- It is a big problem in trauma (15% of all traumas).
- It is an independent cause of mortality.
- It is preventable.

- Solution: Think Tropical Always

WHAT IS HYPOTHERMIA?

Hypothermia ≤ 35°C
Severe ≤ 32°C.

WHAT IS THE INCIDENCE OF HYPOTHERMIA IN TRAUMA PATIENTS?

A study performed by Keith Gunning at Liverpool Hospital showed that 17% of patients with an ISS of more than 15 were hypothermic (< 35°C) at some stage during their first 24 hours in hospital. 3% of patients became hypothermic in the ED or CT scanner. All patients who underwent surgery in the first 24 hours were normothermic in the ED and became hypothermic in the operating theatre (OT).

The incidence of hypothermia in trauma victims in other countries may be as much as 50%. In some of these studies the greatest temperature losses occurred during the resuscitation period. In another study, 18% of trauma patients became hypothermic in the ED and only 1% of patients became hypothermic in the OT. Nonetheless, 47% of patients who had a trauma laparotomy were hypothermic in the OT.

REMEMBER - WARM THEM EARLY AND KEEP THEM WARM.

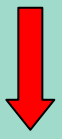
PRE-ARRIVAL PREPARATION IN RESUSCITATION

- Give warm fluids only.
- Keep patient covered.

COMPLICATIONS OF SEVERE HYPOTHERMIA

- Cardiac dysrhythmia.
- DIC.
- Stress ulcers.
- Pneumonia.
- Infections.
- Renal failure.
- Hepatic failure.
- Pancreatitis.
- Diabetes-like syndrome.
- Hypoglycaemia.

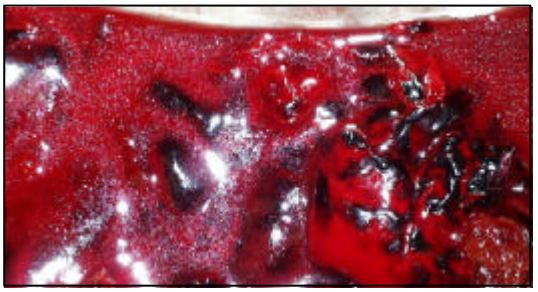
THE BIGGEST CAUSE OF HYPOTHERMIA IS BLEEDING



CONTROL HAEMORRHAGE EARLY!

COAGULOPATHY

The direct effects of hypothermia on clotting mechanisms are difficult to measure and are frequently masked by dilutional coagulopathy or DIC in the trauma setting. Hypothermia *per se* does not result in a reduction in clotting factor levels and conventional clotting studies will be near normal. Routine clotting tests are performed on blood that is warmed to 37°C.



When these laboratory tests are repeated at hypothermic temperatures the clotting times are prolonged in a dose-related manner. A temperature of 32°C equates to clotting factor activity of 2.5% of normal. It is postulated that the major effect on clotting factors during hypothermia is on the kinetic activity of clotting enzymes.

The appropriate treatment for hypothermia-induced coagulopathy is rewarming rather than administration of clotting factors.

Hypothermic coagulopathy is implicated as the cause of significantly increased blood loss and increased mortality following trauma laparotomy. Even when patients were stratified by injury severity score (ISS), blood loss was significantly increased by intraoperative hypothermia.

MYOCARDIAL ISCHAEMIA

Inadvertent peri-operative hypothermia has been shown to be associated with myocardial ischaemia, angina and hypoxia (PaO_2 < 80mmHg). A randomised, controlled trial of routine vs supplemental warming care in patients undergoing abdominal, thoracic or vascular surgical procedures with pre-existing coronary disease showed that maintaining normothermia reduced the risk of cardiac events by 55%.

OUTCOME

It has been pointed out that hypothermia naturally occurs during the process of dying and that retrospective data simply identify those that are succumbing to their injuries.

There are a number of retrospective studies identifying hypothermia as an independent predictor of poor outcome in trauma patients. The landmark study of Jurkovich *et al* showed that a core temperature of 35 - 32°C was associated with a significant increase in mortality from trauma. Patients with core temperatures less than 32°C were unlikely to survive.

More recently the same investigators in Seattle have published a number of papers extolling the virtues of rapid correction of hypothermia. A recent study was a randomised, controlled trial of conventional rewarming vs rapid rewarming of critically ill trauma patients. Rapid rewarming was achieved using a continuous arteriovenous rewarming device (CAVR) similar to an AV haemofiltration circuit, but with the filter replaced by a heat exchanger.

