Initial care of the burn patient

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What to Consider for Initial Care

- Mechanism of Injury
- Airway Management/ Inhalation Injuries
- Calculating TBSA
- Fluid resuscitation
- Prevention of Hypothermia
- Need for transfer to the Burn Center?
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<th>Sources of Burn Injuries</th>
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What do you need to do first?

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<th>Question</th>
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<td>Is the scene safe for you? Don’t become a patient to.</td>
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<td>Stop the burn/Need decontamination?</td>
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<td>How is the airway/breathing/circulation?</td>
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<td>Contact/flame/scalds/electrical/chemical/inhalation? Abuse?</td>
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<td>How deep are the burns?</td>
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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.
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.
Initial Care and Diagnosis

What are the steps in the initial care and management of a burn patient?

• Stopping the burn
• Fluid resuscitation
• Minimizing the risk for hypothermia
• Decontamination
• Transporting to the nearest burn center
Why is the initial management so vital?

Every step of the process from the time of the injury impacts a patient's overall outcome.

- Survivability
- Recovery
- Length of Stay
ABA Guidelines Rule of Nines

Fig. 4.2: Estimation of burn size using the Rule of Nines.
When calculating size of burn

- Total Body Surface Area (TBSA)

- Use Rule of 9’s or palmer method

- **Only count Second and Third degree burns**

- First Degree: 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.
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
First Degree Burn

- Thinner outer epidermis layer
- Characterized by erythema and mild discomfort.
- Tissue damage is minimal and the skin functions are intact.
- Pain is the chief complaint
- Usually resolves in 2-3 days.
- (Is not included in TBSA)
Second Degree Burn (Partial Thickness)

- Involve the entire epidermis.
- Variable portions of the dermis have been destroyed by heat.
- Either superficial or deep.
- Should blanch and color should return when released.
- Superficial second degree burns involve the upper third of the dermis.
- characterized by edema, pain, generally pinkish to light red, and is moist.
Superficial Partial Thickness
Second degree (deep)

- Epidermis, papillary dermis and varying depths of deep dermis have been damaged
- Pale, pink-white, dry appearance common. Does not blanch
- Can convert to full thickness (third degree)
- Remains painful to pinprick and presents with less pain than superficial 2\textsuperscript{nd} degree
Deep second degree

• Can heal but may take 3-4 weeks

• Excisional debridement with temporary skin coverage may be required
Third Degree Burn (Full Thickness)

- Destroy the entire epidermis and dermis layer.
- No residual epidermal cells left to re-epithelialize the affected areas.
- The hard dark yellow tissue is known as eschar.
- May also have a waxy white or yellow color due to its avascular nature.
- They may also be leathery or black if the tissue is charred.
- Dry, non edematous and painless
Forth Degree Burn or Deep Third Degree burn with Loss of Body Part

- Extend beyond the dermis and involve muscle and/or bone or underlying tissue.
- Injuries are usually the result of high-voltage electrical injury or prolonged exposure to intense heat.
- Appearance is dry and charred. No sensation, and limited or no movement.
- Myoglobinurea is usually seen when the muscle is involved.
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
  - Limit progression of depth and extent
Burn Assessment

- Primary and Secondary Surveys
- Specialized resources
  - Patient rescue or removal
- Safely remove from source
  - Thermal, chemical, electricity
  - Toxic by-products, smoke
Stop the Burning Process
Initial Assessment

A - Airway
B - Breathing
C - Circulation
D - Disability, Neurologic Deficit
E - Exposure/Environmental Controls
Inhalation Injury

• Inhalational injuries complicate nearly one third of all major burns
• Doubles the mortality of cutaneous burns
• Three distinct components
  ▪ Carbon monoxide poisoning
  ▪ Upper airway thermal burns
  ▪ Lower airway chemical injuries
Inhalation Injury

- Physiologic changes associated with injury
  - Impaired ciliary activity
  - Inflammation
  - Hyper-secretion
  - Edema formation
  - Ulceration of the airway mucosa
  - Increased blood flow

- Accounts for 50 to 70% of burn mortality
Signs of a possible inhalation injury:

- Facial Burns
- Singed eyebrows, nasal hair, facial hair
- Carbonaceous sputum
- Unconsciousness
- Closed Space
- Signs of hypoxemia (cyanosis, agitation, etc)
- Signs of respiratory distress
- Hoarse voice
- Inability to swallow
- Erythema or edema of tissues
Carbon Monoxide

• Produced by the combustion of organic material
• Systemic poison
  • Inhibits transport and mitochondrial use of oxygen
• Pulse oximeter gives spuriously high reading for O2 saturation
• Pulse ox is not reliable
  \[ O_2 \text{ dissolved in plasma (Pa } O_2) \text{ is unaffected and oximeter detects } Hgb \text{ saturated by } O_2 \]
Carbon Monoxide Poisoning

• 0% - 5% = Normal value
• 15% - 20% = Headache, confusion
• 20% - 40% = Visual changes, nausea
• 40% - 60% = Hallucinations, combativeness, coma
• > 60% = Mortality rate > 50%
Carbon Monoxide Poisoning

• Treatment
  ▪ 1/2 life on room air = 240 minutes
  ▪ 1/2 life at 100% FIO2 = 30-40 min (tight-fitting non-rebreather face mask or ET tube)
  ▪ HBO (O2 at 3 atm.) will shorten 1/2 life even further...Several randomized, controlled trials have failed to show significant benefit over 100% O2 (Tibbles, Perrota, Ann. Em. Med. 1994)
Upper vs Lower Inhalation Injuries

