

Acute management of Paediatric burn wounds

Key Points

- Always assess and manage burn injuries like any trauma case - requiring primary and secondary survey.
- It is essential to have an accurate Total Body Surface Area (TBSA) estimation, as this dictates fluid resuscitation decision making.
- REMEMBER - TBSA calculation does not include simple erythema.
- Burns $\geq 15\%$ TBSA require fluid resuscitation according to the modified Parkland formula. See charts and flow diagram below.
- A is for Airway, but when it comes to burns, A is also for ANALGESIA. Essential for accurate assessment and management.
- Ask parents to take photographs of initial burn wounds, as this will serve as a timeline tool in future wound assessment.
- Significant burn wounds lead to excessive heat loss. Keep the patient WARM throughout assessment, resuscitation and transfer.

The 10 Essential steps of Paediatric burn wound management:

1.0 History

- Time of injury
- Mechanism of injury,
 - Scald: estimated temperature and nature of the liquid.
 - Contact: estimated temperature and nature of the surface.
 - Friction: enquire about circumstances.
 - Flame or explosion: product/material that burned/explored; location (enclosed vs. open space); duration of exposure; concerns for inhalation injury.
 - Electrical: voltage, type of current (AC or DC), duration of contact.
 - Chemical: type of product?
 - Cold: direct contact with cold surface or exposure (frostbite).
 - Radiant: sunburn
- First aid pre-hospital
 - Time started (was it within 3 hours of the injury and maintained)
 - Agents used?
 - If clothes and jewellery were removed?
 - Decontamination method (for chemical exposure).
- Consider co-existing non-burn injuries.
- Consider non-accidental injury.
- Ask about Tetanus status.

2.0 Examination

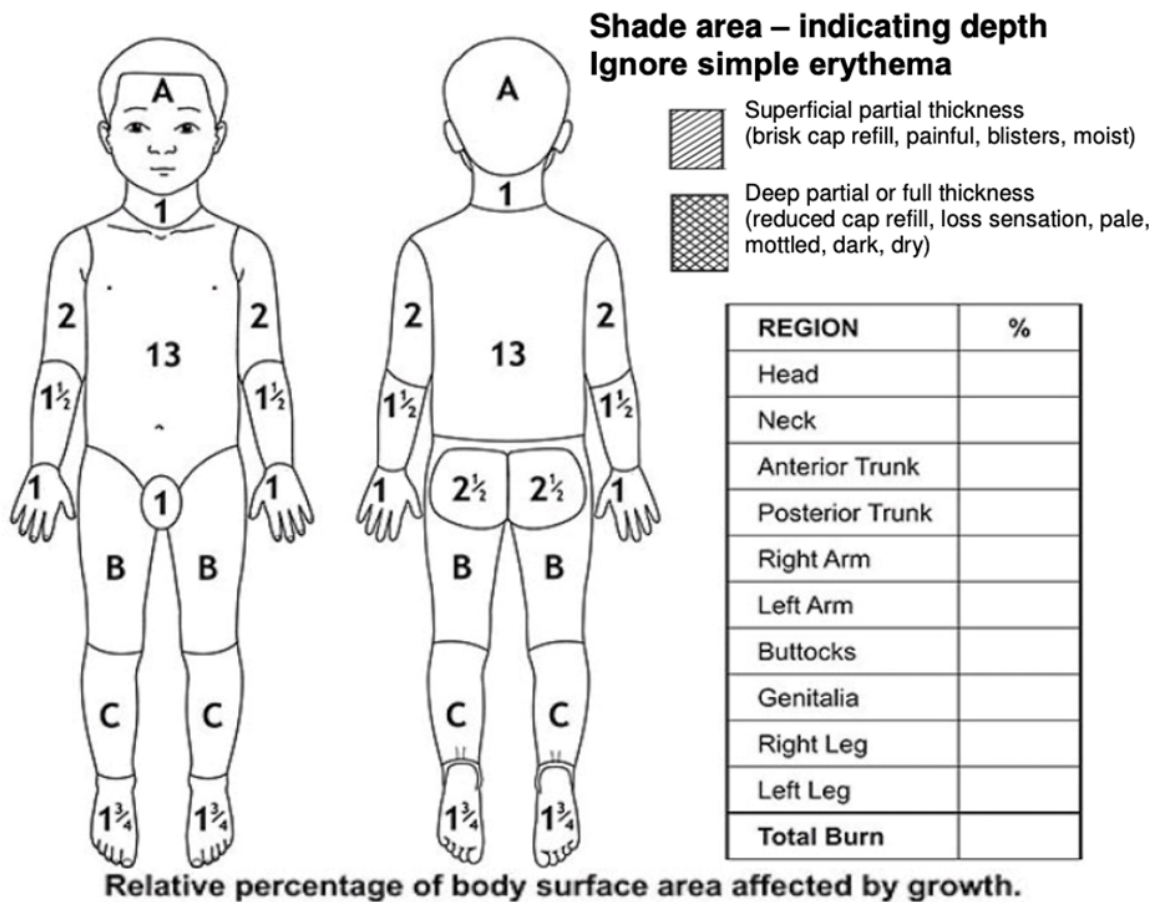
Stick to the basics - primary and secondary survey with the initial aim of identifying and managing immediate life threats:

