Guidelines for the management of the patient with a burn injury

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Contributors

Dr. Chandini Perera MS	Consultant plastic surgeon, Burns and reconstructive surgical unit NHSL
Mrs. R. P.A.S. Jayasinghe	sister in charge Burns unit NHSL
Ms. A Amara	staff nurse Burns unit NHSL
Ms. K. P. M. Pathirana	staff nurse Burns unit NHSL
Mrs. Pryadharshini Perera	staff nurse Burns unit NHSL
Mrs. Asha Karunathilleke	Senior Occupational therapist Burns unit NHSL
Mrs. G. A. D. Perera	Senior Physiotherapist Burns unit NHSL

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Section 1 Introduction

Pathophysiology of a flame burn wound - Local and General Response to Burn Injury

Local response.
The burn wound model created by Jackson in the1970s helps in understanding the pathophysiology of the burn wound

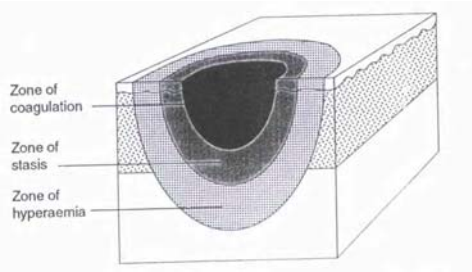

Figure 1.1 depicts the burn wound model. Nearest the heat source or where heat cannot be conducted away rapidly enough to prevent immediate coagulation of cellular proteins there is cell death. The central zone of tissue death is called the zone of coagulate necrosis. Surrounding this is the zone of stasis, where the microcirculation is compromised. This area will undergo progressive necrosis due to microcirculatory mediators. Clinically this is seen as progression in the depth of burning. This is an area that appears initially viable but subsequently becomes necrotic. Jackson showed that if surgery was undertaken early to this area it was possible to salvage tissue by application of skin graft so that the dermis that would otherwise be necrotic could be made to survive. This is the basis of early tangential excision and surgery.

Surrounding the zone of stasis is the zone of hyperaemia which is due to inflammatory mediators which cause dilatation of blood vessels. After resolution of the hyperdynamic stage, the tissues of this area return to normal. In a burn involving more than 25% of the body the zone of hyperaemia may virtually involve the whole body. The contribution of these three zones to the overall burn wound depends on the burn itself. On occasion the zone of stasis may involve only the mid dermis but progressive vascular compromise extends the zone of necrosis producing a deep burn. This is likely to occur in the elderly, and where timely resuscitation has not taken place. Thus timely and effective care of the burned patient can promote wound healing.

Systemic response

Capillary exchange is impaired leading to oedema formation and loss of albumin from the circulation. Burns also cause widespread general effects on the circulation, temperature control, immune competence, and function of the gut and lungs.

The burns unit at NHSL

This is the only organized facility in the country with a total of 18 beds and a trained team. The beds are for acute burns and burn reconstruction (e.g.: Eyelid burns, electrical burns of hand, Contractures). Patients needing ICU care need to be admitted to the Accident service ICU. Admission to the burn unit depends on availability of beds, and on infection or carrier state of patient (i.e. MRSA, pseudomonas).

Transferring patients to the Burns Unit

Contact the consultant in charge or a medical officer for advice. Direct transfer is not possible. All patients need to be stabilized and properly resuscitated prior to transfer.

Section2. First aid

Cooling
Done for all flame and chemical burns and explosions. Cooling reduces retained heat and flushes out chemical reducing depth of penetration and severity of damage.

Cooling

- Done with cool running tepid water.
- Done for 20 minutes.
- Eye irrigation continues until all the chemical is diluted and flushed out.
- Eye irrigation is done prior to transfer , during transport and whilst waiting for assessment.

Avoid hypothermia.
Keep the patient covered, warm and dry.
Avoid transport with patient uncovered, in damp clothing, or with wet towels.
Hypothermia can add to the depth and severity of the injury.

Covering: Covering the patient prevents airplay on the wound and reduces pain. Use a sheet. All hospitals should have clean sheets and blankets to cover trauma patients.
Do not use gauze as it adheres to the wound causing shearing and damage to the skin and pain on removal.

Section 3. Initial assessment and evaluation of area and depth of burn

Initial assessment

The management of the burn is secondary to the 'ABC' of trauma care. (see trauma guideline)

History

It is important to obtain a detailed history from the patient or a witness. Usually the first person to interview the patient has the best chance to document what actually happened. The history should include the

- **mechanism of injury** (e.g. was the patient trapped in an enclosed space, was there an explosion)
- **method of escape from the fire** (e.g. did the patient fall, run or was thrown) this will help to search for concomitant injuries.
- **agent or accelerant** e.g.; kerosene, chemical. A history of what the causative agent was will give clues as to whether the burn is likely to be superficial or deep.

Non accidental burns (abuse, rape, incest and homicidal and suicidal attempts) are sometimes missed. This can lead to legal problems. Documentation, both by the JMO and the MO at time of admission should be meticulous. Suspect non-accidental injury in a child or assault in an adult when there is an inconsistency between the appearance of the visible injury and the history of the incident.

The history takers name should be documented.

If the patient is able to communicate, the **height and weight** is noted. This is important for calculation of body surface area, fluid rate, nutritional support, and drug dosages.

Examination

After adequate analgesia or, in children, anaesthesia, the clothes are removed. Wounds are washed using 1% Povidone iodine scrub or Chlorhexidine scrub. The blisters are opened and all dead skin is removed. Depth and extent of burn is assessed and recorded.

Assessing burn depth

Superficial partial thickness wounds –Painful. Light pink and moist. Maybe associated with blisters. Capillary return present. Will be allowed to heal spontaneously.

Deep dermal burns Dark red or white with dry surface

Third degree burns or full thickness burns. Dead white or black eschar with thrombosed veins.

Pinprick is used for recording the hypo or anaesthetic regions as deep dermal or full thickness burn. The wounds are reassessed 24 hours later for any change

NOTE: Surrounding inflammation and exudates in burns seen late suggest infection.

It is usually possible to diagnose the depth of the burn using the above criteria. If there is any doubt regarding the depth or treatment of such a burn contact the burns unit for advice

Assessment of the area of the burns

This is done using Wallace's rule of nines. (Fig 1) The palm from fingertips to the wrist is considered as 1%. This is used as a guide

to assess the extent of small or patchy burns.

