THERMAL INJURIES IN CHILDREN

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Epidemiology

• Children < 5 yr - at high risk
• The 2006 National Injury Surveillance Unit reported that in Australia 191 children per 100 000 population <4 yr were hospitalised for burns - 12% of all persons hospitalised for burns
• Rates for children 5-14 yr < 50 per 100 000 population.
• In hospitalised burns 75% of infants (predominantly > 7 mo) and 63% of 1-4 yr were scalds.
Causes

• Accident: Unavoidable or understandable lapse in the usual protection given to children

• Neglect/negligence: failure to protect the child from inadequate parenting

• Abuse: deliberately inflicting the injury
Epidemiology of abusive burns

- In 1.7 - 25% of children hospitalised with burns - inflicted
- Lower end of this range in UK, Australia and New Zealand
- Burns from neglect thought to be > than abusive burns in Australia and New Zealand
- Children with inflicted burns are younger, have longer hospital stays and greater mortality vs. children with accidental burns
Risk factors for burns in children

- Male
- 1-2 yrs
- Young mother
- Single parent
- Having older siblings
- Lower SES
- Kitchen > bathroom
Classification

- According to depth
- According to body surface affected
- According to cause
Burn Depth

Epidermis

Dermis

Fat

Partial Thickness

Full Thickness
Classification of burns

Superficial burn (first degree burn):
• involves epidermis
• painful
• dry (non blistered)
• red
• blanches on pressure
• heals in 3-6d without scarring
Classification of burns

Superficial partial thickness burns (second degree burns)
• involves epidermis and dermis
• painful with air movement or change in temperature
• red, blistered, seep fluid
• blanches with pressure
• heals in 7-21 d
• burned area may be darker or lighter in colour but no scarring
Classification of burns

Deep partial thickness burns (third degree burns)
• extends deeper into the dermis
• almost always blisters, blisters immediately and blisters may persist for several weeks
• painful on deep pressure
• does not blanch on pressure
• takes > 21 d to heal
• always scars and the scar may be severe
Classification of burns

Full thickness burns (fourth degree)
• all layers of the skin completely destroying the skin
• painless
• waxy white, leathery grey or charred black
• dry
• does not blanch with pressure
• does not heal without surgery
• scarring is severe
Types of thermal injury

- Contact dry burns
- Cigarette burns
- Scalds
- Fire burns
- Radiant burns
- Chemical burns
- Electric burns
- Friction burns
- Cold injury
Contact burns

- caused by hot objects usually metallic
- looks like a brand mark, sharply demarcated and with the shape of the object that caused it
- burn is dry and tends to be of a uniform depth
Abusive contact burns caused by potato smasher-number
Contact burn caused by curling iron

- age of child, number of burns and location concerning for abuse
- age of child, single area location suggests accidental contact
Abusive contact burn caused by head of dryer

- location atypical for accidental burn
Contact burn

- patterned contact burn from metal grate surrounding heater
- location atypical for accidental
Contact with hot car seat
Cigarette burns

- burn at temp of 200 C
- circular, punched out
- 0.8 cm to 1 cm
- sharply demarcated eschar
- surrounding collarette of exfoliation and tissue reaction
Cigarette burns

Accidental cigarette burns - brushing against a lit cigarette
  single
  superficial
  not completely round, more linear appearance
  higher degree of intensity on one side

Common sites
  face
  hands
Cigarette burns

Inflicted
• deep, multiple, circular, any location
Scald burns

• Caused by hot liquids or steam

• Patterns:
  1. Spill/Splash/Geographical or Flow type scalds also called Cascade or Pour scalds
  2. Immersion scalds
Time to burn by water temperature

- 1 sec at 65 C
- 2 sec at 60 C
- 12 sec at 55 C
- 2 min at 50 C
- The time to burn in children would be shorter as a child’s skin is thinner than that of an adult
Features of scald burns

- clothing wet
- skin sodden, bleached
- red line of demarcation between burned and non burned skin
- vesication most marked over burned area
- flow, trickle and splash marks
Spill/splash/geographical

- hot liquid falls from height
- accidental pulls or spills
- splash burns at site of initial contact
- usually superficial as contact time is short

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Hot water splash marks

Spill/splash/geographical-accidental scald pattern

- younger child - accidental spill or flow scalds are usually frontal, asymmetric and on head, neck and upper trunk
- older child may occur on the lower trunk, and limbs including legs and thighs.

