BATLS

Battlefield Advanced Trauma Life Support

Chapter 12
Burns

AIM

1201. On successfully completing this topic you will be able to:

- Identify the methods used to assess the size and severity of burns.
- Outline the measures used to stabilize, treat and evacuate casualties with burn injuries.

INTRODUCTION

1202. The incidence of burn injury in battle casualties has increased steadily throughout the last century. An analysis of recent conflicts suggests that, in the modern armoured battle, 10-30% of all battle casualties will have sustained burns[1]. Of these, approximately half will also have other physical injuries.

1203. Burns can be caused by the high temperature combustion from modern explosives as well as by secondary ignition of fuel and lubricants. In addition, specific types of weapons are designed to inflict burn injury, for example flame-throwers and napalm munitions.

ASSESSMENT

1204. Successful management of burns depends on the ability to assess the severity of the injury accurately and early. The severity depends on:

- The area of the body burnt - Body Surface Area (BSA) burnt.
- The depth of the burn.
- The presence or absence of respiratory tract thermal injury.

Assessing The Body Surface Area

1205. The BSA can be assessed by the *Rule Of Nines*:

- Head and neck = 9%
- Each upper limb = 9%
- Front of trunk = 18%
- Back of trunk = 18%
- Each lower limb = 18%
- Perineum = 1%

Remember that the area of the casualty's palm is approximately 1% of the body surface area. In children below 30kg weight (about 12 years old and under) the proportions are different; the head represents 18% of the body surface area and the lower limbs only 14% each.

Estimating The Depth Of Burn

1206. Burns can be either:

- Partial-thickness - confined to the epidermis.
- Full-thickness - complete destruction of the epidermis.

1207. Partial-thickness can vary from superficial, with some erythema and pain (as in sunburn), to deep partial-thickness. The latter involves destruction of the whole epidermis at various points but the depth of burn spares sweat glands and hair follicles. Pain is a feature of all these and sensitivity to needle prick is retained.

1208. With full-thickness burns there is total loss of the whole epidermis together with a variable degree of tissue beneath. Destruction of superficial nerve endings render the burnt area insensitive to pain. The affected area (the eschar) may look dirty-white, brown or black and sometimes has an almost transparent, leather like appearance, through which coagulated blood in the blood vessels can be seen.

Full-thickness versus partial-thickness burns.
A simple test is to pull a hair with forceps if it comes out easily the burn is full-thickness.

RECOGNIZING RESPIRATORY INJURY

1209. Many cases are complicated by concomitant injury of the respiratory tract caused by inhalation of the products of combustion. These can cause one or more of the following:

- *Considerable swelling of the upper respiratory tract leading to airway obstruction.* The upper respiratory tract is a very good heat exchanger. Heat damage to the lower respiratory tract is seldom seen except when super-heated steam is inhaled; this can occur, for example, when boilers and pipes in ships' engine rooms fracture.
- *Chemical damage to upper and lower respiratory tracts.* Many products of combustion form gases that are highly irritant, particularly to the lower

[1] ***This figure can be considerably higher on ships.***

respiratory tract; this can lead progressive respiratory failure.
- *General toxicity*. Some products of combustion, which may or may not be locally irritant to the lungs, can be absorbed into the circulation and prove highly toxic. For example, many plastics and modern materials give off cyanide gas which is one of the most common causes of death in fires.

1210. The most common poison in a fire is carbon monoxide. In addition, fire rapidly consumes oxygen in the atmosphere surrounding a victim so that the whole problem is compounded by anoxia. On the battlefield, various nitrate products from explosions are likewise extremely toxic. Inhalation injury is one of the major causes of mortality in burns. Initially, after exposure, a casualty may not demonstrate any adverse effects and a high index of suspicion should be used when assessing a casualty with burns.

1211. On the battlefield, two or more of the following features should be considered sufficient to diagnose inhalation injury:
- A fire in an enclosed space such as a bunker or armoured vehicle.
- Carbonaceous sputum.
- Impaired level of consciousness or mental confusion.
- Burns on the face, lips, nose and mouth - look for singeing of the hairs in the nares and oedema of the uvula.
- Signs of respiratory distress such as increased respiratory rate or shortness of breath.
- Stridor or any abnormal signs in the lung fields such as rhonchi or crepitations.
- Hoarseness or loss of voice.

MANAGEMENT
Remember the A B C D E routine

1212. Immediate first aid is:
- Extinguish the flames on the casualty or clothing by wrapping the casualty in a blanket or laying the affected part on the ground.
- Small burns may be cooled by applying clean cold water. *But remember that liberal application of cold water following extensive burns will produce a hypothermic casualty.*
- Cover all burns except the face with *cling-film.*
- Provide pain relief, ideally, IV morphine (some casualties with severe burns suffer little initial pain).
- Elevate burnt limbs. Burnt hands can be placed in polythene bags to facilitate finger movement.
- Protect from the elements but do not over-warm.