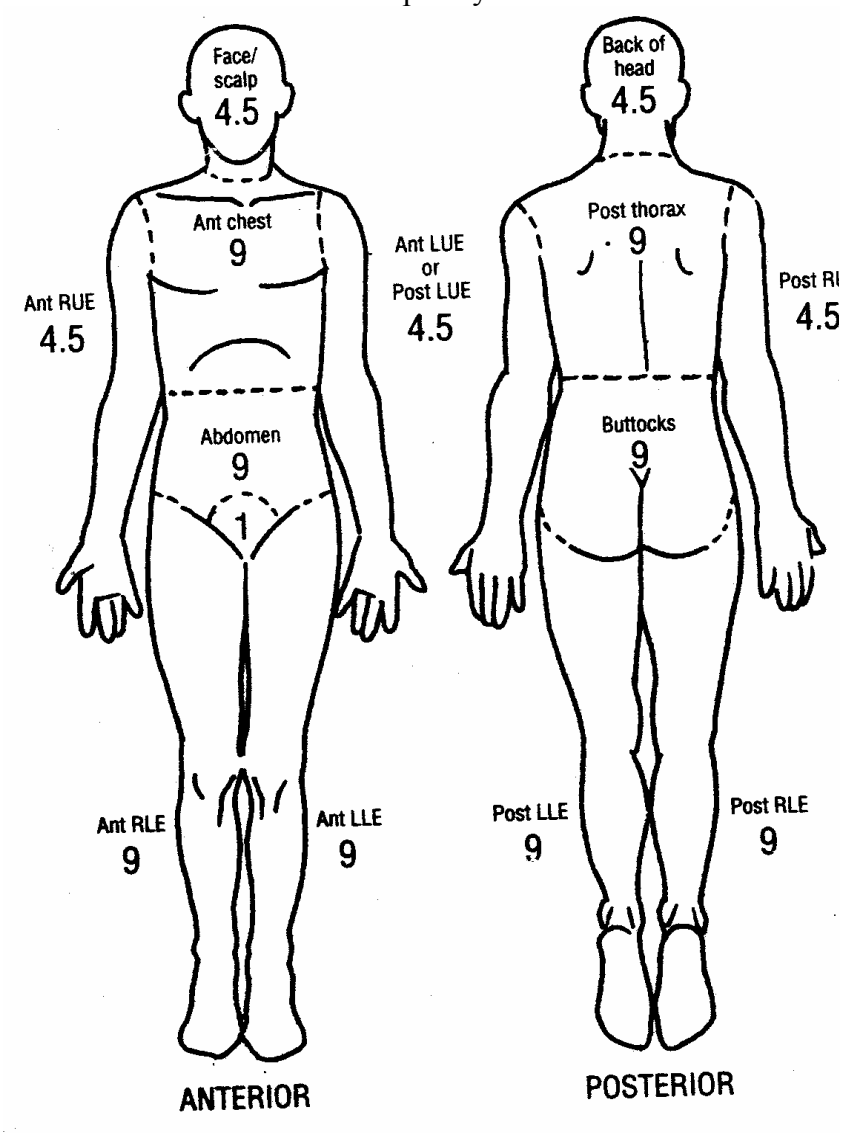

FIG. 1 Wallace's rule of nines

Section 4.

Classification of burns according to the severity of the injury

Minor burns	less than 10 % in adult
Major burns	more than 20 % in an adult
	more than 10 % in a child
	Burns with inhalation injury
	Special areas e.g.; face, hands, perineum, eyes

Levels of care and criteria for transfer of each

Minor burn out patient with follow up can be done in a peripheral unit or base hospital

Major burn Burns 20 to 30 % without inhalation injury can be managed in a base hospital with specialized facilities e.g. eye, ENT consult and lab, blood bank

Burns more than 30 % or with inhalation injury should be managed in a general hospital

Burns due to chemicals, electrical injury, special situations such as suspected child abuse or rape are best managed in a general hospital or teaching hospital

Section 5 Minor Burns

Superficial or partial thickness burns <10 % TBSA which are not infected

Wound management.

- First aid must be done. Cooling must be done even in minor burns.
- Aseptic technique to minimize risk of infection. Care should be taken to prevent further tissue damage.
- If available a 0.1 % or 0.2% chlorhexidine solution is used to wash the wound, but if this is unavailable soap and water is used to gently cleanse the wound.
- Loose skin is removed using sterile scissors. Small blisters on palmar area can be aspirated but large blisters and those over joints must be de-roofed and debrided.
- Once the area is cleaned and debrided the burn wound is reassessed for depth and extent of burn.

Superficial burns

Bright pink to red. Very tender. Without blistering. Limited to the epidermis e.g.; sunburn, or minor flash burn from gas explosion. Treatment; reassurance, pain relief, moisturizing cream

Dermal burns, superficial partial thickness burns -

Blisters, pale base beneath the blister, base should have a capillary return and sensation

Usually heals spontaneously. After the blisters have been removed the papillary dermis is exposed .If this is allowed to dry out or becomes infected then the epidermal elements that will heal the burn by epithelialization are destroyed and the wound will be converted to a deep burn which may need a skin graft to heal.

These burns are dressed using silver sulphadiazine ointment and covered with an absorbent reassessing supported by a crepe bandage. Repeated inspection and close follow up is needed to ensure that the burn has not converted to a deep burn and is not infected.

- Partial thickness burns less than 10% are ideally suited for outpatient management.
- Larger superficial burns approaching 10 % will need to be dressed in outpatient clinics specially designated for this purpose.
- Small burns when appropriately dressed are well suited to oral administration of Paracetamol with codeine in various concentrations.
- Dressing of burns in children may be difficult and produce considerable pain. Oral sedatives and analgesia is given 30 min before the procedure to enable dressing as outpatients.

Infected minor burns

Burn wound sepsis may occur in burns contaminated at the time of injury, or where the wound has been treated with a dressing lacking antibacterial properties. Burns which are infected at presentation or thought to be contaminated at the time of injury

- should be treated with a topical anti- microbial agent such as Silver sulphadiazine or1% povidone iodine ointment.
- should be dressed daily.
- should not be treated by exposure method as it will cause desiccation of the underlying tissues causing deepening of the wound.

Admit for IV antibiotics if there is any invasive wound infection i.e. cellulitis is noted. (An infected partial thickness burn can convert to a full thickness burn that may need grafting.)

