“Burn Injuries in Child Abuse”

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OBJECTIVES:

• DEVELOP UNDERSTANDING OF ACCIDENTAL VERSUS NON-ACCIDENTAL BURN CHARACTERISTICS
• DEVELOP APPROACH FOR EVALUATION OF BURN INJURY TO HELP DISTINGUISH THE TWO
• DEVELOP AN UNDERSTANDING OF MECHANICS OF BURN INJURIES
• BECOME AWARE OF USE OF ANCILLARY TESTS
DISCLOSURES:

• NONE

• WILL NOT BE DISCUSSING “CARE” FOR BURNS

• SOME OF THE PICTURES ARE GRAPHIC INJURIES
GENERAL INFORMATION:

• ONE OF THE MOST DEVISTATING PHYSICAL AND PSYCHOLOGICAL INJURIES

• MOST TEND TO BE ACCIDENTAL

• MOST ARE PREVENTABLE (NEGLECT CONCERNS)
BURN EVOLUTION:

• EARLY 1900’S: FIRE, COFFEE

• 1950’S: TEA BAG DEVELOPED
  – TEA BURNS MORE COMMON THAN COFFEE

• ELECTRIC COFFEE/TEA POTS
  – INFANT/TODDLER PULLS ON CORD

• ELECTRIC HEATERS
  – FIRES AND CONTACT BURNS
RISK FACTORS:

• POVERTY

• POOR CAREGIVER EDUCATION

• CROWDED CONDITIONS

• MIXED RESEARCH ON “FACTORS”; MOST COMMON IN UNDERDEVELOPED COUNTRY
ACCIDENTAL OR NOT?

• ABUSIVE MORE COMMON IN <6 YEARS OLD

• OFTEN PREVIOUS HISTORY OF INJURIES**

• YOUNGEST CHILD IN HOME IS GREATEST RISK

• DELAYED (VERBAL) CHILD MAY HAVE MORE RISK
Figure 2. The top 8 reasons for pediatric burns (N = 1145) at Children’s Hospital of Michigan (1998-2006)
POTENTIAL EFFECTS OF BURN

• INFECTION
• KIDNEY TRAUMA
• RESPIRATORY
• METABOLIC (HYPERGLYCEMIA, ETC)
• INFLAMATORY MEDIATORS
• CATABOLISM
• MENTAL HEALTH
• AND MORE......
Figure 5–3 Perpetrators by Relationship to Victims and Selected Types of Maltreatment, 2003

Based on data from table 5–3. N=38 States.
OFFENDERS:

• FINANCIAL CHALLENGES FOR FAMILY
• LESS EDUCATION
• SINGLE PARENT
• SOCIA LLY ISOLATED
• SOME STUDIES: BOYFRIEND OR PARENT
OFFENDER’S REASONS:

• PUNISHMENT (toilet training)

• INTENTIONAL (TORTURE)

• ANGER RESPONSE

• CAUGHT IN CROSS-FIRE
FOR ALL ABUSE EVAL:

• DOES HISTORY MATCH INJURY

• DOES DEVELOPMENTAL ABILITY MATCH INJURY/HISTORY

• WHAT DO I SEE AND WHAT DO I NOT SEE (PATTERNS)
KEY POINTS (CONT):

• INJURIES CHANGE WITH TIME
  – Burn appearance will change over days

• NEW INJURY CHANGES MAY APPEAR OVER TIME
  – FRACTURES
  – NEW BRUISES
DOCUMENT FINDINGS; BURNS
CHANGE IN APPEARANCE
FIGURE 7. Distribution of inflicted and unintentional immersion burns on young children.
MECHANICS:

• KIDS ARE NOT LITTLE ADULTS!!!!

SKIN IS DIFFERENT
RESPONSE IS DIFFERENT
HEALING IS DIFFERENT
ABILITY IS DIFFERENT
DIFFERENTIAL DIAGNOSIS of BURNS:

INFECTIOUS  METABOLIC  COAG DEFECT  ACCIDENTAL
NON-ACCIDENTAL  CONGENITAL  ENDOCRINE  CONNECTIVE TISSUE
ENVIRONMENT  POISONING  MEDICATION  VASCULAR
RENAL  PULMONARY  CARDIAC  OTHER
HISTORY

• INCIDENT
• PAST MEDICAL HISTORY
• SOCIAL HISTORY
• DEVELOPMENTAL HISTORY
• SOCIAL SERVICE HISTORY
• PARENT MEDICAL HISTORY
• DIET
• MEDICATIONS
• CPS OR LE HISTORY

