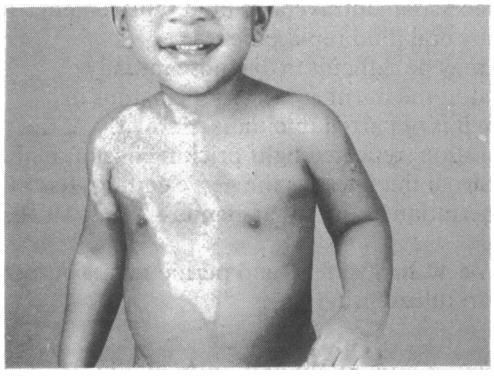
Plastic and Reconstructive Surgery

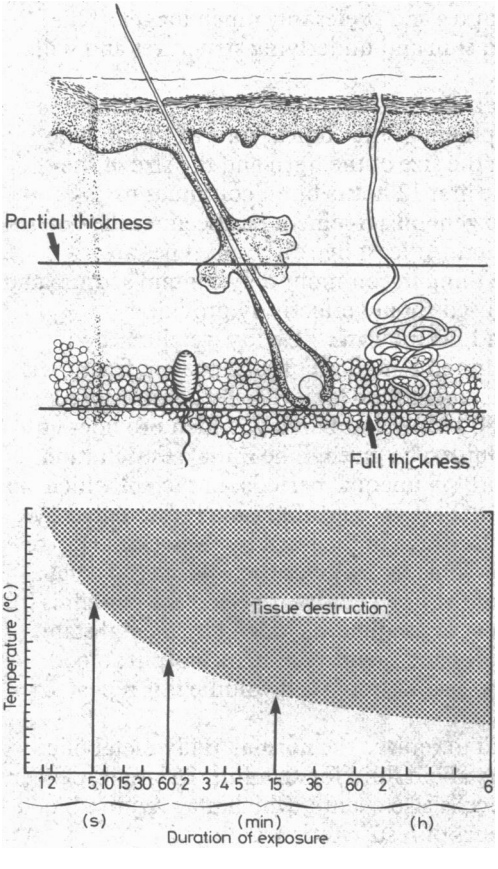
D M DAVIES

BURNS



Thermal injury is common, often sustained in a domestic setting. Most injuries are minor. Each year, however, 12 000 patients in England and Wales are admitted to hospital, of whom only a small proportion require treatment in a specialised burns unit. The most common injury is that sustained by the inquisitive toddler who pulls down a container of hot liquid over himself, scalding his outstretched arm and often the anterior aspect of the chest, neck, and face. Burns can produce a heavy workload for a hospital and considerable morbidity for the patient. Their management requires an understanding of not only the pathophysiology of the local skin injury but also the vascular, metabolic, immunological, and psychological changes.

Pathophysiology



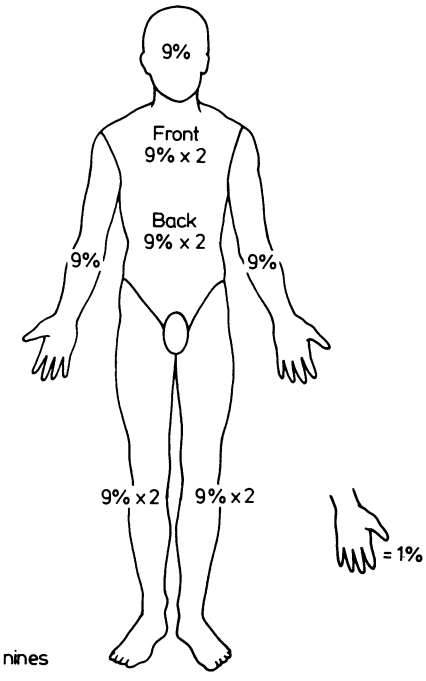
Burns may be classified as partial thickness (will heal spontaneously from epithelial remnants that survive deep in the dermis provided that these are not killed by dehydration or infection) or full thickness (all epithelial appendages are destroyed and epithelialisation therefore can occur only slowly from the edges of the wound; a skin graft will generally be required to achieve skin cover).

The depth of tissue destruction is a function of the temperature and duration of exposure. Most burns do not require enormous temperatures, and tissue destruction can occur at only 45°C provided this is applied for long enough.