- **Airway**
 - Assess airway for burn/inhalation injury: stridor, hoarseness, black sputum, respiratory distress, singed nasal hairs or facial swelling.
 - Signs of oropharyngeal burn: soot in mouth, intraoral oedema and erythema.
 - Always keep significant neck burn injuries in mind - consider early intubation.
 - If suspicion of airway burns or carbon monoxide intoxication apply high flow oxygen early.
 - Protect C-spine with immobilisation if any associated trauma.
- **Breathing**
 - Full thickness and/or circumferential chest burns may require escharotomy to permit chest expansion.
- **Circulation**
 - If early shock is present, consider causes other than the burn injury.
 - IV fluid resuscitation as required - IV or IO access (preferably 2 points of access).
 - For circumferential burns, check peripheral perfusion and need for escharotomy.
- **Disability**
 - If altered conscious state, consider airway support.
 - Assess neurovascular status if any limb involvement.
 - Exposure - including burn assessment (depth and TBSA) and initial management.

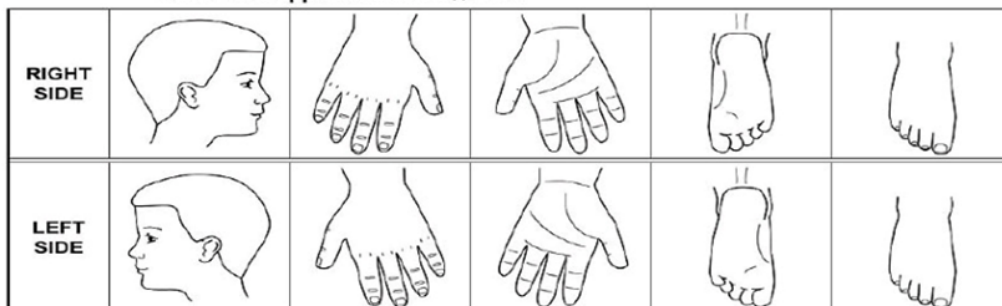
3.0 Assessment of TBSA

- Expose whole body – remove clothing and log roll to visualise posterior surfaces.
- Use Lund and Browder chart, use chart to indicate anatomical area and degree of burns.

Assess the extent and depth of the burn



Small burns - Palm of hand (including fingers together) approximates 1% of body surface area.
Palm alone approximates 0.5% BSA.



4.0 First aid

- Remove jewellery and clothing in contact with burn source.

- Cool affected area as soon as possible (within 3 hours from time of burn) for 20 minutes with cool running water (Keep in mind chemical burns might need specific irrigation).
- If unavailable, other options include frequently changed cold water compresses, immersion in a basin, irrigation via an open giving set.
- Never apply ice!!
- Cover burn with plastic cling film lengthways along the burn:
 - Do not wrap circumferentially.
 - Do not apply plastic cling film to face (use paraffin ointment)
 - Do not apply plastic cling film to a chemical burn
- Discuss chemical burn decontamination with National Poisons Information centre – **01 8092566**.
- Appropriately consented photos of burns prior to dressings are useful for ongoing management. Ask parents to take photographs of initial burn wounds, as this will serve as a timeline tool in future wound assessment.
- Always remember analgesia!