CAVR patients were rewarmed more quickly and required less fluid during resuscitation (~24L vs ~33L). Patients who underwent CAVR had significantly less early mortality (although the mortality advantage was non significant at discharge).

The case for rapid restoration of normothermia in the trauma patient is strong but not without dissenters. Those concerned with the treatment of brain injured patients point toward a small number of studies that suggest a beneficial outcome from hypothermia. These studies are

related to the treatment rather than resuscitative phase of the patients' hospitalisation and not necessarily to patients with multiple injuries.

WHY DO TRAUMA PATIENTS BECOME HYPOTHERMIC?

- **Environmental exposure (pre-hospital and in hospital).**
- **Impaired heat production.**

The influence of environmental exposure is compounded by the reduction in heat production that is a feature of traumatic injury. Severely injured patients do not increase their metabolic rate to compensate for heat loss in the same way as the uninjured. An increase in metabolic heat production may simply be impossible during traumatic shock as the tissues are no longer adequately supplied with oxygen. Rapid resuscitation following trauma produces a rise in oxygen consumption above normal, suggesting that the metabolic response is appropriate when the tissues are adequately perfused.

HOSPITAL ENVIRONMENT

Particularly during the summer months a trauma patient may be exposed to a worse thermal environment when admitted to hospital. Most areas of the hospital, including the ED, OT and ICU are air conditioned and the temperature and humidity may both be considerably lower than outdoors. A normal human's thermoneutral temperature when naked is 28°C. When exposed to a typical ED environment with dry air at 22°C, radiant and evaporative heat loss will continue unless specific measures are taken to reduce them. Many normothermic trauma victims become hypothermic in the ED.

RESUSCITATION AND INVESTIGATION

Exposure of the patient must, of course, continue to allow a thorough survey of injuries. Exposure is also necessary for many of the routine or diagnostic procedures associated with trauma resuscitation. Bladder catheterisation, peripheral and central intravenous access

and peritoneal lavage will all expose a good deal of the patient to further heat loss.

Intravenous fluids are seldom at optimal temperature when infused into the patient, despite efforts to warm them. Even normothermic fluid will simply prevent further heat loss rather than treat hypothermia from other causes. Room temperature crystalloid (the 'hanging bag') and poorly rewarmed blood products will significantly contribute to heat loss.

Initial and definitive radiological investigations require the removal of 'excess' coverings, and transfer to the x-ray department may increase environmental exposure, as well as postpone rewarming techniques.

Intubation bypasses the body's normal humidification system. Up to 10% of total heat loss occurs via respiration, principally due to the specific latent heat required to vaporise water and humidify the inspired gases. Active warming and humidification of the airway is rarely a feature of ED resuscitation.

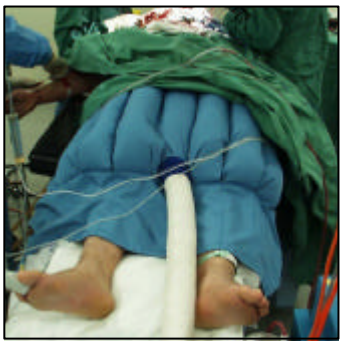
ANAESTHESIA AND SURGERY

The patient requiring surgery will be subjected to a whole new range of heat losing opportunities.

The **thermal environment** may be even worse than the ED as modern theatre suites possess air conditioning systems with high rates of air exchange. Evaporative heat loss is dramatically increased by air flow, particularly over moist body surfaces or cavities. In addition, conduction to the operating table becomes a significant factor.

Surgery itself demands not only exposure of relatively large areas of the body surface, but also involves covering significant areas in cold skin cleaning solutions, some of which are more volatile than water and will cause significant cooling during vaporisation. During any operation there is the potential for further blood loss, requiring fluid replacement. One or more body cavities may be opened, greatly increasing evaporative heat loss.

Anaesthesia causes the greatest heat loss in the OT despite all these 'surgical' factors. This occurs in four distinct ways:



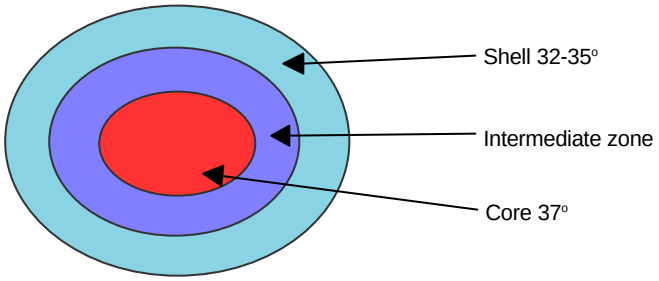
1. All forms of anaesthetic agent reduce the basal metabolic rate from a normal of 50 to 40 W/m^2 .
2. Anaesthesia and muscle relaxation abolish shivering thermogenesis, which can increase heat production by up to 5 times normal.
3. All forms of anaesthesia cause peripheral vasodilation, opposing vasoconstrictive heat conservation. This redistributes the body's heat energy to the periphery, where it can be more easily lost to the environment.
4. Volatile and narcotic agents reset the hypothalamic control of temperature to a lower 'normal'.