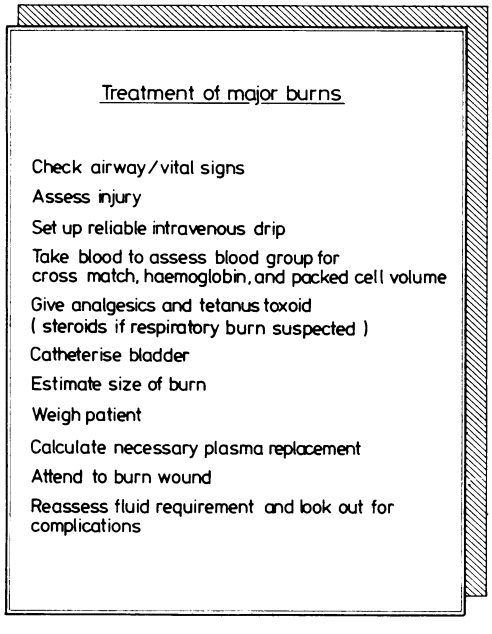
Within a major burn injury will not be uniformly deep. Centrally there is a zone of coagulation where cells are irreversibly damaged. Surrounding this is a zone of stasis in which, although the cells are injured, they can survive if the burn is correctly treated. Outside this is a zone of hyperaemia in which the cells are minimally injured and will recover within seven days.

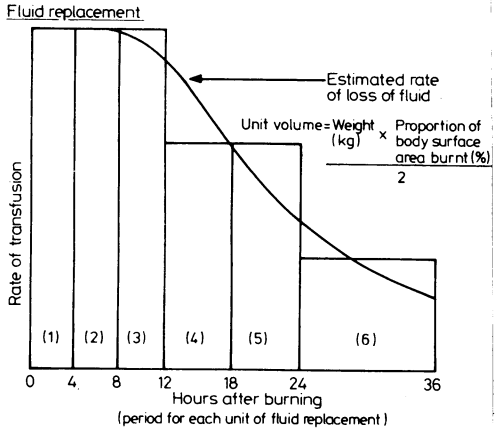
The stratum corneum (the superficial layer of the epidermis) has been described as the waterproof mackintosh of the body. When it is destroyed, as in both deep and superficial burns, water will be lost from the body by evaporation. At the same time the underlying capillaries of the dermal plexus will dilate and fluid and large protein molecules will be lost into the surrounding extracellular space. This will become apparent as oedema and blisters. In addition, in larger burns systemic changes will occur, affecting the heart and lungs and other undamaged tissues, which will also tend to take up water. This fluid loss, which is greatest in the first few hours and continues for at least 36 hours, will if large enough lead to the clinical state of shock. For this reason patients require resuscitation with intravenous fluids. The fluid loss is not greatly influenced by the depth of the injury.

Management



Rule of nines





HISTORY

Important factors are:

The patient's age—burns at the extremes of age (less than 3 years and greater than 60) have a greater morbidity and mortality.

The type of injury—electrical burns tend to be deeper than scalds.

The time of the accident—fluid replacement should be calculated from this time not from when the patient entered the casualty department.

Other relevant medical conditions—for example, alcoholism, epilepsy, diabetes, artherosclerosis, drug abuse.

EXAMINATION

Size—This may be expressed as a proportion of the total body surface area, which may be easily assessed by the "rule of nines," noting also that the palm of the hand is equivalent to 1% of the body surface area. Different calculations are required for children because the head is larger relative to the rest of the body. In general, burns greater than 10% in children or 15% in adults will necessitate intravenous fluid replacement. Smaller burns can be managed by oral fluid replacement.

Depth—The depth of a burn may be difficult to diagnose initially, especially in children. In general, if the burnt area is erythematous in colour and blanches on pressure it is of partial thickness. Similarly, if the burnt area retains pin prick sensation (repeated light pricking over a small area) the injury is probably of partial thickness as the nerve endings tend to lie just below the deepest penetration of the sweat glands—that is, at the lowest level of epithelial cells.

Location—Burns of the face, neck, hands, feet, and perineum may cause special problems and warrant careful attention.

TREATMENT

The table gives the 11 most important steps in treatment of major burns.