Follow up of Minor burn

If no oozing follow up at 48 hours Then at 4 day intervals until healing occurs.
If there is oozing follow up at 24 hours.
Admit if there is difficulty for the patient in attending as an outpatient.

Physiotherapy and occupational therapy of minor burns

Burns around the joints, hands and limbs that do not warrant admission to hospital may need physiotherapy. Burns that take longer than two weeks to heal and infected burns are prone to hypertrophic scarring. Occupational therapists and physiotherapists may be needed for scar control, stretching, etc.

Education post healing of minor burns

- Burnt skin and scarred skin lacks sebaceous glands.
- It is important to keep the area clean and well moisturized. .
- Time off work may be required until the newly formed epithelium can develop normal thickness to withstand shearing.
- Control of itch may require moisturizing as well as antihistamines.

Functional impairment.

Small burns that take longer than 14 days to heal and produce hypertrophic scar may cause contracture especially around the joints. This may cause secondary loss of function. Burns that do not respond to scar management and physiotherapy will need referral to a burns unit for secondary reconstruction. Many minor degrees of shortening and stiffness respond to interventions and treatments by skilled therapists.

Post burn cosmetic deformity.

Small burns may cause cosmetic deformity either due to color mismatch or hypertrophic scarring. Some patients my not be concerned. Occasionally a patient will be distressed out of proportion to the injury and resultant deformity. There may be unreasonable requests for correction of minor deformities Revision or corrective surgery may result in a worse deformity. Surgical judgment and referral for psychological treatment and repeated counseling is the proper treatment.
Make up preparations and camouflage techniques may be useful.

Section 6. Management of Major Burn

First Aid (as above)

Evaluation , Resuscitation and Treatment

Initial management

A) **ABC** (Airway, breathing and circulation)
Check airway for foreign body/ oral oedema.
Oxygen by face mask in suspected CO poisoning.
Infuse 500 ml of Ringer's lactate solution while the calculations are being done.

B) **Prophylactic intubation** if deep oral burns are present. intubation may become difficult after oedema develops.

C) **Venous access** –

- peripheral line only if the site is available.
- Internal jugular or femoral lines are preferred as an access site.
- Tape cannot be used to secure line, as it will not stick. Suturing is better.
- Central access is needed for haemodynamic monitoring, drawing blood, and for aggressive fluid resuscitation. Maintenance of secure venous access is critical. It is difficult to gain access once oedema develops and the patient is vasoconstricted.
- If IV access is done in an institution where a laboratory service is available then take blood for investigations such as Hb, WBC/DC, Serum electrolytes, blood urea, serum creatinine, Grouping and DT and blood sugar

D) **Exposure and estimation of area and depth of burns (see section 3).** In a body diagram note the area of burn (FIG1) Make a drawing of the burn, noting the depth, and

E) determine whether the burn extends across a joint or is circumferential. Estimate the total burned surface area (TBSA) using the Lund and Browder Chart (fig 4) Another convenient way of estimating the burn is to use the palmar surface of the patients hand. The palmar surface (including the digits) can be estimated to be 1% of the body surface. Note also that the palmar surface minus the palmar area of the digits can be considered to be 0.5% BSA. Record the estimate % of burn. This estimate may change after removal of the dirt and soot when patient is cleaned

F) **Analgesics.** IV tramadol can be used only if opiates are not available. IV morphine is the preferred analgesic.

G) IV Ketamine infusion (200mgs in 500 ml of Dextrose over 8 hours is given for comfort care* after medico legal formalities have been completed, full evaluation of the associated injuries have been done and hypoxia ruled out.

H) Indwelling Foley catheter if burn is more than 20% TBSA/genital burns/electrical burns of lesser extent./ inhalation burns

I) **Feeding tube** 10F in burns > 20 % TBSA for naso-gastric feeding

J) **No antibiotics** to be administered.

K) **Tetanus prophylaxis** in all adults. According to immunization status in paediatric patients.

L) **Escharotomy (fig 6)** made on the limbs, chest, abdomen, and neck if circumferential. Should be done within 24 hours post burn.

M) **Acid suppression –** Use IV H_2 blockers

N) If the patient is intubated he is kept on ventilator as he may go in to respiratory depression following analgesics and sedatives.

O) Record statement from the patient and inform the police about the admission.

Patient's condition

The following are critically ill
> 15% in a child
> 20 % in an adult with second degree or third degree burns
All inhalation injuries.
Patients transferred late from other institutions with inadequate resuscitation, provision of nutrition and in a state of sepsis are very seriously ill patients.
> 50 % TBSA are very critical and the outcome is unpredictable.
> 80% are provided comfort care only.

***Comfort care**

This refers to care for the non salvageable burn. E.g. 60% burn with inhalation injury or 50% burn with severe sepsis and no skin cover. In Sri Lanka we do not have skin banking facilities and cannot salvage burns over 50%.A close relationship with relatives and the burn team must be established at the ouset and patient's relatives and friends must be educated regarding the severity of the condition and the outcomes that can be expected or achieved

Initial fluid resuscitation
First 24 hrs-
Fluid calculated as per

Parklands formula- 4ml/kg/%TBSA

.
This can be done quickly using the "Rule of nines".
Begin calculations from the time of injury not when the patient arrives at the casualty or emergency room.
Crystalloid solution is given.
Hartmann's solution is the fluid of choice. **(recommendation X)**
The first half is given in the first 8 hours post burn and the remainder over the next 16 hours.
These are broad guidelines and need to be individually tailored targeting a urine output of 1ml/kg/hr.

The next 24 hours
Colloids or Human albumin is given during this period.
0.5ml/kg/%TBSA is given as colloid.

Maintenance Fluids
After the first 24 hours the maintenance fluid is given.

Method for calculating maintenance fluid for 24 hours as dextrose saline

First 10 kg	100ml/kg
Second 10 kg	50ml/kg
Every kilogram above 20 kg	20ml/kg

Water for evaporation is added to the maintenance fluid
This is calculated as:

TBSA +(25xBSAin m2) = number of ml of evaporative loss/hr
Body surface area (BSA) is calculated as follows (do not confuse with TBSA)

$$\frac{87(H+W)-2600}{10{,}000} = \text{surface in m2}$$

This is given as free water

Maintenance fluid and fluid for evaporation is given both orally and IV.
If the patient is unable to tolerate oral or enteral feeds then must be given IV.
Paediatric patients receive the maintenance volume as dextrose containing fluid IV if unable to accept orally.