Maguire S Arch Dis Child Educ Pract Ed 2010;95:170-177
Spill/geographical-frontal asymmetric and on the head, neck, upper trunk accidental scald pattern
Spill burns

- uneven in depth; deeper at the first point of contact become superficial distally as the liquid cools as it flows downwards
- as the hot liquid flows down it causes scalds in the shape of flow tracks and ends in an inverted arrow head or arrow down shape
Tap flow scald

- note splash marks
- flow track
- arrow head at the distal end of flow
Immersion burns

- concerning for abuse
- location: buttocks, perineum, extremities
- circumferential
- uniform depth
- absence of splash marks
- tide marks
- sparing
Immersion burns-location perineum, buttocks and extremities-very concerning for abuse

Figure 2: A. Scald; B. "Zebra striae" with preservation of the gluteal region (resting point) and C. "glove" burn

Adapted source: Kos L, Shwayder T

Immersion
Abusive immersion scald ‘glove and stocking’ pattern
Abusive immersion scald pattern

- uniformity of depth of burns
- water line or tide marks-horizontal marks indicating depth of immersion

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Figure Legend:
Large serous bullae of the buttocks and perineum with surrounding erythema. The arrow indicates the gluteal cleft tide mark.
Bilateral sock scald burns

- absence of splash marks concerning for abuse
- however debatable, at temp < 54C takes time to burn so absence of splash marks neither supports or refutes abuse.
- abused children could struggles and have splash marks
Interpretation of the pattern of burns-immersion

- circumferential
- water tide mark
- sparing of flexures
Interpretation of the immersion burns-sparing

- hand immersed in hot liquid
- back of hand first contacted the water
- wrist and fingers were flexed
- partially protecting palmar surface
Immersion burns-sparing

- “Hole in the doughnut” or “halo sign”
- when a child is forcibly seated in hot water in a tub the contact of the buttocks with the cooler surface of the tub causes an area on the buttocks that escapes burning or has less severe burning.
Immersion burns-sparing-zebra stripes scald pattern

Flame burns

- clothing burned
- skin dry and charred
- blistering may be seen at the edge
- red line of demarcation between burned and non-burned skin
- ulceration only when burn is infected
Radiation burns-sunburns

- sunburns are radiant burns
- superficial or superficial partial thickness
- may be from neglect
Chemical burns

- clothing have typical stains and odour
- skin may be stained- black by hydrochloric acid, yellow by nitric acid, and brown by sulphuric acid
- vesication rarely seen
- red line of demarcation rarely seen
- burns are deep or deep partial thickness
- significant ulceration due to penetration and devitalisation effects of the corrosives
Electric burns

Low voltage burns
• mostly in children <5 yrs
• mouth and hand
• contact with wire with worn out insulation
• small burn
• but deep and involving muscle, vessels and tendons

High voltage burns
• entry charred centrally depressed and leathery
• exit- exploded
• widespread tissue destruction between
• high fatality
Friction burn

• Friction burn is a form of abrasion and burn caused by rubbing of the skin against a surface when the friction is severe enough to generate heat

• Deep friction burn from touching moving belt of treadmill
Cold Injury

Non freezing:
- Chilblains: cold wet weather, painful or itchy purple red papules or reddened swollen toes, nose, ears
- Immersion foot

Freezing
- Frost nip
- Frost bite
Frosting or Aerosol burn

- aerosol sprayed very close to the skin
- for sustained periods
- fluorinated hydrocarbon propellant lowers skin temperature by 60 °C
- results in a cold injury
Differential Diagnosis

- Cigarette burns-
  impetigo, papular urticaria
- Scalds:
  staphylococcal scalded skin syndrome, TEN, any blistering disorder, phytophotodermatitis
Features concerning for abusive burns

1. **History incompatible with examination findings;**
   - denial by carer that the injury is a burn
   - history not compatible with the physical features of the burns for example history stating a flow mechanism when the pattern is clearly one of immersion scalds
   - when the pattern of burns is incompatible with the development of the child

2. **Delay in presentation for treatment**

3. **Child brought in someone other than parent**

4. **Blaming a sibling**

5. **Passive introverted fearful child**
Features concerning for abusive burns

6. **Associated unrelated injury:** Bruises, lacerations and swellings more common in children with intentional scalds compared to children with accidental scalds. Rarely scalds are associated with sexual abuse.

7. **Coexisting fractures:** Obvious fractures on examination of a child with burns or occult fractures on imaging suggest that burns may be inflicted.

8. **Scars from previous burn in juries**

9. **Clinical features of neglect and failure to thrive.**

10. **Total burn surface area:** There is disagreement whether total burn surface area is greater in inflicted rather than accidental burns.