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## CASE REPORT

### Fatal Laryngeal Oedema in Cases of Burns: An Evaluation of Inhalational Injuries

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#### ABSTRACT

The present case, reports the cause of death of a 45-year-old male victim of fire incident. Autopsy findings reveal gross laryngeal oedema with narrowing of the air passage. The burn injuries involved about 8 % of the total body surface area. The person suffered from inhalation injuries along with burn injuries. Inhalational injuries are not easy to diagnose and a clear suspicion of their presence plays a significant role in determining the survival of burn patient. A thorough literature review brought forth the fact that laryngeal oedema and inhalational injuries can be a delayed complication of burn injury and timely intubation could save patient's life. Incidence of laryngeal oedema, clinical features of inhalational injuries and priorities in inhalational injuries research are discussed in the paper with review of literature.

**Keywords:** Laryngeal oedema; Burn injuries; Autopsy.

## Introduction

Laryngeal oedema can result from various causes like inhalation of flame or irritant gases, infections, anaphylactic reactions, tumours, foreign bodies etc. The morbidity and mortality increase when burn injury is associated with smoke inhalation as mentioned in literature. Following burns involving the face and neck, a person may develop laryngeal oedema presenting with hoarseness and stridor. External oedema in such cases may be minimal but the airway oedema may be massive. Some highly water-soluble gases like sulphur dioxide, ammonia and hydrogen chloride react with water in the mucous membranes of the upper airway. This produces strong acids and alkalis leading to irritation, ulceration and oedema of the mucosal surface. Laryngeal oedema is a usual presentation in such cases. Laryngeal oedema may also occur as part of generalized oedema with large body surface area burns > 40%.

Laryngeal oedema is one type of inhalational injury. As per an epidemiological study conducted by Khan Z et al<sup>1</sup>, a diagnosis of inhalational injury was made in 35.3 percent of total burn cases in five years. However, 95.7 percent of patient having facial burns had inhalational injury diagnosed either by bronchoscopy or xenon lung scan.

Inhalation injury may be described as respiratory trauma caused by inhalation of thermal or chemical irritants<sup>2</sup>. For practical purposes inhalation injury has been divided into different phases: 1) injury caused at the site of the fire as the result of noxious gases 2) upper airway heat injury and 3) lower airway chemical injury. Each aspect of inhalation injury has a different pathophysiology, treatment, and long-term implications.<sup>3</sup>

Clark W et al defined inhalational injury as airway or pulmonary parenchymal injury resulting from the inhalation of toxic combustion products, which presents with a wide range of severity in patients with and without skin burns<sup>4</sup>.

In patients with severe injuries, the diagnosis is obvious on the basis of the history and clinical presentation; in patients with less severe injuries or those in whom the clinical consequences are delayed, diagnostic precision is difficult.

## Case Report

The present case is concerned with the death of a 45-year-old male due to the complications of burn injuries. The patient belonged to a rural area. The man was the victim of the flame of a stove while cooking in his house. A medico-legal report was prepared at the peripheral health centre mentioning superficial burns over the face approx. 10% and admitted for further management. For the initial 36 hours, the patient was hemodynamically stable following which his treatment records revealed that he had a pulse of 120/min. blood pressure 90/70 mm Hg, cyanosis, dehydration, cold clammy skin and chest crepitations. He was given IV fluids and IV antibiotics along with a dressing for the burns. The patient was then referred to the nearest higher centre. He was received dead in the casualty of the medical college hospital so no further treatment like direct tracheal intubation or tracheostomy could be done. The treatment records and the history given by the relatives suggested that the person died after about 2 days after the incident. Autopsy of the body was conducted the next day after his death.

On examination, his beard, moustache and hairs over the bilateral temporal region were found singed. Superficial to deep burns were present at places over the face involving bilateral ears, palmar and dorsal aspect of both hands. (Fig 1 and 2) The base of the burnt area was yellowish-green. Unhealthy granulation tissue was present over the burnt surface area at places. Multiple foul-smelling yellowish-green pus points were present over the burnt surface at places. The burn injuries involved about 8 % of the body surface area and were superficial dermo-epidermal burns. The internal examination revealed gross swelling and oedema of the larynx involving the epiglottis and the vocal cords with narrowing of the air passage. (Fig 3 and 4) The heart was intact with fluid blood in the right side chamber. All other internal organs were intact and congested. The stomach contained some semi-digested food without any specific odour. The cause of death, in this case, is burn injury described and its complications.



