Burn Trauma

Presented by:
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EMT-P, CC-EMT-P
Flight Nurse, MedFlight
Burns
Overview

- Basic anatomy and functions of skin
- Epidermal, dermal layers and structures

- Severity of burns
  - Appearance, depth, extent
  - Extent of burn using Rule of Nines

- Complications and management:
  - Thermal, chemical, and electrical burns
  - Carbon monoxide poisoning and inhalation injury
  - Burn center guidelines
• Safety is extremely important.
• Scene Size-up, rescue or removal
• Multiple agents cause burn injuries.
• Pathologic damage to skin is similar.
Functions of Skin

- Largest organ
- Functions:
  - Mechanical barrier
  - Protective barrier
  - Sensory organ
  - Temperature regulation
Burn Trauma

- Skin damage
- Direct injury from heat or caustic chemicals
- Inflammatory response

Sources of damage
- Thermal
- Electrical
- Chemical
- Radiation
Burn Classification

Depth of burn
• Superficial (first degree)
• Partial-thickness (second degree)
• Full-thickness (third degree)

Extent of burn
• Rule of Nines
• Lund and Browder
• Palmar surface
Extent of the Burn

- Rule of Nines
Extent of the Burn

- Lund and Browder
Extent of the Burn

• Palmar surface –
  – Approximately 1%
Burn Depth

- Superficial
  - Minor tissue damage to outer epidermal layer
  - Intense and painful inflammatory response

**Management:**
- Symptomatic treatment
- Examples?
Burn Depth

- Partial-thickness
- Entire epidermis into variable depth of dermis
  - Usually no scarring
- Management
- Cool burn and cover with clean dry dressing
- Often antibiotic creams
  - Silvadene
Burn Depth

• Full-thickness
• Epidermis and dermis
  • Scars contract, limit motion
• Deeper full-thickness
  • “Leather-like” eschar

• Management
• Burn center
### Characteristics of Various Depths of Burns

<table>
<thead>
<tr>
<th></th>
<th>Superficial (first degree)</th>
<th>Partial Thickness (second degree)</th>
<th>Full Thickness (third degree)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cause</strong></td>
<td>Sun or minor flash</td>
<td>Hot liquids, flashes, or flame</td>
<td>Chemicals, electricity, flame, hot metals</td>
</tr>
<tr>
<td><strong>Skin color</strong></td>
<td>Red</td>
<td>Mottled red</td>
<td>Pearly white and/or charred, translucent and parchmentlike</td>
</tr>
<tr>
<td><strong>Skin surface</strong></td>
<td>Dry with no blisters</td>
<td>Blisters with weeping</td>
<td>Dry with thrombosed blood vessels</td>
</tr>
<tr>
<td><strong>Sensation</strong></td>
<td>Painful</td>
<td>Painful</td>
<td>Anesthetic</td>
</tr>
<tr>
<td><strong>Healing</strong></td>
<td>3–6 days</td>
<td>2–4 weeks, depending on depth</td>
<td>Requires skin grafting</td>
</tr>
</tbody>
</table>
Burn Depth

Courtesy of Roy Alson, MD
Burn Depth
Scald
Burn Depth

• Progression
  • Inflammatory response
  • Extends damage and depth (1–2 days)
  • Severe fluid loss (hours or days)
  • Sepsis (days)
• Reduced circulation extends depth

• Management:
  – Initial care focuses on limiting depth and extent of burn
Rule of Nines

