Update in Anaesthesia

Management of burns

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Summary

Burns are a major cause of morbidity and mortality. This article describes the pathological process of burns and a systematic approach to their management. Initial care should follow the basic principles of trauma resuscitation, with assessment and treatment of life threatening problems of the airway, breathing and circulation. Recognition of burn severity, stopping the burning process, initiating fluid and analgesia and early surgical involvement can have a significant effect on patient outcome.

INTRODUCTION

Burns are a serious public health problem throughout the world. In 2002 fire-related burns were responsible for an estimated 322,000 deaths worldwide.[1] Deaths are only part of the problem; for every person who dies, many more are left with lifelong disabilities. Over 95% of fatal fire-related burns occur in low and middle income countries.[1] The standard of burn care that is routinely available in many countries, is suboptimal due to lack of education and resources.

This article focuses on the basics of the initial management of burns patients, which can have a significant impact on the patient's outcome.

EPIDEMIOLOGY

More than two million people suffer burn injuries in India each year.[2] South-East Asia alone accounts for over one-half of the total number of fire-related deaths worldwide and females in this region aged 15 to 45 years account for 26% of global fire deaths.[3] Burns are the leading cause of adult deaths in the slums of Karachi, Pakistan.

Children under 5 years and the elderly have the highest fire-related burn mortality rates.[1] In the UK there are approximately 250 000 burns per year, 175 000 attend emergency departments and 13 000 are admitted to hospital. Of these, 1000 need fluid resuscitation and, on average, 300 patients die each year.[2]

RISK FACTORS FOR BURN INJURY[2]

- Open fires for cooking, heating and lighting.
- Substance abuse including alcohol and smoking.
- Low socioeconomic status, overcrowding, lack of safety measures, lack of parental supervision.
- Medical conditions such as epilepsy.
- Non accidental injury in children - the incidence of child abuse among hospitalised children for treatment of burns ranges from 5-25%.

Table 1. *Estimated number of deaths and mortality rates due to fire-related burns by WHO region* and income group (2002). Reproduced by kind permission of the WHO from 'A WHO plan for burn prevention and care' (2008).*

Region	Africa	The Americas		South-East Asia	Europe		Eastern Mediterranean		Western Pacific		World
Income group	low/middle	high	low/middle	low/middle	high	low/middle	high	low/middle	high	low/middle	
Number of burn deaths (thousands)	4.3	4	4	184	3	21	0.1	32	2	18	312
Death rate (per 100 000 population)	6.1	1.2	0.8	11.6	0.7	4.5	0.9	6.4	1.2	1.2	5.0
Proportion of global mortality due to fires (%)	13.8	1.3	1.3	59	1.0	6.7	0.02	10.3	0.6	5.8	100

** Countries within each geographical region have been further subdivided by income level, according to the divisions developed by the World Bank*

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- Violence against women related to gender inequality.
- Men at the workplace due to scalds, chemical and electrical burns.

TYPES OF BURN

Burns can be thermal, chemical, radiation and electrical. Thermal burns may be hot or cold. Hot thermal burns include contact, flame, flash, heat and scalding. With scald burns, the more viscous the liquid and the longer the contact with the skin, the greater the damage.

Chemical burns include extravasation injuries such as concentrated dextrose, calcium and sodium bicarbonate. They are more common in the elderly where veins are more friable. Alkaline burns produce liquefactive necrosis and are considered higher risk burns due to their likelihood to penetrate more deeply. Acid burns are the result of coagulation necrosis, limiting the depth and penetration of the burn.

Electrical burns produce heat injury by passing through tissue. Most problems from these burns present in patients exposed to greater than 1000V. Cardiac injury is prominent and cardiac monitoring is recommended for 4-72 hours. Visceral injuries, fractures, myoglobinuria and compartment syndromes should all be considered.

ANATOMY AND PHYSIOLOGY

The skin is a complex organ with a wide variety of functions. Loss of these barrier functions occur with a skin burn. Understanding of these alterations in skin function greatly assists in initial management.

Barrier functions

- Protection from bacterial entry (infection).
- Protection from toxin absorption.
- Fluid balance: avoiding evaporative water loss.
- Sensory (touch, pain, pressure).
- Social-interactive (visible portion skin).
- Protection from injury because of the properties of elasticity and durability.
- Regulation of body temperature to avoid hypo- or hyperthermia.

