Detecting Abuse in the Child with a Burn
You’re getting warmer…

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Disclosure Statement

Jamie Hoffman-Rosenfeld, MD, has no financial relationships with any commercial interests.

Objectives

The learner will be able to:
- Articulate the epidemiology of child abuse by burning
- Distinguish between the two major types of inflicted burns
- Discuss the steps in evaluating and reporting suspicious burn injuries
**Burn Injury - Basics**

- Represent 5%-22% of child abuse
- More common in children < 3 years of age
- Inflicted burns are about 10%-25% of pediatric burns
- Scald burns are the most common type of burn abuse
- 30%-45% of tap water scalds are abusive
- 85% of intentional scalds are tap water


**Burn Abuse Epidemiology**

- Younger children
- Single parent
- Abusive burns are more serious – more likely to be full thickness and require grafting
- Lower SES, unemployed
- Co-morbid FTT


**Four Factors Determine Burn Severity**

- Time
- Temperature
- Thickness of tissue
- Type (dry contact, scald, radiation, electric, chemical)
Clues
- Any burn in a non-ambulatory child
- Scald burns that are consistent with an immersion
- Dry contact burns with sharply demarcated margins
- Absence of reasonable history
- History implausible based on the water temperature and contact or dwell time

Soft Tissue Injury Burns
The two most common types...
- Scald burn (Immersion vs. Spill/Splash)
- Contact

Most burns in children are scald burns...
Abuse AND Accidental
Water Temperature Study

Spill Patterned Burn

Typical scald or splash burn
Scald or splash injury from liquids usually results in a single burn that diminishes in intensity from point of contact.

Dunk Burn

Typical immersion burn
Uniform degree of injury with interspersed protected areas. There is an immersion demarcation line and areas of skin spared by flexion.
Thermal Burns: Scald: Splash/Spill

Child falls into hot cooking liquid.
1. Toddler with an immersion pattern burn.
2. Family had taken a recently boiling pot of chicken off of the stove and placed it on the floor.
3. Child ran in, saw chicken in bottom of pot, and stuck her arm into the boiling water, so it took a second before she pulled her hand out.
4. Law enforcement interviewed all adults present and everyone corroborated story.
5. Immersion pattern burn, non-inflicted.

Spill vs. Immersion

<table>
<thead>
<tr>
<th>SPILL</th>
<th>IMMERSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scatter or satellite lesions</td>
<td>Sharp demarcation</td>
</tr>
<tr>
<td>Generally less severe</td>
<td>Uniform depth</td>
</tr>
<tr>
<td>Can be accidental or inflicted</td>
<td>Typical patterns of sparing</td>
</tr>
<tr>
<td>Can be accidental or inflicted</td>
<td>Can be accidental or inflicted</td>
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</tbody>
</table>
Immersion
Accident vs. Inflicted

**ACCIDENT**
- Less severe due to briefer contact time
- More satellite burns due to struggle

**INFLECTED**
- Deeper
- More sharp demarcation
- Simultaneous feet, perineum and buttocks
- Bilateral symmetric hands and feet

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Spill
Accident vs. Inflicted

**ACCIDENT**
- Head, face and neck

**INFLECTED**
- Lower torso, buttocks and legs

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Contact and Flame Burns

- May have recognizable pattern or shape.
- When inflicted tend to be deeper and have sharply demarcated margins.
- When inflicted may be on clothing covered parts of the body.
- Accidental burns from hot implements tend to be partial.
Poll Question
Does this burn pattern fit the history of placing the hand on the stove?
Yes
No

Grid Burn

Poll Question
What is this implement?
Cigarette Burns

- Round
- Well demarcated
- 7 – 10 mm
- Deep central crater with raised edges
- When accidental tend to be oval, eccentric and more superficial

Poll Question

Is this mark suspicious for a burn?

Yes
No

Poll Question

If not a burn, what is it?
Thermal Burns: Contact: Cigarette Lighter

- Note the smiley face appearance

Electrical Burns

- Account for 3%-9% of admissions to burn centers.
- Types
  - Low voltage (<1,000 V), e.g., biting electrical cord
  - High voltage (>1,000 V), e.g., power lines, lightning strikes
- Visible areas usually only show a small portion of the tissue destruction.

Electrical Burns (continued)

- Multiple serious morbidities
  - Contractures of oral commissures
  - Permanent defects
  - Compartment syndrome, possibly leading to amputations
  - Cardiac arrhythmias, possibly leading to cardiac arrest
**Electrical Burns**

A 12-year-old playing with frayed wires got an electrical shock and a circumferential neck burn. The current likely traveled through his arms, which were sweaty at the time, and caused the burn around his neck above his sweatshirt.

