# Pediatric Burn Management

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Children's Hospital of Michigan

# Lecture Overview

- Burn statistics and etiologies
- Pre-hospital evaluation
- Anatomy of a burn
- Transfer / treatment guidelines

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# Burn Statistics

## Scope of the problem

250,000 children/yr suffer from burn injuries

(This is 30% of all burns in the US)

30,000 children/yr sustain burns requiring admission to a hospital at a cost of $2.3 billion/yr

10,000 suffer permanent disability

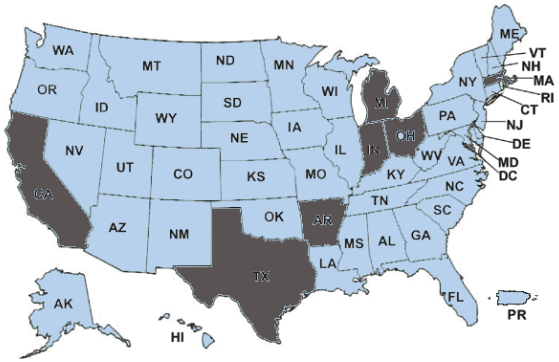
2,500 deaths/yr

(#2 cause of accidental death in children)

# CHM Burn Statistics

600 burns admitted annually

CHM is the only children's hospital in MI with a verified Pediatric Burn Center as designated by the ABA and ACS

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# Burn Statistics Cont.....

- Etiology

| Agent | Pediatric | Adult |
|---|---|---|
| Scald | 55 % | 25 % |
| Flame | 30 % | 55 % |
| Contact | 9 % | 12 % |
| Electrical | 2 % | 3 % |
| Other | 4 % | 5 % |

# Types of Burns – Scald

Scald Burn's are most prevalent in pediatric patients.


# Types of Burns - Flame

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# Types of Burns – Contact

Contact burn from firework

Contact burn from curling iron

# Types of Burns – Electrical

# Types of Burns - Chemical

# Lecture Overview

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# Pre-Hospital Initial Evaluation

- Assess the scene
- Stop the burning process/extinguishing the fire
- Remove the burning clothes and/or chemically contaminated clothes
- Cool synthetic materials retain heat with water

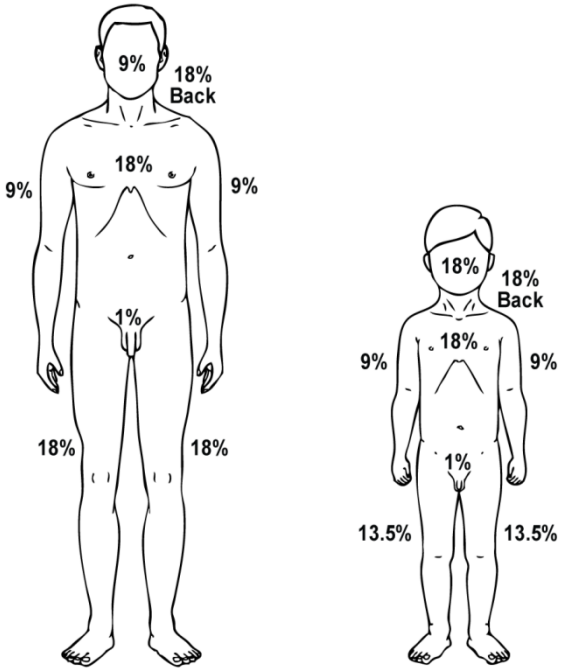
# Airway and Breathing On Scene

- Goal: Secure airway along with adequate oxygenation and ventilation.
  - For burns to the head, face, neck, or circumferentially to the chest should always be provided 100% oxygen.
  - Absolute indications for intubation are:
    - Full thickness burns to face
    - Airway obstruction from glottic edema
    - Carbon Monoxide poisoning w/ neurological changes
    - Massive body burns (circumferential chest burns)
    - Always consider prophylactic intubation in the presence of soot in the airways, singed nasal hairs, hoarseness, or dysphagia.

