"Hot Stuff!"

DALHOUSIE UNIVERSITY
Inspiring Minds

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Figure 1: Facial Burns

David's Case

David, a 26-year-old male, presents to the ED via ambulance with burns to his face (figure 1), neck, left upper chest, and circumferential burns to both hands and forearms (figure 2). He had been sitting approximately five feet from a campfire, when an unknown accelerant was added to the fire and subsequently exploded in his face. He had been dressed in a tank top, two t-shirts and jeans. The shirts were cut off by paramedics on-scene.

In the ED he is alert and oriented, with a Glasgow Coma Scale (GCS) of 15. Breathing is unlaboured, with a respiratory rate of 20 per minute. The rest of his vital signs are normal. His lips are burned and peeling and his eyebrows and eyelashes are singed. There is soot in the nares, which does not extend into the posterior oropharynx. His voice is normal and he denies any shortness of breath or dysphagia. Direct laryngoscopy under topical anesthesia reveals no evidence of airway burns; the epiglottis and vocal cords are easily visible and there is no carbonaceous sputum. His chest is clear, with no stridor. His past medical history is unremarkable.

Read on for more on David.

Questions and Answers

1. How do we categorize the severity of burns?

Burns are classified as first degree, second degree (superficial or deep) and third degree depending on the extent of the burn. First degree burns are superficial and involve the epidermis only. They present as painful, dry, red areas that do not form blisters (*e.g.* sunburn) which resolve within 48 to 72 hours. Second degree burns are partial in thickness, involving the epidermis and varying levels of dermis. They are painful, swollen and mottled areas with blisters and open, weeping surfaces. Superficial second degree burns involve the epidermis and upper third of the dermis. They typically heal within two weeks, often without scarring. However, deep second degree burns extend further into the dermis, leaving fewer viable epidermal cells. These wounds require months to heal and result in dense scarring if the wound heals primarily (*i.e.*, if left alone to heal). Third degree burns are "full thickness" burns, involving the entire epidermis and dermis. They present as painless, swollen, dry, "waxy", or "leathery" areas that do not heal without debridement and skin grafting. Burns are sometimes described as "fourth degree" if they involve underlying fat, bone, muscle, and tendons.

The percent total body surface area (% TBSA) is a way of measuring further the level of burn severity, accounting for all areas of the body affected by second and third degree burns. Estimation of the % TBSA can be done using the Rule of Nines or Rule of Palm (the surface area of the patient's palm excluding fingers is approximately 1% of TBSA). A more accurate, but

time-consuming, estimation can be made using the Lund & Browder charts, which are used by most burn units.

2. What is the initial management of facial burns in the Emergency Department?

Management of burn patients should begin with ATLS protocol, and assessment of the ABCDEs (airway, breathing, circulation, disability, exposure/environment). Special attention should be paid to ensure that other injuries sustained during the incident are not missed because of the distractive power of severe burns. In-line cervical immobilization should be considered when the mechanism suggests the possibility of a c-spine injury, (*e.g.* in cases where the burn follows an explosion in which the patient was thrown). Adequate pain control should also be addressed. Patients with burns greater than 10% TBSA or deeper than superficial partial thickness should be given tetanus toxoid. Dry, sterile dressings should be employed on burn wounds, however, prophylactic antibiotics are not recommended.

Airway

It is imperative to evaluate the risk of progressive airway failure in patients with facial burns, and to maintain a low threshold for intubation. Indicators of inhalation injury are shown in Table 1. The consequences of inhalation injury include upper airway edema, bronchospasm, small airway occlusion, increased dead-space and intrapulmonary shunting, decreased lung and chest wall compliance, and infection. A suspected inhalation injury requires emergent intubation due to impending airway edema. Failure to recognize the gravity of inhalation injury can result in total obstruction of the airway as a result of progressive edema. Delay in obtaining a definitive airway may also result in the eventual intubation becoming far more difficult, as the airway edema progresses.

Breathing

Check for bilateral breath sounds, and ensure adequate respirations by the patient, providing assistance if necessary. If there is burn eschar encircling the chest, an escharotomy is indicated to relieve constriction. 100% O_2 via Non-Rebreather (NRB) mask should be administered immediately if smoke inhalation and carbon monoxide poisoning are suspected, until carboxyhemoglobin on Arterial Blood Gas (ABG) is less than 10%; remember that a carbon monoxide level of greater than 60% is associated with 50% mortality.

Smoke inhalation leading to pulmonary injury carries a risk of pulmonary insufficiency (up to 48 hrs) and pulmonary edema (48 to 72 hours). Secondary bronchopneumonia (3 to 25 days), may occur due to the loss of ciliary clearance mechanism, small airway occlusion, alveolar flooding, and in association with endotracheal intubation.

