Burn Injuries

by **Paddy Bourke EMT-D**

L-R: An example of first, second and third degree burns

Every seventeen seconds someone will be burned. Some of these burns will be minor, caused by touching off an iron or grill, or receiving a small spot burn. Others will be more serious. The most common site of burn injury is the home. Those most prone to burn injury are children, the elderly and the disabled. Occupations that present the highest risk for burn injury include electricians, and people who work in the chemical, petroleum and food services industry.

All burns should be treated with concern. It is important to keep in mind the golden rule of burns management: If someone has a burn on their body the size of the palm of their own hand (1 per cent TBSA), where blisters are present or suspected, this person should seek medical attention, either by going to a doctor or by referral to casualty. Extra care should always be taken where the face, hands, feet, groin, perineum, and major joints are concerned.

In the front line situation the burn area is usually measured by the rule of nines according to which the body is segmented into divisions of 9 per cent or a multiple thereof. For example, an adult head is 9 per cent, an adult leg (front and back) is 18 per cent. The only exception to this rule is the groin area, which is calculated at one per cent.

The measurements for a child are different to those of an adult. For example a child's head constitutes 18 per cent, as opposed to 9 per cent in an adult.

Burn depth

Burn depth is measured in one of the following three categories: superficial, partial, and full thickness burns (first,

second and third degree respectively).

Superficial: These burns involve only the epidermis, the colour of which may vary from pink to red. They usually heal within three to six days and can be quite painful. The outer layer of skin may peel away and reveal new healed skin underneath with no residual scarring. A common example of superficial burns is sunburn.

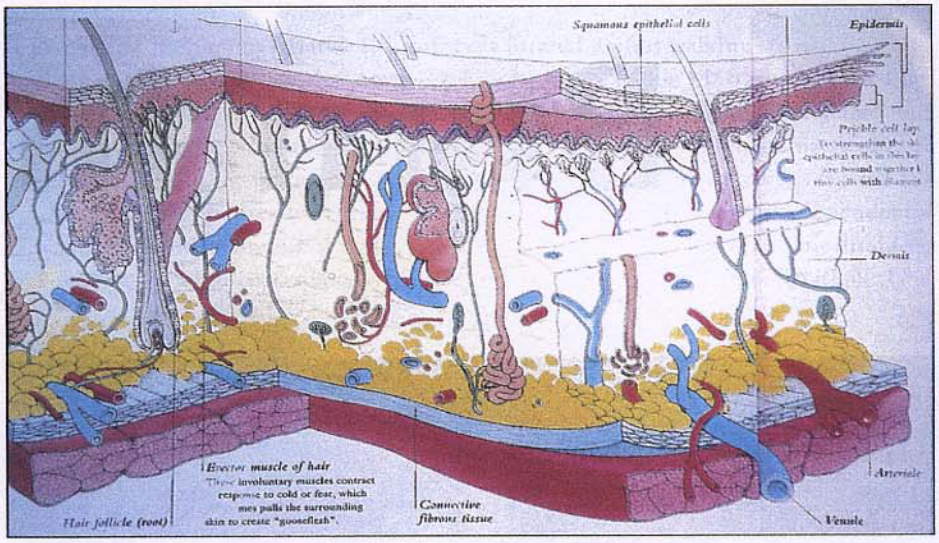
Partial Thickness: This category can be divided into two sections – superficial partial thickness and deep partial thickness burns.
Superficial partial thickness burns involve the epidermis and dermis, it will often be bright red, blistered and painful. These burns can take up to 21 days to heal usually with no scarring.
Deep partial thickness burns will include all of the epidermis, and deep into the dermis, the site of insult may be dry or wet, and capillary refill will be reduced, sensation to pressure remains intact, and the site is less painful. These burns take a long time to heal and may result in hypertropic scarring if not excised and grafted.

Full Thickness: This burn will involve all layers of the skin, and possibly subcutaneous fat, muscle, and bone. They may present as charred, waxy, mottled, leathery, pale and dry, and will be firm to the touch. These burns are in a semi-anaesthetic state and will not be sensitive to pain and light touch, they will require excision and grafting.

Heat sources

With burn injuries there are five heat sources: thermal, chemical, mechanical, electrical and radiation.

Thermal: This source is divided into two categories – Dry Thermal and Wet



Detailed diagram of the epidermis

Thermal injuries. Dry thermal will involve flame (direct contact), very hot objects, and heat from a fire site. Wet thermal will involve steam and hot liquids.

When managing dry thermal injuries the following points should be considered, all burnt clothing, and foreign objects on the burn location *must not* be removed, the body's defence mechanism will start to send fluids to the site, thus causing edema, in those circumstances where there is a concern that constrictive clothing, jewellery, footwear, etc. will prevent perfusion of the location. Cut the offending item of jewellery or clothing and allow it to expand on site.

