Upper Aerodigestive Tract Burn: A Case Report of Firework Injury

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Abstract

The case of a 46 year-old German man with upper aerodigestive burn by firework was reported. He presented with the symptoms and signs of upper airway obstruction. Tracheostomy was done and direct laryngoscopy with microscopic examination revealed swelling and denudation of the mucosa of the oral cavity and supraglottic area. Intravenous steroids and antibiotics were administrated for treatment. It is suggested that proper management needs an understanding of the mechanism and effect of the corrosive agent. Careful airway management resulted in a good outcome in this patient.

Key word : Burn, Firework, Potassium Nitrate (KNO_3)

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Burn injuries of the upper aerodigestive tract usually result from the inhalation of hot or volatile gases and ingestion of hot food or chemicals. In addition to these common etiologies, firework injury is rarely encountered in clinical practice. We report herein a case of severe burn of the upper air and food passage caused by the explosion of a firework in the mouth. Symptoms, signs, first aid and definitive management were discussed. To the best of our knowledge this is the only reported case of the entity.

CASE REPORT

A 46 year-old German man presented at the emergency department with dyspnea of one hour's duration following a firework bursting into his oral cavity. He had held the firework in his mouth during his artistic play, unfortunately, he

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wrongly placed the bursting side directly into his oral cavity. The firework thus exploded into his mouth. He then went to a private clinic nearby and was treated with an antibiotic and antiseptic spray. Six hours later, he became worse and had difficulty in breathing, resulting from a gradual swelling of the oral mucosa. When he came to the emergency department of our hospital, he was dyspnic and had stridorous breathing when lying down. The respiratory rate, pulse rate, body temperature, blood pressure was 20/minute, 100/minute, 37.5 degree Celsius, 110/70 mmHg. respectively. Physical examination revealed a drooling of saliva, erythema and swelling with bleb at the uvula, soft palate, tongue and lower lip. Fiberoptic flexible laryngoscope (FOL) demonstrated a swollen uvula and enormaously enlarged and inflamed epiglottis with petichial hemorrhage. The glottic chink and vocal cords were obscured and could not be identified. The lateral neck roentgenogram showed an increase of soft tissue density at the supraglottic area.

An initial diagnosis of oropharyngeal thermal burn with upper airway obstruction was made and the patient was immediately taken to the operation room for an emergency tracheostomy. He was admitted to the ENT ward for close observation and further investigations. The next morning, he underwent direct laryngoscopy, bronchoscopy and esophagoscopy, which revealed edematous and injection of the buccal mucosa and soft palate. The oropharynx also revealed swelling and denudation of the mucosa. The supraglottic area including the false vocal cords and arytenoids were swollen and the obscured true vocal cords were grossly edematous (Fig. 1). However, the subglottis was normal. A nasogastric tube feeding was put in place.

The patient was conservatively treated by intravenous corticosteroid and antibiotic therapy. amoxycillin with clavulanic acid 1.2 g and dexamethasone 5 mg were administered four times daily. Intravenous gentamycin 160 mg was also used twice daily. Adequate hydration and calories *via* an intravenous line and feeding tube were monitored. In the second half of the first week, painful swallowing and speaking had gradually reduced. The antibiotics were switched to amoxycillin and clavulanic acid (375) in oral form four times daily and 30 mg of prednisolone was administered daily. In the second week, the pain subsided, the burned mucosa had healed and swollen edematous mucosa returned to normal. The patient could speak and ingest well. Nasogastric feeding tube and tracheostomy tube were withdrawn. The patient was discharged at the end of the second week without any complication. The patient was healthy with a good quality of life at least one year post injury.

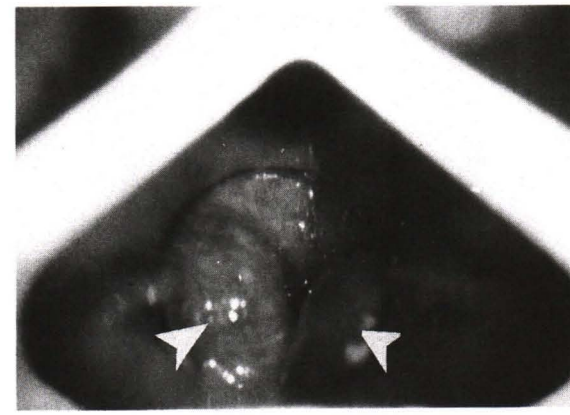

Fig. 1. Laryngoscopic exam showed swelling and edema of supraglottic and glottic area. Both arythenoid (arrow head) revealed marked swelling and injection.

