Definitions

Superficial or Epidermal
  Epidermis only involved
  Burn appears red, no blistering, is painful
  Heals quickly without cosmetic blemish

Partial thickness

Superficial partial thickness or Superficial Dermal
  Superficial part of dermis as well as epidermis involved
  Burn has blisters, base of blister is pink, normal cap refill, is painful
  Should heal spontaneously by epithelialisation within 14 days, colour match defect only

Deep partial thickness or Deep Dermal
  Destruction of the dermal vascular plexus
  May have some blistering, base of blisters are blotchy red, loss of capillary refill, loss of sensation
  Do not heal spontaneously

Full thickness
  Destruction of epidermis and dermis
  White/waxy/charred appearance, no capillary refill, no sensation
  Do not heal spontaneously

Children’s skin is much thinner and therefore more susceptible to deep burns.

<table>
<thead>
<tr>
<th>Depth</th>
<th>Colour</th>
<th>Blisters</th>
<th>Cap refill</th>
<th>Sensation</th>
<th>Heal with dressings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epidermal</td>
<td>Red</td>
<td>No</td>
<td>Normal</td>
<td>Normal</td>
<td>Yes</td>
</tr>
<tr>
<td>Superficial Dermal</td>
<td>Pale pink</td>
<td>Yes</td>
<td>Normal/Sluggish</td>
<td>Normal</td>
<td>Yes/usually</td>
</tr>
<tr>
<td>Deep Dermal</td>
<td>Blotchy red</td>
<td>+/-</td>
<td>Absent</td>
<td>Absent</td>
<td>No</td>
</tr>
<tr>
<td>Full thickness</td>
<td>White</td>
<td>No</td>
<td>Absent</td>
<td>Absent</td>
<td>No</td>
</tr>
</tbody>
</table>
PAEDIATRIC BURNS

Causes

Burns and Scalds
- Mortality from burns and scalds is low but morbidity (pain and scarring) is high.
- Rates of injury are highest in the 12 to 24 month age group (44/100000/year)
- Around half of these are scalds, almost all of which occur in the home.
- Hot drinks, water on stoves, kettles and hot tap water are most commonly involved.
- The severity of the burn is closely related to temperature of the liquid. Liquid at 60°C will burn children in less than 5 seconds, compared with 10 minutes if the liquid is at 49°C.
- Hot object burns also typically occur in the home and typically involve heaters, irons and ovens.

Electrical
- Usually low voltage in children (<1000 volts), usually involve extension cords in young children.

Chemical
- Ingested dishwasher powder (alkali) is the most common cause of chemical burns to children.

House fire
- Admission rate following injury related to house fire is relatively low (around 4/100000).
- Mortality from house fire is significant - accounting for 10 to 15% of child injury mortality.
- Young children have the highest mortality when involved in house fires.

Management

Initial Assessment

Primary survey
- Airway – beware hoarse voice, stridor, cough, carbonaceous sputum.
  Secure airway by intubation early if burn to airway is suspected.
- C spine
- Breathing
  Consider Carbon monoxide (CO) poisoning:
  - CO has a much greater affinity than oxygen for haemoglobin and so displaces oxygen.
  - Assume carbon monoxide exposure in patients burned in enclosed areas.
  - Diagnosis of CO poisoning is made primarily from a history of exposure.
  - Patients with CO levels of less than 20% usually have no physical symptoms.
  - Higher CO levels may result in headache and nausea, confusion, coma and death.
  - CO dissociates very slowly but this is increased by breathing high-flow oxygen via mask.
- Circulation
  If shock present look for an alternative cause – acute burns very rarely cause shock.
PAEDIATRIC BURNS

- Disability
- Environment – temperature (beware hypothermia), remove clothing and jewellery
- Consider co-existing injuries especially if associated motor vehicle accident, blast or explosion, electrocution, jump or fall while escaping fire.
- Resuscitate as abnormalities in the primary survey are detected.