# TBSA and Why It's Important!

- Children have relatively greater surface area per unit of body weight.
- This means:
  - Child is more in contact with the environment
  - Child has relatively greater fluid needs/Kg body weight
  - Child has greater evaporative water loss/ Kg body weight

# TBSA and Why It's Important!




Pediatric Considerations

- Rule of 9's not accurate for pediatric patients except teenagers
- Pediatric body surface area varies with age
- Age specific diagrams exist but time consuming and impractical in the field
- **Calculating BSA (quick method)**
  - **Pt palm is roughly 1%**
  - **Only count 2nd and 3rd degree burns**

# Fluid Resuscitation in the Field

- Establishing intravenous access may be difficult
  - PIV **can** be placed through a burned site
  - IO if less than 4 years of age

- Start LR at

  150 cc/hr < 5 yrs

  250 cc/hr for 5 to 15 yrs

  500 cc/hr for > 15 yrs

  DO NOT BOLUS!!!

# Thermoregulation

- Keep the patients warm, dry, and covered.
  - Why?
    - Conservation of body heat is compromised by the larger body surface area. (Hypothermia sets in quickly when skin is wet or exposed)
    - Intrinsic heat generation by shivering is hampered by small muscle mass in children.

# What to use in the field?

- Clean dry gauze
- Warm blankets
- Consider increasing temperature in the rig

- Remove any wet, cold, soiled dressings that parents or outside facilities may have applied.
  - Do not immerse/soak extremities in water or ice
  - Tea tree oil is not indicated

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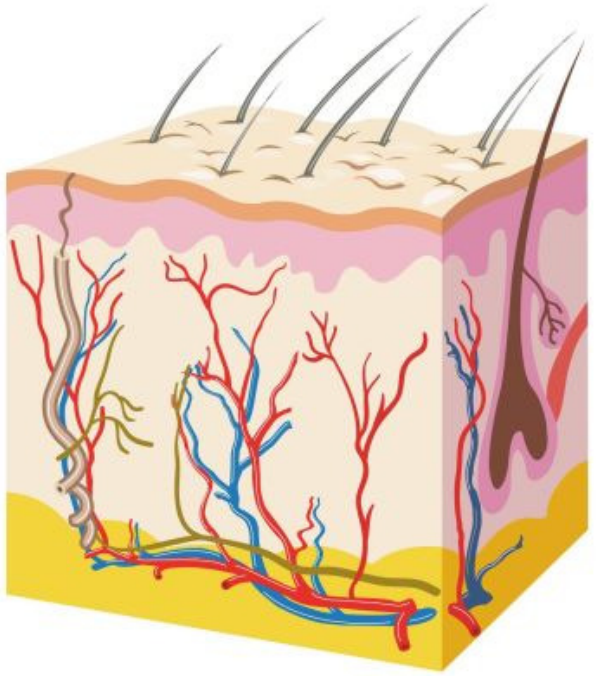
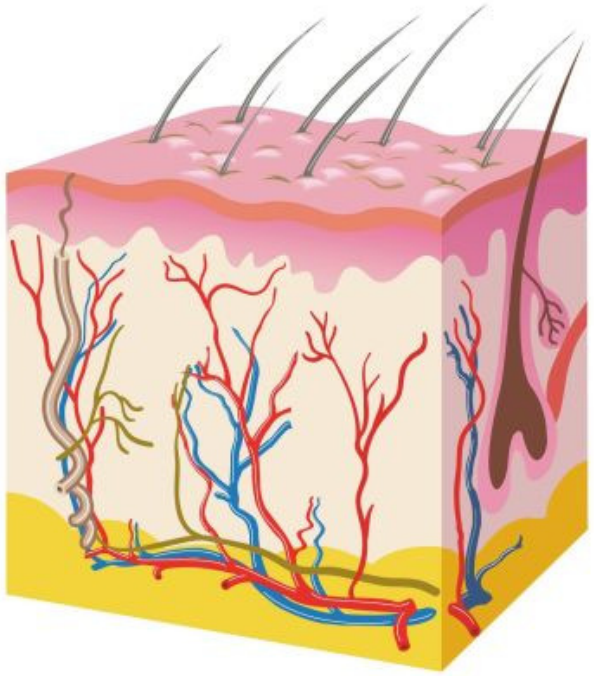
# Anatomy of the Skin