Skin structure

Epidermis

The outer, thinner layer, known as the epidermis, is composed mainly of epithelial cells. The deepest epidermal cells are immature cells that are continually dividing and migrating toward the surface. The same types of regenerating epidermal cells are found in hair follicles which are anchored in the dermis.

Dermis

The dermis is the deeper layer, responsible for skin durability and elasticity. The nerves for touch and pain, blood vessels and hair follicles are present in the dermis. The dermis is responsible for reforming the outer epidermis. So, if the outer layer is burned, the wound can heal as long as there is dermis. If the dermis is destroyed, the burn cannot heal.

PATHOLOGY

The depth of the burn is dependent on the temperature of the heat insult, the contact time and the medium. Excess heat causes protein denaturation and cell damage. Scalds travel more rapidly into tissue than dry heat. A surface temperature of over 68°C, caused by wet heat, produces immediate tissue death. A higher temperature is required with dry heat. The thickness of the skin is important; the thinner the skin (the elderly and children) the deeper the burn. The dead tissue on the surface is known as **eschar**. Toxic agents released by inflammation cause much of the tissue damage after the burn.

A thermal burn causes coagulation of soft tissue. Areas that were marginally perfused become re-perfused, triggering a release of vasoactive substances. These chemicals cause formation of reactive oxygen species, leading to increased capillary permeability. Fluid loss results and plasma viscosity increases, with formation of micro-thrombi.

After the initial 24 hours, fluid requirements abruptly drop as the capillary permeability returns to normal. Under resuscitation in this initial 24-hour time period leads to significant morbidity from hypovolemia and shock.

Major burns cause a hypermetabolic (inflammatory) state manifested by fever, increased metabolic rate, increased minute ventilation, increased cardiac output, decreased afterload, increased gluconeogenesis and increased catabolism.

INITIAL ASSESSMENT

Early management of burns can reduce the degree of pain, the rate of infection, the degree of scarring and increase the rate of healing. Early management can substantially reduce mortality and morbidity.

Initial care of the burn, victim should follow the basic principles of trauma resuscitation, with assessment and treatment of life threatening problems of airway, breathing and circulation. Recognition of burn severity, stopping the burning process and initiating fluid and analgesia, should be the next steps.

History

The history of the burn injury can give important information about the nature and extent of the burn, and any likelihood of inhalation or other injuries. Consider the type of burn, (thermal, chemical, radiation) and the location. Other important points include a history of trauma (e.g. an explosion), past medical history, medications, allergies and the patient's tetanus immunization status. Ascertain the history early because often the paramedics are the only source of information about the event.

Medical personnel must consider abuse as a cause of burns in both children and the elderly. Components of the history that should raise suspicion of abuse include:

- Conflicting stories of how the injury was sustained.
- Injury claimed to be unwitnessed.
- Pattern of burns that suggest contact with an object e.g. cigarette burns.
- Stocking, glove, or circumferential burns.
- Burns to genitalia or perineum.

- Injury incompatible with developmental level of the child.
- Injury attributed to a sibling.
- Presence of adult male who is not child's father living in household.

Accidental scalds often show a pattern of splashing, with burns separated by patches of uninjured skin. In contrast, intentional scalds often involve the entire extremity, appearing in a circumferential pattern with a line that marks the liquid surface.

Examination and burn assessment

Burn severity is determined by:

- Burn depth,
- Burn size,
- Burn location.

In some countries the depth of a burn is classified by degrees. In the UK a different classification exists to help decide the need for surgery, guide treatment and predict outcome.

Assessment of burn depth

Simple erythema (1st degree) burn

This is confined exclusively to the outer surface and is not considered a significant burn. No barrier functions are altered. The most common form is sunburn, which heals by itself in less than a week without scarring.

Superficial partial thickness (2nd degree) burn

This involves the entire epidermis and no more than the upper third of the dermis. Rapid healing occurs in 1-2 weeks, because of the large amount of remaining skin and good blood supply. Scarring is uncommon. Initial pain is the most severe of any burn, as the nerve endings of the skin are exposed to the air. This depth of burn is at low risk for infection unless grossly contaminated.