Wet thermal injuries are caused by hot liquids such as boiling water, coffee, tea, soup, chip pan oil, tar, molten liquids, etc.. If clothing is saturated it will have to be cooled and removed, otherwise it will continue to act as a heat source. If possible try not to deroof underlying blisters. With an exposed scald injury immediate cooling can be started.

Chemical: The source for this category is all chemicals both wet and

dry, alkalis, and hydrocarbons and phenols (industrial cleaners, solvents, degreasing agents, petrol, etc.). Chemical burns are not usually thermic, but are caused by tissue reaction to **noxious** substances, the amount of tissue damage will depend on the chemical and exposure time. This category is an anomaly in that full irrigation of all liquid chemical spill sites must take place prior to any cooing procedure, large amounts of flowing water will be required to wash away and break down the chemical or chemicals in question. It is worth considering using warm water for irrigation as this will help to protect the core temperature of the patient.

Remove all saturated clothing, footwear, watches, jewellery, etc. from the patient. Dry chemicals *will not* be irrigated, only brushed or blown away off the patient. Once full brushing or irrigation has taken place there will be a residual burn, this site will then be managed by the standard recognised protocols. If there is a considerable spill of hazardous chemical you should notify the local county fire service.

Mechanical: The main source of a mechanical burn will be surface friction, e.g. carpet burns, plastic, playing pitches, rope burns, RTA involving motor cyclists. Mechanical burns will always occur where the skin is in contact with a surface moving quickly in the opposite direction.

Electrical: Patients in this category will have been in contact with one of three sources of electricity: alternating current, (AC) direct current (DC), or three phase (industrial electricity). Electrical injuries can be classified into three groups: True Electrical Injury, Arc burn, and Electrical Thermal Burn.

True electrical injury occurs when electricity passes through the body after contact with an electrical conductor. This burn will present the classic entry and exit wounds, along with deep tissue destruction. Because the entry and exit wounds have been cauterised, the patient may not be able to say where the exit wound is, because the wound sites are in a semi-anaesthetic state. However, they may complain of an aching pain in their heel or toe or some other location, this is usually the point of exit.

With an *Arc burn,* the victim is not in actual contact with electricity, but occupies the space where there is a differential electrical potential between the victim and the electrical source. These injuries are most common with high tension current. There may be an entry and exit wound. Usually there are scattered spots of injury where the current made momentary contact as it jumped to ground. Note: extremely deep burns can occur if the arc is close to the body.

Electrical thermal burns are caused by sparks or electrical arcing close to the body which ignites clothing or results in facial blast. Cardiac complications should always be considered when called to an electrical burn injury, on arrival make sure that your patient is disconnected before approaching.

Radiation

In Ireland our primary source of radiation concern is the sun. In the northern hemisphere our sun is extremely violent, due to the depletion of our ozone layer. This combined with our pale skin pigmentation, can subject us to danger of extreme sunburn if we do not heed the warnings issued by our plastic and casualty consultants. In the case of serious sunburn, where blisters are present medical intervention is advised.

Cold burns

There is one category of burn not

KEY TERMS

OEDEMA
An excessive accumulation of serious fluid in the intercellular spaces of tissue

NOXIOUS
Poisonous or harmful

HAEMOGLOBIN
A protein that gives red blood cells their characteristic colour. It combines reversibly with oxygen and this is very important in the transportation of oxygen to tissues.

CRYOGENIC BURN
A burn resulting from very low temperatures

addressed in the above list, ***CRYOGENIC*** *or cold burn. In the case of any of the above five, we are trying to cool the site of insult down to 37 degrees, with a cryogenic burn we want to bring the injured area back up to 37 degrees, this will be dealt with in a later article.*

Inhalation injuries

The respiratory complications associated with cutaneous burns and smoke inhalation present an enormous clinical challenge to our casualty units and burn centres. An inhalation injury can be in one or all of the following three stages: Supralottic injury, tracheal mucosa insult, and carbon monoxide poisoning. Before we go into this let us consider the following fact: **haemoglobin** carries oxygen around the body feeding the tissues, but carbon monoxide (which is a common by-product of the combustion of organic material) has a 200 fold greater affinity for haemoglobin than oxygen, this in turn further decreases the blood's ability to deliver oxygen to the tissues.

Supraglottic (Nasopharynx) Injury

In the event of a flash explosion or fire the normal reaction would be to shut our eyes and take a breath, unfortunately we may breathe in hot air, airborne particles, and smoke. In the case of supraglottic injury it is the inhalation of hot air and steam that will cause inflammation of tissue within the nasopharynx.

Tracheal mucosa insult

Another mechanism for respiratory problems is the deposit of airborne particles on the lining of the bronchi and alveoli, the resulting chemical reactions within the smaller airways will lead to bronchoconstriction, pulmonary edema, and mucosal sloughing of the lower airways.