Circulation

"Burn shock" refers to the loss of fluid from intravascular space as a result of burn injury, which causes "leaking capillaries" and "third spacing" that requires crystalloid infusion. Fluid resuscitation is the mainstay of treatment for second and third degree burns covering more than 10% TBSA, and therefore two large bore IVs should be started. Fluid requirements (beyond regular maintenance fluid) for the first 24 hours are estimated using the Parkland formula:

Table 1
Indicators of inhalation injury/smoke inhalation

- Facial burn
- Singed nasal/facial hair
- Soot and smoke in nares/oral cavity/sputum
- Throat/mouth erythema
- History of loss of consciouness/explosion/fire in small enclosed space
- Voice hoarseness
- Conjunctivitis
- Tachypnea, dyspnea
- Low O_2 saturation
- Carboxyhemoglobin
- Confusion
- Headache
- Coma

24 hour volume requirement = 4 cc Ringer's Lactate (RL) x weight in kg x % TBSA

Appropriate laboratory tests include: Complete Blood Count (CBC), electrolytes, urea, creatinine, International Normalized Ratio (INR), partial thromboplatin time (PTT), and type & screen, and arterial blood gas, including carboxyhemoglobin levels.

Disability

Use the Glasgow Coma Scale (GCS) or Alert Verbal Painful Unresponsive (AVPU) methods for assessing level of consciousness. Check for eschar and compartment syndromes. Look for further trauma that may have been sustained. Assess ocular involvement using Fluorescein and look for corneal clouding. Consider an ophthalmology consult if necessary.

Exposure

Remove all clothing and jewelry, and perform a log roll to assess the extent of burns and concomitant injuries. Estimate the % TBSA. Use dry sheets, blankets, or a forced-air warming system to keep the patient warm.

Figure 2: Burned Hand

3. *What about pain control?*

Burns are associated with significant pain; intravenous morphine or fentanyl, titrated to effect, should be started early and continued as needed. Topical oral analgesics, such as lidocaine, may be employed for airway injuries, and to facilitate direct laryngoscopy on the awake patient. For most patients, an oral narcotic medication administered 30 to 60 minutes prior to a planned dressing change provides adequate pain control later in their care.

4. *Where should he go from the ED?*

Significant facial burns should be managed in a burn unit (criteria for transfer to a Burn Unit are shown in Table 2). Care will focus on surgical debridement of necrotic tissue, and skin grafting of second and third degree burns. Escharotomy or fasciotomy will also be per-

Table 2
Transfer to Burn Unit Criteria

- Total 2° and 3° burns > 10% TBSA in patients <10 or >50 years of age
- Total 2° and 3° burns > 20% TBSA patients any age
- 3° burns/full thickness > 5% TBSA in patients any age
- 2° or 3° burns posing a serious threat of functional or cosmetic impairment (i.e. circumferential burns, burns to face, hands, feet, genitalia, perineum, major joints)
- Inhalation injury (may lead to respiratory distress)
- Electrical burns, including lightning (internal injury underestimated by TBSA)
- Chemical burns posing a serious threat of functional or cosmetic impairment
- Burns associated with major trauma/serious illness

formed on any circumferential burns if there is any concern of poor distal circulation or compartment syndrome. Regular dressing changes (q.d., or b.i.d.) with sterile dressings and topical antimicrobials will be done to prevent infection of the burn wounds. Ongoing nutrition is also a priority, as metabolism is increased in burn patients; patients with burns over 40% TBSA have basal metabolic rates 2 to 2.5 times greater than predicted.

David's case cont'd

Because he required transfer to a burn unit by Emergency Health Services (EHS), it was decided that David required prophylactic intubation. A limited examination of his airway using a laryngoscope suggested no immediate danger, so the intubation was delayed until the arrival of an anesthesiologist who performed the intubation using a fibreoptic bronchoscope under topical anesthesia and minimal sedation.

David's burns were assessed to cover approximately 12% of his Total Body Surface Area (TBSA). His fluid requirements were calculated using the Parkland formula: (4cc RL x 100kg x 12 = 4800 cc), with 2400 cc given over the first 8 hours, and the remaining 2400 cc over the following 16 hours.

He was admitted to the Burn Unit under the care of Plastic Surgery. An escharotomy was performed on his right arm for circumferential burns. He subsequently required skin grafting to the face, neck, chest, arms, and hands, but had a good outcome after an intensive rehabilitation program.

As the seriously burned patient begins to recover, rehabilitation becomes very important. Priorities include continuing passive ranging, increasing active ranging and strengthening, minimizing edema, pursuing activities of daily living, and preparing for work, or play and school. Important aspects of rehabilitation after discharge include ongoing and progressive ranging and strengthening, postoperative therapy after reconstructive operations, and scar management. Dx

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