Evaluation of serum sodium will give an indication of adequate replacement the optimal sodium level to be maintained is 135 to 137 mg /dl.

Colloids i.e. fresh frozen plasma or human albumin is continued only for 2 to3 days. Mainly in extensive burns.

3rd day onwards
In major burns some fluid and nutritional supplement will be necessary intravenously. Fluids containing sodium should not be given for a few days as sodium gets reabsorbed from the ECF. Potassium needs to be supplemented. (Oral or IV)

Initial wound care
After adequate **analgesia** or, in children, anaesthesia, the clothes are removed. Wounds are washed using 1% Povidone iodine scrub or Chlorhexidine scrub. The blisters are opened and all dead

skin is removed. Depth and extent of burn is assessed and recorded. Strategy of further management is planned. Burn wound swab is taken on day one.
The antiseptic of choice is silver sulphadiazine. The wound is dressed with Silver sulphadiazine cream and covered with fresh autoclaved absorbent dressings. All wounds of the peripheries are covered with crepe bandages to minimize oedema. Splints are applied to hands neck and lower limbs in **position of function.** (Burn patients tend to keep their limbs in the position of deformity.)

Escharotomy
Escharotomy refers to an incision made through the full thickness of burnt skin (the eschar) to release underlying pressure in circumferential burns of the extremities and trunk where it can compromise blood supply to the limb or compromise breathing. It is an aseptic procedure done along definite lines of surgical incisions. This is to prevent damaging important nerves and vessels and also unnecessary breaching of tissue planes which can compromise the burn wound healing or function. Please refer diagrams for the recommended incisions.

Positioning
This is the key to preventing scar contracture and deformity and starts at admission and continues throughout hospital stay.

- Supine, elevate 20 to30 degrees in head and neck and facial burns
- No pillow is allowed under the head, if neck face or ears are burned.
- Shoulders abducted 90 degrees,
- Hands to be kept in functional position (20 degrees dorsiflexion at wrist, flexion of 90% at MP joints IP joints fully extended and thumb in opposition) and elevated.

- The lower limbs are separated by 15 degrees from each other.
- Water balloons or latex gloves filled with water to be kept under the heels and other pressure points.
- If the patient has majority of burns on the dorsal surface then he may be nursed on an air mattress or may be nursed in a prone position with his feet hanging beyond the mattress his face should be turned frequently.

Ambulation is started from day one in minor burns (<10%). Should be done every day in major burns if general condition permits. After lower limb grafting immobilize for 3 to 4 days and then mobilize with supportive bandages supervised by a physiotherapist

Nutritional support.

Early aggressive nutritional support is essential for the management of burn injury. This is essential for survival in the severely burnt patient. All burns of 20% or more TBSA will need enteral feeding via a nasogastric tube. The response to injury known as hyper metabolism is seen most dramatically following burns. This response can be 200 % of the normal metabolic rate and returns to normal only following closure of the burn wound. Because the metabolic rate is so high, energy requirements are immense.

The goals of nutritional support are;

To maintain and improve organ function
Prevent protein-calorie malnutrition
Improve outcomes

The following need to be done for nutritional support

1. Calculation of the caloric needs
2. Composition of the nutritional supplements
3. Mode of delivery of the nutrients

Calculating Caloric Needs

Curreri formula;

25kcal/kg / day + 40kcal/ %TBSA /day

This provides for maintenance needs, plus additional calorie needs of the burn wounds

Dietary Composition

The optimal dietary composition contains 1-2 gm/kg/day of protein, (patients with severe stress such as burn patients need 2 to3.2 g of protein /day)which provides a calorie to nitrogen ratio at 100:1.

Generally the composition is 60% from carbohydrates, 25% to 30 % from proteins and 10 to 15 % from fats.

The commercial formulae used for feeding

Isocal for carbohydrates energy and some protein
Casilan to provide additional protein
Pure Whey proteins e.g. coach's formula

Enteral formulae and the vitamin and mineral supplementation are purchased by the patients.

In addition protein shakes made up as follows provide both energy and protein these can be liquefied in an electric blender

Bananas 2
Curd 1 cup
Eggs 2
Sugar 2 tblsp this is made up to 500ml

If patient can take orally, this can be given orally as well.

In addition to the enteral feeds patient is encouraged to eat protein rich high-density foods small quantities at a time e.g. dates, samaposha aggala, sesame and jaggery (thala guli)

Nasogastric feeds are started **as early as 6 hours post burn** at a low rate and ½ strength. Increased over a period of 24 to 48 hours to full strength formula feeds. Before each feed the tube is aspirated to check for residual feed to avoid gastric distention and risk of aspiration. A head up tilt of 20 degrees is recommended for naso gastric feeding.

Diarrhoea is a common problem in tube fed patients diarrhoea is defined as > 1500cc /day. This may be due to various reasons such as osmolarity of the feeds and altered bacterial flora due to antibiotic use.
Measures to be taken if diarrhoea occurs:

- Check for *clostridium difficile* and treat with oral Metronidazole or Vancomycin.
- Include bulk in the tube feed by adding Fybogel®(soluble fibre, commercial preparation)
- Reduce the concentration of the feed. The volume must be increased to meet the required calorie need.
- As soon as patient is able and willing their normal diet is given in addition to naso gastric feeds.

Vitamin and mineral supplementation
Multivitamin 1 dose q.i.d
Folic acid 1g daily
Ascorbic acid 1000 mg daily
Vitamin A 5000u IU
Zinc sulfate 200mg q.i.d

Electrolytes

The amount of sodium required ranges from 60 to 200 meq /day. Less is required in patients with cardiac and renal failure. The amount of potassium is 50 to 160 meq / day. Those patients who are stressed, on nasogastric suction ,with hyper insulin state , or have a metabolic alkalosis require more. Chloride requirements are 100 to 200 meq/day, more with gastric loss. Calcium requirements range from 4 to 30 meq. In the Burn unit the standard solution is ½ NS + 20 meq KCL. This can be adjusted, and repletion of electrolytes can be given as guided by laboratory analysis.