Airway
1213. With casualties who have, or are likely to develop inhalation injury, you must suspect airway compromise and give it a high priority. If necessary, you must secure the airway either by endotracheal intubation or cricothyroidotomy. Control of the airway is best established before major symptoms of obstruction become apparent and, under field conditions, a surgical airway may be preferable to an endotracheal tube.

Local Management Of Burn Wounds
1214. Burning often sterilizes the skin at the time of injury. At the same time, burnt skin instantly loses its ability to resist invasion by bacteria; you must cover the burns with appropriate dressings as soon as possible. Cover the burns with cling-film. Ensure that the film is laid in strips and stuck to each other along the limb - rather than wrapped around the limb like a bandage as this may cause constriction.

1215. Put the casualty's hands and feet in polythene bags secured at the wrist or ankle and encourage movement of the fingers and toes inside the bags. If available, you may put a small quantity of antiseptic such as flamazine cream on the hands and feet. Treat burns of the face and head by exposure; warn the casualty that gross swelling of the eyelids may occur - reassure him that this is temporary and that he is not losing his sight.

Escharotomy
1216. The dead tissue caused by full-thickness burning (the eschar), if circumferential in any part of the body, will constrict as it is formed. This may have dire consequences. For example, in a limb it will obstruct the bloody supply, around the chest it may restrict respiratory excursion and around the neck it may produce respiratory obstruction. Division of the eschar (escharotomy) may be a life- or limb-saving procedure that should be performed as soon as a circumferential full-thickness burn is diagnosed.

1217. The procedure is to incise the eschar down to the deep tissues with any form of sharp blade. Since the burn is full-thickness, no form of anaesthesia is required. Make a cut starting at the centre of the eschar and passing longitudinally up and down the limb until sensitive tissue is reached. For circumferential, full-thickness burns on the trunk, it may be necessary to incise both vertically and horizontally. Gauge the depth by finding the level at which the eschar splits open. Haemorrhage may be significant and may require a pressure dressing. *Do not allow this dressing, in turn, to cause constriction.*

Fluid Replacement
1218. Due to excessive capillary permeability, there is a loss of protein-rich fluid from the burn surface, as well as significant interstitial oedema in the area. In

full-thickness burns there is direct destruction of blood within burnt vessels. Replacement of fluid loss as early as possible is one of the most important aspects of treatment to prevent the development of hypovolaemic shock. In burns up to 15% BSA in adults (10% in children), rehydration can be achieved by the oral route using *Moyer's* electrolyte solution. This is made up by adding one sachet of the solution to a casualty's standard-issue water bottle full of water[1]. This solution is not particularly palatable - adding orange juice or something similar improves the taste.

1219. Burns over 15% BSA in adults require intravenous fluid. There are many different formulae used to determine the approximate amount of fluid needed; most depend on knowing the casualty's body weight. In forward areas this is impractical and the British Army formula is based on the body surface area burnt. The total amount of fluid needed is 120ml of colloid per 1% of BSA burnt, administered over 48 hours. Half of this should be administered in the first eight hours *from the time of burning.* (In another words, if six hours has elapsed before intravenous resuscitation has started, the first half of the calculated fluid volume should be given in two hours). A quarter of the calculated volume is given in the next 16 hours and the final quarter given during the second 24 hours. In addition, 100ml of fluid per hour is required for normal metabolic purposes. If the casualty can swallow, it should be given orally, if not, as IV crystalloid.

1220. This formula is only a rough guide and it should be monitored by means of:

- Pulse rate.
- Peripheral perfusion.
- Minimum urinary output of at least 50ml per hour (catheter required).
- A falling haematocrit, measured hourly.

Surgical Treatment

1221. This will depend on facilities available, the nature of the burn and the number of casualties to be treated. Certain full-thickness burns require urgent surgery, particularly those involving the eyelids, dorsal surfaces of hands and flexion aspects of joints.

1222. Triage Priorities

- *Priority 1:* Burns between 15 and 30% BSA, casualties with respiratory compromise and electrical burns.
- *Priority 2:* Burns of less than 15% BSA involving face, eyelids, hands, perineum and across joints.
- *Priority 3:* All remaining burns cases.

1223. In civilian life, the dividing line between adults requiring life-saving emergency treatment and those who do not is considered to be burns of 20% BSA or more. In the military setting, 15% is selected because of the likelihood of multiple casualties, delays in the evacuation chain and the high incidence of other concomitant physical injuries.

1224. Priority 1 cases will normally be evacuated as soon as possible to a field hospital with a specialist burns team. Casualties with burns of more than 30% BSA should normally be held as P1 hold at a Role 3 facility until they have survived the 48 hour shock phrase.

SPECIAL BURNS

Phosphorus Burns

1225. Phosphorus combusts spontaneously on contact with air and consequently contamination of clothing, skin or flesh with particles of phosphorus produces deep burns. Such burns, extremely rare in civilian life, are common on the battlefield. This is because many munitions designed to produce smoke screens rely on the widespread scattering of phosphorus pellets.

Immediate treatment is as follows:

- Douse the flames and keep covered with water or some other solution such as saline.
- If possible, remove with forceps any large fragments of visible phosphorus that are not adherent.
- Apply moist dressings and keep them wet.
- Continue with standard burn therapy.
- Avoid contaminating yourself with particles of phosphorus.

