In Good Hands?
Death of a Child due to Intentional Immersion in Hot Water and the Resulting Complications

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Disclosures

• None

Background

• 2 y/o male in custody of paternal grandmother
• Suffered extensive burns one night which were treated at home
• Presented to hospital 6 days later after becoming unresponsive
Hospital findings

- Hgb 5 g/dL with:
  - Blood per rectum and NG tube
  - “Dark” stools and “brownish black” emesis
- Received blood transfusion
- Continued melanotic stools
- Hemodynamically stable with normal mental status on hospital day 5:
  - Scheduled for skin grafting
  - Abrupt drop in hgb → could not be resuscitated

Autopsy
• Cause of death: Complications of thermal injuries
• Manner of death: Homicide

Immersion burns
• Intentional burn injuries:
  – 10% of child abuse cases
  – 10% of pediatric admissions to burn units
  – Almost always < 10 y/o
  – Majority < 2 y/o
• In comparison to accidental burns:
  – Younger
  – Longer hospital stay
  – Higher mortality rate
Immersion burns

• Often occur during toilet training
• Frequently a delay in seeking medical attention

Characteristics

• Child lowered into water feet first → involuntary flexion of knees and hips
• Characteristic distribution:
  – Sharp line of demarcation with sparing of flexor surfaces and skin in contact with bottom of tub (“donut” pattern)
  – Uniform depth and distribution
  – Circumferential, full thickness, with minimal splash marks
  – “Glove and stocking” pattern

Spill or splash burns

• Hot liquid falls from height
• Irregular margins and non-uniform depth
• Liquid cools as it moves away from initial point of contact
Burn classifications

- Superficial (formerly first degree burns):
  - Confined to epidermis (ex: sunburn)
  - Dry, painful, do not blister

- Partial thickness (formerly second degree burns):
  - Involve epidermis and dermis
  - Painful, moist, can have blisters
  - Superficial partial thickness:
    - Clear fluid in blisters
    - Will blanch to pressure
  - Deep partial thickness:
    - May have bloody fluid in blisters
    - Will not blanch to pressure

- Full thickness (formerly third degree burns):
  - Involve epidermis, dermis, and subcutaneous tissue
  - May extend to skeletal muscle (formerly fourth degree burns)
  - Can appear black, white, or leathery
  - Do not blanch to touch
  - Not painful (unless edges of burn are partial thickness)

Rule of Nines
Curling’s ulcer

- Thomas Blizard Curling described duodenal ulceration associated with burns in 1842
- Possible mechanisms:
  - Hypoperfusion
  - Hypermetabolism
  - Immune dysregulation
- Incidence dramatically decreased with early medical intervention

Additional considerations

- Thorough scene investigation:
  - Max water temp in bathtub = 120 degrees
  - Mop placed over drain as described by grandma → 3-3.5 inches of water in tub after 6 minutes
  - Height of tub = 14 inches

Table 12.3 Water Temperature in Relation to Scalding Burns Time

<table>
<thead>
<tr>
<th>Temperature (°F)</th>
<th>Threshold for Epidermal Injury</th>
<th>Full-thickness Burns</th>
</tr>
</thead>
<tbody>
<tr>
<td>120</td>
<td>200 s</td>
<td>000 s</td>
</tr>
<tr>
<td>125</td>
<td>40 s</td>
<td>120 s</td>
</tr>
<tr>
<td>130</td>
<td>15 s</td>
<td>90 s</td>
</tr>
<tr>
<td>140</td>
<td>2.8 s</td>
<td>7 s</td>
</tr>
<tr>
<td>150</td>
<td>&lt;1 s</td>
<td>2.3 s</td>
</tr>
</tbody>
</table>

* s = seconds

Note: Downward adjustments to time needed for young children.
References

• Collins KA, Byard RW. Forensic pathology of infancy and childhood. New York: Springer; 2014.