Burns - Assessment and Management

A burn is an injury caused by thermal, chemical, electrical or radiation energy. A scald is a burn caused by contact with a hot liquid or steam but the term 'burn' is often used to include scalds.\(^1\)

Most burns heal without any problems but complete healing in terms of cosmetic outcome is often dependent on appropriate care, especially within the first few days after the burn. Most simple burns can be managed in primary care but complex burns and all major burns warrant a specialist and skilled multidisciplinary approach for a successful clinical outcome.\(^2\)

Epidemiology

- **UK admission rate** is 0.29 per 1,000 with burns or smoke inhalation (see separate Inhalation Injury article).
- In the UK, it is estimated that each year about 250,000 people with burn injuries present to primary care teams.\(^1\)
- The number of burns-related deaths in the UK averages 300 a year.\(^2\)

Risk factors

- Highest rates are seen in children under the age of 5 and the elderly over the age of 75.
- About 50% of burns and scalds occur in the kitchen.\(^1\)
- Infants and toddlers are at high risk of scalds from pulling hot beverages over themselves and at particular risk of burns from touching irons, hair straighteners or oven hobs.\(^3\)

Assessment

- Assess airway, breathing, circulation, disability, exposure (prevent hypothermia) and the need for fluid resuscitation. Also, assess severity of burns and conscious level.\(^4, 5\)
- Establish the cause: consider non-accidental injury.
- Assess for associated injuries: associated injuries may be sustained while the victim attempts to escape the fire. Explosions may throw the patient some distance and result in internal injuries or fractures.
- It is essential that the time of the burn injury be established.
- Burns sustained within an enclosed space suggest possible inhalation injury.
- Pre-existing illnesses, drug therapy, allergies and drug sensitivities are also important.
- Establish the patient's tetanus immunisation status.

**Body surface area - Rule of Nines:**\(^6\)
- The adult body is divided into anatomical regions that represent 9%, or multiples of 9%, of the total body surface. Therefore 9% each for the head and each upper limb; 18% each for each lower limb, front of trunk and back of trunk.
- The palmar surface of the patient's hand, including the fingers, represents approximately 1% of the patient's body surface.
- Body surface area differs considerably for children - the Lund and Browder chart takes into account changes in body surface area with age and growth.\(^2\)
- If not available:
  - For children <1 year: head = 18%, leg = 14%.
  - For children >1 year: add 0.5% to leg, subtract 1% from head, for each additional year until adult values are attained.

- Depth of burn (previously described as first-degree, second-degree and third-degree burns). Burn wounds are dynamic and need reassessment in the first 24-72 hours because depth can increase as a result of inadequate treatment or superadded infection. Burns can be superficial in some areas but deeper in other areas:\(^2\)
  - Epidermal (superficial partial-thickness): red, glistening, pain, absence of blisters and brisk capillary refill. Not life-threatening and normally heal within a week, without scarring.
  - Superficial dermal: pale pink or mottled appearance with associated swelling and small blisters. The surface may have a weeping, wet appearance and is extremely hypersensitive. Brisk capillary refill. Heal in 2-3 weeks with minimal scarring and full functional recovery.
  - Deep dermal: blistersing, dry, blotchy cherry red, doesn’t blanch, no capillary refill and reduced or absent sensation. 3-8 weeks to heal with scarring; may require surgical treatment for best functional recovery.
  - Full-thickness (third-degree): dry, white or black, no blisters, absent capillary refill and absent sensation. Requires surgical repair and grafting.
  - Fourth-degree: includes subcutaneous fat, muscle and perhaps bone. Requires reconstruction and, often, amputation.

- Circumferential extremity burns: assess status of distal circulation, checking for cyanosis, impaired capillary refilling or progressive neurological signs. Assessment of peripheral pulses in burn patients is best performed with a Doppler ultrasound.
- Baseline determination for the major burn patient:
• Blood: FBC, type and crossmatch, carboxyhaemoglobin, serum glucose, electrolytes, and pregnancy test in all females of childbearing age. Arterial blood gases.
• CXR. Other X-rays may be indicated for associated injuries.
• Circulation: severely burned patients may have hypovolaemic shock:
  • Blood pressure may be difficult to obtain and may be unreliable.
  • Monitoring hourly urinary outputs reliably assesses circulating blood volume and so an indwelling urinary catheter should be inserted.

Stop the burning process

• Remove all clothing - adherent synthetic clothing and tar should be actively cooled with water, and left for formal debridement.
• Dry chemical powders should be carefully brushed from the wound.
• Rinse the involved body surface areas with copious amounts of tap water. Cool the burn with running water from a cold tap for at least 20 minutes but avoid using ice or refrigerated water as this can cause further vasoconstriction and tissue damage. Great care is required, as cooling may cause hypothermia, especially in children, and in those with extensive burns - and may worsen shock.[4]
• Remove constricting clothing and jewellery before covering the patient with warm, clean and dry linens, to prevent hypothermia.