DISCUSSION

The most common cause of head and neck burns is thermal injury by flame[1], but inhaled toxic gases that are the incomplete products of combustion can cause inhalation injury in burn victims and firefighters. Certain irritant gases (such as carbon monoxide) have a direct effect on the lower respiratory tract and gas exchange system[2]. The subglottic airway is injured less commonly than the glottic region because the vocal cords are the main anatomical barrier to the passage of fumes, heat or gases into the trachea. The classic diagnostic criteria for evaluation of an inhalation injury includes the burn sustained in a closed space involving the face, singed nasal vibrissae[3,7]. Eighty seven per cent of burns in the respiratory tract are closely related to respiratory difficulty, and mortality is associated with second and third degree burns[4].

Fig. 2. The traditional firework; the proximal end with thread (arrow), the distal end (arrow head) which is the bursting site.

A firework (Fig. 2) is composed of potassium nitrate (KNO_3) wrapped by hard paper and a thread is used for initiation of the combustion (Fig. 2). KNO_3 is a transparent, colorless or white crystalline powder or crystals, slightly hygroscopic with a specific gravity of 2.1062, melting point of 337° celsius and decomposes at about 400° celsius. It is used in pyrotechnics, explosives, matches and for preservation of pickled meat. It is a fire hazard and dangerous when in contact with organic materials causing violent combustion or ignition[5,6].

Injury from a firework actually is the result of external burn by heat or chemical reaction. In this case the patient accidentally pointed the explosive end into his mouth, so the heat, chemicals and explosive force could easily injure the oral cavity and upper aerodigestive tract.

Immediately post injury, the authors could not get any information about physical signs of the upper airway, but it was assumed that the findings might not be serious, so he was treated with only an oral antibiotic and oral soothing drug. As time went on, the injured mucosa was more inflamed and edematous. The clinical symptoms and physical signs became more obvious and worse. He presented with upper airway obstruction. The physical examination showed inflammation of the oral cavity, oropharynx and epiglottis, which can be graded into three groups based on the endoscopic examination. Grade I injury includes mucosal edema, erythema hyperemia, or superficial erosions that extend to the muscularis mucosa. Grade II injuries are exudative, with blisters or frank hemorrhage, and extend through the submucosa into the underlying muscular layer. Grade III injuries have extensive ulceration into the muscle layer, have eccentric hemorrhage with gray or black coagulative nicresis, show proximal luminal dilation with atonic muscles or have perforation with mediastinitis or peritonitis[7-9]. In this case, it was indicated that the firework injury had extended beyond the oropharynx. Occasionally thermal and chemical steam can injure the larynx, trachea or other lower respiratory tracts[10,11]. In this situation, tracheostomy is preferred rather than endotracheal intubation to avoid further trauma to the larynx and to prevent pulmonary insufficiency[13]. However, Robert et al reported a satisfactory upper airway control in 11 severe oral and facial burns and in smoke inhalation by endotracheal intubation[13]. In some cases of severe respiratory burn, the patients may need positive pressure ventilation and humidified oxygen[3]. In the reported case, although, the supraglottic and glottic structure were severely injured, the subglottic area was spared, this could be explained by the protective mechanism of the larynx. The explosive pressure was not high enough to overcome the adductor muscle, and also the exposure time was short.

Within the first 24 to 48 hours following contact of a chemical agent, the initial inflammatory phase of erythema, edema, and ulceration is seen[14]. Tracheostomy is needed to maintain the airway. The initial chest X-ray may be unremarkable in the majority of cases. Laryngoscopic and bronchoscopic examinations provide more information about degree of injury and extension of pathology. Recent studies have shown that the use of ^{133}Xenon lung scans permits the early diagnosis of inhalation injury by identification of an impaired ventilatory removal of radio-

active gas[15]. Serial X-rays of the lung show return of scintillation to background level within 90 seconds and uniform and equal scintillation density throughout the examination, but it can produce a false negative in pre-existing chronic bronchitis.