The microvessels perfusing this area are injured, resulting in leakage of large amounts of plasma, which in turn lifts off the heat-destroyed epidermis, causing blister formation. The blisters will continue to increase in size in the post-burn period. A light pink, wet, very painful wound is seen as blisters are disrupted. Frequently, the epidermis does not lift off the dermis for 12 to 24 hours and what appears initially to be a first degree burn is actually a second degree burn.

Deep partial thickness (2nd degree) burn

Most of the skin is destroyed except for a small amount of remaining dermis. The wound looks white or charred, indicating dead tissue. Blood flow is compromised and a layer of dead dermis, or eschar, adheres to the wound surface. Pain is much less, as the nerves are destroyed by the heat. Usually, one cannot distinguish a deep dermal burn from a full thickness (third degree) burn by visualization. The presence of sensation to touch usually indicates the burn is a deep partial thickness injury.

Re-epithelialization is extremely slow, sometimes taking months. In these patients, blister formation does not characteristically occur,

Table 2. *Summary of assessment of burn depth.*

Degree of burn	Characteristic appearance
Erythema (1st degree)	Redness Reversible Tissue blanches with pressure Heals within a week
Superficial partial (2nd degree)	Confined to upper third of dermis Blisters, wet pink, painful Tissue blanches with pressure Heals in 10-12 days without scarring
Deep partial (2nd degree)	Involves majority of the inner dermal layer Dry, white, or charred skin Pain is minimal If heals, scar is severe Tissue does not blanch with pressure May heal in 2-3 months
Full thickness (3rd degree)	Complete destruction of both layers White, charred, dry Painless Needs to be excised and skin grafted

because the dead tissue layer is sufficiently thick and adherent to underlying viable dermis that it does not readily lift off the surface. The wound surface may be red and dry in appearance, with white areas in deeper parts. There is a marked decrease in blood flow, making the wound very prone to conversion to a deeper injury and to infection. A deep dermal burn requires 4 to 10 weeks or longer to heal. Excision and grafting is the preferred treatment.

Full thickness (3rd degree) burn

Both epidermal and dermal layers of skin are completely destroyed, leaving no cells to heal. Any significant burn will require skin grafting. A characteristic initial appearance of the avascular burn tissue is a waxy white colour. The burn wound is also painless and has a coarse non-pliable texture to touch.

Assessment of burn area

The more body surface area (BSA) involved in a burn, the greater the morbidity and mortality. Burn extent is only calculated for individuals with partial thickness or full thickness burn.

There are three ways of assessing the burn area:

Palmar area

A simple method to estimate burn extent is to use the patient's palmar surface, including fingers, to measure the burned area. An individual's palmar surface classically represents 1% of the BSA, but this is considered an over-estimate by some, who consider the palm to be 0.4% or 0.8% including the fingers.

Rule of nines (Figure 1)

A second method is to use the 'rule of nines' to estimate the extent of burn injury. The head represents a greater portion of body mass in children than it does in adults.

