Pediatric Burn Management

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Objectives

- Categorize burn depth and its significance
- Identify surface area of burn and significance
- Review ABA referral guidelines and transport guidelines
- Discuss pre-burn center fluid management
- Non-accidental burns
- Transport recommendations
Some things are just bad combinations.
Epidemiology

- >500,000 people affected by burn injuries each year
- Approximately 60,000 pediatric burn admissions per year
- Nearly 4,000 deaths/year related to burns and associated complications
  - Risk of mortality proportional to extent of burn and patient’s age
  - Deaths usually occur immediately after injury or several weeks later in response to infection/sepsis, multisystem organ failure, or hypermetabolic response
Epidemiology

- Fire and burn deaths 3rd leading cause of unintentional deaths in children <14yrs
  - Most occur in the home
- Burns considered one of the most pathophysiological and psychologically stressful injuries
- TBSA and mortality
  - Historical mortality
    - 1949: 50% death for kids with >49% TBSA
    - 2018: 50% death for kids with >98% TBSA
IT'S FINE
We still got this.
They call me a nurse because apparently bad ass life saver isn't a job title.
THIS IS WHY EMERGENCY ROOMS EXIST
The relevance of anatomy and burns
Pediatric Burns

- Largest organ in the human body
  - Structural support
  - Immunity
  - Regulation of heat and water loss
- Comprised of three layers
  - Epidermis
  - Dermis
  - Subcutaneous tissue
Pediatric Burns

- Thickness of epidermis is variable
- Dermis constitutes majority of skin’s thickness, variable as well
- Vascular
- Innervated
- Mostly collagen
- Adnexal structures
In the 1940’s Moritz et al documented the time required in order to sustain a full thickness burn from hot water.

- 160: <1 sec
- 150: 2 sec
- 140: 5 sec
- 130: 30 sec
- 120: 10 min
- 150: <2 sec
- 140: <5 sec
- 130: 15 sec
- 120: 5 min

With regards to blood supply, the more vascular an area is (is face) the more the heat can dissipate more efficiently.
Common temperatures

- 102-104°F Spa/Jacuzzi
- 120°F Recommended water heater setting
- 175-180°F Holding temperature fast food coffee
- 212°F Boiling water
- 300-500°F Grease frying
Pediatric Burns - Body Surface Area

- Relatively greater surface area per unit of body weight
  - A 7kg boy is 1/10 the size of adult but has 1/3 the surface area
Pediatric Burns-Temp Regulation and Thickness of skin

- Body heat rapidly lost secondary to more surface area
- Babies <6 months do not shiver
- Thinner dermal layer
Burn Depth and Total Body Surface Area
Depth of Burns

- Superficial burns (1st degree);
- Injury confined to outer epidermal layer of skin
- No disruption of skin integrity; pain, erythema
Depth of Burns

- Partial thickness burns (2\textsuperscript{nd} degree);
- Destroys epidermis and part of dermis
- Blisters, bright red, mottled, wet, severe pain
Depth of Burns

- Deep, partial thickness burns (2\textsuperscript{nd} degree);
- Complete destruction of epidermis, severe dermal
- Few dermal appendages; Dark-red/yellow-white, slightly moist, minimally blanch, decreased sensation
Depth of Burns

- Full thickness burns (3rd degree);
- Injury to epidermis, dermis and subcut tissue
- Charred or white, dry, leathery, insensate, thrombosed blood vessels
Depth of Burns

- Mechanism causing injury is through coagulation necrosis
- 3 concentric zones of thermal injury: coagulation, stasis, and hyperemia
Why is it important to measure TBSA?

Because EVERYTHING depends on it!!!

Errors of size estimation before burn center transfer are frequent

Absolute errors 1.3%-16%, mean 6.28%

Overestimation more common

Relative error: 75%-3500%

12%-60% have no estimation
How do you assess size of the burn?

In the case of smaller burns

The best measurement is to cut a piece of clean paper as the size of the patient’s whole hand (digits and palm), which represents 1% TBSA, and match this to the area.

II- THE EXTENT OF BURNS:

Role of 9 → Adult
- head & neck = 9% TBSA
- upper limb = 9% TBSA
- trunk = 18% TBSA
- back = 18% TBSA
- genitalia = 1% TBSA
- lower limb = 18% TBSA
Coming Soon: CMH Pediatric Resuscitation App
Assessing Extent of Burn
Lund-Browder Chart

Do not include superficial burns
Burn Center Referral Criteria

A burn center may treat adults, children, or both.

Burn injuries that should be referred to a burn center include:

1. Partial thickness burns greater than 10% total body surface area (TBSA).
2. Burns that involve the face, hands, feet, genitalia, perineum, or major joints.
3. Third degree burns in any age group.
4. Electrical burns, including lightning injury.
5. Chemical burns.
6. Inhalation injury.
7. Burn injury in patients with preexisting medical disorders that could complicate management, prolong recovery, or affect mortality.
8. Any patient with burns and concomitant trauma (such as fractures) in which the burn injury poses the greatest risk of morbidity or mortality. In such cases, if the trauma poses the greater immediate risk, the patient may be initially stabilized in a trauma center before being transferred to a burn unit. Physician judgment will be necessary in such situations and should be in concert with the regional medical control plan and triage protocols.
9. Burned children in hospitals without qualified personnel or equipment for the care of children.
10. Burn injury in patients who will require special social, emotional, or rehabilitative intervention.

Severity Determination

First Degree (Partial Thickness)
Superficial, red, sometimes painful.