• ALL OLD RECORDS: LOOK FOR PATTERNS
MEDICAL RED FLAGS:

• No history to explain the injury

• History given doesn’t explain the injuries

• Changing history

• Delay seeking medical care
QUESTIONS NEEDED:

• WHERE IS THE BURN (BODY PART)
• SOURCE FOR BURN INJURY (TAP HOT WATER)
• HISTORY OF THE BURN EVENT
• CLOTHING WORN BY VICTIM AT INJURY TIME
• TIME TILL PATIENT SEEN FOR CARE
• WHO ELSE SAW THE INJURY
• WHERE DID THE INJURY OCCUR (LOCATION)
TUB MEASUREMENTS

WATER TEMP:
FIRST TURNED ON
AFTER RUNNING

WATER HEATER TEMPERATURE

PHOTOGRAPHS

TRAPS CONTENTS

“WORKSHEETS”
HEIGHT OF FAUCETS
HEIGHT OF STANDING CHILD
ABILITY OF CHILD
OTHER CHILDREN IN TUB?
## Evidence Worksheet for Hot Water Burns

**Items needed for scene investigation**
- Thermometer
- Tape Measure
- Timer/Stopwatch
- Camera (film/digital)

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Present Date</th>
<th>Suspect Name</th>
<th>Victim’s Name</th>
<th>Incident Location (within dwelling)</th>
<th>Address</th>
</tr>
</thead>
</table>

**A1**
- Type of Burn: □ Immersion □ Splash □ Running water □ Other (spill, splatter, etc.)

**Water Heater Temperature Measurement:** (Electric – Disconnect power before removing plates)

**B**
- Electric Water Heater
  - Brand:
  - Capacity:
  - Upper plate temp:
  - Lower plate temp:

**Gas Water Heater**
- Brand:
- Capacity:
- Temperature Setting:

**C**
- Incident Location Measurements (in inches): □ Bathtub □ Basin/Sink □ Other
- Width: □ Inside Depth: □ Height from Floor:
- Length: □
- Distance to faucet handles:
  - Porcelain, fiberglass, etc.

**C1**
- Running Water Temperatures (Hot)
  - (in Fahrenheit or Celsius)

<table>
<thead>
<tr>
<th>Seconds</th>
<th>Degrees</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>45</td>
</tr>
<tr>
<td>5</td>
<td>60</td>
</tr>
<tr>
<td>10</td>
<td>120</td>
</tr>
<tr>
<td>20</td>
<td>180</td>
</tr>
<tr>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

**D**
- Standing Hot Water in Incident Location
  - (temp. measured in middle of location, mid-depth)

<table>
<thead>
<tr>
<th>Inches</th>
<th>Min/Second</th>
<th>Minutes</th>
<th>Degrees</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

**Maximum Temp**
- (Full hot running water), (Full H/C running water)
- Peak temp. Seconds: □
- Peak temp. Seconds: □

**E**
- **(For a single handle faucet-use middle position)**
- ran water in __________ identified as source of burn injury.
- Results: __________ inches of water. One minute after water turned off the mid-depth temperature is __________ degrees F/C.

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**Figure 23.14** An evidence collection worksheet for documentation of hot water burn scene information. (Adapted with permission from Philip Palfer, District Attorney Investigator [retired], Paradise, Calif., and from Palfer PJ, Purdy G, Shepherd JR. Burn injuries in child abuse. U.S. Department of Justice Office of Juvenile Justice and Delinquency Prevention 1997, 19.)

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are inaccurate and should be avoided in burn scene investigations. Even scientific thermometers can lose accuracy over time and need to be recalibrated.

Before arrival at the scene, investigators should discuss the case with medical providers to determine the suspected mechanism of injury. In cases of suspected hot liquid burn injuries, the investigators should record the water heater temperature. In the United States, most homes are heated with either an electric or gas water heater. If the scene has an electric water heater present, investigators need to examine...
DEVELOPMENTAL ABILITY:

• NORMAL DEVELOPMENT

• CURRENT SKILLS
  – WHAT CAREGIVER REPORTS
  – WHAT WELL CHILD RECORDS SHOW

• ALLOSIO/FISHER STUDY
  – YOUNGEST (NON-WALKER) 10 MONTHS OLD
  – MOST WENT IN FEET FIRST
BURNS AND AGES

• INFANT
  SCALDS

• TODDLER
  SCALDS
  CONTACT
  ELECTRICAL

• SCHOOL AGE
  SCALDS
  CONTACT
  ELECTRIC
  FLAME

• TEENS
  HIGH RISK BEHAVIOR
  SELF MUTILATING/BRANDING
  SUICIDE
SELF INFLECTED BURNS:

- Branding
- Initiation into group
- Self-harm
- Suicide attempt
BURNS THAT ARE CONCERNING:

- Multiple burns
- Pattern
- Stocking-/ Glove-pattern
- Mirror-image burns of the extremities
- Symmetric burns on buttocks
- Absence of sparing of flexor creases
- Absence of splash marks in immersion
- Tide water marks
CONCERNING BURNS:

- HANDS, FEET, GENITALS, BUTTOCKS
- MULTIPLE AGED BURNS
- BURN “AGE” NOT CONSISTENT WITH HISTORY
- OTHER INJURIES (BRUIISING, FRACTURES)
- UNWITNESSED INJURY
- PARENTS ATTITUDE TOWARD INJURY (APATHY)
REMEMBER:

• MULTIPLE TYPES OF ABUSE/NEGLECT CAN COEXIST:

  PHYSICAL ABUSE
  NEGLECT
  SEXUAL ABUSE
  EMOTIONAL ABUSE
TYPES OF BURNS

• ELECTRICAL
• CHEMICAL
• THERMAL
• RADIATION—SUNBURN**
• FROSTBITE*
• FRICTION
SEVERITY FACTORS

• LENGTH OF TIME OF EXPOSURE

• TEMPERATURE

• THICKNESS OF SKIN/LOCATION

• TYPE OF BURN
Reference Temperatures deg. F

- 101  Comfortable Infant Bathing
- 104-108  Hot tub
- 109-113  Painful for adults
- 113  2\(^{nd}\) degree burn; 6 hours
- 120  2\(^{nd}\) degree burn; 10 minutes
- 127  2\(^{nd}\) degree burn; 1 minute
- 130  2\(^{nd}\) deg; 10 sec (child), 30 sec (adult)
- 140  2\(^{nd}\) deg; 1 sec (child), 3 sec (adult)
- 156  3\(^{rd}\) degree burn; 1 second child
• Thermal
  – Scalds
  – Contact
  – Flame
  – Radiant
THERMAL BURNS:

• SCALDS
  • most common type
  • majority are accidental
  • types:
    » SPLASH/SPILL
    » IMMERSION
      • Most common abusive burn injury
<table>
<thead>
<tr>
<th>Intentional scald must be excluded</th>
<th>Intentional scald should be considered</th>
<th>Intentional scald unlikely</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical features</strong></td>
<td><strong>Physical features</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Mechanism:</strong></td>
<td><strong>Mechanism:</strong></td>
<td></td>
</tr>
<tr>
<td>• Immersion</td>
<td>• Spill injury</td>
<td></td>
</tr>
<tr>
<td><strong>Agent:</strong></td>
<td>• Flowing water injury</td>
<td></td>
</tr>
<tr>
<td>• Hot tap water</td>
<td><strong>Agent:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Pattern:</strong></td>
<td><strong>Pattern:</strong></td>
<td></td>
</tr>
<tr>
<td>• Clear upper limits</td>
<td>• Uniform scald depth</td>
<td></td>
</tr>
<tr>
<td>• Scald symmetry (extremities)</td>
<td>• Skin fold sparing</td>
<td></td>
</tr>
<tr>
<td><strong>Distribution:</strong></td>
<td>• Central sparing buttocks</td>
<td></td>
</tr>
<tr>
<td>• Isolated scald buttock/perineum</td>
<td>• Glove and stocking distribution</td>
<td></td>
</tr>
<tr>
<td>• +/- lower extremities</td>
<td>• 1 limb glove/stocking</td>
<td></td>
</tr>
<tr>
<td>• Isolated scald lower extremities</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Clinical Features:</strong></td>
<td><strong>Clinical features:</strong></td>
<td></td>
</tr>
<tr>
<td>• Associated unrelated injury</td>
<td>• Previous burn injury</td>
<td></td>
</tr>
<tr>
<td>• History incompatible with examination findings</td>
<td>• Neglect / faltering growth</td>
<td></td>
</tr>
<tr>
<td>• Co-existing fractures</td>
<td>• History inconsistent with assessed development</td>
<td></td>
</tr>
<tr>
<td><strong>Historical / Social features:</strong></td>
<td><strong>Historical / Social features:</strong></td>
<td></td>
</tr>
<tr>
<td>• Passive, introverted, fearful child</td>
<td>• Trigger, such as: Soiling / enuresis / misbehaviour</td>
<td></td>
</tr>
<tr>
<td>• Previous abuse</td>
<td>• Differing historical accounts</td>
<td></td>
</tr>
<tr>
<td>• Domestic violence</td>
<td>• Lack of parental concern</td>
<td></td>
</tr>
<tr>
<td>• Numerous prior accidental injuries</td>
<td>• Unrelated adult presenting child</td>
<td></td>
</tr>
<tr>
<td>• Sibling blamed for scald</td>
<td>• Child known to social services</td>
<td></td>
</tr>
</tbody>
</table>
SPLASH/SPILL