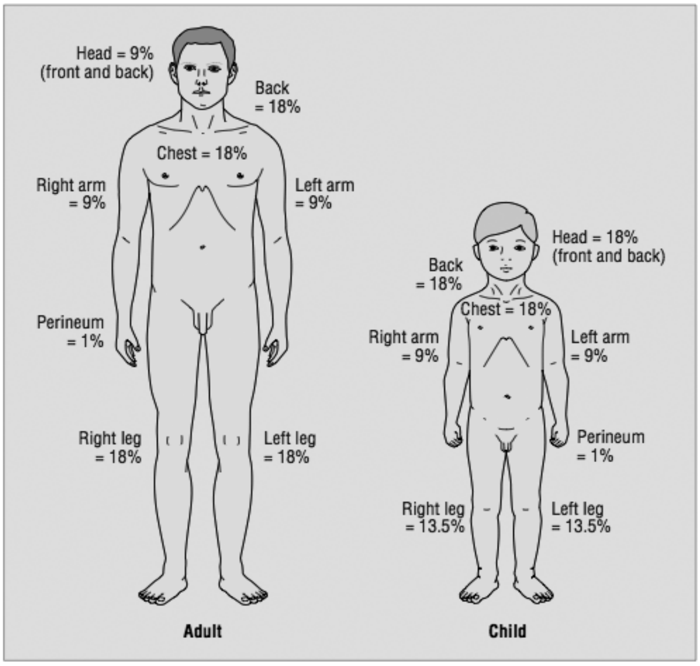
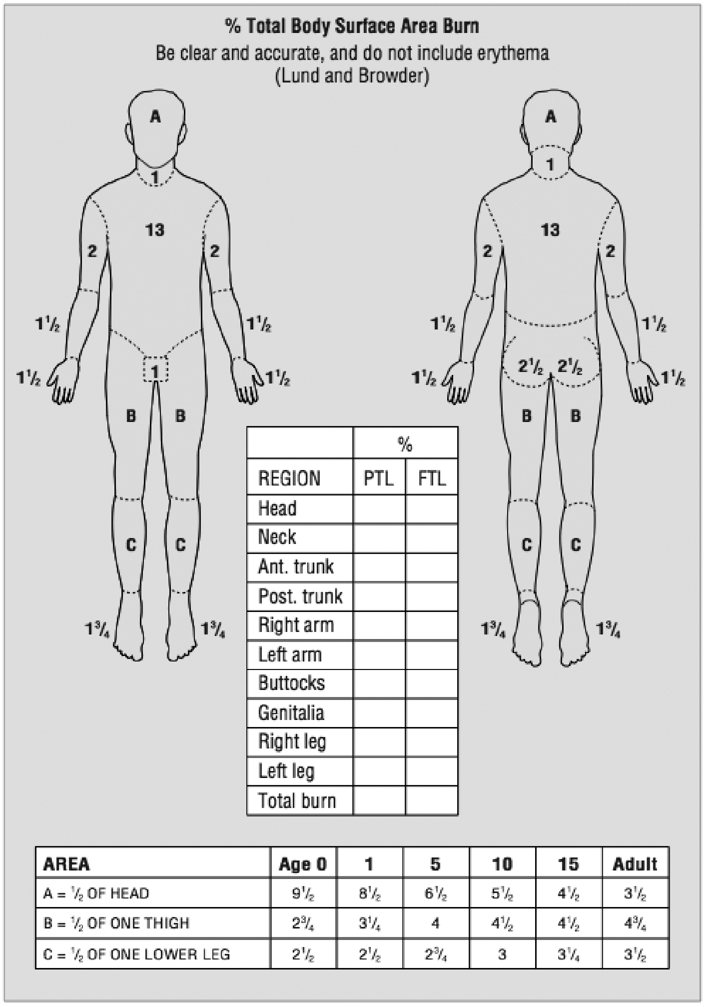


Figure 1. *The 'rule of nines' (reproduced from reference 3, by kind permission from John Wiley and sons).*



	%	
REGION	PTL	FTL
Head		
Neck		
Ant. trunk		
Post. trunk		
Right arm		
Left arm		
Buttocks		
Genitalia		
Right leg		
Left leg		
Total burn		

AREA	Age 0	1	5	10	15	Adult
A = $\frac{1}{2}$ OF HEAD	$9\frac{1}{2}$	$8\frac{1}{2}$	$6\frac{1}{2}$	$5\frac{1}{2}$	$4\frac{1}{2}$	$3\frac{1}{2}$
B = $\frac{1}{2}$ OF ONE THIGH	$2\frac{3}{4}$	$3\frac{1}{4}$	4	$4\frac{1}{2}$	$4\frac{1}{2}$	$4\frac{3}{4}$
C = $\frac{1}{2}$ OF ONE LOWER LEG	$2\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{3}{4}$	3	$3\frac{1}{4}$	$3\frac{1}{2}$

Figure 2. *The Lund and Browder chart (reproduced from reference 3, by kind permission from John Wiley and sons). PTL = partial thickness, FTL = full thickness*

Lund and Browder chart (Figure 2)

This is used to calculate the burn surface area (BSA). It compensates for the variation in body shape with age.

INITIAL MANAGEMENT

Immediate death is the result of coexisting trauma or airway compromise. Perform a rapid primary survey to assess the status of the patient's airway, breathing, and circulation. Immediately correct any problems found. Figure 3 summarises the goals of initial management.