1226. At Role 3, phosphorus burns may be treated as follows, usually under general anaesthetic:

- Irrigate the wound with 1% copper sulphate solution. This combines with the phosphorus to neutralise it, and turns the fragments black allowing easy identification for removal.
- You must then flush the copper sulphate from the wound with saline.

Copper sulphate is highly toxic if absorbed and must never be left on a wound as a dressing

Electrical Burns

1227. Electric currents passing through the body generate heat deep in the tissues and many produce serious burns. Much of the heat damage is to deep tissues and visible burns on the skin may be small. These burns are always far more extensive than initially apparent. The burns may cause massive breakdown of muscle tissue giving rise to:

- Renal failure (due to myoglobinuria).
- Metabolic acidosis.

[1] *The standard Service issue sachet contained 4.5g each of sodium chloride and sodium bicarbonate.*

1228. The general effects of electrocution may also produce cardiac or respiratory arrest, or cardiac arrhythmias. Intravenous fluids should be given in sufficient volume to produce a minimum of 100ml of urine per hour to try to prevent renal failure and to combat metabolic acidosis. In order to monitor this the casualty should be catheterized. Such casualties should be evacuated to a special burns unit as Priority 1.

SUMMARY

- Remember the **A B C D E** routine with special emphasis on A in known or suspected burns of the airway - thermal or chemical.
- Calculate BSA burnt, give intravenous fluid according the the British Army formula to burns of more than 15% BSA and monitor effectiveness. Adjust the volume of intravenous fluid to maintain effective resuscitation.
- Cover with cling-film, use polythene bags on hands and feet.
- Do not hesitate to do escharotomies for circumferential full-thickness burns.
- Evacuate as appropriate to a specialist burns unit.

Chapter 13
Ophthalmic Injuries

AIM

1301. On successfully completing this topic you will be able to:

- Take an ophthalmic history.
- Examine the globe and orbit.
- Identify conditions requiring expert ophthalmic surgery.
- Give treatment prior to evacuation.
- Treat conditions that do not require evacuation.

1302. About 10% of battle casualties have an eye injury. Of these, 15% are bilateral. Hysterical bilateral blindness is an important symptom of battleshock.

ASSESSMENT

Remember the A B C D E routine

History

1303. Ascertain as far as possible the details and circumstances of the injury:

- Activity of the casualty, such as hammering metal or a laser strike.
- Is the injury due to blunt or penetrating trauma?
- If a chemical injury, record whether acid, alkali or NBC agent (note swelling of lids or clouding of the cornea).
- *Drops.* Is the casualty on eye medication or has he been given miotics/mydriatics?
- *Eyewear.* Was the casualty wearing goggles, spectacles, anti-laser protection or contact lenses?
- *Foreign Body.* Do you suspect a foreign body in the eye? If so, is there a sample?

Examination

1304. Check the casualty for the following:

- *Visual acuity.* Can he read normal text or headlines? Can he count fingers? Can he detect hand movements? Has he any perception of light?

Perception of light can still be tested with the eyes closed - by shining a torch through the eyelid.

- *Conjunctiva and cornea.* Look for corneal abrasions, ideally using fluorescein and a blue lights. Look for superficial foreign bodies, blood inside the eye, perforations of the iris, clouding of the cornea and corneal perforations.
- *Soft eye*. This will indicate a posterior perforation of the globe.

Do not press on a soft eye.

TREATMENT

1305. Treat the casualty as follows:

- Wash out chemicals and foreign bodies with saline or *Hartmann's Solution* immediately and continue for 15 minutes holding the lids open.
- Use chloramphenicol ointment liberally on the lids and in the conjunctival sac.

It is better to use chloramphenicol drops every hour if a perforation is seen.

- Apply one drop of 1% atropine.
- Apply pad and bandage firmly (unless the globe is soft in which case do not apply pressure to the eye but protect it with a plastic shield).
- With a large penetrating foreign body, pad both eyes to prevent further injury due to concomitant eye movements.
- Remember tetanus toxoid and systemic antibiotics.

PRIORITIES AND EVACUTION

1306. All casualties with loss of visual acuity will need to be seen by an ophthalmic surgeon, preferably within 24 hours. An intraocular foreign body, if metallic, will cause blindness within ten days unless removed. Perforations of the globe are usually blinding to that eye; they require to be seen urgently by an ophthalmic surgeon. Remember perforations of one eye may blind the other eye by sympathetic ophthalmia unless treated within a few days. All eye injuries, except simple abrasions, are

P2 and require early evacuation to a specialist eye unit. A high priority should be given to intraocular foreign bodies from anti-laser goggles; such fragments cause an intense retinitis. Ideally most casualties should be evacuated by *air*.

SUMMARY

- All but the most simple of eye injuries will require expert ophthalmological opinion. This is particularly so with all actual or suspected penetrating injuries.
- Rest the *part*, that is atropine to the affected eye and pad both eyes (if circumstances allow).
- Rest the *whole*, that is evacuate P2 as a stretcher case.