- Skin is our largest organ
- Skin functions
  - Protection from infection
  - Water vapor barrier
  - Temperature regulation
  - Sensation



NORMAL SKIN

# Classification of Burns
# First Degree

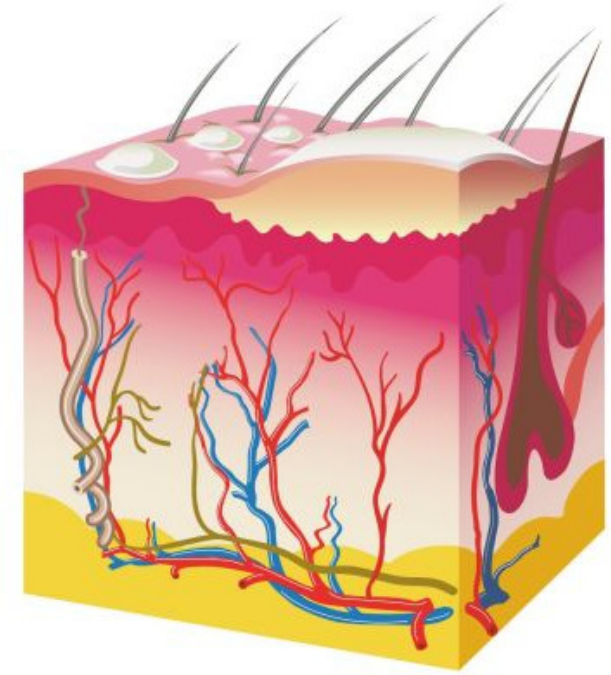


FIRST DEGREE BURN

# Classification of Burns
# Second Degree

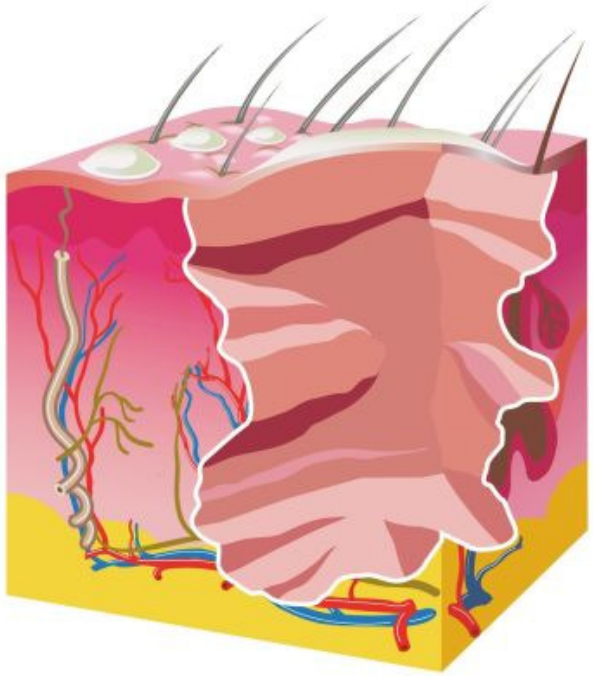
Second degree burn

- Superficial
- Mid dermal (intermediate)
- Deep dermal



SECOND DEGREE BURN

# Classificaton of Burns
# Third Degree



THIRD DEGREE BURN

# Classification of Burns
# Fourth Degree

# Pathophysiology of Burns

- Depth of burn depends on
  - Temperature
  - Duration of exposure
  - Dermal thickness
- The thinner the dermis – deeper the burn
  - Child vs. Adult
  - Back vs. Face

# Pathophysiology of Burns

- Cellular damage at >113 degrees Fahrenheit (45 degrees Celsius)
- Extent of burn depends on temperature and duration of exposure.