Additional heat losses will continue if intravenous fluid is inadequately warmed and if inspired gases are allowed to remain dry and cold.

Measuring body temperature: Core temperature can be misleading!!

The human body is not a thermally homogeneous mass. The body may be divided into three thermal areas:

Core	=	brain, thoracic and abdominal organs, deep tissues in limbs
Intermediate zone	=	can be part of core or can reduce in temperature
Shell	=	variable depth, in contact with / insulation from external environment.



Temperature regulation and the relative size of these areas is under central control in the pre-optic anterior hypothalamus which responds to both central and peripheral temperature receptors. Vasoconstriction in response to cold will increase the size of the intermediate zone and reduce the temperature of the shell in order to maintain the core temperature. Core temperature is maintained despite a considerable loss of heat energy, until a critical decrease in body heat content has already occurred.

Measurement of core temperature alone will miss total body heat loss until decompensation. Waiting for core temperature to drop before instituting treatment is analogous to waiting for hypotension before treating blood loss.

TREATMENT OF HYPOTHERMIA

Fiddling whilst Rome burns

According to the available evidence, ED physicians and anaesthetists are simply watching (and maybe documenting) whilst many of our sickest patients are progressively becoming more hypothermic. We are then expecting the surgeons to deal with a haemorrhaging patient whose clotting factor function is next to zero. In one series of trauma victims undergoing laparotomy, 90% of deaths occurred in the coldest patients (< 33°C). Nine of these ten patients exsanguinated either in the OT or in the immediate postoperative period.

The ideal scenario would be one of early identification of at-risk trauma patients and timely intervention to prevent the development of hypothermia. Local audit will identify those at risk and their differentiating features, protocols backed by staff education and awareness will provide a framework for intervention. This may not be as sexy as the dramatic intervention of a portable bypass machine but certainly better for patient outcome.

PREVENTION OF FURTHER HEAT LOSS

1. **Drying**
   The benefit of removing wet clothing and drying the patient as soon as possible cannot be overemphasised. Water is a much better thermal conductor than air and will convey heat away from the body by evaporation and conduction to any objects in contact with the patient.

2. **Environment**
   Radiation to surrounding objects and the air immediately adjacent to the skin accounts for 40% of heat loss. Convection of the surrounding air and conduction to surfaces in contact with the body (the resuscitation trolley) account for a further 30% of heat loss. These three forms of heat loss are dependant upon a temperature gradient between the patient and his or her surroundings.

The closer the environmental temperature is to the patient's thermoneutral temperature, the less the heat loss.

Thus the thermal comfort of the staff working in ED, OT and ICU is paid for by the induction of hypothermia in a proportion of their patients. Similarly, evaporative heat loss continues to be a significant factor even when the patient is cold. Up to 20% of total body heat loss may be via evaporation. 100% humidity in the resuscitation areas would, of course, reduce this loss to zero.

More realistically, surgeons and anaesthetists who care for paediatric or burns patients are more acutely aware of the effect of the environment and describe ambient OT temperatures of up to 26°C as "tolerable". In Liverpool Hospital this would mean a rise of 4°C in ED and OT temperature. A 4°C difference between the patient's skin and the environment has the same thermal consequences as infusing 4 litres of room temperature fluid per hour.

3. Insulation

1. Blankets
   - Several layers trap air which acts as effective insulation.
   - Pre-warming blankets is important. Otherwise, the patient's body heat is used to increase the blankets' temperature.
2. Space blankets
   - Better insulation than a standard blanket.
   - Must be closely applied next to skin to act as radiant barrier - cover with normal blanket(s).
3. Convective air blankets
   - When body well covered and blanket 'sealed' by additional coverings around the edges - provides very effective (43°C) insulating layer.
   - Little active warming as air has minimal heat content.
   - Patient must be dry to prevent evaporative loss.