Acute Treatment of Burn

Cool the Burn
- Apply tap water at room temperature onto burned area for at least 20 minutes (within 3 hours of burn), unless completed prehospital.
- Never use ice or iced water
- Keep the non burned area dry and warm
- Stop cooling if core body temperature is <35°C

Analgesia
- Opiate analgesia is often required initially (even for relatively small burns). Consider IV morphine or IN fentanyl
- Covering the burn with an occlusive dressing (cling film) will reduce pain

Fluid resuscitation
- Insert IV line if burn >10% BSA.
- Take blood for Hb, U and Es, Cr, BSL. Albumin if >10% BSA.
- Request carboxy Hb if possible inhalation injury.
- If shocked, give a bolus of 0.9% saline (20ml / kg) and look for cause of shock other than burn.

Tetanus prophylaxis

Further Assessment

History
- When did it happen?
- How did it happen?
- Who saw it?
- What was done? Length of cooling?
- Consider non-accidental injury – concerns about supervision, delay in presentation, history of burn but unexplained or inconsistent with injuries, repeated injuries, multiple burns, burns to buttocks or genitals. If in doubt discuss with senior colleague.

Complete secondary survey
Assessing the extent of the burn

See page 9 – **Assess the Extent and Depth of the Burn**
Consider printing sheet and incorporating in your clinical record

**Be aware that the extent and depth of a burn is likely to evolve.**
Burns often change rapidly over the first few hours and the best definitive assessment can be made at 48 to 72 hours post burn.

**Chemical burns**
- Can result from exposure to acids, alkalis, or petroleum products.
- Alkali burns (liquefactive necrosis) tend to be deeper and more serious than acid burns (coagulative necrosis).
- Immediately flush away the chemical with large amounts of water for at least 20 to 30 minutes (at least 1 hour for alkali burns).
- Alkali burns to the eye may require continuous irrigation during the first 8 hours after the burn.
- If dry powder is still present on the skin, brush it away before irrigation with water.
- Consider the possibility of systemic effects of the chemical.
- Ingestion of corrosive agent
  - If intra-oral burns then endoscopy is usually recommended – discuss with Paediatric Surgeon
  - Systemic steroids do not prevent stricture formation

**Electrical burns**
- Usually ‘low voltage’ (<1000 volts) - cause local burns but not usually deep muscle damage
- If the child meets all the following criteria;
  - Healthy child
  - Exposed to common household currents (AC ≤240V or DC), without water contact.
  - Asymptomatic at ED presentation
  - No ventricular arrhythmia or cardiac arrest prior to presentation
  - Then they do not need an ECG or further monitoring/observation for cardiac arrhythmia.
- If the child does not meet these criteria then consider ECG and admission for cardiac monitoring – suggest discussing with senior doctor.
- May be more serious than they appear on the surface if higher voltage injuries
- May cause **rhabdomyolysis** which results in myoglobin release. This can cause acute renal failure. If the urine is dark, start therapy for myoglobinuria immediately:
  - Fluid administration should be increased to ensure a urinary output of at least 1 to 2 ml/kg/hour
  - Mannitol should be given if the pigment does not clear with this increase in fluid.
  - Metabolic acidosis should be corrected by maintaining adequate perfusion and adding sodium bicarbonate.
PAEDIATRIC BURNS

Disposition

The Paediatric Burns service is based at Middlemore Hospital.
Contacts include:
- Plastics Registrar is on call for Burns advice and admission 24 hours a day – contact through the Middlemore Hospital operator 902 8700
- Burns Clinic 276 0044 ext 8214 or 8664

Referral to the Paediatric Burns service is indicated in the following circumstances
- Area of partial thickness burn greater than 10% of total body surface area
- Full thickness or deep partial thickness burn
- Partial thickness burns to face, hands, feet, genitalia, perineum, and over major joints
- Circumferential partial thickness burns of limbs or chest

Suspected Non-accidental injury (NAI) that does not need review by the paediatric burns service should be referred to Te Puaruruhau during the day or General Paeds consultant on call after hours as per other physical non accidental injury (see guideline).

