Case Report

Inhalational burns in a choke hold

K. Ramasubramaniam*

Consultant and Interventional Pulmonologist, Kauvery Hospital, Tennur, Trichy, Tamil Nadu
*Correspondence

Abstract

Background: Inhalational injury is a major contributor to morbidity and mortality in patients with burn trauma. Resulting from the inhalation of hot gases, smoke, and toxic combustion products, it can involve the upper airway, lower respiratory tract, and cause systemic toxicity from gases such as carbon monoxide and cyanide. The presence of inhalation injury increases mortality two- to threefold compared to burns alone and significantly prolongs hospital stay. Early airway protection, high-flow humidified oxygen, and prompt bronchoscopic evaluation using the Abbreviated Injury Score (AIS) are critical components of management.

Key words: Abbreviated Injury Score (AIS); Total body surface area (TBSA); Inhalational burns; Acute respiratory distress syndrome (ARDS).

Citation: K. Ramasubramaniam. Inhalational burns in a choke hold. Kauverian Med J. 2026;3(8):37—42.

Academic Editor: Dr. Venkita S. Suresh

ISSN: 2584-1572 (Online)

1. Introduction

Inhalational burns, also referred to as inhalation injury, denote damage to the respiratory tract caused by inhaling thermal energy, smoke particles, and toxic gases—most commonly during enclosed-space fires. Approximately one-third of patients with significant cutaneous burns have associated inhalation injury. Its presence is one of the strongest predictors of mortality in burn patients, independent of total body surface area (TBSA) involvement.

Pulmonary complications following burns and inhalation injury account for a substantial proportion of burn-related deaths. The injury may affect the airway at multiple levels and can also result in systemic poisoning, placing the patient in a life-threatening "choke hold."

2. Types and Pathophysiology of Inhalational Injury

2.1. Thermal Injury – Upper Airway

Thermal injury primarily affects the oropharynx and larynx. Heat exposure leads to mucosal edema, hyperemia, and progressive airway narrowing. Because inhaled air cools rapidly, the lower airways are usually spared from direct thermal damage. However, progressive edema can result in sudden airway obstruction, often within the first 24 hours.

2.2. Chemical Injury – Lower Airway and Lung Parenchyma

Smoke inhalation causes chemical injury due to toxic gases and particulate matter. This results in:

- Airway inflammation
- Bronchospasm
- Increased capillary permeability
- Alveolar damage
- Sloughing of bronchial epithelium and fibrin cast formation may obstruct airways, leading to atelectasis and pneumonia. Severe injury can progress to acute respiratory distress syndrome (ARDS).

2.3. Systemic Toxicity

- Carbon monoxide (CO): Binds hemoglobin with high affinity, causing tissue hypoxia and neurological dysfunction.
- Cyanide: Impairs oxidative phosphorylation at the cellular level, leading to profound metabolic acidosis and early cardiovascular collapse.

3. Clinical Evidence and Diagnosis

Clinical suspicion is crucial, particularly in patients exposed to enclosed-space fires. Important indicators include:

- Loss of consciousness
- Facial burns
- Singed nasal hairs
- Hoarseness or voice change
- Carbonaceous sputum
- Wheeze, dyspnea
- Confusion or headache (suggestive of CO poisoning)

Presence of inhalational injury increases mortality 2–3 times compared with burns alone.

4. Abbreviated Injury Score (AIS)

- 5-point (0–4) grading system used during fiberoptic bronchoscopy to quantify airway damage, typically within 24–48 hours of injury
- It evaluates the presence of carbonaceous debris, edema, erythema, bronchorrhea, and obstruction/necrosis

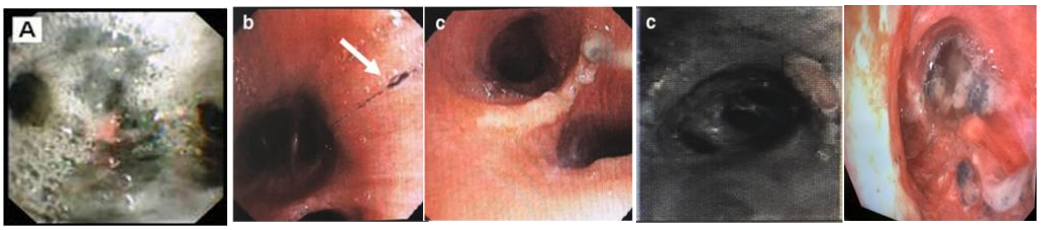
- Higher grades (3–4) associated with worse outcomes, including increased risks of pneumonia, ARDS, and prolonged mechanical ventilation.

5. AIS Bronchoscopy Grading Scale (0-4)

The Abbreviated Injury Score (AIS) is a 5-point grading system (0–4) used within 24–48 hours of injury. It evaluates erythema, edema, carbonaceous deposits, bronchorrhea, and necrosis.