Immersion time to **full thickness burn**

| Temp (F) | Time (adult) | Time (child) | Time (infant) |
|---|---|---|---|
| 156 | | 1 sec | Instant |
| 149 | | 2 sec | Instant |
| 140 | | 5 sec | 1 sec |
| 130 | 30 sec | 10 sec | 5 sec |
| 127 | | 1 min | 7 sec |
| 124 | | 3 min | 11 sec |
| 120 | | 10 min | 20 sec |

# Calculating % BSAB Cont.

Patient's palm = 1% BSA

Count 2nd and 3rd degree only

Accurate calculation of %BSAB allows more accurate Determination of fluid needs for resuscitation

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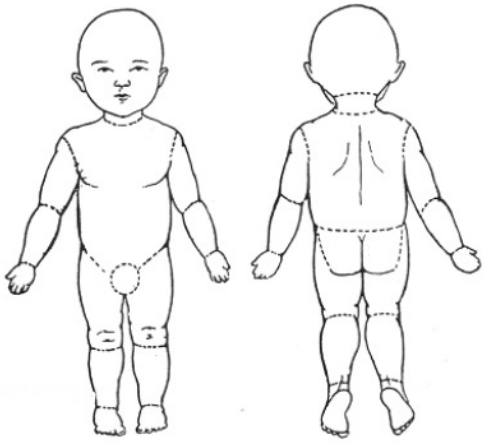
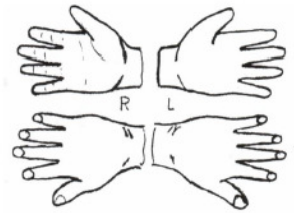
Burn Diagram
Burn Record **Birth to 1 Year**



| Area | Birth To 1 | 2nd degree % | 3rd degree % | Total % | $cm^2$ %x$cm^2$x100 |
|---|---|---|---|---|---|
| Head | 19% | | | | |
| Neck | 2% | | | | |
| Ant Torso | 13% | | | | |
| Pos Torso | 13% | | | | |
| R Buttock | 2 ½ % | | | | |
| L Buttock | 2 ½ % | | | | |
| Genitalia | 1% | | | | |
| R upper arm | 4% | | | | |
| L upper arm | 4% | | | | |
| R lower arm | 3% | | | | |
| L Lower arm | 3% | | | | |
| R Hand | 2 ½ % | | | | |
| L Hand | 2 ½ % | | | | |
| R thigh | 5 ½ % | | | | |
| L thigh | 5 ½ % | | | | |
| R leg | 5% | | | | |
| L Leg | 5% | | | | |
| R Foot | 3 ½ % | | | | |
| L Foot | 3 ½% | | | | |
| | **Total** | | | | |




L Bottom R

L Lateral R

L Medial R

Surface Area _____ $m^2$

Weight _____kg, Height _____cm

History_____

_____

_____

_____

_____

_____

_____

Photos:
□ Yes: Photographer _____
□ No: Reason _____
_____

RN Signature_____ Date_____ Time_____

MD Signature_____ Date _____ Time_____

Attending Signature_____ Date_____ Time_____

LV 3/2016
Trauma/Burns

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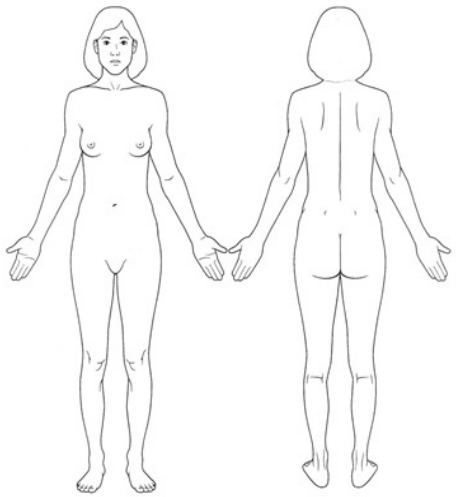
Burn Diagram
Burn Record **15 Years to 18 Years - Female**