Second Degree (Partial Thickness)
Skin may be red, blistered, swollen. Very painful.

Third Degree (Full Thickness)
Whitish, charred or translucent, no pin prick sensation in burned area.

Percentage Total Body Surface Area (TBSA)

Excerpted from Guidelines for the Operation of Burn Centers (pp. 79-86), Resources for Optimal Care of the Injured Patient 2006, Committee on Trauma, American College of Surgeons.
How deep?

Wet Blisters  Tender  Blanches
Superficial, partial thickness
TBSA?
TBSA?
Anterior Trunk: 13% TBSA

1. \( \frac{13}{4} = 3.25\% \)
2. \( \frac{3.25}{2} = 1.5\% \)

TBSA = 4.75%
**TBSA?**

TBSA Left Thigh: 6.5%
What is TBSA?

TBSA: Anterior torso 4.75% + left thigh 6.5% = 11.25%
How deep?

Wet Blisters Blanches Partial thickeess
How deep?

Less wet  Central part non-blanching
Insensate in center, sensate on periphery
TBSA?
1. Define anatomic limits: Posterior torso: 13% TBSA
TBSA?

13/2 = 6.5% TBSA  
Guesstimate 2% no bum (hand)  
TBSA: 6.5% - 2% = 4.5% sup and deep
How deep: Mixed partial and deep

TBSA = 4.5%
How deep now?

Majority deep, some superficial and deep partial thickness
How deep?
How deep?

Wet  Bright red  Painful  Blisters
Partial thickness  Superficial or Deep?
1. Define anatomic limits: Anterior torso: 13% TBSA
1. Define anatomic limits: Anterior torso: 13\%TBSA
1. Define anatomic limits: Right arm: 7\%TBSA
TBSA - Anterior torso

Anterior torso: $\frac{13}{2} = 6.5\% \quad 9.75\%$
1. Define anatomic limits: R upper arm: 4%
2. Define anatomic limits: R lower arm: 3%
Right arm total: 7% TBSA
Half of right arm: 3.5% TBSA
1. Anterior torso: 9.75% + right arm 3.5% = 13.25%
"I have a 4 month old male who sustained 13% TBSA superficial, partial thickness burns to his anterior torso and right arm from hot water"
How deep?
Children’s Mercy Burn Unit

(816) 234-3520
Pediatric Fluid Resuscitation
Pediatric Burns-Circulation

- Looked at predicted vs administered fluids
- Over-resuscitation was prevalent due to overestimation of burn
- <20% TBSA, too much while >20% TBSA too little
- Over resuscitated even after correction for overestimation of TBSA
- Titration based on UOP was a major problem
Pediatric Burns - Circulation

- 5 years old and younger:  
  125ml/hour LR

- 6-14 years old: 250 ml/hour LR

- 3ml/kg/TBSA

- For children <10kg, use D5 LR

- For children <30kg add D5LR maintenance fluid
Antibiotics, Wound Care and Temperature
What you need to know for the operating room: Debridement vs Excision
Bum related child abuse

Intentional harm or threat of harm to a child by someone acting in the role of caregiver
### The Children’s Mercy Hospitals and Clinics

<table>
<thead>
<tr>
<th>Case of NAT</th>
<th>27</th>
<th>9%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>18</td>
<td>67%</td>
</tr>
<tr>
<td>Age (yrs)</td>
<td>2.4</td>
<td></td>
</tr>
<tr>
<td>TBSA</td>
<td>10.1%</td>
<td></td>
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<tr>
<td>Previous CPS</td>
<td>37%</td>
<td></td>
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<tr>
<td>Avg LOS (days)</td>
<td>10.7</td>
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<tr>
<td>Intentional</td>
<td>78%</td>
<td></td>
</tr>
<tr>
<td>Scald</td>
<td>67%</td>
<td></td>
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</table>
Take note of the details
Scald burns

- The burn occurs where the hot liquid touches the skin
- Water follows the law of gravity
  - In a spill, water flows towards the ground
  - In a container, it forms a flat horizontal line
Falling objects don’t cause these bums
Can you guess what happened?
Accident?
What else do you see?
He turned on the hot water by accident...
Common temperatures

- 102-104°F  Spa/Jacuzzi
- 120°F  Recommended water heater setting
- 175-180°F  Holding temperature fast food coffee
- 212°F  Boiling water
- 300-500°F  Grease frying
What is critical to do?
Transport Recommendations
Pre Hospital and ER stabilization

- Confirm TBSA involved
- Room temperature 31ºC (87.8ºF)
  - Increased core body temp common within hours of burn injury, up to 39ºC
- Ensure vaccination status
  - Age appropriate Tetanus booster or vaccine
  - Tetanus immunoglobulin for unimmunized
    - Must be given at site far away from Tetanus vaccine
- NG/OG tube placement
- Foley catheter
- Pain control
  - Morphine, Fentanyl, dexmedetomidine
Transport Stability

- **Bum Wound Care**
  - Ensure burned sites are dry and covered with at least a clean sheet
  - Avoid wet dressings
  - Avoid any ointments or bum treatments
Transport Stability

- Start fluid resuscitation, avoid fluid boluses if possible
  - We recommend using 10ml/kg for fluid bolus, if clinically indicated

- Use ABA transport recommendations for IVF until patient arrives to CMH or other burn center
  - ≤5 years - LR at 125ml/hr
  - 6-14 years - LR at 250ml/hr
  - 15+ years - LR at 500ml/hr
References