Figure 1



Figure 2



Figure 3

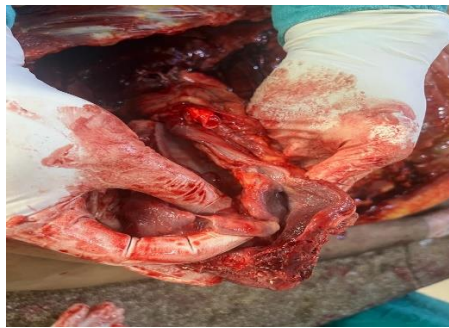


Figure 4

### Discussion

The incident occurred in a closed room from the flame of a stove and the person died within few hours. The burns involved about 8 % of the body surface area, mostly confined to face. There was singeing of nostril hairs and oedema of larynx. All the above facts indicate that the person suffered from inhalation injuries along with burns. In a retrospective study done by Madnani et al<sup>5</sup>, they concluded that patients with soot in the oral cavity, facial burns and/or body burns should be monitored closely because these findings indicate a higher likelihood of laryngeal oedema and the need for intubation. Barin Bose's management of burns has highlighted that if there is a burn around the nose and mouth, the possibility of flame inhalation must be considered<sup>6</sup>. Laryngeal oedema can develop rapidly and lung function may deteriorate. The oedema of the larynx involving epiglottis and vocal cords correlated well with the findings in burns and scalds as mentioned by B. B. Ong<sup>7</sup>. The proportion of inhalation injuries in burn victims is known to be quite high and found in about 20% of admissions to burn centres.

Dry heat does not penetrate easily and is limited to the oropharynx and upper airway. Toon et al<sup>8</sup>. concluded in their work, that thermal injury below the vocal cords is rare because of effective heat dissipation in the upper airway. The person in our case study died after almost 48 hours of the incident

just as opposite of which was mentioned by Heimbach and Waeckerle<sup>9</sup> in their work that thermal burns occurring in the upper airway are usually manifested within 24 hours of injury. Diagnosis is made by direct visualization of the upper airway, looking for signs of thermal injury. Blinn et al<sup>10</sup>. in their research stated, estimating the severity of inhalation injury is difficult, as signs of respiratory failure may occur hours or even days after the injury. One should also be careful in judging the cause of laryngeal oedema as it can occur in patients intubated for 4 days or more as concluded by Bastiaan H. J. Wittekemp et al<sup>11</sup> in their research study. In such cases ulceration and granular tissue are found mostly posterior to the level of vocal cords.

Cheng et al<sup>12</sup> in their study of burns found that severe laryngeal burns could manifest as severe laryngeal oedema or atrophic changes. The treatment of thermal burns with inhalation injuries needs meticulous intervention. Clark<sup>4</sup> in his work concluded that the mortality rate of smoke inhalation victims without a burn is < 10% and with a burn is 30% to 50%, suggesting that thermal injury or its treatment is responsible for further lung damage. Ziyad Alharbi and others in their work suggested that in burn injuries early recognition of airway compromise followed by prompt intubation can be live saving. If there is soot in the mouth consider early intubation even if the patient is

breathing normally. Blinn et al<sup>10</sup>. and co-workers mentioned that patients with as little as 15% total body surface burns with mild smoke inhalation are at significant risk of respiratory failure and the need for ventilator support but in our case the burn surface area was 8%.

Cancio et al<sup>13</sup>. has stated smoke inhalation injury to be a unique form of acute lung injury that greatly increases the occurrence of post burn morbidity and mortality. In addition to early intubation for upper airway protection, subsequent critical care of patients who have this injury should be directed at maintaining distal airway patency. In cases of burn injuries, even if the percent of body surface area involvement is less, one should be careful to identify inhalation injuries. Laryngeal oedema most often presents as laryngeal stridor and may be associated with respiratory failure due to airway obstruction. Endotracheal intubation can be life saving in such cases.

### **Conclusion**

The most significant fatality determining factor in a patient of burn is the affected part of the body rather than the total burnt surface area. Inhalational injury cannot be only the immediate complication but can also be a delayed manifestation of burn as we encountered in our case. It can be of different presentations ranging from supraglottic insult to

systemic and parenchymal injury of the lung. Therefore, a patient with facial burns should be under continuous observation for any sign or symptom of respiratory distress to rule out inhalation so that timely intubation/Tracheostomy can be done.

### **How to prevent it?**

Providing 100 per cent O<sub>2</sub> to the patient at the site of fire incidence so that the hypoxia due to inhaled toxic gases can be minimised.

Examination for nasal/facial burns and presence of soot in mouth or nostrils.

Early clinical diagnosis of inhalational injury.

Timely intubation/Tracheostomy once the inhalational injury is suspected.

### **Priorities In Inhalational Injuries Research**

Research in defining the diagnostic criteria and to develop a universally applicable grading system of inhalational injury.

Grading the extent of laryngeal edema in relation to the fatality.

Developing the standard operating procedures and treatment guidelines.

Assess and improve long-term outcomes (physical, functional, psychological).

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