Management of minor burns[2]

• Clean burns with soap and water, or a dilute water-based disinfectant to remove loose skin.
• Blistered smaller than 1cm in diameter (or smaller than the patients little finger nail) should be left intact to minimise the risk of infection.[7]
• Larger blisters or those in an awkward position (in danger of bursting) should be aspirated under aseptic technique.
• Non-adhesive dressing with gauze padding is usually effective; however, biological dressings are better, especially for children.
• Dressings should be examined at 48 hours to reassess the burn, including depth.
• Dressings on superficial partial-thickness burns can be changed after 3-5 days in the absence of infection.
• If infection occurs, daily wound inspection and dressing change is required. The patient should be prescribed seven days of flucloxacillin first-line or erythromycin. Clarithromycin should be used if the patient is intolerant of erythromycin.
• Ensure adequate analgesia and assess the need for tetanus prophylaxis.

Management of major burns
The initial treatment of burns needs to include the following possible injuries:

• Direct thermal injury producing upper airway oedema and/or obstruction.
• Inhalation of products of combustion (carbon particles) and toxic fumes, leading to chemical tracheobronchitis, oedema, and pneumonia.
• Carbon monoxide (CO) poisoning.

Immediate management
Airway

• The airway above the glottis is very susceptible to obstruction because of exposure to heat. The clinical presentation of inhalation injury may be subtle and often does not appear in the first 24 hours.
• Clinical indications of inhalation injury include:
  • Face and/or neck burns.
  • Singeing of the eyebrows and around the nose.
  • Carbon deposits and acute inflammatory changes in the oropharynx.
  • Carbon particles seen in sputum.
  • Hoarseness.
  • History of impaired awareness - eg, alcohol or head injury, and/or confinement in a burning environment.
  • Explosion, with burns to head and torso.
  • Carboxyhaemoglobin level greater than 10% if the patient is involved in a fire.

• Management of acute inhalation injury:
  • Early management may require endotracheal intubation and mechanical ventilation.
  • Transfer to a burn centre.
  • Stridor is an indication for immediate endotracheal intubation.
  • Circumferential burns of the neck may lead to swelling of the tissues around the airway and so require early intubation.

Breathing

• Arterial blood gas determinations should be obtained as a baseline but arterial PO2 does not reliably predict CO poisoning. Therefore, baseline carboxyhaemoglobin levels should be obtained and 100% oxygen should be administered.
Elevation of the head and chest by 20-30° reduces neck and chest wall oedema. If a full-thickness burn of the chest wall leads to severe restriction of the chest wall motion, chest wall escharotomy (burn incised into subcutaneous fat and underling soft tissue; no anaesthetic is required) may be required.

- CO poisoning: has a much greater affinity than oxygen for haemoglobin and so displaces oxygen:
  - Assume CO exposure in patients burned in enclosed areas.
  - Diagnosis of CO poisoning is made primarily from a history of exposure.
  - Patients with CO levels of less than 20% usually have no physical symptoms.
  - Higher CO levels may result in headache and nausea, confusion, coma and death.
  - CO dissociates very slowly but this is increased by breathing high-flow oxygen via a non-rebreathing mask.

**Intravenous access and fluid replacement**

- Large-calibre intravenous lines must be established immediately in a peripheral vein.
- Any adult with burns affecting more than 15% of the total body surface area burned (where superficial burns are disregarded) or a child with more than 10% of the total body surface area burned requires fluid replacement.
- Replacement fluids required in the first 24 hours from the time of injury aim to maintain a good urine output - 0.5-1 ml/kg in adults, 1-2 ml/kg in children:
  - Adults:
    - For partial-thickness and full-thickness burns, or those with associated inhalation injury, use 4 ml of Hartmann's solution/kg body weight/% total body surface area (superficial burns are discounted here).
    - Half of this calculated volume is given in the first eight hours and the other half is given over the following 16 hours.
  - Children:
    - Replacement fluid as above plus maintenance (0.45% saline with 5% dextrose) which should be titrated against nasogastric feeds or oral intake:
      - 100 ml/kg for first 10 kg body weight plus 50 ml/kg for the next 10 kg body weight plus 20 ml/kg for each extra kg.

- Ensure adequate analgesia: strong opiates should be used.
- Prevent hypothermia.

**Management of the burns**

- Prompt irrigation with running cool tap water for at least 20 minutes (but no more than one hour) provides appropriate cooling. Very cold water, ice and objects from a freezer to cool the area should be avoided as these cause vasoconstriction and may worsen tissue ischaemia and local oedema. Chemical burns may need longer periods of irrigation, but irrigation should last no longer than one hour as a maximum period.
- Dressings help to relieve pain and keep the area clean but avoid circumferential wrapping, as this can cause constriction. The choice of dressing used can vary between specialist units. However, some studies have suggested that paraffin gauze dressings are a valuable option in superficial burns, while silver-based dressings are preferable in deeper burns.
- All patients with facial burns or burns in an enclosed environment should be assessed by an anaesthetist for early intubation.
- For full-thickness circumferential burns, escharotomy may be required to avoid respiratory distress or reduced circulation to the limbs as a result of constriction.