Airway

During airway assessment, give careful attention to signs of airway injury. Facial or oral burns, singed facial or nasal hair, hoarse voice, carbonaceous sputum or altered mental status suggest the possibility of airway or inhalation injury. Changes in voice suggest laryngeal oedema.

If any doubt exists, secure the airway by induction of anaesthesia, paralysis using suxamethonium and endotracheal intubation. Do not cut the endotracheal tube as significant facial swelling is likely in the next 24 hours. Ventilate with an increased minute volume and 100% oxygen until carboxyhaemaglobin levels are known.

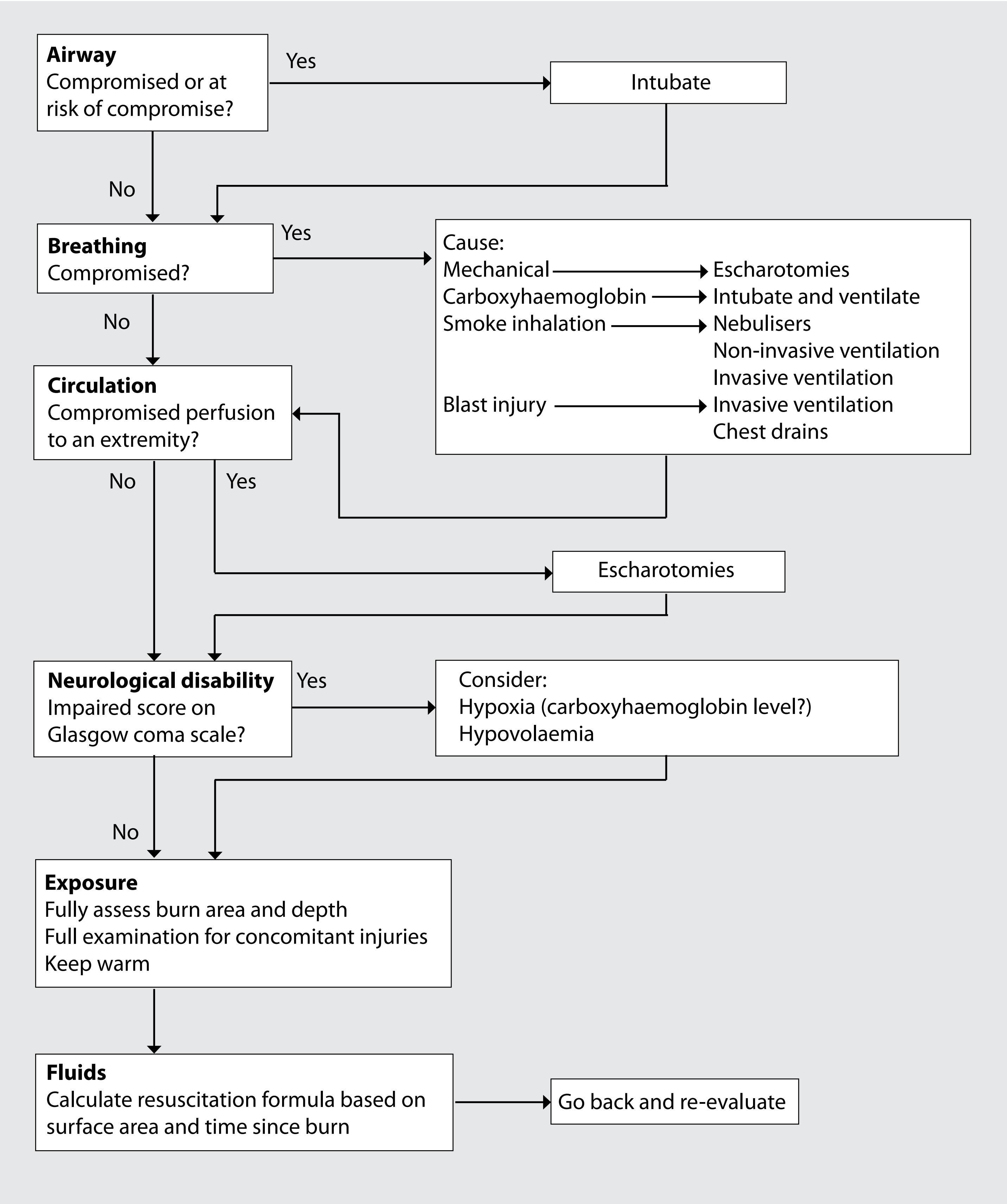


Figure 3. *Algorithm of primary survey and initial management of a patient with a major burn injury (reproduced from reference 4, by kind permission from John Wiley and sons).*