- POINT OF CONTACT
- GRAVITY FLOW
- SPLASH AREAS
- HIGHER VISCOSITY; GREATER BURN
- PATTERN MAY ALTER DUE TO CLOTHES
- CHANGE IN DEGREE OF BURN
- IRREGULAR MARGINS
- TEMP NEEDS TO BE 140 DEGREES F
FLOW

GRAVITY FLOW?

NO CHANGE IN DEGREE OF BURN

MOST INTENTIONAL BURNS INVOLVE TAP WATER
IMMERSIONS:

OCCURS FROM FALL OR BEING PLACED

DEGREE OF BURN IS UNIFORM (SUGGESTS RESTRAINING)

MAY BE SYMMETRICAL

360 DEGREE INVOLVEMENT

TIDE-WATER MARKS

LACK OF SPLASH MARKS
CONTACT BURNS

• FLAMES OR HOT SOLIDS
• BURNS: MORE DEPTH TO BURN
• USUALLY NO PATTERN (accidental)
• LOCATION
• BRANDING INJURY (mirror object)
PHOTOGRAPHS:

• BLUE BACKGROUND BEST

• BIG PICTURE, THEN CLOSE-UP

TAKE LOTS OF PICTURES
— MANY VIEWS
University of British Columbia teaching webpage
OTHER BURN CAUSES

• FROSTBITE
• CHEMICAL
• ELECTRICAL
• RADIANT
MIMICS
BURN POINTS:

• AGE = DEVELOPMENTAL = HISTORY

• LOCATION

• OTHER FACTORS
  – CLOTHING
  – DELAY IN SEEKING CARE-alter appearance

• CAN’T AGE BURN

• SCENE INFORMATION
  – HEIGHT OF COUNTER
  – HOT WATER HEATER SETTINGS
EXAM

• COMPLETE HEAD TO TOES
  – Burns change; must be seen early on

• PHOTOS TO DOCUMENT
  – Lots of photos; multiple angles
  – Blue background

• REPEAT EXAMS DAILY IN HOSPITAL
EVALUATION:

- EXAM
- X-RAYS?
- HEAD SCANS?
- EYE EXAMS?
- LABS?

FOLLOW SKELETAL SURVEY GENERAL RULES

AGE/NEURO

ABNORMAL CT

UNDER 2 ALWAYS CONSIDER
SKELETAL SURVEY:

• SKELETAL SURVEY
• ? REPEAT SKELETAL SURVEY

WHO GETS SKELETAL SURVEY? UP TO 33% POSITIVE FINDINGS IN BURN VICTIMS

UNDER AGE 2
SIGNIFICANT TRAUMA VICTIM

AGE >2: DO FILMS AS NEEDED

REPEAT SKELETAL SURVEY IN 2-3 WEEKS
SKELETAL SURVEYS

• <2: all physical abuse victims
• all sexual abuse victims
• neglect and drug on case by case

• 2-5: if victim has disabilities
• severe injury
• otherwise specific bones

• >5: rarely needed; do specific bones
LABS:

- AS INDICATED FOR BURN CARE

- CONSIDER IF WORRIED ABOUT ABD INJURY

  AMYLASE
  LIPASE
  UA
  SGOT
  SGPT
  IF > 80 (LFT): CONSIDER CT ABDOMEN
OTHER:

- SAFETY IN HOSPITAL (VISITS)
- OTHER POTENTIAL CHILDREN AT RISK
- MENTAL HEALTH FOR PATIENT AND FAMILY
SUMMARY:

- PHOTOS
- EARLY EXAM
- HOME/SITE INFORMATION
- HISTORY = INJURY = ABILITY
- EVEN WITH HISTORY, CANNOT R/O INFLECTED
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