

BURN INJURIES IN CHILDREN

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Epidemiology

- Children below the age of 5 years are at high risk of burn injuries particularly scald burns
- The Australian Institute of Health Welfare reported that in Australia, in 2013-2014, 126 children below 4 years per 100 000 population, were hospitalised for burns
- Rates for children between the ages of 5-9 years and 10-14 years were 35 and 28 per 100 000 population
- Children < 10 years accounted for 22% of cases hospitalised with burns
- 79% of the burn injury related hospitalization in children aged 0-4 years were as a result of scalds and contact with hot substances

Australian Institute of Health and Welfare. Hospitalise burn Injuries Australia 2013-2014. <https://www.aihw.gov.au>

Epidemiology of abusive burns

- In 1.7 - 25% of children hospitalised with burn injury the burns are 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

Risk factors for burns in children

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

Causes for injuries in children

- 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

Accident vs negligent vs abusive

Accidental/neglect

- Exploratory behaviour without cognitive awareness or motor skills
- Unavoidable or understandable lapse in supervision
- Failure to protect – supervisory neglect

Abusive burns

- Less than 25% referred for evaluation
- Burned children < 3 years are 7x more likely to suffer future abuse/neglect than case-matched controls
- Younger, longer hospital stays, greater mortality
- Sentinel and significant injuries of maltreatment

Classification

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

Superficial burn (first degree burn)

- Involves the top layer of the skin (epidermis)
- Painful
- Dry (non-blistered)
- Red
- Blanches on pressure
- Heals in 3-6days without scarring
- e.g. non blistered sunburn

Superficial partial thickness burn (second degree burn)

- Involves the epidermis and superficial dermis
- Painful with air movement or change in temperature
- Red, blistered and seep fluid
- Blanches with pressure
- Heals in 7-21 days
- Burned area may be darker or lighter in colour but no scarring

Deep partial thickness burn (third degree burn)

- Extends deeper into the dermis
- Almost always blisters, blisters immediately and blisters may persist for several weeks
- Painful on deep pressure
- Does not blanch when pressed
- Takes more than 21 days to heal
- Always scars and the scar may be severe
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Full thickness burn (fourth degree)

- All layers of the skin completely destroying the skin
- Burned area is painless
- Burned area is waxy white, leathery grey or charred black
- Skin is dry
- Does not blanch when pressed
- Does not heal without surgery
- Scarring is severe

Types of Burns

Thermal Injury

Heat Injury

- Contact dry burns
- Cigarette burns
- Scalds
- Fire/flame burns

Cold injury

Radiant burns

Chemical burns

Electric burns

Friction burns

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

Accidental Contact Burns

- e.g. irons, heaters, hot pavements, car seats
- Location on extremities, hands
- Age 1-2 years
- Smeared edges as child pulls away

Pavement burns abusive or accidental

- Hot pavement burns on soles of feet
- Common
- Often bilateral
- Superficial or superficial partial thickness

Abusive contact burns

- Age of child very young child
- More than one contact burns of same pattern
- Location on trunk or buttock

Cigarette burns

- High temperature > 200 C
- Punched out
- Circular or oval
- 0.8 to 1 cm
- Sharply demarcated, eschar
- Surrounding collaret of exfoliation and tissue reaction
- Heals with wrinkled scar

Accidental: brush-by, single, superficial – child withdraws, ovoid or wedge-shaped – “trailing off”, exposed areas – face, hands

Abusive: deep, often multiple, grouped, often hands or feet but can be in any location

Cigarette burn mimics: careful Hx required

- Infections: Impetigo and bullous impetigo, ecthyma, focal pyoderma, Chicken pox scars.
- Inflammation: Epidermolysis bullosa
- Moxibustion
- Discoid eczema

Scald Burns

Caused by hot liquids or steam

Patterns:

1. Spill/Splash/Geographical or Flow type scalds also called Cascade or Pour scalds more often seen in accidental/negligent scalds
2. Immersion scalds-concerning for abusive scalds

Time to burn by water temperature (in pigs)

- 1 second at 65 C
- 2 seconds at 60 C
- 12 seconds at 55 C
- 2 minutes at 50 C

The time to burn in children would be shorter given that a child's skin is thinner

Clinical features of scalds

- Clothing wet
- Skin sodden and bleached
- Red line of demarcation between burned and non-burned skin
- Vesication most marked over burned area
- Trickle and splash marks
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Splash/splash/geographical scalds

- Hot liquid falls from height
- Accidental pulls or spills
- Splash burns at site of initial contact
- Usually superficial as contact time is short
- In the younger child accidental spill or flow scalds are usually frontal, asymmetric and on the head, neck and upper trunk
- In the older child they may occur on the lower trunk, and limbs including legs and thighs.

