Detecting Abuse in the Child with a Burn

You're getting warmer…

Jamie Hoffman-Rosenfeld, MD
Child Abuse Pediatrician
JE and ZB Butler Center for Children and Families
Children's Hospital at Montefiore

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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

Kos and Scwayder. Cutaneous Manifestations of Child Abuse. *Pediatric Dermatology.* 2006

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

Child Abuse: Medical Diagnosis & Management, 3rd edition. Edited by Robert M. Reece and Cindy Christian. 2008.

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

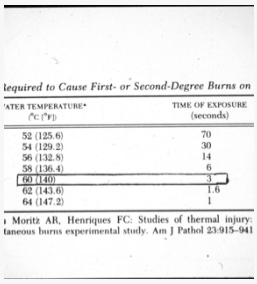
The two most common types…

- Scald burn (Immersion vs. Spill/Splash)
- Contact

Most burns in children are scald burns…

Abuse AND Accidental

Water Temperature Study



lequired to Cause First- or Second-Degree Burns on

'ATER TEMPERATURE* (°C (°F))	TIME OF EXPOSURE (seconds)
52 (125.6)	70
54 (129.2)	30
56 (132.8)	14
58 (136.4)	6
60 (140)	3
62 (143.6)	1.6
64 (147.2)	1

Moritz AR, Henriques FC: Studies of thermal injury: taneous burns experimental study. Am J Pathol 23:915–941

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.

- Toddler with an immersion pattern burn.
- Family had taken a recently boiling pot of chicken off of the stove and placed it on the floor.
- 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.
- Law enforcement interviewed all adults present and everyone corroborated story.
- Immersion pattern burn, non-inflicted.

Thermal Burns: Scald: Splash/Spill

- Law enforcement interviewed all adults present and everyone corroborated story.
- Immersion pattern burn, non-inflicted.

Spill vs. Immersion

SPILL

- Scatter or satellite lesions
- Generally less severe
- Can be accidental or inflicted

IMMERSION

- Sharp demarcation
- Uniform depth
- Circumferential
- Typical patterns of sparing
- Can be accidental or inflicted

Immersion
Accident vs. Inflicted

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

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

Spill
Accident vs. Inflicted

ACCIDENT
- Head, face and neck

INFLICTED
- Lower torso, buttocks and legs

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.

Stun Gun Injury: A New Presentation of the Battered Child Syndrome

Alan Frechette, MD* and Mary Ellen Rimsza, MD‡

ABSTRACT. Stun guns are self-protection devices that are increasingly available with few restrictions on their use and sale. We present a case of child abuse with a stun gun. The signs of such abuse are often subtle, and they may be underrecognized currently. The skin lesions that are often seen are hypopigmented circular macules, measuring approximately 0.5 cm in diameter. They may be raised slightly and erythematous if inflicted recently. Most characteristic of stun gun assault is pairing of lesions approximately 5 cm apart. We discuss the design, operation, and effects of stun guns, and give an extensive differential of abusive and nonabusive circular lesions. ***Pediatrics*** **1992;89:898–901;** ***stun gun, child abuse, burns.***

user, and potential for injury. The electrical impulses they deliver cause repetitive muscular contraction, numbness, confusion, and loss of balance. Voluntary muscle control is interrupted temporarily, leaving the victim dazed, limp, and incapacitated for up to 15 minutes.[1] The guns are designed and marketed as a nonlethal alternative to firearms for personal protection. Police also have found them to be of great help in subduing subjects with a minimum of physical injury. To be effective most stun guns must come in close contact with the victim's skin or clothing.

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
- Phytophotodermatitis
- 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
(continued)

- Presence/absence of witnesses
- Time of presentation for medical care
- If 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
- Toileting 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.

Case Example: Importance of Obtaining Skeletal Survey

(continued)

- 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