First aid treatment—Remove overlying clothing immediately as heat is retained within the fibres of the garment. Then immerse the damaged area in cold water for at least 10 minutes and preferably much longer. This immediately cools the damaged skin and underlying structures and will prevent further damage.

Fluid replacement—For larger burns intravenous fluid replacement is required to prevent the development of the clinical state of shock. The amount of fluid will depend on the size of the burn and the size of the patient. More fluid is lost in the first 12 hours but it continues to be lost for at least 36 hours. No general agreement has been reached on the best type of fluid for resuscitation. At least five different types are recommended but all have one thing in common: they contain sodium and water. The amount of fluid infused should effectively provide 0·5-0·6 mmol(mEq) sodium and 2-4 ml water/kg body weight/% body surface area damaged. In the United Kingdom plasma protein fraction is the most commonly used replacement fluid. It is usually administered according to a formula devised by Muir and Barcley, which provides an initial guide to the amount of fluid to be given. The initial resuscitation period of 36 hours is divided into six unequal periods, in each of which an equal volume of plasma is given. This volume of plasma is calculated by multiplying the percentage surface area of the burn by the weight (kg) of the patient and dividing by two. This figure gives the volume (ml) that should be infused. At the end of the first four hour period the patient is assessed, and if fluid replacement is adequate as judged by mental state, pulse rate, blood pressure, quality and quantity of urine output, blood haemoglobin concentration, and proportional cell volume it is repeated again for a further period.

Additional fluids are required to replace the normal, daily metabolic requirements of roughly 3 l crystalloid fluid for an adult. In larger, deeper burns destruction of red blood cells also occurs, which may require blood transfusion in the second 24 hours of resuscitation.

Important factors in electrical injury

- Type of current
- Voltage of current
- Amperage of current
- Resistance offered by body
- Pathway of current through body
- Duration of contact

Complications of electrical injury

- Cardiac arrest
- Renal failure
- Renal calculus
- Spinal cord damage
- Cateract formation

INHALATION INJURY

The inhalation of poisonous gases is the single most lethal component of a burn and should always be looked for at the initial assessment. Apart from the history of the accident having occurred in an enclosed space, examination may show burnt skin around the mouth and nostrils with carbon inside the nose and oedema of the oral, nasal, and pharyngeal mucosa. Inhaled hot air damages the upper respiratory tract and, in particular, produces oedema of the larynx. This is usually diagnosed early and can be compounded by hypoxia, the inhalation of carbon monoxide and, particularly in a domestic setting, very toxic gases such as hydrogen cyanide, which are released from the combustion of synthetic modern upholstery. The damage produced by these chemicals tends to become apparent later and affect the lower respiratory tract leading to atelectasis and pneumonia. Investigations include baseline chest radiography, monitoring of blood gas and serum carbon monoxide concentrations, and examination of the upper respiratory tract by laryngoscopy and fibreoptic bronchoscopy. Treatment rests on the inhalation of humidified air, correction of pulmonary oedema, and the administration of prophylactic antibiotics. Treatment with a short course of high dose steroids may be helpful. More severe injuries require oxygen treatment, and if the blood gases deteriorate positive pressure ventilation may be required. Tracheostomies are generally best avoided.

ELECTRICAL INJURY

Resistance to the flow of electrical current results in the production of heat. Bone has the highest resistance, followed by in descending order, fat, muscle, skin, blood vessels, and, least of all, nerves. Skin epidermis is non-vascular and offers a high resistance when dry, but this resistance is proportional to the thickness of the skin, its temperature, and the amount of moisture it contains. Skin can be damaged by either the flow of electricity through it, an arcing injury, or by the ignition of clothing causing flame burns. Deeper damage depends on the path of the electric current. Passage along bone produces the greatest heat and will result in adjacent deep muscle damage. The indication for a fasciotomy (releasing of the deep fascia) may not initially be evident. Delay results in even more muscle necrosis from ischaemia caused by the unrelieved oedema. The passage of the current along blood vessels can produce intimal damage with vessel thrombosis. This will in turn produce tissue death, which may become apparent only later. Both these factors account for many electrical burns being far more extensive than was apparent at the initial examination.