Grade 0	Normal mucosa
Grade 1	Mild erythema or carbon deposits
Grade 2	Moderate inflammation and partial obstruction
Grade 3	Severe inflammation with friability and heavy deposits
Grade 4	Mucosal sloughing, necrosis, massive obstruction

Higher AIS grades correlate with poor oxygenation, increased pneumonia risk, prolonged mechanical ventilation, and higher mortality. However, grading remains subjective and operator dependent.



6. Limitations of AIS

Prognostic Value: Higher AIS grades (2–4) correlate with higher mortality rates, reduced oxygenation (PaO2/FiO2 ratio), and increased likelihood of mechanical ventilation.

Limitations: The AIS is based on the subjective, visual interpretation of the bronchoscopist, leading to potential variability in grading.

7. The Real Impact

The presence of smoke inhalation injury prolongs the length of hospital stay 2.5-fold compared to those without smoke inhalation injury (24 days vs. 10 days). Lipovy and Rihová found a 40% increase in mortality rate in severely burned patients with pneumonia, but if the pneumonia occurred in patients with inhalational injury the mortality rate went up to 60% and this could mean that pneumonia increased mortality of inhalation injury significantly. According to the American Burn Association Repository, inhalation injury is present in 17% of patients with flame burns and increases the overall mortality rate of these patients up to 24%, while the mortality of burn patients without inhalation injury is 3%.

8. Management

Immediate Management – Primary Survey (ABCDE)

A – Airway (Most Critical): Early endotracheal intubation is recommended if inhalation injury is suspected. Delay can result in catastrophic airway loss due to progressive edema.

B – Breathing: Administer 100% humidified oxygen immediately.

C – Circulation: Ensure hemodynamic stabilization and appropriate fluid resuscitation.

D – Disability: Assess neurological status, especially in suspected CO poisoning.

E – Exposure: Complete burn assessment and prevent hypothermia.

Specific Management

Carbon Monoxide Poisoning: 100% oxygen is needed, hyperbaric oxygen therapy should be initiated if the following symptoms noted COHb>25% (lower in pregnancy), Neurological symptoms, Cardiac ischemia, Pregnancy with COHb>15–20%

Cyanide Poisoning: Suspect in severe metabolic acidosis with elevated lactate following enclosed-space fire exposure.

Treatment

- Hydroxocobalamin (preferred)
- ± Sodium thiosulfate

Pulmonary Care: Goals include relieving bronchospasm, reducing secretions, and clearing fibrin casts and necrotic debris to prevent atelectasis and pneumonia.

Important reminders:

- Prophylactic antibiotics are not indicated.
- Routine corticosteroids offer no proven benefit.

9. Pharmacotherapy

- Bronchodilators: For bronchospasm
- N-acetylcysteine (NAC): 3 mL of 20% solution every 4 hours (may cause bronchoconstriction)
- Nebulized Heparin: 5,000–10,000 units in 3 mL normal saline every 4 hours

Reduces fibrin cast formation when combined with beta-agonists and mucolytics, reduces duration of mechanical ventilation and increases ventilator-free days.

10. Role of Bronchoscopy

Bronchoscopy plays a central role in inhalation burns:

- Early Bronchoscopy (6–24 hours):
- Confirms diagnosis
- Grades severity
- Guides airway management

Repeat Bronchoscopy (24–48 hours):

- Edema and necrosis peak
- Suctioning of soot and sloughed tissue

Subsequent Bronchoscopies (As Indicated):

- Persistent hypoxia
- Rising airway pressures
- Atelectasis
- Suspected infection
- Ventilator Strategy

Even if chest X-ray is normal, bronchoscopy is indicated when inhalation injury is suspected.

11. Monitoring for Complications

Pneumonia, ARDS, Fluid overload, Hypermetabolism and malnutrition, Sepsis and multi-organ failure, Prognostic Factors

Outcome depends on:

- Severity of inhalational injury
- Total body surface area (TBSA) burned
- Type of inhaled toxin

Need for mechanical ventilation

- PaO_2/FiO_2 ratio < 200
- High COHb levels
- Severe metabolic acidosis
- Delayed airway intervention
- Severe lower airway injury combined with >40–50% TBSA burns carries very high mortality.

12. Summary

Inhalational injury places burn patients in a critical "choke hold," significantly worsening outcomes through airway damage, parenchymal injury, and systemic toxicity. Early recognition, prompt airway protection, and aggressive pulmonary care are crucial. Bronchoscopy remains both diagnostic and therapeutic. Mucolytics and inhaled heparin play an important role, while steroids and antibiotics should be used only when clearly indicated. Vigilant monitoring and timely intervention for complications are key to improving survival.

13. Conclusion

Inhalational injury represents a critical and often underestimated determinant of outcome in burn patients. It affects not only the airway and lungs but may also cause life-threatening systemic toxicity. Early suspicion, prompt airway protection, and bronchoscopic evaluation are fundamental to management. A proactive and multidisciplinary approach remains the cornerstone for improving survival in patients caught in the "choke hold" of inhalational burns.