Child burnt by teething on electric cable

Signs to look for indicating possible inhalation injury, any facial burns, burnt eyebrows, singed nasal hairs, sooty sputum, swollen lips, dry cough (steam).

It is important when presenting the burn patient to the casualty department or burns unit to give a general description of the location and circumstances from where the burn patient was removed, as this will help the burn carers to decide more quickly what treatments to give to the patient.

Carbon monoxide poisoning

If we light a fire out in the open the carbon monoxide level may reach 35,000 ppm (parts per million) but in an enclosed space such as a house, these levels may reach highs of 570,000ppm, the carboxyhaemoglobin level in any on patient is a result of the ambient concentration of carbon monoxide as well as the time of exposure to the toxic agent. Carboxyhaemoglobin levels of 70 per cent may occur after only one or two minutes of exposure at CO concentrations of 10,000ppm.

A woman suffering from severe sunburn

Carbon monoxide is a major contributor to early deaths following smoke exposure. These early deaths are usually a manifestation of central nervous system and cardiac ischemia.

Burn site management

The four primary concerns for the management of a burn site are:

- Seal the burn from further airborne contamination.
- Cool the burn site as soon as possible.
- Retain vital fluids on site.
- DO NOT induce hypothermia.
- Human skin cooks at 104 degrees, human bone carbonises at 1400 degrees.

Why are the current first response burn management protocols on our front line emergency vehicles?

Water will always be the first response medium for burns. But although water may eventually be effective in cooling the site, it will not seal the burn site from airborne contamination, yes it will cool the site, eventually. If the burn is an open wound the water will wash the fluids away from the site, and because of the recommended time required for immersion in water for cooling, hypothermia is a serious possibility.

Water Jel burn dressings were developed for immediate burn management over 17 years ago in America, they are a gelatinised water mix designed to perform the four main concerns for burn management in one application. Because of their gelatinous nature they seal the burn from further airborne contamination, they cool the burn site by heat transfer into themselves, the fluids on the burn site cannot soak into the dressing nor can they evaporate through them. And finally as the burn site cools down the dressing warms up, leaving the site surrounded by a warm dressing, helping to keep hypothermia away. Remember that human bone will carbonise at 1400 degrees, dressings could melt onto the site. Water Jel burn dressings will absorb temperatures in excess of 2000 degrees. There is plenty of extra gel to use on any hypoeraemic or stasis sites surrounding the main burn, it can be left on for four hours plus.

Always remember to protect the core temperature of the burn patient, use a space blanket inside an ambulance blanket.

Conclusion

Responding to a burn call is never an easy one, but if one can focus on and understand the circumstances and requirements of the incident it will go a long way to easing the pressure of decision on the responding Emergency Medical Technicians, and at the same time allowing them to give comfort to their patients. ■

References

Gretchen J. Carrougher/*Burn Care and Therapy*, First Edition, Mosby, 1998

According to the national guidelines, each ambulance should be equipped with two burns packs. Each containing the following:

- Four conforming bandages 10cm X 4m
- One sterile burn-wrap blanket(body) 91.0cm X 76.0cm
- Two sterile, Water-Jel soaked burn dressings 20cm X 45cm and 10cm X 40cm
- One sterile Water-Jel soaked face mask 30.5cm X 40.5cm

Water-Jel is a unique multi-purpose product for emergency burn care and fire protection. This one-step product helps to rapidly reduce and then stabilise peripheral temperature within the normal range, helping to relieve the pain and protect the covered wound from further contamination whilst not contributing to any hypothermia which may result from a large area burn

Tools *of the* Trade

BURN PACK

If there is a chance that the patient is to be referred to a specialist burns unit, the dressing and Water-Jel content should not be discarded, as the benefits of Water-Jel during further transportation of the patient will be lost. Water-Jel may be removed from the patient and re-applied, it will maintain its properties and optimum effect for over four hours from initial application.

The Water-Jel Sterile Burn Dressings consist of a scientifically formulated cooling gel and medical grade non-woven carrier. When applied to the wound, these burn dressings cool the burn, relieve the pain, protect against airborne contamination and retain vital body on site. Water based and water soluble, Water-Jel Sterile Burn Dressings won't stick to the wound and may be applied directly over clothing. They are available in different sizes to accommodate a variety of emergency situation

Water-Jel Fire Blanket. When placed on the victim these blankets help stop the burn progression, ease the pain, cool the skin, protect against airborne contamination and stabilize the victime for transportation, all in one simple, easy step. They can also be used to extinguish flames on a victim, protect from intense heat and extinguish small fires.

Water-Jel Fire Blankets consist of a scientifically formulated cooling gel and a special carrier. The gel is biodegradable, bacteriostatic and water soluble. The carrier is a 100 per cent worsted wool with an intercellular weave capable of absorbing up to 13 times its own weight.

Face Mask

The Water-Jel face mask allows for free access to nasal passages, mouth and eyes, protects covered wound from further contamination and helps prevent burn progression. ■