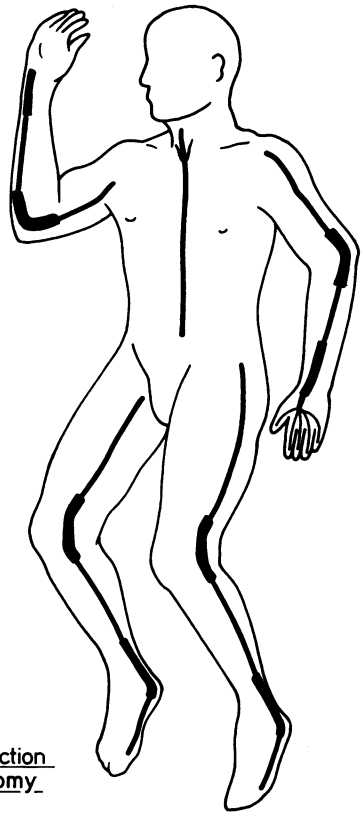
Agents causing chemical burns

Agent	Common use	Cleansing and dilution	Special treatment
Lime	Agriculture	Brush off,	
	Cement	then water	
Oxidising agents			
Potassium permanganate, Sodium hypochlorite	Disinfectants, bleach, deodorisers	Water	
Chromic acid	Metal cleansing	Water	
Corrosives phenols			
Phenols	Deodorisers, sanitisers, disinfectants	Ethyl alcohol	
White phosphorus	Armaments industry	Water and debride particles	Irrigate with 1% $CuSO_4$
Hydrofluoric acid	Etching	Water	Topical calcium cream

CHEMICAL BURNS

The severity of a chemical burn depends on the agent encountered, its concentration and quantity, and the length of time the tissues are in contact with it. Chemical burns are often deeper than they initially appear to be and may progress with time. Initial treatment is dilution of the chemical, which is usually best achieved by prolonged submersion in continuous running water. In general, neutralising agents are contraindicated as they may cause exothermic reactions and increase tissue damage. Damage to the eye should be managed by initial copious irrigation with saline or water, and an ophthalmic opinion should be obtained.

Management of the burn wound

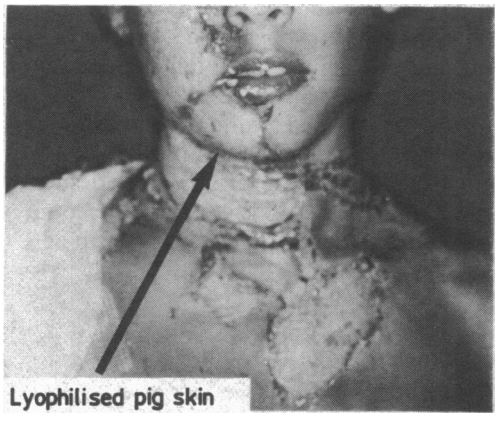


Sites for election of escharotomy

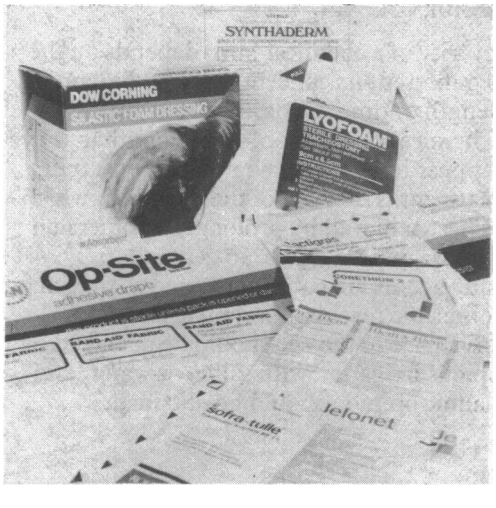
Treatment is initially aimed at relieving pain, which is greatest in superficial burns. This is best achieved by covering the exposed injury with a dressing, which should also provide optimum conditions for epithelial regeneration. Dehydration and infection are the two principal causes of epithelial death, and the dressing should be designed to prevent these occurring. Prophylactic antibiotics are not generally given, but topical antiseptic agents are often used, for example, silver sulphurdiazine cream, which is particularly effective against pseudomonas. In children the depth of the burn is difficult to diagnose; consequently, most are treated initially by conservative measures and spontaneous healing awaited for two to three weeks. Any area that has not healed after this time may be regarded as full thickness and treated with skin grafting. In specialist hands there is a case for early excision and grafting for this type of injury. Adults with an obvious well circumscribed full thickness burn are best treated by early excision and grafting before infection develops. Larger burns treated in specialised units are usually serially excised and skin grafted as donor site skin becomes available.