Adult

Child

Infant

Front 18%
Back 18%
13% 9%
13% 9%
**TABLE 16-3 Lund and Browder Chart**

<table>
<thead>
<tr>
<th>Area</th>
<th>Age (Years)</th>
<th>%</th>
<th>%</th>
<th>%</th>
<th>%</th>
<th>%</th>
<th>Total</th>
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<tbody>
<tr>
<td></td>
<td>0-1</td>
<td>1-4</td>
<td>5-9</td>
<td>10-15</td>
<td>Adults</td>
<td>2°</td>
<td>3°</td>
</tr>
<tr>
<td>Head</td>
<td>19</td>
<td>17</td>
<td>13</td>
<td>10</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neck</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
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<tr>
<td>Ant. Trunk</td>
<td>13</td>
<td>17</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post. Trunk</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R. Buttock</td>
<td>2½</td>
<td>2½</td>
<td>2½</td>
<td>2½</td>
<td>2½</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L. Buttock</td>
<td>2½</td>
<td>2½</td>
<td>2½</td>
<td>2½</td>
<td>2½</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Genitalia</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R.U. Arm</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L.U. Arm</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R.L. Arm</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L.L. Arm</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R. Hand</td>
<td>2½</td>
<td>2½</td>
<td>2½</td>
<td>2½</td>
<td>2½</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L. Hand</td>
<td>2½</td>
<td>2½</td>
<td>2½</td>
<td>2½</td>
<td>2½</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R. Thigh</td>
<td>5½</td>
<td>6½</td>
<td>8½</td>
<td>8½</td>
<td>9½</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L. Thigh</td>
<td>5½</td>
<td>6½</td>
<td>8½</td>
<td>8½</td>
<td>9½</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R. Leg</td>
<td>5</td>
<td>5</td>
<td>5½</td>
<td>6</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L. Leg</td>
<td>5</td>
<td>5</td>
<td>5½</td>
<td>6</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R. Foot</td>
<td>3½</td>
<td>3½</td>
<td>3½</td>
<td>3½</td>
<td>3½</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L. Foot</td>
<td>3½</td>
<td>3½</td>
<td>3½</td>
<td>3½</td>
<td>3½</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Weight ______
Height ______

[Diagram of Lund and Browder Chart]
Burn Assessment

- Primary and Secondary Surveys
  - Immediate burn death
    - Inhalation or airway compromise
  - Patient rescue or removal
- Safely remove from source
- Thermal, chemical, electricity
- Toxic by-products, smoke
Critical Problems

• Mechanism-how happened
  • Confined in closed space
  • Electrical burns
  • Chemical exposure
• Falls from a height
• Major blunt-force trauma
• Management
• High-flow oxygen as soon as possible
Burn Assessment

- Airway
- Facial and scalp burns
- Sooty sputum
- Singed nasal hair, eyebrows
- Soot, swelling, redness
- Hoarse voice, persistent cough
- Wheezing or rales
- Frequent Ongoing Exams

Courtesy of Roy Alson, M.D.
Early burn deaths: airway compromise, not burn injury.
So what do we do until EMS arrives?

• Safety-for you and the patient
  – If suspected trauma, move only if necessary.
• Stop the burning process
• Keep the patient calm
• Remove clothing from area of burn but keep patient warm
• Remove all jewelry.
Burn Management

- Address immediate life threats
- Limit burn progression—rapid cooling
  - Cool skin, clothing with clean water 1–2 minutes
    - Longer induces hypothermia
  - Clean, dry sheets, blankets
    - Sterile sheets not necessary
- Maintain body temperature
  - Prevent hypothermia
  - Remove wet clothing and items
Burn Management

• Evaluate burn
• Remove loose clothing and jewelry
  • Cut around adherent clothing; do not pull off of skin
• Assess depth and extent

• Large bore IV access, if needed
• Pain management
• Isolated burns; no coexisting trauma
• Controversial in multiple trauma
Burn Center Guidelines

- Recommend burn center
- Partial-thickness burns >10% total BSA
- Involve areas affecting function, appearance
- Third-degree burns in any age group
- Electrical burns, including lightning injury
- Chemical burns
- Inhalation injury
Burn Center Guidelines

- Recommend burn center
- Preexisting medical disorders that complicate management, prolong recovery, affect mortality
- Burn poses greater risk than associated trauma
- Children in hospitals without qualified personnel or equipment for care of children
- Require special social, emotional, or long-term rehabilitative intervention
Specific Burns

Multiple burn types can be combined.

- Flash burns
- Inhalation injuries
- Chemical burns
- Electrical burns
- Lightning injury
- Radiation burns
- Circumferential
- Secondary transport
- Pediatric burns
Burn Types

• Flash burn
  • Source is explosion, not sustained fire
  • Superficial or partial-thickness to exposed skin
    • Full-thickness (rare)

• Associated symptoms

• Explosion trauma
  • Fractures
  • Internal injuries
  • Blast chest injuries
Burn Types

- Inhalation injuries
- Burn related deaths (US): >50%

- Mechanism
- Confined space or entrapment

- Classifications
  - Carbon monoxide poisoning
  - Heat-inhalation
  - Smoke-inhalation
Inhalation Injuries

- Carbon monoxide poisoning
- Hypoxia due to hemoglobin binding
  - Most common cause of early death

- Associated symptoms
- Altered level of consciousness
- Cherry-red skin color or cyanosis (rare)
  - Pulse oximetry not useful
- Progressive cardiac hypoxia
Carbon Monoxide Poisoning