4. Passive rewarming

If thermal insulation reduces heat loss to less than metabolic heat production, then the patient's temperature will increase. If all heat loss is prevented then basal heat production can be expected to achieve a rewarming rate of 1.2°C per hour. If the effects of hypoxia, trauma or anaesthetic agents do not prevent it, shivering can increase the rewarming rate to 3.6°C per hour. This will be at the expense of a greatly increased metabolic rate and oxygen consumption and may lead to anaerobic metabolism, lactic acidosis and significant cardiopulmonary stress. Passive rewarming should therefore be reserved for patients with moderate hypothermia who still have some physiological reserve to allow an increase in metabolic rate.

It should always be remembered that as much as 50% of radiant heat loss occurs from the head, particularly in those who lack their natural insulation.

5. Active Rewarming

Afterdrop

External active rewarming of a hypothermic patient will cause peripheral vasodilation. Increased blood flow through the peripheral tissues is thought to return cold, acidotic blood to the central circulation. Core temperature initially falls 0.5 to 1°C before rising again. In severe hypothermia the acidosis may increase myocardial irritability and acute peripheral vasodilation may cause a relative hypovolaemia and require volume correction.

6. External rewarming

1. Water-circulating heating blankets.
   Electrically heated pads.
   - External active warming to body surface in contact with pad / blanket (20-30% of BSA).
   - More effective when placed over patient (decreased radiant heat loss).
   - May burn poorly perfused tissues.

2. Radiant heaters.
   - Radiant heat gain requires that the patient is uncovered.
   - Allows procedures without interrupting rewarming.
   - Heats attending staff as well as patient.
   - May cause thermal injury to underperfused tissues.

3. Airway rewarming.
   - Modest heat transfer.
   - 41°C supersaturated air - water condenses releasing latent heat of vaporisation.

7. Core rewarming

Water is a very efficient conductor and therefore a donor of heat energy. Heat transfer is simply a function of the temperature change of the fluid that is being infused or circulated and the volume of the fluid. Core rewarming avoids the problem of afterdrop.

1. Warmed intravenous fluids.
   - Many IV warming devices are inefficient at resuscitation flow rates.
   - The greater the temperature difference between fluid and body, the greater the heat transfer.
   - Technique is volume limited.
   - Hyperthermic fluids would add benefit but < 45°C provides only modest heat transfer and 45 - 65°C requires central venous access to avoid tissue damage.
2. Body cavity lavage.
   - Stomach via NG tube (risks aspiration), rectum, peritoneal, pleural and bladder cavities.
   - Relies on a large supply of preheated (40°C) sterile balanced salt solution.
   - Delivers heat energy in proportion to the in-out temperature difference.
   - Rewarms faster than most other methods (approx. 3°C per hour).

3. Extracorporeal circulation.
    - Most efficient and rapid methods of rewarming.
    - Continuous arteriovenous rewarming (CAVR) or cardiopulmonary bypass (CPB).
    - Circumvent limitations imposed by patient's volume or veno-veno bypass requirements.
    - Require specialist equipment and experience / training in use.
    - Invasive techniques with associated risks.

SUMMARY

On current evidence hypothermia is a common danger faced by trauma patients and every effort should be made to avoid its development. The majority of severely traumatised patients develop their hypothermia after arrival in the hospital. Techniques to prevent hypothermia are cheap, easy and relatively free of side effects. A fall in core temperature represents thermal decompensation and occurs only after considerable heat energy loss. Effective, rapid treatment of hypothermia requires equipment and expertise but may improve patient outcome.

All personnel should remain alert to the dangers of hypothermia in the trauma victim. Many are distracted during resuscitation by more obvious injuries but do not forget to minimise heat loss!

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2. Gunning KA, Sugrue M, Sloane D, Deane SA. Hypothermia and severe trauma. *ANZ J Surg* 1995: 65; 80-2 .
3. Bernabei AF, Levison MA, Bender JS. The effects of hypothermia and injury severity on blood loss during trauma laparotomy. *J Trauma* 1992: 33(6); 835-9.
4. Gore DC, Beaston J. Infusion of hot crystalloid during operative burn wound debridement. *J Trauma* 1997: 42(6); 1112-5.

BURNS

A patient with burns requires a multidisciplinary approach. In the initial phase of management of a seriously burnt patient, the ambulance personnel, Trauma Surgeon, Anaesthetist and Intensivist are part of this approach. After the resuscitation phase the plastic surgeon should be involved. Burns may be devastating in terms of morbidity and mortality and can lead to lifelong disfigurement and functional loss in survivors.