Deep circumferential burns require special consideration. In the arms and legs they can embarrass the circulation and about the thorax they can restrict respiratory movements. The eschar in these cases should be divided longitudinally, which can be done without any form of anaesthesia. Eyelid damage presents a serious threat if the cornea is exposed. Fortunately, full thickness damage is rare, and split thickness skin grafts applied under Stent moulds permit resurfacing of the lids.

Dressings



Lyophilised pig skin

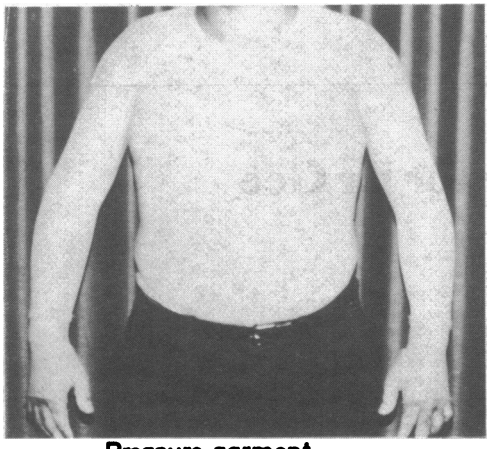


The standard burn dressing consists of gauze impregnated with soft paraffin, which helps to prevent adherence to the wound. A topical antiseptic may be applied over this followed by cotton wool or Gamgee to absorb the exudate. Newer dressings have been introduced that are claimed to be less adherent and allow less water to be lost by evaporation from the wound while also protecting it from external pathogens. These may be classified into two groups:

(1) *Biological dressings*—These may be of homograft or heterograft skin—for example, porcine or amnion. They can be used either fresh or after storage following preparation by freezing in liquid nitrogen or rapid dehydration (lyophilisation) and later reconstitution with saline. One of the more commonly used is lyophilised pig skin. Pig skin was originally used as a dressing in the late 1800s but it had to be abandoned because of antivivisection pressure at that time. It was reintroduced in 1965. Whichever dressing is used, they principally consist of an adherent collagenous dermal surface and a keratinised waterproof epidermis. Criticisms of these dressings go back 130 years to Dupuytren who described "incorporation into the integument," and antibodies may be shown as a response to foreign proteins trapped within the dermis.

(2) *Physiological dressings*—These consist of synthetic materials such as polyethylene or silicone, which prevent adherence to the wound, and plastic films, which reduce evaporation and contamination.

Late treatment



Pressure garment

On discharge from hospital patients will require regular review. Treatment is directed at relieving the initial local symptoms, which are usually quite severe itching and dryness. Lanolin (face cream) can be lightly massaged into the grafted area. Topical pressure as provided by elasticated, individually made garments has radically altered the management of these patients. Not only does it alleviate the itching symptoms but it has also been shown to prevent contractures. Scarring can impose severe functional and cosmetic disability. Where there is functional limitation of movement at joints or around the orifices of the face release of the scars with skin grafting is required. Many patients, however, are referred later with cosmetic deformities. Shaving of the wounds down so that they are flat followed by overgrafting has not proved a satisfactory way of managing these patients, and some may therefore require prolonged psychological support.

Mr D M Davies, FRCS, is consultant plastic surgeon, West London Plastic Surgery Centre, West Middlesex University Hospital, Isleworth, and consultant plastic surgeon and honorary senior lecturer, Royal Postgraduate Medical School, Hammersmith Hospital, London W12 0HS.

MATERIA NON MEDICA

A visit to Sappho

For years we had wanted to explore Lesbos, "Where burning Sappho loved and sung." So one day we left a cold, wet, and windy London and after just two hours' flight landed at the sun drenched airport of Mytilene, the capital of the island. Mytilene has little to endear itself to a philhellenic visitor, being ramshackle, tawdry, and rather squalid, except for some fancy Victorian houses and the splendid ruins of a large 16th century Genoese castle on top of a hill that divides the old harbour from the new. The view from the top is vast, extending over the intense (almost methylene) blue of the sea towards the distant Turkish coast and suggesting the ancient trade route of the Hellespont, when Lesbos was one of the wealthiest Greek islands, with close commercial links with the Orient (in Naucratis in Egypt the seamen and traders from Lesbos had their own enclave and shrine).