Breathing

Assume inhalation injury in any person whose history suggests prolonged entrapment or confinement in an enclosed area of fire. Inhalation injury may include systemic effects of carboxyhaemaglobin (COHb), hydrogen cyanide absorption, chemical pneumonitis or a combination. If present, carbon monoxide (CO) has up to 250 times the affinity for haemoglobin (Hb) than oxygen. COHb has a half life of 3-4 hours in room air, 30-40 minutes in 100% oxygen and 20 minutes in hyperbaric oxygen.

Table 3: *Interpretation of carboxyhaemoglobin levels*

% COHb	Effect
0.3-2%	normal non-smokers
5-6%	normal smokers
15-30%	headache, dizziness, nausea
30-40%	confusion
> 60%	convulsions, coma, death

Consider cyanide toxicity if there is a history of toxic fumes, an unexplained metabolic acidosis, raised lactate or anion gap. Cyanide is also found in smoke, especially from burning polyurethane. Plasma cyanide levels are difficult to obtain, so treatment is usually based on a high index of suspicion. For cyanide poisoning, cardiopulmonary support is usually sufficient treatment. Sodium nitrite can be used (300mg IV over 5-10 minutes) in severe cases.

If your patient's respiratory function worsens, remember that there are many toxins released from different compounds in household fires. They can all cause different degrees of mucous membrane irritation, bronchospasm, bronchorrhoea, mucous plugging and pulmonary oedema. Treatment is supportive with humidified oxygen, bronchodilators and ventilation as necessary.

Circumferential or deep chest wall burns may restrict breathing and so require escharotomy (incision of the eschar).

Circulation

Any burn greater than 15% of the total body surface area may produce shock due to hypovolemia. Fluid administration should begin immediately with warmed fluid. Intravenous cannulae may be placed through burned skin if necessary. If intravenous access is not possible, consider using intraosseous access early. Inadequate resuscitation, resulting in shock or vasoconstriction, can reduce blood flow causing the burn to become greater in size or depth and reduce healing.

With the loss of the barrier provided by intact skin, burn victims have large fluid losses due to evaporation. Remember burn victims will need generous fluid resuscitation as only 20-30% will remain in the intravascular space.

Fluid therapy for a burn victim in the acute phase can be calculated using the **Parkland formula**, as follows:

Fluid requirement in first 24 hours (in ml) = 4 x (% BSA burn) x (body weight in kg)

Example: A man who weighs 70 kg and has a 30% BSA burn would require:

$30 \times 70 \times 4$ ml.kg^{-1} = 8400ml in the first 24 hours.

One half of the calculated fluid requirement is administered in the first 8 hours, and the rest is given over the remaining 16 hours. Thus, fluids would be given at 525ml.h^{-1} for the first 8 hours, then at 262.5ml.h^{-1} for the remaining 16 hours.

For children a **modified Parkland formula** exists, due to the influence of surface area to body weight ratio:

For the first eight hours give normal maintenance and 2ml.kg^{-1} per %BSA over eight hours.

For the subsequent 16 hours continue maintenance but add 1 ml.kg^{-1} per %BSA.

Remember that a formula is only an estimate and adjustments need to be made based on the patient's status. The formula does not predict fluid resuscitation needs in electrical injuries accurately. In addition the presence of coexisting trauma may increase fluid volumes required for resuscitation.

Monitor markers of fluid status (e.g. urine output) and adjust fluids accordingly. Placement of a urinary catheter ensures accurate measurement of hourly urine output. Urine output should be maintained at 0.5ml.kg^{-1}h^{-1}. In children, maintain urine output at 1ml.kg^{-1}h^{-1}, a pulse of 80-180 per minute (age dependent) and a base deficit of < 2.