BASIC PRINCIPLES OF BURN CARE

- Implementation of basic resuscitation principles.
- Fast relief of life and limb threatening circumferential burns.
- Prevention of infection.
- Early excision of necrotic tissue and wound closure / coverage.
- Delivery of adequate nutrition.
- Achievement of maximum functional and aesthetic recovery.

BURN ASSESSMENT – THE BASIC INFORMATION

- Age and weight.
- Estimate total body surface area (TBSA) burnt.
- Full or partial thickness burn, extent of full thickness area.
- Presence / absence of inhalation injury.
- Aetiology (thermal, electrical, chemical, contact, irradiation).
- Associated injury.
- Co-morbidity.

TYPES OF BURN

Scald injury
- Commonest cause of thermal injury.
- Mostly partial thickness, but deeper injury more common in children and elderly.
- Full thickness burn is often patchy and early diagnosis difficult.

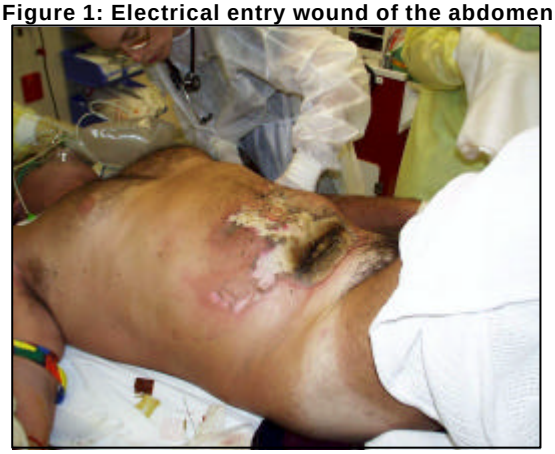
Flame burn
- Commonest cause of fatal injury.
- Generally full thickness.
- Associated inhalation injury occurs in enclosed space.
- Potential for circumferential limb / chest / neck injury.

Flash burn
- Explosion injury without clothing fire.
- Full or partial thickness.
- Commonly face and hands.
- Suspect injuries as in blunt trauma because of explosive force.

Contact burn
- Victim commonly unconscious (alcohol, epilepsy, drugs).
- Often full thickness.
- Suspect compartment syndrome because of prolonged pressure.

Electrical injury
- High (> 1000 V) or low (< 1000 V) tension.
- High tension causes dramatic tissue destruction.
- Entry / exit wounds are sites of focal skin burn.
- Muscle damage often severe and occult.
- Muscle necrosis causes myoglobinuria / acidosis with renal failure.
- Suspect compartment syndrome.
- Arrhythmias in 1/3 of patients with high tension injury. Myocardial damage is rare. Arrhythmia is rarely dangerous if patient reaches hospital.
- Domestic (low tension) electricity commonly causes small burns to the periphery without muscle damage.

Figure 1: Electrical entry wound of the abdomen



Chemical injury

- Becomes deep without appropriate first aid. High volume water irrigation for at least 30 minutes (optimum temp = 15 degrees, prevent hypothermia in children).
- Hydrofluoric acid burn is very uncommon but very important. May cause fatal hypocalcaemia even in a relatively small cutaneous burn. Immediate excision and monitoring may be necessary.

RESUSCITATION PHASE

Early resuscitation can be divided into two phases: performed at the location of the burn by the ambulance personnel; and continuing when arriving in the resuscitation room.

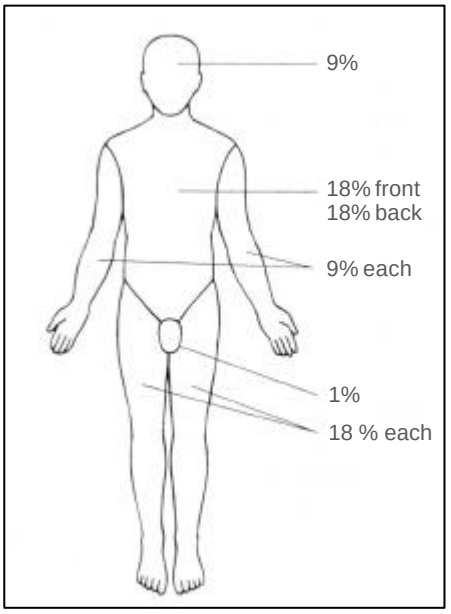
1. Pre-Hospital Care

- Removal of the patient from the source of the burn. This minimises risk to the patient and rescue team members.
- Removal of burning clothing immediately.
- Assessment, as for any trauma victim, following ABC

principles of resuscitation and communicating assessment to the resuscitation room.

