

Early Respiratory Intervention in Victims of Smoke Inhalation: Clinical Profile and Outcome

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Abstract

Objective: To evaluate the clinical profile, management, and outcomes of patients with inhalation injury following the Jay Bhawani building fire in Mumbai. **Design:** A retrospective observational study. **Subjects/Patients:** A total of 52 patients exposed to smoke inhalation, including 6 brought-in-dead cases, were studied following a residential high-rise fire on October 6, 2023. **Methods:** Patients were triaged and treated at a tertiary care hospital. Clinical data, investigations (CBC, ABG, COHb levels, renal function tests, chest X-rays), interventions, and outcomes were recorded. All patients received standardized therapy including oxygen, bronchodilators, steroids, and N-acetylcysteine. **Results:** Among 52 patients, 7 deaths occurred (12% mortality), all due to suffocation. Common symptoms included cough (77%), breathlessness (62%), wheeze (73%), and low oxygen saturation (50%). Respiratory failure was noted in 35 patients (Type 1: 58%; Type 2: 10%). Oxygen support was required in 67%, with only 3 needing invasive ventilation. 92% of patients were discharged. **Conclusion:** Early and aggressive management of inhalation injury, including oxygen therapy and supportive care, led to favorable outcomes. Efficient triage, timely intervention, and trained emergency personnel are essential. Future protocols should consider incorporating bronchoscopy and nebulized heparin to further improve outcomes.

Keywords: Inhalation Injury, Smoke Inhalation Injury, Respiratory Insufficiency, Fires, Emergency Medical Services.

Introduction

Inhalation injuries resulting from fire incidents are a major cause of morbidity and mortality in burn-related emergencies, often surpassing the direct effects of thermal burns. These injuries, caused by the inhalation of hot gases, smoke, and toxic combustion products, can lead to significant respiratory compromise, airway edema, and delayed pulmonary complications. Pulmonary

complications alone have been reported to account for up to 77% of fire-related deaths, emphasizing the critical need for early recognition and intervention. On the early morning of October 6, 2023, a devastating fire engulfed the Jay Bhawani building, a seven-storey Slum Rehabilitation Authority (SRA) residential high-rise in Goregaon West, Mumbai. The incident, which occurred around 3:00 a.m., resulted in seven fatalities including two minors and left 62 individuals injured. Notably, none of the deaths were attributed to

burn injuries; instead, all victims succumbed to smoke inhalation and subsequent suffocation, underscoring the lethal potential of inhalation injury even in the absence of direct thermal trauma. The building lacked a functional firefighting system, and rapid smoke spread during the early morning hours contributed significantly to the high rate of respiratory complications. This study presents clinical and observational data from patients affected by the Goregaon fire, aiming to assess the immediate respiratory complications, treatment modalities employed, and outcomes associated with inhalation injury in the absence of direct burns. Our findings highlight the critical role of early oxygen therapy, corticosteroids, and supportive respiratory care in reducing mortality. Additionally, this event raises urgent questions about urban fire safety protocols, the role of prehospital oxygen administration, and the need for functional firefighting systems in high-density residential settings. By analyzing this incident, we seek to contribute valuable insights into optimizing inhalation injury management and disaster preparedness in urban environments.

Materials and Methods

The aim of the study was to examine the clinical profile and outcome after standard treatment in inhalational injury. Patients were brought in by the fire department to a tertiary care centre in Mumbai. They were triaged as necessary and investigations like CBC, ABG, COHb levels, Renal function tests and Chest X-ray were conducted. The clinical profile, investigations, prognosis and overall outcome were recorded

Results

A total of 52 patients with inhalation injury were included in the study, of which 6 were brought in dead and 1 patient died within 8 hours of admission, resulting in an overall mortality rate of 12%. The remaining 48 patients (92%) were discharged, and 3 patients were transferred 2 to Kasturba Hospital and 1 to a private facility. The patient pool included 9 from Cooper Hospital and 43 from trauma cases. 12 of the documented cases were smokers, 6 were patients of Diabetes Mellitus and 8 of hypertension. Clinically, cough was present in 40 patients, with 30 of them having expectoration, and 22 patients exhibited carbonaceous sputum. Breathlessness was reported in 32 patients, 28 had tachypnoea, 26 showed low oxygen saturation on pulse oximetry, and 38 had wheeze on auscultation. Other clinical signs included hypotension in 5 patients, hoarseness of voice in 5, and superficial burns in 40 patients. Investigations revealed leukocytosis in 20 patients and elevated creatinine in 4. Chest X-ray infiltrates were noted in 15 cases. Respiratory failure was common, with Type 1 (hypoxia) seen in 30 patients and Type 2 (hypercarbia) in 5. Oxygen supplementation was required in 35 patients (67%), of whom 10 progressed to a non-rebreather mask (NRBM), 5 required continuous positive airway pressure (CPAP), and 3 needed invasive ventilation. Pulmonary complications following burns and inhalation injury are responsible for up to 77 percent of the deaths

All patients received broad-spectrum antibiotics, nasal oxygen, nebulized bronchodilators, steroids, and N-acetylcysteine (NAC). Chest physiotherapy and position changes were implemented for all patients. Those with wheeze and respiratory failure were also administered systemic steroids, while cough expectorants were provided to symptomatic patients. These interventions likely contributed to the relatively low mortality and high discharge rate observed in this cohort.