Essential fatty acids Patient should receive at least 1000kcal/wk as fat to avoid essential fatty acid deficiency. Added as **sesame oil (gingelly oil) 1 to 2 tablespoons to enteral diet/ orally** for proper absorption of vitamins

Transitioning to regular diet

The transition from tube feeds to oral ma y be very slow and take several weeks.
Reduce tube feeds accordingly as the oral intake increases (the sum should be 100% of the goal assessed.
When the oral diet is 50% of the required calories give a 3-day trial of oral intake only.
Limit fluid administration. Avoid free water and fluids without calories to prevent hyponatraemia.

Assessment of nutrition

- Weekly weight chart
- Weekly serum albumin (a clinical assessment i.e. for wasting, pallor, brittle hair, nails, and hypoproteinaemic oedema is better than mere reliance on laboratory testing)
- Fluid intake and output should be monitored as well as serum electrolytes, blood glucose, and serum creatinine

- In large burns serum calcium and magnesium levels must also be monitored at least once every 3rd day. (If available)
- Urinary urea and urine nitrogen are not done routinely. These are the recommended tests for checking adequacy of energy requirements.
- Liver enzymes are done weekly.

Parenteral *vs.* enteral feeding.

Several studies have shown parenteral feeding to increase the mortality particularly in major burns. TPN is reserved only for those patients who cannot tolerate enteral feeds.

In burn patients enteral feeds are recommended over parenteral feeds.

The advantages are;

More physiologic and less costly

Maintains gut structure and function, may help prevent the translocation of bacteria and toxins

Blunts hyper metabolic response to injury

Associated with decreased incidence of sepsis

Wound management:

Superficial partial thick ness burns:

- Good wash with 1% Povidone iodine/chlorhexidine scrub under adequate analgesia or anaesthesia.
- As far as possible iv morphine combined with dormicum is preferred except in very major burns where ketamine in small bolus doses may be used iv. This prevents prolonged fasting in major burns and calorie depletion.
- Remove the burned skin and dead skin from blisters and all debris. Wash and re-assess the wound.
- Dress with Silver sulphadiazine covered with absorbent dressings (gauze and cotton) supported by cotton bandage and covered with a crepe bandage. Support with splints if it is across hand, elbow, knee etc.
- Dressings must be changed if they are wet with oozing.

- If not can be kept in place for 3 to 4 days in superficial partial thickness wounds.
- If on the first inspection there is fever, redness, cellulitis, discharge or odor, take a swab for culture and start on the appropriate antibiotic.
- Re-dress infected wounds with 1% Povidone Iodine or alternate with 1% acetic acid or 1/20 Milton solution.

Deep partial thickness burn

Review all burns after 24 hours. If the wound is the same:

- In children give 8 to 10 days of conservative treatment. Whatever does not heal is grafted.
- Adults are taken for early excision and skin grafting to prevent hypertrophic scar and scar contractures. Tangential excision is best done between the 3rd and 5th day and covered with auto graft.

Third degree burn

Early excision and skin grafting is offered to the patients arriving in the unit soon after the injury. If the patient has been treated in another hospital for one to two days and is not resuscitated adequately and the burn wound biopsy shows colony count >100,000 then this surgery is deferred for some time.

Timing of surgery

Surgery is planned 24 to 36 hours post burn and after 48 hours in major burns.

Tangential excision and grafting depends on the availability of donor sites, also on the requirement of sheet grafts depending on the areas to be grafted

Sheet grafts are used in the anterior neck, face, dorsum of hands and across all joints.

Priority for early excision is given to eyelids, anterior neck and dorsum of hands, as these areas are more prone to hypertrophic scarring.

In contrast to dorsal burns, palmar burns of the hands will often heal without grafting, but need splinting and aggressive occupational therapy and scar management.

Up to 40 % burn can be sheet grafted if meticulous attention is paid to surgical timing, excision and grafting, and dressings with infection control.

Limitations in managing burns of more than 50% in a Sri Lankan burns unit

- Lack of skin substitutes and a tissue bank
- Lack of facilities for isolation for proper infection control,
- In such situations our protocol is to allow the back to heal spontaneously.

Shower/Bath protocol

This is a clean procedure for burn patients and should be undertaken only by trained personnel i.e. nurses or paramedics. Should be done in a clean environment reserved only for burns. Very ill patients are not showered. Initial showering is done at time of cooling and cleaning on admission. Septic patients are showered and dressed even on Sundays.

Caution! Avoid Hypothermia

Postoperative dressings

If the wound has no growth and no color change at the time of surgery then the dressing change can be deferred for 48 hours. Patients should not be febrile beyond the reactionary phase and there should be no foul smell. A fever of 102 degrees can be expected in a major burn due to inflammatory response to the burn injury alone.

Dressings are opened after 24 hours if the surgery is done in less than ideal conditions. Graft inspection is a sterile procedure and should be done in a theatre environment with trained personnel. 75 % of graft loss can occur at the first dressing.

Management of the grafted wound

- The first dressing change is after 48 hours, then again 2 days layer and then on the 6th day.
- Clips or staples and sutures are removed on the 10th postoperative day.
- By the 10th day most grafted areas are healed and the donor site should be healed as well.
- Small non healed areas are treated with 1% Povidone Iodine or 2% Mercury chrome solution.
- Gentle active physiotherapy is started on the 5th postoperative day and pressure bandaging and garments as soon as the graft is healed completely.
- It is important to give instructions to keep skin clean, daily baths and cleansing using soap and water as well as to keep the skin moisturized.
- When the wound is healed completely the patient is asked to use olive oil or sesame oil to moisturize the skin 2 to 3 times a day. Burnt and grafted skin lack sebaceous glands and require emollients to maintain moisture.
- When grafted areas like hand are not in use and during sleeping hours splints are given to prevent deformity and maintain function. Gradually the physiotherapy is increased to achieve optimum function.
- Patents may require pressure garments and scar management for 12 to 18 months, Active and passive physiotherapy is continued throughout scar maturation period and until full functional range of motion is achieved.

Management of donor site

Donor site dressing is generally not disturbed till the 10th day. Only if there is a lot of soakage or foul odor that the covering above the Vaseline gauze is removed and fresh absorbent dressings are applied, when donor sites are healed they are dry, and have no odor and the dressings peel off easily. When healing is delayed the dressing is stuck to the donor site will not peel off easily and there may be a foul smelling discharge present. If the dressings do not peel off easily they must be moistened with olive oil or liquid paraffin and the site re-dressed with 1% povidone iodine solution. A swab must be taken to ensure that the donor site is free of infection. Once healed donor sites also require regular moisturization to control dryness and itch.
Donor sites are also treated with pressure garments to prevent hypertrophic scarring.