Transfer to a burns centre or other appropriate care centre as indicated.

**Referral to a specialist burns unit**

All complex injuries should be referred - particularly:

- Age under 5 years or over 60 years.
- Site of injury: face, hands, perineum, any flexure (including neck or axilla) and circumferential dermal burns or a full-thickness burn of the limb, torso or neck.
- Inhalation injury.
- Mechanism of injury:
  - Chemical burns affecting over 5% total body surface area burned (over 1% for hydrofluoric acid burns).
  - Exposure to ionising radiation.
  - High-pressure steam injury.
  - High-tension electrical injury.

- Suspected non-accidental injury in a child.
- Large affected area:
  - Age under 16 years: over 5% total body surface area burned.
  - Age 16 years or older: over 10% total body surface area burned.

- Co-existing conditions - eg, serious medical conditions, pregnancy or associated fractures, head injury or crush injuries.
Further management

- Circulatory insufficiency caused by a circumferentially burned limb is best relieved by escharotomy. Escharotomies are usually not required within the first six hours of burn injury.
- Fasciotomy: seldom required, but may be necessary to restore circulation for patients with associated skeletal trauma, crush injury, high-voltage electrical injury or burns involving tissue beneath the investing fascia.
- Gastric tube insertion: if there is nausea, vomiting, abdominal distention, or if more than 20% of the total body surface area is burnt.
- Analgesia and sedation:
  - Severely burned patients may be restless and anxious from hypoxaemia or hypovolaemia rather than pain. The patient then responds better to oxygen or increased fluid administration rather than to narcotic analgesics or sedatives that may mask the signs of hypoxaemia or hypovolaemia.
  - Intravenous narcotic analgesics and sedatives may be administered in small, frequent doses.
- Fasciotomy: seldom required, but may be necessary to restore circulation for patients with associated skeletal trauma, crush injury, high-voltage electrical injury or burns involving tissue beneath the investing fascia.

- Wound care:
  - Partial-thickness (second-degree) burns are painful when air currents pass over the burned surface. Gently covering the burn with clean linen relieves the pain and deflects air currents.
  - Do not break blisters or apply an antiseptic agent.
  - Any applied medication must be removed before appropriate antibacterial topical agents can be applied.
  - Application of cold compresses may cause hypothermia. Do not apply cold water to a patient with extensive burns.
- Antibiotics: should be reserved for the treatment of infection.
- Tetanus: determination of immunisation status is very important.
- Full-thickness burns: require excision and grafting unless they are less than 1 cm in diameter. Grafting is required within three weeks in order to minimise scarring. Therefore, early referral is essential.

After healing:

- The area of healed burns should be moisturised and massaged to reduce dryness.
- A high-factor sun cream should be used to prevent further damage and pigmentation changes.

Chemical burns

- Can result from exposure to acidic, alkaline or petroleum products.
- Alkali burns tend to be deeper and more serious than acid burns.
- Immediately flush away the chemical with large amounts of water for at least 20 to 30 minutes (longer for alkali burns). Alkali burns to the eye require continuous irrigation during the first eight hours after the burn.
- If dry powder is still present on the skin, brush it away before irrigation with water.

Electrical burns

- Are often more serious than they appear on the surface.
- Rhabdomyolysis results in myoglobin release, which can cause acute kidney injury. If the urine is dark, start therapy for myoglobinuria immediately.
- Fluid administration should be increased to ensure a urinary output of at least 100 ml/hour in the adult.
- Metabolic acidosis should be corrected by maintaining adequate perfusion and adding sodium bicarbonate.

Complications[1]

- Respiratory distress from smoke inhalation or a severe chest burn.
- Fluid loss, hypovolaemia and shock.
- Infection.
- Increased metabolic rate leading to acute weight loss.
- Increased plasma viscosity and thrombosis.
- Vascular insufficiency and distal ischaemia from a circumferential burn of limb or digit.
- Muscle damage from an electrical burn may be severe even with minimal skin injury; rhabdomyolysis may cause acute kidney failure.
- Poisoning from inhalation of noxious gases released by burning (e.g., cyanide poisoning due to smouldering plastics).
- Haemoglobinuria and renal damage.
- Scarring and possible psychological consequences. Hypertrophic scarring is more common following deeper burns treated by surgery and skin grafting than with superficial burns.[2]

Prognosis

- Will depend on depth of burn and the body surface area affected.
- Superficial burns usually heal within two weeks without surgery.[2]
- Risk factors for death include age over 60 years, more than 40% of body surface area affected and inhalation injury.[2]
- Death may result from severe extensive burns or electric shock.

Prevention

There are many important aspects of prevention of burns, including:
Safety in the workplace.
Safety in the home, including regularly checking smoke alarms.
Good parenting to protect children.
Care of the frail elderly and the socially isolated.
Prevention of sunburn: appropriate duration and timing of sunbathing, sun protection creams and regulation of tanning booths. See separate Sunburn article.

Further reading & references

1. Burns and scalds; NICE CKS, May 2013 (UK access only)

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