Discussion

Our study found a mortality rate of 12% among patients with inhalation injury (7 deaths out of 52 cases, including 6 brought-in-dead cases and 1 death within 8 hours). This is lower than previously reported studies, where mortality associated with inhalation injuries has ranged from 30–77%, depending on the severity and presence of associated burns. Ryan *et al.* [1] estimated higher mortality rates in burn patients with inhalation injury, using an objective scoring system to predict death risk. Their findings emphasize that burn size, age, and inhalation injury are the strongest predictors of mortality. Compared to this, our study observed better survival rates, likely due to early oxygen therapy, steroid use, and aggressive airway management. Dyamenahalli *et al.* [2] reinforced the Modified Baux Score, which adds 17 points for inhalation injury. If applied to our study, the score would predict a higher mortality rate than what was actually observed, suggesting that our treatment interventions may have improved survival beyond traditional expectations. Our study found that 67% of patients (35/52) required oxygen supplementation, with: 10 progressing to NRBM (Non-Rebreather Mask), 5 requiring CPAP, and 3 needing invasive ventilation. In contrast, Gupta *et al.* [3] reported that early ventilatory support was necessary in a larger proportion of patients with severe inhalation injury, particularly those with carbon monoxide poisoning or airway edema. Our lower intubation rates suggest that early use of steroids, bronchodilators, and N-acetylcysteine (NAC) may have prevented progression to invasive ventilation. Galeiras *et al.* [4] emphasized the importance of early airway management and mechanical ventilation, particularly in patients with carbonaceous sputum and hypoxia. In our study, only 3 patients required invasive ventilation, suggesting that our treatment approach may have effectively reduced the need for intubation.

Our study did not use nebulized heparin, but all patients received nebulized bronchodilators and NAC. Lan *et al.* [5] conducted a systematic review and meta-analysis, demonstrating that nebulized heparin reduced mortality and improved oxygenation in inhalation injury patients. Since our study had a lower-than-expected mortality rate without nebulized heparin, it raises an interesting question: Could adding nebulized heparin further improve survival and reduce oxygen dependence? Desai *et al.* [6] found that aerosolized heparin and NAC significantly reduced mortality in pediatric inhalation injury cases. Given our adult-focused study, further research could explore whether a similar protocol improves adult outcomes. In our study, diagnosis was based on clinical symptoms and imaging (chest X-rays showing infiltrates in 15 cases). However, studies suggest that bronchoscopy plays a vital role in assessing severity: Gupta *et al.* [3] and Dyamenahalli *et al.* [2] highlight that bronchoscopic grading of inhalation injury helps predict disease progression. Our study did not utilize bronchoscopy, but adding it could help refine risk stratification and optimize treatment decisions. Lan *et al.* [5] also emphasized bronchoscopy's ability to assess fibrin cast formation in the airways, which could guide decisions on nebulized heparin therapy.

Our study reported Type 1 Respiratory Failure (Hypoxia) in 30 patients (58%) and Type 2 Respiratory Failure (Hypercarbia) in 5 patients (10%). Similar findings were reported in Galeiras *et al.* [4], who stated that hypoxia is common in inhalation injury patients and that failure to correct hypoxia early correlates with poor outcomes. Lan *et al.* [5] found that patients receiving nebulized heparin had lower rates of respiratory failure, suggesting that adding this therapy to our protocol might reduce hypoxia-related complications. Our study reported 48 out of 52 patients were discharged (92%), 2 were transferred to other hospitals, and 1 in-hospital death occurred within

8 hours. Compared to existing studies, Ryan *et al.* [1] found that patients with severe inhalation injury had significantly lower discharge rates due to prolonged hospital stays and respiratory complications. Our study's high discharge rate suggests effective early management strategies. Desai *et al.* [6] noted that patients receiving nebulized heparin/NAC therapy had higher survival and discharge rates. Since our study used NAC but not nebulized heparin, this raises the question: Would our discharge rates improve even further if nebulized heparin was included in treatment? Our study presents promising survival outcomes with early intervention and oxygen therapy. However, incorporating nebulized heparin and bronchoscopy could further optimize patient care. Future clinical trials should explore these interventions to refine inhalational injury management protocols.

Conclusion

Our study demonstrates that early and aggressive management—including prompt oxygen therapy, steroid use, bronchodilators, and N-acetylcysteine—can significantly improve outcomes in patients with inhalation injury, as reflected by a lower-than-expected mortality rate and high discharge rate. The relatively low need for invasive ventilation further supports the effectiveness of our treatment protocol. Pulmonary complications following burns and inhalation injury are known to account for up to 77% of deaths, and carbon monoxide poisoning should be presumed in any patient presenting after smoke inhalation. Therefore, proper airway management is critical, and early intubation is justified in patients with suspected inhalation injury and signs of respiratory distress. Our findings highlight the importance of raising awareness about inhalation injury as a leading cause of death following fire accidents. Efficient triage, early nasal oxygen administration, and timely escalation of oxygen delivery and ventilation are essential steps in improving survival. Furthermore, training paramedical personnel to initiate oxygen therapy during rescue and transport can play a crucial role in reducing morbidity and mortality. Although we did not utilize nebulized heparin or bronchoscopy in this study, existing literature suggests these interventions may offer additional benefits. Future research should explore their role in optimizing management strategies for inhalation injuries.

Declarations

Human subjects

Consent for treatment and open access publication was obtained or waived by all participants in this study. HBT Medical College and Dr. R N Cooper Municipal General Hospital approval EC/96/2023. The IEC-II hereby approves the proposal entitled Protocol version no. 1.3 "Early Respiratory Intervention in Victims of Smoke Inhalation - Clinical profile and outcome".

Animal subjects

All authors have confirmed that this study did not involve animal subjects or tissue.

Conflicts of interest

None

Payment/services info

All authors have declared that no financial support was received from any organization for the submitted work.

Financial relationships

All authors have declared that they have no financial relationships at present or within the previous three years 9 of 10 with any organizations that might have an interest in the submitted work.

Other relationships

All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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