Dressings

1) Initially consider covering burns with temporary covering of plasticized polyvinyl chloride film or cling film prior to initial assessment of wound occurring.
   a) The film should never constrict movement or be applied to the face or head area.

2) Ensure adequate analgesia

3) Clean and debride the wound
   a) Clean wound with warmed 0.9%NaCl..
   b) Remove devitalised tissue (loose nonviable skin)
   c) Tense large blisters should be drained by popping with a sterile needle and may need debriding, small blisters can be left alone
   d) Blisters over digits should not be debrided

4) Definitive dressing
   a) The preferred acute burns dressing in CED is a nanocrystalline silver dressing (eg Acticoat).
   b) Nanocrystalline silver protects the wound site from bacterial contamination while the inner core helps maintain the moist environment optimal for wound healing.
   c) This dressing consists of three layers: an absorbent inner core sandwiched between outer layers of silver coated, low adherent polyethylene net.
   d) To apply
      i) Trimmed to fit burn (but does not need to be a perfect fit and if in doubt extend onto area of simple erythema)
      ii) Moisten the Acticoat with warm water (Not with normal saline – it will deactivate the silver)
      iii) Place low allergy dressing retention sheet (Hypafix) over the top – it is required to overlap the nanocrystalline silver dressing onto normal skin.
e) Parents educated about moistening
f) Handout given to parents explaining dressing and burn care requirements

5) Usually the wound should be reviewed in 3 days in CED
   a) If superficial only or very small could be followed up by GP
   b) Usual practice would be to dress with nanocrystalline silver dressing again
   c) Vigorous debriding or cleaning at this stage should be discouraged

6) If ongoing concerns review again at day 6
   a) May be suitable for discharge with aqueous cream only
   b) May be able to apply a transparent dressing like “Comfeel” at this time. This can be removed in a further 2 days

7) Removal of dressing
   a) Care must be taken when removing the low allergy dressing retention sheet.
   b) Caregivers should be asked to apply olive oil to the edges of the cover dressing prior to coming to CED
   c) When olive oil has not been applied or the glue in the cover dressing is still sticky, an adhesive remover wipe may be used to loosen the dressing.
   d) Ensure none of the solvent from the adhesive removal wipe comes in contact with the wound surface.

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**Prevention**

**Burns and Scalds**
- Reducing the temperature of tap water reduces the severity of scalds.
- Secondary prevention by cooling the burn for 20 mins reduces burn severity.

**Advice for parents**
Install child safety gates to Keep Kids Clear of the Kitchen
Place guards or barriers around fires and heaters
Take care with microwaved food and fluid
   - Allow microwaved food or fluid to stand
   - Stir the food thoroughly to disperse any hot spots before feeding child
   - Test the temperature before serving
Reduce the hot water temperature to less than 50°C (120°F) at all outlets in the house, by using a tempering valve or reducing the preset temperature at the hot water heater.
Ensuring hot drinks, kettle cords and pots are placed out of reach
Avoid the use of table cloths (as children pull on them)
Don’t drink hot drinks while holding or feeding infants
Bath water temperature should always be checked before putting children in.
Electrical
Electrical safety switches (Ground Fault Circuit Interrupters) have been shown to prevent electrocution fatalities in the home.

Advice for parents
• Electrical safety switches should be installed and be tested every 3 months.
• Electrical safety
  - Install power point covers
  - Avoid the use of electrical appliances near water
  - Ensure extension cords are not accessible and any frayed or damaged cords are replaced.

Chemical
• Dishwasher powder ingestion injuries can be reduced by using products of lower alkalinity.

Advice for parents
• Store chemicals in their original containers, in cupboards with child resistant latches or locks
• Ensure children cannot access dishwasher powder, including left over powder in the dishwasher itself.

House Fire
• Smoke alarms work
  - Giveaway programs reduce the incidence of fire-related injuries
  - Door-to-door canvassing is an effective method for distribution of smoke alarms to communities
  - Maintenance programs are required as battery loss/failure is a common problem
• School education programs improve knowledge
• Fire department involvement in programs is helpful
• It is likely that Reduced Ignition Propensity (RIP or "fire safe") cigarettes will reduce the incidence of house fire (they have become mandatory in Canada and some states in the USA).