Spill/flow/cascade

- 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 or spill or cascade if large amount of water
- The scald burn ends in an inverted arrow head or arrow down shape

Immersion burns

- Concerning for abuse
- Location: buttocks, perineum, extremities
- Circumferential
- Uniform depth
- Absence of splash marks
- Tide marks or water line indicating depth of immersion
- Sparing-as in hole in doughnut sparing of central buttocks when the buttocks contact the base of the tub and the area in contact is spared, flexion sparing of groin/ back of knees, palmar surface of hands, zebra pattern on abdomen caused by sparing in skin folds when trunk is flexed forwards
- Glove and socks/stocking patterns for limbs

Scald burn mimics

- Toxic epidermal necrolysis – follows medication use
- Stevens Johnson
- Staph scalded skin – febrile illness, skin redness then blistering, and sloughing followed by wet epidermal base
- Blistering distal dactylitis – group A strep
- Good Hx important

Flame burns

- Clothing burned
- Skin dry and charred
- Blistering may be seen at the edge of the burn
- Red line of demarcation between burned and non-burned skin
- Ulceration only when burn is infected
- Usually after house fires – high mortality
- Abusive – purposefully holding child's skin in contact with flame or igniting clothes

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

Aerosol burns-frosting

- Aerosol held close to the skin
- Fluorinated hydrocarbon propellants drop skin temperature by 60C

Radiation burns-sunburns

- Sunburns are radiant burns
- May be superficial or superficial partial thickness burns
- May be as a result of neglect

Microwave burns

- Most are scalds related to hot liquids and food
- Rarely abusive
- Demarcated on site adjacent to MW source
- No skin charring
- Spared tissue levels
- MW absorbed by tissues with higher water content skin and muscle >fat

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

Electrical 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 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

- Carpet burns -superficial often on the back
- Deep friction burns e.g. on palmar surface of hands from touching moving belt of treadmill

Burns and cultural practices

- Cupping – heated alcohol on rim of cup
- Maquas – deep burns on skin near diseased organs – Arabic
- Moxibustion
- Coining – usually bruising but if heated can burn
- Garlic burns – crushed garlic under adhesive bands

Assessment of burns

History

- **History in compatible 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

Pattern of burns is incompatible with the development of the child

- **History of soiling before the burns**
- **Delay in presentation for treatment of burns**
- **Child brought in someone other than parent**
- **Blaming a sibling**

Clinical features

- **Passive introverted fearful child**
- **Symmetrical pattern, bilateral, imprint burns**
- **Location on buttocks, genitalia, lower limbs**
- **Scalds without splash and drips and immersion pattern**
- **Associated unrelated injury:** Bruises, lacerations and swellings are reported to be more common in children with intentional scalds compared to children with accidental scalds. Rarely scalds are associated with sexual abuse
- **Coexisting fractures:** Obvious fractures on examination of a child with burns or occult fractures on imaging suggest that burns may be inflicted
- **Scars from previous burn in injuries**
- **Clinical features of neglect and failure to thrive.**
- **Total burn surface area:** There is disagreement whether total burn surface area is greater in inflicted rather than accidental burns

Investigations

- Fewer children with abusive burns had SS, LFT and MRI head compared with those with other injuries
- Same proportion (burn v other injury) had occult bony injury
- Similar proportion (burn v other injury) had evidence of intra-abdominal injury
- Significantly fewer children with burns had cranial injuries identified

- Children with burns are not Ix as well as other children with concerning injuries – although 16% had positive SS (similar to the rate in children with other injuries)
- Of 25% that had MRI, 14% were positive -? need for MRI
- **Children with concerning burns should be better investigated**

Ref: Pawlik et al Children with burns referred for child abuse evaluation: Burn characteristics and co-existent injuries. Child Abuse & Neglect

Role of Police – scene investigation

- Site visit – running water temperature, rate of rise of water temperature, scene photos, measurement of tub/sink, tub/sink material, plug/drainage characteristics (can water pool?), tap characteristics (easy to turn on/off?)