5.0 Prevent hypothermia

- Remove wet clothes/dressings after initial cooling.
- The child should be covered in a foil sheet and at least two blankets.
- The child's head should be covered with a foil or wool hat.
- Where possible, an electric warming blanket should cover the child's bed/trolley.

6.0 Fluid Management in burns $\geq 15\%$ TBSA

- The aim is optimal replacement of fluid losses to maximise wound and body perfusion, while minimising wound and body oedema and associated adverse effects.
- Calculate requirements from time of the burn, NOT time of presentation.
- Calculate resuscitation fluid volume using Modified Parkland Formula (see below)
- Maintenance fluids are also required, either po or iv.
- Insert urinary catheter for strict fluid balance.
- Patients with delayed fluid resuscitation, extremely high BMI, electrical injury or inhalational injury may have different fluid requirements. Discuss with specialist team.

6.1 Resuscitation fluid

- Resuscitation fluid - Hartmann's solution IV.
- Resuscitation fluid volume required in the 24 hours from injury (in ml) should be calculated using the following modified Parkland formula:
 $2\text{ml fluid} \times \text{Weight (kg)} \times \% \text{TBSA}$
- The volume is divided in 2, and the first half of the fluids administered over the first 8 hours from the injury.
- The second half of the fluid volume is titrated according to urine output.
- N.B. The first 8 hours begins from the time the injury occurred.

6.2 Modified Parkland Formula

First, gather the following key information you will need:

TBSA of burn = **A** %
Patient weight = **B** kg
Time since burn = **C** hrs (if more than 7 hrs, use 7)
IV fluids already given = **D** ml

Now, use 5 steps to make best use of the Modified Parkland Formula:

Step 1: Estimate the volume of fluid required in the first 24 hrs (from time of burn injury)

$$2 \times \text{A} \text{ } \% \times \text{B} \text{ } \text{ kg} = \text{E} \text{ } \text{ ml}$$

Step 2: Adjust volume to account for any IV fluids already received

$$\text{E} \text{ } \text{ ml} - \text{D} \text{ } \text{ ml} = \text{F} \text{ } \text{ ml}$$

Step 3: Adjust rate calculation for initially maximally increased vascular permeability

$$\text{F} \text{ } \text{ ml} \div 2 = \text{G} \text{ } \text{ ml}$$

Step 4: Adjust rate calculation to account for time elapsed since the burn injury

$$\text{G} \text{ } \text{ ml} \div (8 - \text{C} \text{ } \text{ hrs}) = \text{H} \text{ } \text{ ml}$$

Step 5: Start IV resuscitation fluids at rate **H** ml/hr

From this starting rate, **ongoing changes in resuscitation** IV fluid rate are not determined by the Modified Parkland Formula, but by the patient's **urine output and fluid status**, which are re-evaluated every 1-2 hours during the first 24 hours post burn injury. Targets for optimal urine output to guide/adjust resuscitation fluid rates:

Infant under 1 year = 1-1.5ml/kg/hr

Child 1-15 years = 0.5-1 ml/kg/hr

If urine output is below target, increase rate by 10-20% and monitor fluid status response
If urine output is above target, decrease rate by 10-20% and monitor fluid status response

6.3 Maintenance fluid

- Maintenance fluid is indicated in all burns >15% TBSA.
- Maintenance fluid can be administered enterally (orally or via nasogastric tube) or intravenously. Hence, no need if adequate oral intake.
- Oral fluid intake should be accurately recorded from time of the injury.
- Preferred intravenous maintenance fluid is 0.9% NaCl /5% Dextrose.
- IV maintenance fluid should run through **a separate IV line** to the resuscitation fluid.
- 24-hour maintenance fluid requirements for children can be calculated using the following formula, based upon their weight:
 - 100ml/kg for the first 10kg
 - 50ml/kg for the next 10kg
 - 20ml/kg for each kg thereafter

7.0 Analgesia

- Especially during assessment, cooling, dressing and mobilisation.
- Consider intranasal fentanyl or IV morphine.