| Area | 15 to 18 | 2nd Degree % | 3rd Degree % | Total % | $cm^2$ %x$cm^2$x100 |
|---|---|---|---|---|---|
| Head | 9% | | | | |
| Neck | 2% | | | | |
| Ant Torso | 13% | | | | |
| Pos Torso | 13% | | | | |
| R Buttock | 2 ½ % | | | | |
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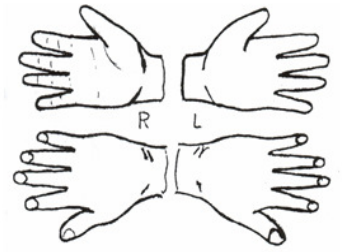
| Genitalia | 1% | | | | |
| R upper arm | 4% | | | | |
| L upper arm | 4% | | | | |
| R lower arm | 3% | | | | |
| L Lower arm | 3% | | | | |
| R Hand | 2 ½ % | | | | |
| L Hand | 2 ½ % | | | | |
| R thigh | 9 % | | | | |
| L thigh | 9 % | | | | |
| R leg | 6½ % | | | | |
| L Leg | 6½ % | | | | |
| R Foot | 3 ½ % | | | | |
| L Foot | 3 ½% | | | | |




L Bottom R

L Lateral R

L Medial R

Surface Area _____ $m^2$

Weight _____kg, Height _____cm

History_____

_____

_____

_____

_____

_____

_____

Photos:
□ Yes: Photographer_____
□ No: Reason _____
_____

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Severity of a burn injury depends on:

1. Depth of burn
2. TBSA involved


# Lecture Overview

- Burn statistics and etiologies
- Pre-hospital evaluation
- Anatomy of a burn
- Transfer / treatment guidelines

# ABA Guidelines for Admission to a Burn Center

- Any size third degree burn or second degree burn greater than 5% BSA
- Associated smoke inhalation
- Burns of the face, hands, feet, and genitalia
- Circumferential burns
- Burns that cross joints
- Chemical burns
- Electrical burns
- Suspected abuse
- Associated trauma (Friction burns)
- Associated chronic illness
- Older burn that failed outpatient treatment

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# Initial Evaluation:
# Immediate Resuscitative Measures

Initial step as with every burn patient involves

- Stopping the burning process / extinguishing fire
- Removing burning clothes
- Cooling synthetic materials which retain heat with water
- Removing chemically contaminated clothes
- Covering burns with dry clean sheets

Next steps

- A airway
- B breathing
- C circulation
- D disability
- E exposure

# Airway

## Goal: Secure Airway

- Airway edema / inflammation
  - Direct thermal injury
    - Rapid onset
    - Rare below cords unless due to steam
  - Chemical and particulate injury
    - Tracheobronchial and parenchymal
      - Progressive stridor / hoarseness
      - Singed nasal hairs
      - Soot in oral cavity
      - Carbonaceous secretions
  - Cutaneous burns of face / neck
    - Slower progressive swelling

# Airway

- Airway Management
  - Intubation by most experienced person
  - Nasal intubation preferred
    - Particularly facial involvement and large burns
    - Consider re-intubation by nasal route in presence of anesthesia
  - Secure using trach ties
  - Remember to maintain C-spine precautions

# Breathing

## Goal: Adequate Oxygenation and Ventilation

- Provide 100% oxygen
- Consider CO poisoning
  - >15 CNS dysfunction
  - >40 obtundation / LOC

# Breathing

- Circumferential chest burn
  - May need escharotomy
- Rib fractures / pneumothorax
  - May need chest tube
- Pediatric considerations
  - Chest wall is compliant
    - Restriction of circumferential burn
  - Rely on diaphragm
    - Decompress stomach

# Circulation

## Goal: Establish intravenous access and begin fluid administration

- Access is necessary if:
  - Burn >10%
  - Transport time > 60 minutes
  - Shock / hypotension
  - Need for IV medication
- Large bore peripheral IV's
- LR, warm if available
- Continuous heart rate / blood pressure monitoring