- If water is available cool the burnt surface with lots of water for up to 30 minutes. This is only useful for up to 3 hours post burn. Prevent hypothermia in paediatric patients. Optimal temperature for water is 15 degrees Celcius. No iced water.
- Cover the burn with a clean sheet / towel or clingfilm.
- If possible get IV access and fluids running in burns > 15% TBSA. Pre hospital infusion: roughly 500mls.
- Nil by mouth in major burns (>15% TBSA).
- Analgesia: cooling works initially, morphine is required in burns > 5% TBSA.

The rule of nines



Airway / Breathing

It is best to assume that all patients have suffered smoke inhalation injury, therefore, administer high flow oxygen via a face mask until the situation becomes clearer. If the airway has to be protected, cervical spine precautions should not be overlooked. Apply collar if doubt exists about cervical spine injury.

2. Hospital Management

a. Initial reassessment

- Establish A,B,C,D status. The burn wound does not take priority above potential life-threatening injuries.
- Review of Airway. Particularly in unintubated, unventilated patients. In these patients the potential for deterioration always exists (for up to 72 hours post-burn). Clinically examine the hair, eyes, eyelashes, eyebrows, nose, mouth, oropharynx and chest for any signs suspicious of inhalation injury. Voice change is also an early clinical sign. Get chest x-ray and arterial blood gas. Remember to request carboxyhaemoglobin (COHb) estimation. The pulse oximeter is **unreliable** for assessing oxygenation as it cannot differentiate between oxyhaemoglobin (OHb) and COHb.

Table 1. Symptoms and signs of carbon monoxide (CO) poisoning

Approximate inspired CO (%)	Blood COHb (%)	Symptoms and signs
0.007	<10	None
0.012	20	Headache, nausea, vomiting
0.02	30	Severe headache, confusion, weakness, visual impairment
0.05	50	Tachycardia, tachypnoea, syncope, collapse
0.08	60	Coma, convulsions, cardio-respiratory depression or collapse, risk of death
0.2	80	Rapidly fatal

b. Intubate patients with loss of conciousness, patients with stridor / threatened airway and inadequately ventilating patients.

c. Obtain ECG.

d. Get history (time and place of burn), causing agent and details of the accident. Get past medical history, patient age and weight.

e. Assess fluids prior to admission, urine output since injury.

f. Assess what medication has been given and tetanus status.

g. Assess TBSA burnt. The rule of nines can be used in adults. The palm represents approximately 1% TBSA (infants and adults).

h. Assess burn depth. This is difficult in the first few hours after injury and experience is useful. Depth is classified as full or partial thickness. This is a better way than expressing in degrees. Get an idea of how much TBSA is probably full thickness. Do not waste too much time estimating burn depth as it is not included in calculations of fluid management.
   - Partial thickness: damage to epidermis, dermis intact. Skin can regenerate.
   - Full thickness: both epidermis and dermis are destroyed. Skin will not regenerate.

TREATMENT

IV fluids

FLUIDS ARE GIVEN BASED ON TIME OF BURN NOT TIME OF ARRIVAL.

When TBSA > 15%:

A. Adult replacement fluid:
Volume = weight x % TBSA x 4ml

Hartmann's (lactated Ringers) solution
Total volume is given at different rates:
- First 8 hours: half of total
- Next 16 hours: half of total

B. Adult maintenance fluid:
- Daily maintenance requirement of 2-3 litres on top of replacement fluid.
- Remember to correct for any pre-hospital volume given!
- Adjust fluid volume to achieve urine output of minimum 30-35 ml/hour.

C. Child replacement fluid

i. First 24 hours:
Volume = weight x % TBSA x 3 mls

First 8 hours: half of total
Next 16 hours: half of total

ii. Second 24 hours:
Volume = weight x % TBSA x 0.5 mls as colloid

Adjust fluid input to achieve urine output of 1ml/kg/hr.

D. Child maintenance fluid

Add on 4% Dextrose + N/5 saline to replacement fluid according to the following schedule:

First 0-10 kg	100ml / kg / 24 hrs
Next 11-20 kg	Add 50 ml / kg / 24 hrs
Next > 20 kg	Add 20 ml / kg / 24 hrs

Correct for any pre-hospital volume given!
Adjust fluid input to achieve urine output of 1ml/kg/hr.