Treatment is determined by the severity of injury and respiratory disability. In those patients with mild disease, conservative treatment by encouragement of coughing, humidification of inspired air, and intermittent positive pressure breathing are utilized. For more severe cases, bronchodilator and mucolytic agents are considered. Frequent suction of secretion is necessary. As ulcers in the oral cavity, oropharynx and endobronchial area are susceptible to bacterial infection, periodic cultures of the necrotic tissue and specific antibiotics are recommended.

The role of corticosteroids remains controversial. Some authors have used steroids in transmucosal (grade 2) injuries, for prevention of strictures that occur more often in the transmural than in the superficial (grade 1) injuries[7,8]. However, they must be used for a brief period because of the high risk of infection and acute upper gastrointestinal ulceration in the patient, as well as increased pulmonary edema[3]. Robinson et al (1982) indicated that steroids have no positive influence upon pulmonary related morbidity and mortality following smoke inhalation[16]. Moylan (1978), in a randomized prospective trial, documented a fourfold-increased mortality in the steroid treated group, presumably secondary to steroid immunosuppression and decreased tracheobronchial clearance mechanisms [17]. In the presented case, a short course, high dose steroid for reducing the inflammation and edema of mucosa, in order to prevent stricture of the mucosal injuries in oropharynx, supraglottic and glottic area was used. The patient recovered well without any complication either from the steroid or from the injury.

SUMMARY

Accidental airway injury from a firework is very rare. The authors described a 46-year old German man suffering from a severe burn and edema of the upper aerodigestive tract resulting from explosion of a firework directly put into his mouth. The subglottic area was spared, probably from the protective mechanism of the vocal folds. The combination of heat, chemicals and explosive pressure play a major role in this type of injury. Proper management needs an understanding of the mechanism and effect of all agents. Airway management and looking for other associated injuries of adjacent structures are essential. Antibiotic therapy is useful for bacterial eradication. The use of steroids is controversial but is of great benefit in cases with secondary edematous mucosa, such as in this case. However, a short administration with watchful monitoring is acceptable.

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แผลไหม้ของระบบทางเดินหายใจส่วนบน : รายงานผู้ป่วยอุบัติเหตุจากประทัด

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แผลไหม้ของระบบทางเดินหายใจมักเกิดจากอุบัติเหตุไฟไหม้ในสถานที่ที่ไม่มีการระบายของอากาศ ผู้ป่วยจะได้รับผลของความร้อนของก๊าซพิษของผลจากการเผาไหม้ แผลไหม้ที่เกิดจากประทัด มักพบตามอวัยวะภายนอกทั่วไป รายงานนี้กล่าวถึงผู้ป่วยชาวเยอรมันที่มีแผลไหม้ของระบบทางเดินหายใจส่วนบนจากประทัด เนื่องจากอุบัติเหตุจากการแสดงด้านศิลปะ และได้มารับการรักษาที่โรงพยาบาลจุฬาลงกรณ์ ด้วยอาการหายใจลำบาก

ผู้ป่วยได้รับการตรวจด้วยกล้องตรวจสายเสียง (laryngoscope) กล้องตรวจดูหลอดลม (bronchoscope) และกล้องตรวจหลอดอาหาร (esophagoscope) ผู้ป่วยมีแผลไหม้ระดับหนึ่งและสองของช่องปาก ลำคอ (pharynx) และกล่องเสียงส่วนบน (supraglottic area) แต่ในส่วนของกล่องเสียงส่วนล่าง (subglottic area) ปกติผู้ป่วยได้รับการดูแลโดยการเจาะคอช่วยหายใจ ได้รับยาปฏิชีวนะ ยาลดบวมประเภทสเตียรอยด์ (steroid) ทางเส้นเลือด และให้อาหารทางสายยางผ่านจมูก (Nasogastric tube) ผู้ป่วยมีอาการดีขึ้นในปลายสัปดาห์แรก หลังการรักษาและหายดีในสัปดาห์ที่ 2

รายงานนี้ยังกล่าวถึงคุณสมบัติสารโปแตสเซี่ยมไนเตรด (KNO_3) ซึ่งเป็นส่วนประกอบของประทัด

คำสำคัญ : แผลไหม้, ประทัด, โปรแตสเซี่ยมไนเตรด

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