Perfusion to a burnt distal extremity must be closely monitored. Pain and colour are unreliable indicators of perfusion in the presence of a burn to the area. Be aware that circumferential extremity burns can impair perfusion (escharotomy or fasciotomy may be required) and that jewellery may become tight with tissue swelling.

Disability

A low conscious level could be due to hypoxia, carbon monoxide, hydrogen cyanide, head injury or drugs. A reduced conscious level could precede the burn, if the patient has other medical conditions such as diabetes, epilepsy or cerebrovascular disease. Where available, check the patient's blood gas, COHb, blood sugar, electrolytes, alcohol level and urine toxicology. Look carefully for evidence of head injury, focal neurology or pupil asymmetry, that would suggest neurological injury.

Exposure

Remove all clothing, cool the burn with running water or saline, but avoid hypothermia. Cover the patient with dry, sterile sheets or clean clear dressing, such as 'cling film'. Take the opportunity to assess the depth and extent of the burn thoroughly. Clean other areas with minor burns with the use of a mild soap and gentle scrubbing.

Debridement of intact blisters is subject of debate; the intact skin serves as a barrier to infection, although the blister fluid can serve as an excellent medium for bacterial growth. Blisters that are intact, but are located in areas that have a high likelihood of rupture, may be debrided. The World Health Organization (WHO) recommends debridement of all bullae and excision of all adherent necrotic tissue.

Fluids

Intravenous fluid replacement is necessary for:

- Adults with greater than 15% body surface area burns,
- Children with greater than 10% body surface area burns.

There is no clear evidence that crystalloid or colloid is superior. Colloid has inherent risks of allergy and pruritus and there is some evidence that starches may increase renal injury.

Ongoing fluid losses are difficult to quantify. There can be significant fluid losses in soaked bandages and bed sheets. After 24-48 hours, standard maintenance fluids may be adequate. Repeated assessment of urine output, clinical signs, biochemistry and haematocrit is useful to assess the adequacy of fluid resuscitation.

Gastric feeding

Place a nasogastric or orogastric tube in those patients who are comatose, as they tend to have gastric dilatation. Start enteral feed early or add gastric protection (H_2 antagonists, proton pump inhibitors or sucralfate, as available).

The patient's energy and protein requirements will be extremely high due to the catabolism of trauma, heat loss, infection and the demands of tissue regeneration. If necessary, feed the patient through a nasogastric tube to ensure an adequate energy intake (up to 6000kcal per day). Anaemia and malnutrition prevent burn wound healing and result in failure of skin grafts. Use of eggs, peanut oil and locally available supplements are encouraged.

Head up

Nurse the patient thirty degrees head up.

Infection

A fresh burn is initially sterile but soon becomes colonised. Infection is almost inevitable and sepsis is a major cause of morbidity and mortality. Topical antimicrobials, dressing changes and prevention of cross infection (e.g. strict hand hygiene) are all important. Intravenous antibiotics are not recommended in the initial treatment of most burn patients, as it may increase the chance of colonization with more virulent and resistant organisms. They should be reserved for those patients with secondary infections. Administer tetanus immunization as appropriate.

INDICATIONS FOR PATIENT TRANSFER

The American Burn Association has developed criteria for admission to a specialist burn centre, as follows:

- Full thickness (third degree) burns over 5% BSA,
- Partial thickness (second degree) burns over 10% BSA,
- Any full-thickness or partial-thickness burn involving critical areas (e.g. face, hands, feet, genitals, perineum, skin over any major joint), as these have significant risk for functional and cosmetic problems,
- Circumferential burns of the thorax or extremities,
- Significant chemical injury, electrical burns, lightning injury, coexisting major trauma, or presence of significant pre-existing medical conditions,
- Presence of inhalation injury.

INVESTIGATIONS

Where available, consider the following:

- Full blood count, urea and electrolytes, liver function tests,
- Arterial blood gases with carboxyhemoglobin levels,
- Coagulation profile,
- Urine analysis,
- Group and save,
- Creatine phosphokinase and urine myoglobin levels in electrical injuries. The presence of myoglobin can signify muscle breakdown (rhabdomyolysis) as well as impending kidney impairment.
- Chest Xray in cases of smoke inhalation.