Donor sites once healed may be used for regrafting. When sequential excision is done for extensive burns. Therefore care of the donor site is important as much as the burn wound

Pain management

Burns are painful. Dressings and grafting are associated with pain. The post-grafting period is also painful. Interventions such as cannulation , suctioning, exercises and physiotherapy give rise to acute episodes of pain.

Goals of burn pain management

Keep pain within acceptable levels.

Do not overuse narcotics leading to over sedation. This will make the patient prone to complications such as pneumonia, deep vein thrombosis and bed sores. Early active mobilization will be impeded promoting contracture and deformity.

During the acute periods intravenous opioids are used.
Intramuscular or subcutaneous routes are unreliable due to altered physiology.
Following the acute period oral analgesics and suppositories of opioids or NSAIDS can be used.
Amitryptaline is both useful for background pain and depression

Early psychological assessment and treatment is very effective in the management of pain as are relaxation techniques and behavior modification.

Fentanyl combined with dormicum is better than GA for dressings. Fasting and GA can lead to inability to provide the required nutritional demands as well as predispose to pneumonia. General anesthesia is needed mainly in the very extensive burns of > 45 to 50 %

Psychological assessment and treatment
Early assessment and treatment is essential for the cooperation of both patient and family in what is going to be a prolonged hospital stay that may result in death or considerable morbidity requiring many months or years of treatment. Psychological treatment is best done by personnel familiar with this type of injury and an understanding of procedures involved in the treatment and long-term rehabilitation.

Management of Smoke Inhalation injury
Suspect in a patient with history of burn in a closed room, unconsciousness, use of chemicals in the fire, facial burns or circumferential burns of the chest.
Clinical signs; restlessness, hoarseness of voice**,** oedema of face/neck, stridor and dyspnoea.

Objective assessment
Look for

- Respiratory rate of >30/min,
- O_2 saturation dropping,
- Tachycardia.

Stridor and hoarseness are signs of partial airway obstruction and need immediate attention. Patients can have bronchospasm and bronchorrhoea.

Inhalation injury should suspected and investigated**;**

- **Fibre-optic bronchoscopy** assess severity of injury to the mucosa much before clinical signs are evident. Bronchoscopy without findings cannot rule out the possibility of parenchymal damage It is **useful only in finding upper airway injury**. Findings include presence of soot, charring, mucosal necrosis, airway edema and inflammation.

- **Arterial blood gases** will reveal hypoxia and hypercarbia as gas exchange gets affected. Chest X-ray shows changes 5 to 24 hours later in the form of diffuse soft infiltrates. However CXR is a very poor indicator of inhalation injury and is seldom diagnostic but is important for **baseline evaluations**

- A frequent concurrent form of injury, carbon monoxide poisoning can be evaluated only by measurement of serum carboxy haemoglobin levels. Clinical findings include headache, nausea, and behavioral disturbances which occur at levels above 30%. The time from injury to measurement is important because it takes 4h to fall by one half while patient breathes room air.

Inhalation injury treatment Protocol

- Titrated humidified oxygen to maintain SaO_2>90%
- Cough deep breathe exercises every 2 h
- Turn patient side to side every 2h
- Chest physiotherapy every 4h
- Nebulize with salbutamol 4h

- Alternate nebulization with 5000 u of Heparin with 3 cc of normal saline every 4h
- Sputum cultures for intubated patients every Monday, Wednesday, Friday
- Patient and family education regarding inhalation injury.
- Pulmonary function studies prior to discharge.

Indication for ventilation
Patient is intubated if there is evidence of mucosal lesion of moderate severity along with early hypoxia. Ventilation is begun early as a response is seen only then. Ventilation requires taking consent and explaining to the relatives the gravity of the disease.

Central line
Patients require a central line to monitor intravenous fluids. These patients require 20% more fluids. If the fluid input is less there is hypotension .

Antibiotic cover.
Patents with smoke inhalation injury have a high incidence of sepsis occurring early manifesting as, change in wound colour, intolerance to glucose, inability to feed enterally, and a high white cell count and therefore are given a good wide spectrum antibiotic.

Tracheostomy If secretions are extensive or ventilator is needed more than 10 days.

Signs of pneumonia: Diagnosed by clinical deterioration, sputum positive for polymorphonucleocytes, and new bacteria, and CXR positive.

If ventilation is not available management in ward
Aggressive physiotherapy by a therapist trained in chest physiotherapy and intensive care unit.

Nebulization using ventolin and heparin. (Heparin is used to reduce cast formation)
Regular suctioning.
Mobilization and propping up of patent.
Sputum culture and ABST

Physiotherapy and occupational therapy
Begins at the time of admission and should continue during before and after wound care and during follow up. Management of scars and pressure therapy for treatment and prevention of hypertrophic scars continue from the time of discharge until the scars have flattened and no longer blanch to pressure. This requires wearing pressure garments for 12 to 18 months continuously for 23 hours of the day .1 hour is given for bathing and for skin care Scars that do not respond to pressure may require surgical intervention.

Section 7 Special areas

Facial burns

All hair is shaved especially in flame burns where the accelerant is kerosene or petrol, and in all burns where the forehead burn extends to the scalp and ears. The beard is also shaved. Trimming is not sufficient. The face is cleaned every 2 hours with clean, boiled and cooled water and soap (lifebuoy) and application of 1% Povidone iodine ointment which is the application of choice for the face. This is done until all scabbing and crusting stops. If there are non-healed areas after 10 to 12 days other solutions such as Oxoferrin can be used for a further week. All patients with facial burns must be nursed in propped up position. The scalp is cleaned daily with chlorhexidine solution. If the anterior neck is burned, a cervical collar of gauze and cotton is used for splinting the neck and changed when soiled. No dressings are applied on the face.

Any facial burn that is full thickness and not healed at the end of 3 weeks must be referred to the nearest facility with plastic surgeon as resurfacing needs to be done according to aesthetic subunits. However in extensive burns life

In extensive burns life takes precedence over facial scars and chondritis.