# Disability

## Goal: Assess Brain

- Burn patient should be alert / oriented
  - If not:
    - Carbon monoxide poisoning
    - Traumatic brain injury
    - Hypoxemia
    - Hypovolemia

- Assess quickly using AVPU acronym

| | |
|---|---|
| A | alert |
| V | responds to verbal stimuli |
| P | responds to painful stimuli |
| U | unresponsive |

# Exposure

## Goal: Expose, Assess, and Protect

- Clothing removed except when adherent to burn
- Remove jewelry and constricting objects
- Evaluate for other signs of trauma
- Determine TBSA
- Cover patient in dry dressings / sheets

# Resuscitation: The first 24hrs

- Fluid Resuscitation
  - Age 0-18 yrs (>15%)
  - Modified Parkland formula
    - 4mL x kg x %TBSA burn
    - Adjust to 6ml with inhalation injury
  - LR for all fluid
    - ½ volume given over 1st 8 hours from injury
    - ½ volume given over next 16 hours
  - <1 yr of age
    - Add D5LR at maintenance
  - Most add albumin after 8 hrs

# Resuscitation: The first 24hrs

- Fluid Resuscitation
  - Document urine output hourly
    - 1mL/kg/hr for <30kg
    - 0.5mL/kg/hr for >30kg
  - Low urine output
    - 2 consecutive hours
      - Increase fluid rate by 15%
      - Repeat x 1 if output remains low
  - High urine output
    - 2 consecutive hours
      - >2mL/kg/hr for <30
      - >1mL/kg/hr for >30
    - Reduce fluid rate by 15%
      - After checking for glucosuria

# Resuscitation: The first 24hrs

- Nursing Care
  - Height / Weight on admission
  - Stryker bed
    - With scale
  - Foley with temp probe
  - Central line care through burn skin
  - Room temp at 32 degrees C
    - Unless febrile
  - Circumferential burns
    - Doppler q1 hr x 24 hours
    - Doppler q4 hr x next 24 hours
  - Extension of neck and elevation of extremeties
  - Q2 turning
    - Avoid sliding due to shearing of dressings

# Subsequent 24 hrs – 48 hrs

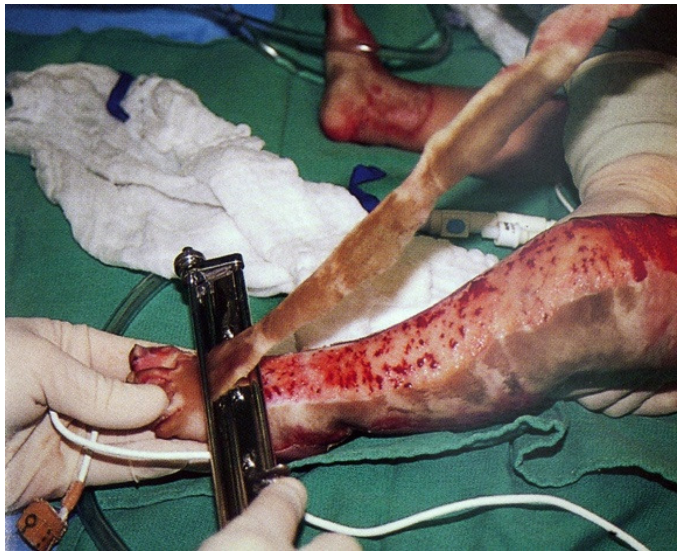
- Resuscitation phase should be concluding
- Fluid rates reduced to maintenance or near maintenance rate
- Enteral nutrition initiated if tolerated
- Operative plans made for excision and closure

# Multidisciplinary Team

- Consults – All Admissions
  - Social work
  - Physical therapy
  - Occupational therapy
  - Nutrition
  - IR for PICC / NJ
  - Psychology
  - Ophtho
    - If facial burns involving eyes/periorbital area

# Surgical Management

- Operative choices
  - Debridement only
  - Excision and coverage
    - Temporary coverage with allograft
    - Definitive (immediate or delayed) coverage with autograft
      - » Sheet
      - » Meshed
      - » Cultured



# Pediatric Burn Management

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