Advice for parents
• Smoke alarms should be installed and be regularly tested
• Homes should have a fire extinguisher, placed at the entrance to the kitchen.
• Care should be taken with cigarette stubs
• Cooking shouldn't be left unattended,
• Avoid placing items on heaters.
• Electric blankets should be turned off before going to sleep.
• Educate children about
  - Which things in the home are hot
  - That hot things are painful
  - Not to play with fire.
• Children and their families can develop, learn and practice a fire escape plan for the household including "stop, drop and roll".
Burn Management Summary

Perform primary survey

Cool the burn

Give appropriate analgesia

Obtain history of burn and perform secondary survey

Assess extent and depth of the burn

Does it meet referral criteria?
Area of partial thickness burn greater than 10% of total body surface area
Full thickness burn
Partial thickness burns to face, hands, feet, genitalia, perineum, and major joints
Circumferential burns of limbs or chest
Suspected Non-accidental injury*

YES
Refer to MMH Burns by discussing with “Registrar covering paediatric burns” Phone 902 8700

NO
Blisters or sluggish capillary refill?

YES
Partial thickness burn.

If to be seen immediately, cover burn with “clingfilm”

If to be reviewed in clinic, dress with Acticoat and Hyperfix

Dress with Acticoat and Hyperfix. Review in ED in 3 days and 6 days post burn

If uncertain about depth of burn. Dress with Acticoat and Hyperfix. Review in 3 days. If OK @ day 3 discharge to GP care

NO
Erythema only = Superficial Burn

If certain can: a) leave open or b) use occlusive dressing for analgesia (eg Hyperfix)

GP review in 24 hours

* Needs referral to Child Protection Service

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Service: Children’s Emergency Dept
Editor: Dr Raewyn Gavin
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Assess the Extent and Depth of the Burn

Ignore Simple Erythema

Shade area – indicating depth

- Superficial partial thickness (brisk cap refill, painful, blisters, moist)
- Deep partial or full thickness (reduced cap refill, loss sensation, pale, mottled, dark, dry)

<table>
<thead>
<tr>
<th>REGION</th>
<th>%</th>
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<tbody>
<tr>
<td>Head</td>
<td></td>
</tr>
<tr>
<td>Neck</td>
<td></td>
</tr>
<tr>
<td>Anterior Trunk</td>
<td></td>
</tr>
<tr>
<td>Posterior Trunk</td>
<td></td>
</tr>
<tr>
<td>Right Arm</td>
<td></td>
</tr>
<tr>
<td>Left Arm</td>
<td></td>
</tr>
<tr>
<td>Buttocks</td>
<td></td>
</tr>
<tr>
<td>Genitalia</td>
<td></td>
</tr>
<tr>
<td>Right Leg</td>
<td></td>
</tr>
<tr>
<td>Left Leg</td>
<td></td>
</tr>
<tr>
<td>Total Burn</td>
<td></td>
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</table>

Relative percentage of body surface area affected by growth.

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>0</th>
<th>1</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>Adult</th>
</tr>
</thead>
<tbody>
<tr>
<td>A 1/2 of head</td>
<td>9 1/2</td>
<td>8 1/2</td>
<td>6 1/2</td>
<td>5 1/2</td>
<td>4 1/2</td>
<td>3 1/2</td>
</tr>
<tr>
<td>B 1/2 of one thigh</td>
<td>2 3/4</td>
<td>3 1/4</td>
<td>4 1/2</td>
<td>4 1/2</td>
<td>4 3/4</td>
<td>4 3/4</td>
</tr>
<tr>
<td>C 1/2 of one leg</td>
<td>2 1/2</td>
<td>2 1/2</td>
<td>2 3/4</td>
<td>3 1/4</td>
<td>3 1/4</td>
<td>3 1/2</td>
</tr>
</tbody>
</table>

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