Analgesia

IV morphine, do not give IM.
Initial dose of 0.1 mg per kg is advised, then half this dose can be given hourly. However, this may need to be titrated to response as larger or smaller doses may be necessary.

CONSULTATION WITH / REFERRAL TO BURN UNIT

For all patients in the following categories, consultation should take place with the appropriate burns unit **at presentation**. Although not all patients in these categories will require transfer to a specialised burn unit, advice should be sought early in their management.

- Full thickness burns involving 10% or more TBSA in adults and 5% or more TBSA in children.
- Burns to the face, hands, feet, perineum, inner joint surface and inhalation injury.
- Burns and any of the following: major pre-existing disease, suspected child abuse, concomitant injury.
- Electrical and chemical burns.

It is recommended that patients who fulfill the following criteria be transferred as soon as is practical to a specialized Burns Unit by a medical retrieval team (MRT). The Medical Retrieval Unit (MRU) can also assist with finding appropriate beds.

- Any intubated patient.
- Facial or airway burns.
- Any child with burns > 10%.
- Any burns > 20% in adults.
- Any circumferential burn.

STABILISATION IN PREPARATION FOR TRANSFER

1. **Respiratory care**
   Give 100% oxygen (preferably humidified) to all patients, except in minor burn cases.

   Intubate any patient with cyanosis, respiratory distress, stridor or hoarseness. Consider intubation if there are burns to the face showing increasing swelling.

2. **Circulatory care**
   Two peripheral lines preferably through unburnt skin. 16 gauge in adults, no smaller than 22 gauge in children. Insert a urinary catheter for all patients with 20% or more TBSA burns. Follow the fluid resuscitation guidelines above.

3. **Gastrointestinal care**
   Nil by mouth at least until after consultation with the burns unit.

4. **Pain management**
   IV morphine. Do not give analgesia IM.
   Initial dose of 0.1 mg per kg is advised, then half this dose can be given hourly. However, this may need to be titrated to response as larger or smaller doses may be necessary.

5. **Burn wound care**
   Place the patient on a clean sheet and wrap around. The unburnt areas should be covered with a thermal blanket to avoid hypothermia.

6. **Check tetanus immunisation.**

7. **Transfer should take place within 4 hours if possible.**

8. **The NSW Burns Transfer Information Chart should be completed and faxed to the burns unit. A photocopy of the fluid balance chart should be attached.**

CONTACTING BURN UNITS

ROYAL NORTH SHORE HOSPITAL
To transfer patient first ring Senior Plastics Registrar:
02 9926 8940 page 41069 who will contact the Bed Manager
Fax 02 9926 7589
Nurse in charge of ward 9D
02 9926 8942
Wound management issues:
02 9926 8940 page 41244
Dressings Sister:
02 9926 7988 or 9926 8940 and page 42027
Main Switchboard
02 9926 7111.

CONCORD HOSPITAL
Burns Specialist & Plastic Surgical Registrar
02 9767 7775 then page
Fax 02 9767 7435
Wound management issues
NUM or CNC, Burns Unit: 02 9767 7775
Main Switchboard
02 9767 7791/5000.

CHILDREN'S HOSPITAL, WESTMEAD
Senior Surgical Registrar, Burns ward
02 9845 1114
Fax 02 9845 0546
After hours contact the Senior Registrar on call
02 9845 0000 then page
Reception desk Burns Unit
02 9845 1114
Wound management issues
Burns Surgical Liaison CNS (Mon – Fri 0730 – 1600 hrs)
02 9845 0000, page 6153.

IF AFTER CONSULTATION WITH A BURNS UNIT TRANSFER IS NOT NECESSARY, THE FOLLOWING PATIENTS SHOULD BE ADMITTED TO LIVERPOOL HEALTH SERVICE.

- Any burn over 10% TBSA (adults, children and elderly).
- Any suspicion of inhalation injury.
- Burns to face, neck, hands, feet, perineum.
- Electrical or chemical burns.
- Full thickness burns where grafting is indicated.

EARLY SURGICAL MANAGEMENT

Wound dressings

Dressings should:

a. Reduce colonisation of the wound by environmental organisms
b. Reduce evaporative heat and fluid loss
c. Relieve pain by preventing drying and padding tender surfaces.

- In the emergency setting (prior to transfer) covering the burnt surface with polypropylene glycol 25% (Solugel) and plastic wrap is effective and prevents heat loss.
- Simple dressings with vaseline gauze are cost effective and work well initially.
- Most frequently used are topical silver sulphardiazine and bulky dressing to burn wounds, changed daily or more often if infection is suspected.

