Our recommendation is that it would be reasonable to use nebulised heparin at the treating clinician's discretion at a dose of 5000 Units 4-hourly.

Nebulised NAC (N-acetyl-cysteine)

NAC is a potent mucolytic but also a potent bronchoconstrictor. The only randomised prospective trial of its use in humans with burn injury is the trial quoted above where it was co-administered with heparin. Again, our recommendation is that it would be reasonable to use together with nebulised heparin at clinician's discretion at a dose of 3ml of a 20% solution 4-hourly.

Bronchodilators

Any evidence of wheeze or bronchospasm in patients with an inhalational injury should be treated with nebulised bronchodilators as per local protocols.

More reading:

Smoke inhalation injury. Gill P and Martin R V. BJA Education. 15 (3): 143–148 (2015)

The utility of bronchoscopy after inhalation injury complicated by pneumonia in burn patients: results from the National Burn Repository. Carr JA, Phillips BD, Bowling WM. J Burn Care Res. 30 (6): 967-74 (2009)

Nebulized heparin for inhalation injury in burn patients: a systematic review and meta-analysis. Xiaodong Lan et al. Burns & Trauma, 2020, 8, tkaa015

Diagnosis and management of inhalation injury: an updated review. Walker PF et al. Crit Care. 19:351 (2015). doi: 10.1186/s13054-015-1077-4