8.0 Initial investigations

Burn >=15% TBSA)	Haemoglobin, electrolytes, blood glucose, group & hold, venous blood gas.
Multi-trauma	As per ATLS primary and secondary survey .
Suspected inhalation injury	ABG for carbon monoxide.
Electrical injury	ECG

9.0 Special Considerations

9.1 Chemical Burns

- Discuss decontamination with National Poisons Information centre – **01 8092566**, available 24/7.
- PPE (gloves, mask, gown, eye protection) for first aid givers.
- ALWAYS remove contaminated clothing.
- Remove chemical agent and brush away any powders and carefully remove any particulate matter.
- Avoid allowing rinsing water to flow over uninjured skin.
- Do not irrigate dry lime, phenols, muriatic acid, concentrated sulphuric acid or elemental metals with water – chemical-specific instructions should be followed.
- Irrigate skin with sterile isotonic solution (e.g. Hartmann's) or room temperature running water for at least 20 minutes.
- Following copious irrigation with water, irrigate with Diphoterine®, an amphoteric irrigating agent which neutralises both acids and alkalis, if available.

- Irrigation should be continued until skin pH 7 is documented using topical pH strips.
 - Small hydrofluoric acid burns (>1%) can result in systemic toxicity due to fluorosis, which results depletion of calcium and magnesium.
 - Patients at risk of fluorosis should be managed in a resuscitation area and have continuous cardiac monitoring.
 - Hypocalcaemia should be monitored and corrected accordingly.
 - Following irrigation, topical calcium gluconate should be applied to the wound by a healthcare provider wearing gloves, applying every 15 minutes until the pain has stopped and then 4 hourly.

9.2 Electrical Burns

- Liaise early with paediatric burn service and paediatric intensive care.
- Inspect for entrance/exit wounds.
- Consider spinal precautions and/or need for full trauma protocol.
- Cardiac monitoring is required if unconscious, cardiac arrest or observed abnormal rate or rhythm.
- Elevate affected limbs, monitor for compartment syndrome.
- Monitor for elevated creatine kinase and urine for haemoglobin/myoglobinuria.

9.3 Cold Thermal Burns/Frostbite

- Prioritise systemic hypothermia or severe trauma over regional cold.
- Rewarm area in circulating water at 37°C to 39°C for at least 30 minutes within 12 hours of injury.
- Rewarm until the injured tissues have regained sensation, feel soft and pliable to touch, with a red-purple appearance.
- Do not use dry heat, and do not apply pressure, massage or rub the affected area.
- Elevate the affected area to prevent oedema.

9.4 Ocular burns

- Urgent ophthalmology review
- Signs include blepharospasm, tearing, conjunctivitis
- All facial burns should have assessment with fluorescein 2% eye drops to assess for corneal damage
- Irrigate with copious 0.9% sodium chloride & topical anaesthetic.
- Topical chloramphenicol to prevent secondary infection.

10.0 Tetanus and Antibiotics

- Tetanus toxoid should be given if the child's immunisations are not up to date according to childhood vaccination schedule.
- Prophylactic antibiotics are **not indicated** in the acute management of a burn.

Referral to paediatric burns unit

Consider referral in the following situations:

- ≥4% TBSA

- Full thickness burn of ANY size
- Circumferential burn
- Associated with trauma and/or spinal cord injury
- All inhalation/airway burns
- Special areas: hands, feet, face, perineum, genitalia or flexor surfaces of joints
- Chemical burns
- Electrical burns
- Cold thermal/frostbite burn
- Unwell/febrile child with a burn or concerns for toxic shock syndrome
- Comorbidity that may affect treatment or healing of burn (Think immunocompromised, T1DM or chronic renal disease)
- Suspicion of non-accidental injury

If patients have been referred to the paediatric burns unit, wounds should be dressed with a non-adherent silicone dressing (e.g. Mepitel, Adaptic Touch) and overlying wound gauze.

All patients with burn injuries, who are referred for admission to a CHI site under plastic surgery, should have undergone primary survey, evaluation for associated injuries and stabilisation prior to transfer. It is expected that patients transferring from the MTC in CUH, will have received plastic surgery review locally, so can be directly transferred to an available inpatient bed in the burns unit.

Other patients, who meet major trauma criteria but have not undergone assessment and stabilisation, should be referred to the receiving ED prior to admission.