Antimicrobial agents

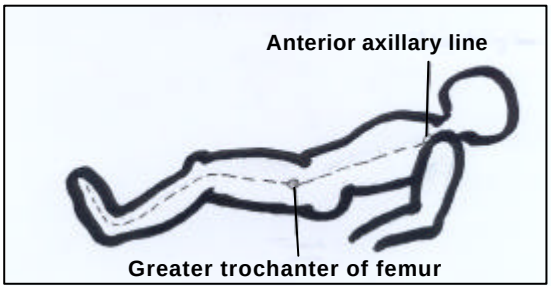
- Systemic antibiotics are contraindicated in children.
- Systemic antibiotics in adults are not recommended.
- Topical silver sulphardiazine dressings as stated above.

ESCHAROTOMY

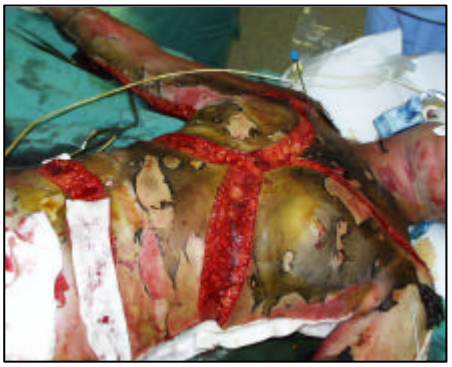
In circumferential full thickness burns to the extremities, chest or neck, escharotomy may be required. Commonly required in flame burns. Less often this may be required in chest or neck circumferential burn to improve pulmonary compliance or prevent airway obstruction. Constriction occurs due to shrinkage and loss of elasticity in heat coagulated skin with associated intense underlying oedema which develops progressively. Raised tissue pressure damages the soft tissues, occludes blood vessels and necrosis develops if unrelieved. Escharotomy is an urgent procedure which should be carried out in the first few hours post-burn. It is ideally carried out by an expert surgeon under theatre-type aseptic conditions. Electrocautery should be available as major blood loss is possible.

Typical incisions

1. From the anterior axillary line down to the iliac crest, then proceeding down the lateral side of the leg to the lateral malleolus and along fifth metatarsal bone if necessary.

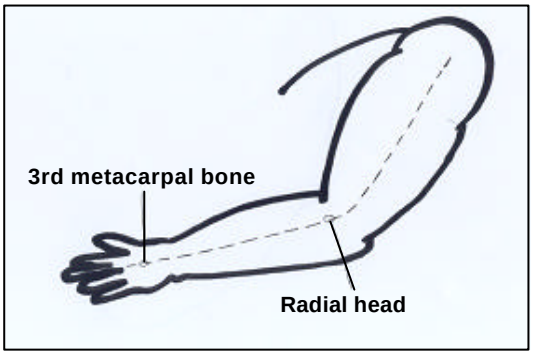


2. This can be supplemented by an incision across the chest along the costal margins, along the sternum and towards the lateral clavicles if necessary (X shaped escharotomy). The abdomen can be decompressed with a horizontal escharotomy along the superior border of the pubic bone.

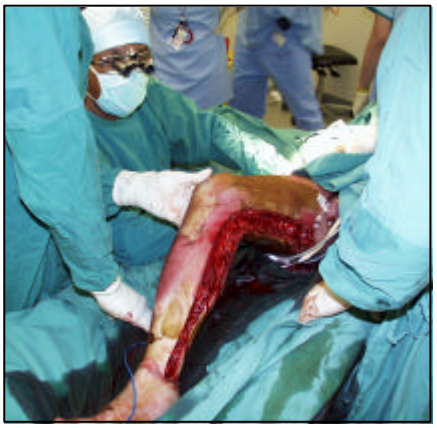


3. Bilateral incisions down the anterior border of the sternocleidomastoid muscle relieves neck.

4. Incision along third metacarpal bone - dorsal forearm - lateral humerus to relieve arm.



5. If the legs are involved, escharotomies down the medial side of the leg give a better cosmetic result. However, they must be supplemented by lateral escharotomies if decompression is inadequate.



FASCIOTOMY

A compartment syndrome of the muscles may occur in electrical burns, deep flame burns and crush / burn injuries. Diagnose by clinical suspicion and compartment pressure measurement. Pressure monitoring is particularly useful in unconscious, intubated patients and in the proximal part of the limb in electrical conduction injury. Escharotomy / fasciotomy is useful to identify and excise devitalised muscle.

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