ANALGESIA

Opioids provide rapid pain relief that can be titrated to achieve the desired comfort level for each patient. Where available, a patient controlled analgesia pump is appropriate. Take extra care in those patients with hypoxaemia and reduced conscious level. Use regular paracetamol and, where not contraindicated, non-steroidal antiinflammatory drugs (NSAIDs). Ketamine infusion is useful, where opioid analgesia is unavailable or inadequate. Ketamine bolus and entonox are useful for dressing changes. At later stages, oral opioids and tricyclic antidepressants, such as amitriptyline, can be useful.

SURGERY

In the initial stages after a burn, surgery is a priority to achieve debridement of affected tissues. At the same time the surgeon will usually try to achieve coverage of the burn with one or more split skin grafts, in order to minimise infection, reduce pain and allow healing. Where the area of burn exceeds the area of healthy skin, skin substitutes (either temporary or permanent) may be used to cover the burn. These include allograft (from a cadaveric donor) and xenograft (for example porcine skin).

Other potential surgery may involve:

- Full thickness skin grafts,
- Flap surgery,
- Tissue expansion
- Late allograft or xenograft.

ANAESTHESIA FOR PATIENTS WITH BURNS

- The anaesthetist may encounter the same burn patient many times throughout their hospital stay. Initial involvement may be in the emergency department including airway assessment, resuscitation, establishing IV access, analgesia, their initial trip to theatre for wound assessment, cleansing, debridement or on the many trips to theatre for grafting or reconstructive surgery.

- Airway concerns change with time. Airway oedema may be due to the initial burn, or develop as a consequence of tissue inflammation or crystalloid resuscitation. At later stages, scarring and contractures can inhibit mouth opening or limit neck movement prohibiting conventional laryngoscopy. Consideration must be given to awake fibreoptic intubation or awake tracheostomy under local anaesthetic. Each patient must be assessed on an individual basis.

- Wet burns or the presence of exudate make mask holding very difficult. Initially the pressure to the face can be painful, then the seal becomes difficult to maintain. The use of dry gauze between the patient and your gloves allows some degree of grip. The endotracheal tube should be maintained with a cord tie not tape. For nasal tubes or nasogastric tubes holter devices ('bridles' that loop behind the nasal septum) are used to secure position, especially in intensive care patients.

- It is considered safe to use suxamethonium for up to 24 hours following the burn. Following this time there is an increase in extra-junctional cholinergic ion channels, beyond the motor end plate, and therefore a risk of hyperkalaemia following depolarisation. The same proliferation of binding sites, along with changes in distribution, metabolism and excretion, increase the requirement for non-depolarising muscle relaxants.

- During wound debridement and grafting, bleeding can be extreme, especially in small children. Ensure blood is available, if needed, and that there is a current group and save specimen. The use of adrenaline (epinephrine) soaked swabs can reduce blood loss through vasoconsrtiction. With larger burns, monitoring can be difficult with no obvious site for ECG leads and the blood pressure cuff. Extensive washing needs thoughtful positioning and repositioning of ECG electrodes.

- Monitor the patient's temperature; with extensive exposure, debridement and general anaesthesia, heat loss may be rapid, especially in children. Burns theatres can be uncomfortably warm with high ambient temperatures. Fluids for irrigation and infusion should be warmed and external warming blankets used where possible.

PROGNOSIS

The traditional formula to predict mortality (age in years + the percentage BSA, giving a predicted percentage mortality) is no longer accurate, with mortality being significantly better with modern treatments. Prognostic factors affecting outcome include early intervention, age, total body surface area of burn, and the presence of lung injury. However, outcome clearly depends on additional co-morbidities and the standard of care received.

CONCLUSIONS

Burn injuries can cause major morbidity and mortality, but good early management can dramatically improve the prognosis. Early management of burns can reduce the degree of pain, rate of infection, degree of scarring and increase the rate of healing. Anaesthetists have a key role in the multidisciplinary team involved in a burn victim's care. A full understanding of the anatomy, physiology and pathological processes is essential for this role. Initial roles include assessment and resuscitation and later roles are as the anaesthetist for debridement, dressing changes, and contracture and cosmetic surgery.

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