<table>
<thead>
<tr>
<th>Carboxyhemoglobin Level (%)</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>Headache common, throbbing in nature; shortness of breath on exertion</td>
</tr>
<tr>
<td>30</td>
<td>Headache present; altered central nervous system function with disturbed judgment; irritability, dizziness; decreased vision</td>
</tr>
<tr>
<td>40–50</td>
<td>Marked central nervous system alteration with confusion, collapse; also fainting with exertion</td>
</tr>
<tr>
<td>60–70</td>
<td>Convulsions; unconsciousness; apnea with prolonged exposure</td>
</tr>
<tr>
<td>80</td>
<td>Rapidly fatal</td>
</tr>
</tbody>
</table>
Carbon Monoxide Poisoning

- Management
- Remove from source
  - Safety
  - Consider multiple patients
- High-flow oxygen
- Loss of consciousness: intubation, ventilation
- Hyperbaric chamber by medical direction
Inhalation Injuries

- Heat-inhalation
- Upper airway only
  - Unless steam or flammable gas
  - Airway obstruction due to swelling
- Onset: delayed
  - Not usually in field
- Associated symptoms
  - Swollen lips, stridor

Management

- Intubation
  - Sedation, if necessary
  - Nasotracheal
  - RSI
  - Surgical
- Avoid aggressive fluid administration
  - May increase swelling
Inhalation Injuries

- Smoke-inhalation
- Destruction of bronchi and alveoli from toxins
- Onset: hours to days

Management
- High-flow oxygen
- Inhaled beta agonists for bronchospasm
Burn Types

- Chemical burns
- Tissue damage
  - Concentration, amount, manner, duration of contact, mechanism of chemical action
  - Initial skin changes minimal even when severe
- Absorbed into body, cause internal organ failure
- Inhaled, cause lung tissue, respiratory failure
- Onset: systemic, not immediate
Chemical Burns

- Remove source
- Protective gear
- Remove clothing, place in plastic bags
- If dry chemical, brush from skin
- Flush copiously with water or irrigant
  - If eyes, remove contact lenses, foreign bodies
- Remove retained agent
  - Repeat flush
- Prevent secondary contamination
Chemical Burns
Chemical Burns
Burn Types

- Electrical burns
- Electricity effect on organ function
- Heat generated by passage of current
- Extremities greater risk of injury

Mechanism
- Type and amount of current (AC, DC, voltage)
- Path of current through body
- Duration of contact with current source
Electrical Burns

• Associated symptoms
• Cardiac arrhythmia
  • PVCs, ventricular tachycardia, ventricular fibrillation
• Entrance and exit wound
  • Impossible to determine extent
• Flame burns
• Fractures, dislocations
• Internal injuries
  • Muscle damage, nerve damage, coagulation
Electrical Burns

- Management
- Safety
- High-flow oxygen
- Transport all electrical injuries
- Large-bore IV access
  - Fluid administration needs often higher than thermal
- Cardiac monitor
- Treat arrhythmias
Electrical Burns
Electrical Burns

Courtesy of Roy Alson, MD
Lightning Injury
Burn Types

• Radiation burns
• Appear same as thermal
• Onset: develop over days
• Danger of fluid shift
• Danger of infection
• Need specialized resources
  • Remove contaminants
  • Only contaminants are radioactive, not patient
Burn Types

• Circumferential full-thickness burns
• As edema progresses, may have tourniquet effect
  • Escharotomy by physician

• Management
• Monitor respiration and chest expansion
• Monitor distal PMS
Burn Types

- Secondary transport
- Monitor airway, respiratory, hemodynamic status
- Monitor burn and associated injuries
- Monitor urinary output (renal function)
- Fluid administration
- Parkland formula

Fluid required in first 24 hours is:
4 cc/kg x % burn area x body weight (kg)
  - Will receive half in the first 8 hours.
Burn Types

• Pediatric burns
  • Greater severity
    • Thinner skin, larger surface area to body mass ratio

• Mechanism
  • Accidental
  • Child neglect or abuse
    • Match object shapes
    • Clear lines without splatter or splash
    • History does not match developmental age
Summary

• Safety is essential.

• Early deaths are due to airway compromise.

• Limit progression of depth and extent.

• Careful, systematic approach:
  • Identify and manage critical life-threatening problems and improve patient outcome
Discussion
Questions?
Thank you for your time and support!