Ears

Shave scalp and beard to prevent bacterial fall out and desquamating material from contaminating the facial wounds. Frequent gentle cleansing to prevent crusting of serum and build up of scabs. 1% Povidone iodine ointment is applied to prevent desiccation. No dressings are applied. Ears are cleaned 2 hourly. No rubbing as oedematous skin is easily damaged. Clean with normal saline gently using gauze. Avoid pressure. Splint the neck

with a cervical collar. This prevents pressing the ears against the hard scalp during sleeping.
No pillows, for all head and neck burns. This is to prevent flexion contracture as well as chondritis.

Hand burns
Hands have a unique functional significance and even minor burns must be treated with great care to optimize function, and prevent deformity. All injured hands must be dressed with care. Blisters over major joints deroofed, dead skin removed and trimmed. Palmar blisters may be aspirated. Fingers must be dressed separately and web spaces separated. The dressings must not be too bulky, all dressings are done from distal to proximal and supported with crepe bandage. Each finger is bandaged using 1-inch crepe and the hand with 3 inch crepe. A Plaster of Paris splint in the position of function is applied and the limb must be elevated to reduce oedema. Tight dressings and circumferential dressings that might compromise circulation is avoided

Caution any constricting device bangles, rings or bands must be removed as the limb will become oedematous in 24 hours. Circumferential burns my lead to ischaemia and will need escharotomy. All circumferential burns will need monitoring for 24 hours. (fig7)

Perineal burns
Perineal burns are dressed by the open method. Clean with normal saline. Rectal and vaginal examinations are done to exclude any concomitant injuries. Swabs must be taken if there is any discharge. Area is kept clean and dry and 1% Povidone iodine solution applied every 2 hours and after cleaning when passing stools. Catheterization is done for patient comfort and ease of nursing the area.
Perineal burns are unusual and rape abuse must be considered in any burn that is not in keeping with the history.

Section 8. Chemical burns

Introduction

In Sri Lanka, chemical burns are commonly a result of assault with acid. The commonest is formic acid followed by Sulphuric and nitric or combinations. Alkali burns may occur in industrial and domestic accidents. Commonly involved alkalis are calcium hydroxide, lithium, barium, ammonia, sodium, and potassium

Protection during first aid

It is vital that all care givers and first aid workers are aware of the need to protect themselves from contamination e.g. wearing gloves, aprons and protective facemasks and overalls. The patients clothes should be removed as soon as possible if contaminated and stored in a protective container for disposal later.

Pathophysiology

Tissue damage due to result of exposure to any chemical depends upon

- Strength or concentration of agent
- Quantity of agent
- Manner and duration of skin / mucosa contact
- Extent of penetration into tissue
- Mechanism of action

The principal difference between thermal and chemical burns is the length of time during which tissue destruction continues since the chemical agent causes progressive damage until diluted with water.The estimation of depth by clinical examination following a chemical burn is difficult during the first few days of injury.

An important feature of some acids is their systemic toxicity

- Hypocalcaemia
- Liver and or kidney damage
- Inhalation injury
- Methaemoglobinaemia and massive haemolysis

First aid

Constant water flow (except elemental sodium, potassium or lithium).

For the best results irrigation should start within 10 min of contact Alkalis can cause more long-term effect as they liquefy tissue and so penetrate more deeply. They need a longer period of irrigation (at least one hour)

Special areas

Face

No dressings-open method of dressing is used.

Shave hair and beard

Clean 2 hourly with normal saline and apply 1% povidone iodine ointment.

If not healed in 12 to 14 days may need grafting, refer to plastic surgeon

Other areas may be dressed with silver sulpadiazine and occlusive dressings similar to flame burns

Eye

Chemical burns of the eye are associated with a high incidence of residual ocular impairment. Treatment is copious irrigation with water. Irrigation with water must be done prior to eye referral.

Wound management

Early excision and grafting of non healed burn (after 10 to 12 days) is the key to successful outcome. Burn wounds following chemical burns heal with deforming hypertrophic scars if healing is delayed or they become infected

Occupational and Physiotherapy

Scar management and pressure garments are essential to prevent hypertrophic scarring and deformity.

Section 9. Electrical injury

Can be of 3 types

1. **Low voltage injury -**Injury due to voltage < 1000 volts

2. **High voltage injury-**Any injury occurring at voltage >1000 volts but commonly 11000 or 33000 volts which are the currents associated with high tension cables.

3. **Lightning Strike-**Is an extremely high voltage and high amperage DC electrical current of ultra short duration with a characteristic pattern of injury.

Types of burn injury

Low voltage
Causes significant local contact wounds and cause cardiac damage but no deep tissue damage. Household AC current can cause muscle spasm or tetany preventing the victim from releasing the source of discharge.

High voltage
Injury occurs in two ways

- **Flash burns.** A cutaneous burn without deep tissue damage occurs with flash burn. Current does not pass through the victim .The arc ignites clothing and causes deep dermal burns without formation of contact sites or entrance or exit wounds.
- **Current transmission** High voltage current transmission generally results in both cutaneous and deep tissue damage and the entrance wound exit and contact areas are full thickness burns. Less commonly there may be associated injury such as fall from a pole or tower.

There may be deep tissue damage underneath the skin which appears normal but there is deep tissue and muscle damage involving whole compartments. This may require a fasciotomy to relieve the tension

Muscle injury and necrosis results in release of myoglobin and muscle cells into the circulation. This pigment along with haemoglobin from haemolysis may lead to renal impairment.

Lightning strike

Direct strike is uncommon and has a very high mortality.
More commonly a side strike or splash occurs when lightening strikes a tree. The current is then deflected through the victim on its way to the ground. Typically current passes over the surface of the victim causing superficial or partial thickness burns. There may be significant exit burns on the feet. There may be associated respiratory or cardiac arrest and the tympanic membrane of the ear maybe damaged. Corneal damage may also occur,

First aid

There is risk to the rescuer from electrocution. Therefore the rescuer must take precautions to protect himself by
switching the power source off before touching the victim
Once clear of the power source the primary survey begins as with all other burn injuries.

Initial assessment

Airway must be cleared and the cervical spine protected.
Breathing and circulation may be arrested as a result of the discharge affecting the medulla or the myocardium and CPR is therefore vital to resuscitation of victims of electrical injury.
Endotracheal intubation may be indicated to maintain airway patency.
Protection of the cervical spine is of importance because trauma may be associated with damage to the cervical spine due to fall

from a height. Violent muscular contractions due to alternating currents can cause fractures
Following the primary survey a secondary survey as done and a detailed history
Taken with the secondary survey attention is paid to entry, exit wound the depth and extent of burn and examination of damage to spinal and peripheral nerves.