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**Chemical Burns**

- **Mechanism:** direct chemical reactions with tissues
- **Common non-abusive mechanism:** exploratory tasting
- **Acid**
- Cause coagulative necrosis, which limits depth of injury
- **Common examples:** drain cleaners (sulfuric and hydrochloric acid), car batteries (sulfuric acid)

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**Stan Gun Injury: A New Presentation of the Battered Child Syndrome**

Alice Frederick, MD and Mary Ellis Rizzo, MD

**Abstract:** Stan guns are self-defense devices that are currently available with the mechanism of a small gas cartridge, which is required to operate it. In many communities, it is illegal to sell or own a Stan gun, as it is considered a weapon. In this report, we describe two cases of Stan gun injuries that involved a 9-year-old boy and a 7-year-old girl. The injuries were caused by the gas cartridge, which produced a significant amount of heat and pressure, causing skin and tissue damage.

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**Chemical Burns**

- **Mechanism:** direct chemical reactions with tissues
- **Common non-abusive mechanism:** exploratory tasting
- **Acid**
- Cause coagulative necrosis, which limits depth of injury
- **Common examples:** drain cleaners (sulfuric and hydrochloric acid), car batteries (sulfuric acid)
Chemical Burns (continued)

- Alkaline
  - Cause liquefactive necrosis, which causes deeper penetration of injury
  - Can increase likelihood of gastrointestinal perforation
  - Common examples: lye (sodium hydroxide), oven and drain cleaners (sodium and potassium hydroxide)
- Bleach
  - Can have distinct red-brown discoloration

Chemical Burns: Bleach

- A 16-month-old sat in bleach while playing in a laundry basket. The child was not wearing clothes at the time of the chemical burn.

Burn or Mimic

- Diaper dermatitis (particularly after laxative ingestion)
- Bullous impetigo
- Phytophthodermatitis
- Ecthyma
Poll Question

What is this?

Other Look-alikes: Phytophotodermatitis

- Citrus, celery or other plant oils + sun

Burn or Bruise Mimic

- "Lime disease": phytophotodermatitis
Poll Question
What kind of burn is this?
- Scald
- Dry Contact

Poll Question
Is this an accident or an abusive burn?
- Accident
- Abuse

Obtaining History of Burns
- Source producing injury: liquid, object, flame, chemical, etc
- Temperature of heat source, such as water in tap water burn cases
- Explanation of burn
- Date/time of burn
- Location of child at time of burn
- Presence/absence of clothing
Obtaining History of Burns

- Presence/absence of witnesses
- Time of presentation for medical care
- Delay, reason for delay
- Reaction to burn
- Developmental level of child
- Prior burns/injuries
- Family composition
- Home investigation

Red Flags in Inflicted Burns

- Inconsistent history
- Changing history
- Incompatible with developmental level
- "Magical" burn—appeared one day
- Young age of child (<5 years)
- Pattern burn
  - Symmetric distribution
  - Immersion
  - Multiple burns
  - Genital burns

Red Flags in Inflicted Burns (continued)

- Deeper or large surface area burn
- Difficult developmental milestones
- Toilet accidents during toilet training
- Other suspicious injuries
  - Bruising
  - Fractures
- Delay in seeking care
  - Unacceptable vs. acceptable
Workup

In children younger than 2 years with burns that are concerning for physical abuse, it is recommended to obtain a skeletal survey.

18%–33% of children with burns concerning for inflicted injury had associated skeletal injuries.

Case Example: Importance of Obtaining Skeletal Survey

- A 6-month-old presented with scald burn to mouth and cheek.
- Original story: Caregiver was driving in the car in the summer and baby had been given a bottle that had been sitting in the sun for a few hours.
- Ultimately, caregiver confessed to heating up bottle in microwave and force-feeding the baby.

On skeletal survey, infant was found to have bilateral distal transverse femur fractures. Fractures were not picked up on physical examination due to diffuse swelling; infant was intubated and paralyzed and so unable to be assessed for pain.
Case Example: Importance of Obtaining Skeletal Survey
(continued)

Caregiver confessed to bending legs backwards at the knees until they snapped due to frustration from infant’s crying.

2 Year Old with Burn

Reported by daycare
No history provided to explain the injury
Child is insufficiently verbal to explain what happened

Poll Question

This burn is most consistent with the following type of burn injury

Scald thermal burn
Dry contact thermal burn
Poll Question
The burn is most consistent with
An acute burn
A non-acute burn

Poll Question
The mother said that the child removed a bowl of soup from the microwave and spilled it on himself while preparing to take a sip. What additional questions would you like to ask?

Poll Question
Based on the information provided, the burn on this child is most likely
An accidental burn
A non-accidental burn
Poll Question

Which of the following additional tests for occult injury would you do?
Head CT
Skeletal survey
All of the above
None of the above