According to Herodotus, the population of the island was of Aeolian stock, from Beotia. The Lesbians were conquered by the Persians in the 5th century BC, but then joined the first Delian League under the hegemony of Athens. During the Pelopponesian war, however, Lesbos rose against the Athenian oligarchy, who resolved to punish the rebels by sending a naval force to Lesbos with orders to kill every male on the island and take all the women into slavery. The ships were already on the way when the Athenian assembly cancelled this cruel decision and sent a trireme with a counter order. Its oarsmen reached Mytilene just in time to stop the wholesale execution. In its later turbulent history Lesbos flourished in the Byzantine age, but was later occupied by the Seljuks, Venetians, Genoese, and Turks, and eventually annexed by Greece.

The island is breathtakingly beautiful; its topography reminds one of a giant polymorphonuclear cell, with the mountainous bilobed nucleus deeply indented by the gulf of Kalloni, and the peripheral coastal lowland forming a densely inhabited rural cytoplasm. Unusually for an Aegean island, Lesbos is heavily wooded, Mediterranean pines, poplars, and miles of olive trees forming a dense cover. The fertile soil produces grain, oil, and wine; there is a substantial sardine fishery.

Two towns, Mytilene and Eressos, claim to have been the birthplace of Sappho, the most illustrious Greek lyric woman poet, who was born around 610 BC. She belonged to the upper crust of the local gentry; her husband Cercolas was a wealthy man, and they had a daughter, Cleis. Many stories about Sappho's life, and especially her illicit affair with Phaon, are certainly invented, and modern studies of her life and work lay less emphasis on the erotic aspects of her poetry, pointing out that it was fashionable in her time to form closely knit female social circles devoted to poetry, dance, and music. It seems certain that within such groups intimate friendships and bitter jealousies flourished just as in some college "sororities," and that the inflamed emotions were expressed with a passion that suggested more than it intended. Nevertheless, in some of Sappho's poems, such as that addressed to Atthis leaving to get married, there is the tone of real despair. The nuptial songs (epithalamia) influenced many Greek poets, including Theocritus, the master of bucolic verse.

Much mystery surrounds the way Sappho's work was copied and circulated in her own time and for centuries after her death. Most of it did not survive the destruction of the Alexandrian library during Caesar's siege—only fragments of nine rolls remain in the quotations of other Greek authors, although some additional papyri were discovered at the end of the 19th century.

Whatever the truth about Sappho's sexual predilections, her glory as the "Tenth Muse" remains undiminished and the present inhabitants of Eressos named their main city square after her, perhaps to support local tourism. Many multinational adherents of the cult of homosexual love gather at the distant beaches, but the local population is very understanding, and regards their antics with amused tolerance.—L J BRUCE-CHWATT, retired professor, London.

Maps and memories

As I write this, the shortest day of the year is approaching and the coldest winter months are still ahead. I can sit in my room, however, and looking at the maps on the walls be reminded of my spring, summer, and autumn outdoor trips of the past few years. These maps are more evocative of memories than photographs, as each line I have drawn on them brings back a whole series of days rather than just one moment.

The apparently most simple map is just a collection of black lines on a white background; there is not even a title. It is The Black Cullin of Skye, and on to the map I have drawn a line showing the ridge and red ones for my ascent to, and descent from, it last summer. I passed, in good company, a memorable twenty four hours on the ridge, partially traversing it. A night spent on Sgurr Dearg particularly comes back to mind. We settled to rest late in the evening and sat watching as the sun slowly settled over the sea, perfectly quiet and fortunately midge free as it was early in the season. It never became fully dark through the short night, and although not cold I awoke several times to see stars through an extremely clear pale sky. Dawn came early and at four o'clock I stood on the ridge looking at the new red sun as it appeared through the lower lying cloud which we were well above. All around below was a dense white layer obscuring the further lands and sea and giving a peaceful sense of isolation. Somehow summer does not seem so far away.—MICHAEL HERBERTSON, medical SHO, Gateshead.