Resuscitation

The fluid required in electrical injuries often greater as there may be hidden muscle damage under what appears to be normal intact skin. In patients with deep tissue damage leading to myoglobinuria or haemoglobinuria the infusion rate is maintained at 70 –100 ml / hr.
In circumstances where urine output cannot be maintained by appropriate IV infusion.12.5g of mannitol should be added to each litre of replacement fluid to produce an osmotic diuresis.

Dysrhythmias

An ECG should be obtained on admission of all patients with electrical injury. Patients who have had a cardiac arrest or where the current has passed through the thorax are at risk of dysrhythmia. Even after a normal ECG changes may continue to occur for 24 to 48 hours.

Hourly assessment of the **peripheral circulation** must be made.

- skin color
- oedema
- capillary refill
- peripheral pulses
- skin sensation

When there is evidence of an entry or exit wound of an extremity the possibility of subfascial oedema must be anticipated. The limb becomes stony hard, there is deep seated pain and there is

progressive loss of sensation and loss of pulses. Under these conditions a **fasciotomy** is required

Fasciotomy

It is important that the patient is well resuscitated prior to the procedure so that haematochromogens released from the muscle may be flushed out from the kidney. Blood loss may be considerable and require resuscitation. The fasciotomy is dressed with Vaseline gauze, lightly applied 1% povidone iodine dressings and supportive bandage. There should be no tight constricting pressure from the dressings.

Wound care is the same as for other burn wounds. However progressive necrosis may require several wound debridements before skin cover or reconstruction can take place.

References

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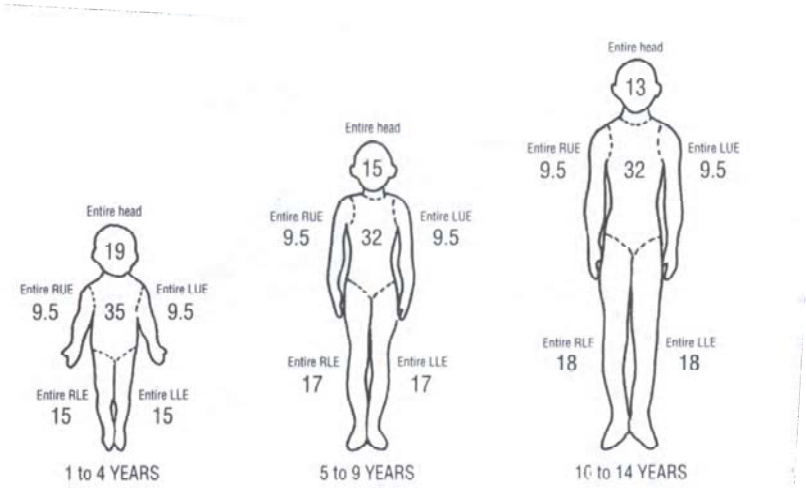
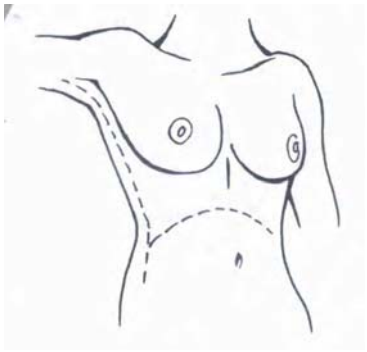
2 Wolf, S.E, Herndon, D Vademecum of Burn Care Landes Bioscience 1999

3 Australian and New Zealand Burn Association Emergency Management of Severe Burns, Course manual 2nd ed 1991

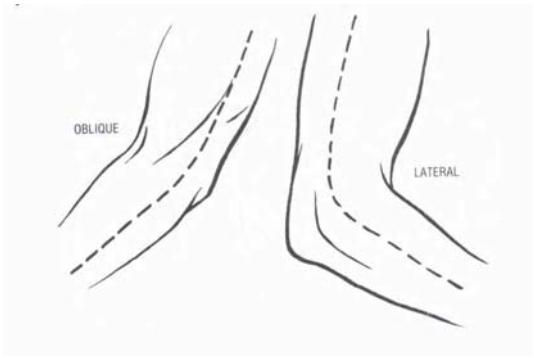
Appendix-1 Modified rule of nine for paediatric patients



Appendix-2 Escharotomy incisions

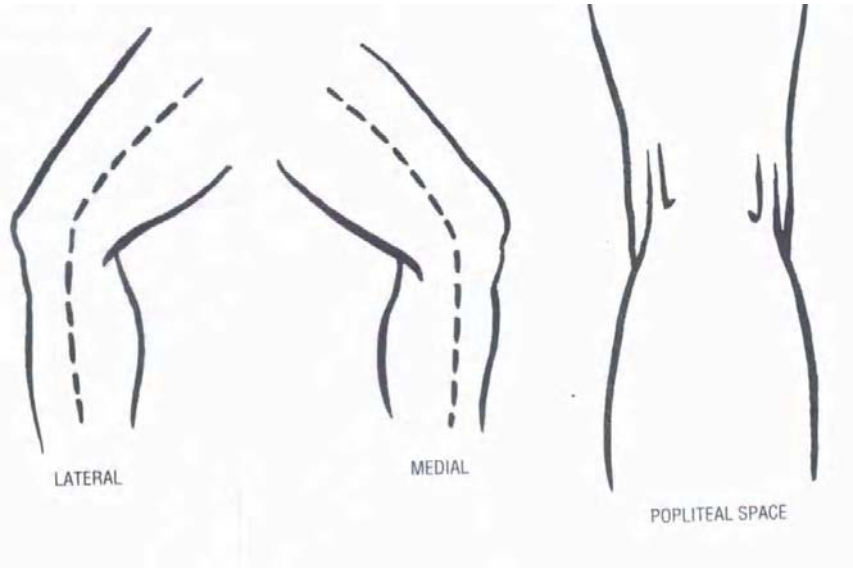


CHEST



UPPER LIMB

LOWER LIMB



Appendix -3

Recommendation

All teaching hospitals should have trained surgeons with and be equipped to manage major burns. These hospitals should have registrars or medical officers with 6 months training in burn management including ICU care, excision and grafting, nutritional care, rehabilitation and follow up.

These hospitals should also have occupational therapists and physiotherapists with 3 months training with certification in managing and treating burns of face hands chest etc. as well as splinting, splint making and scar management.