Oropharynx

- Heat injury
- Inflammatory
- Severe localized edema can occur rapidly
- Indication for prophylactic intubation
- Maximal swelling 12-24 hours
- Resolves in about 3 days
- Resolves faster if not given inappropriate fluids
Upper vs Lower Inhalation Injuries

- Smoke/Chemical or Steam
- Heat in unconscious (may be cobblestoning 2-d appearance)
- Transudate—a transudate is characterized by high fluidity and a low content of protein, cells, or solid matter derived from cells.
- Secretions from goblet cells
- Increased shunting—bypassing of alveoli by blood circulating through the lungs.
- *Beware Volume ventilation*

Tracheobronchial Tree

- Smoke/Chemical or Steam
- Heat in unconscious (may be cobblestoning 2-d appearance)
- Transudate—a transudate is characterized by high fluidity and a low content of protein, cells, or solid matter derived from cells.
- Secretions from goblet cells
- Increased shunting—bypassing of alveoli by blood circulating through the lungs.
- *Beware Volume ventilation*
Treatment for Carbon Monoxide Exposure

• https://docs.google.com/document/d/1x-DTrcPsqrlpZq6zo748bmqjEA7ikBlbT8u4gJAciIk/edit
Lower Airway Thermal Injuries

- Injury to tracheobronchial tree and lung parenchyma
- Due to combustion products in smoke and inhaled steam. More chemical than thermal.
  - Atelectasis
  - Shedding of columnar epithelium
  - Decreased ciliary action
  - Pooling of secretions
  - Bronchorrhea
  - Bronchospasm
  - Pulmonary Edema
To Intubate or Not to intubate?

• If giving a lot of fluid: you will have more edema if there is a heat injury to the oropharynx
• Is there a voice change?
• Stridor?
• Okay to give 100% oxygen via mask or NC with facial burns
• Nares may swell, may have to bring NC to mouth
• Keep on 100% FiO2 if CO suspected.
• If you need to do a surgical airway: good news: the skin won't bleed if full thickness burn.
Bronchoscopy
Management of Inhalation Injury

- Airway assessment
- Endotracheal intubation
- Mechanical ventilation
- High flow - 100% oxygen
- ABGs
- Carboxyhemoglobin
Burn Types

- Circumferential full-thickness burns
  - As edema progresses, may have tourniquet effect
    - Escharotomy
- Management
  - Monitor respiration and chest expansion
  - Monitor distal circulation
Escharotomies & Fasciotomies

• Circumferential Trunk Burns

• Circumferential Extremity Burns
  ▪ Cyanosis of distal unburned skin on limb
  ▪ Unrelenting deep tissue pain
  ▪ Progressive paresthesias
  ▪ Decrease or absence of pulse

• Fasciotomy in OR
CO and CN Treatment

100% FiO2 until known CO level

Do not rely on pulse ox

Altered mental status, CO>25, pregnancy gets hyperbarics x 3

If CO high, expect CN to be high and treat

Cyanokit: turns urine and patient purple

Will be unable to track myoglobinuria
Burns:

- Parkland!
- 4cc LR/kg/TBSA burn
- Half of total in first 8 hours
- Other half over the next 16
- Bolus for low UOP
- We’re done
- Not so fast.
Problems with Parkland??

• State of the Science meeting in 2006:
  • “Fluid Creep” Dr. Basil Pruitt
• Burns were getting 4.6-6.3 ml/kg/TBSA
• Prevalence of Intra-abdominal Hypertension 67-74% major burns
• Prevalence of Abdominal Compartment Syndrome 4-16%
Fluid Resuscitation

• Prehospital/PreAssessment:

  • 5 years old and younger – LR @ 125ml/hr
  • 6-14 years old – LR @ 250ml/hr
  • 15 years and older – LR @ 500ml/hr

• NEVER BOLUS A BURN PATIENT WITH FLUIDS UNLESS THERE IS AN ASSOCIATED TRAUMA
Fluid Resuscitation
Based on Secondary Survey

- Children ≤ 14  \(3 \text{ ml LR} \times \text{TBSA} \times \text{kg}\)
- Adults  \(2 \text{ ml LR} \times \text{TBSA} \times \text{kg}\)
- Electrical  \(4 \text{ ml LR} \times \text{TBSA} \times \text{kg}\)

- Give \(\frac{1}{2}\) in first 8 hours of injury and remainder over next 16 hours.
- Adjust rate to maintain urinary output.
Prehospital or during Primary eval

2010 ABA Consensus Guideline

- Is the burn >30% of the body? yes
- Is this an adult? LR at 500cc/hr
- Is this a kid age 6-14? LR at 250cc/hr
- Is this a kid <6? LR at 125cc/hr
- 400cc/hr electrical Injuries
Over resuscitation issues

- Limb ischemia
- Ocular compartment syndrome
- Increased wound conversion
- Increase ventilator requirements
- Pulmonary edema
- Risk for Intra-abdominal hypertension/compartment syndrome

Avoiding overresuscitation

Fluid is not consequence free:

- Treat the patient

- If acidotic, correct acidosis

- If bleeding, treat as a trauma and give blood and control hemorrhage

- If MAP<55, add pressors

- If fluids at a high rate already, change 1/3 of the rate to albumin

- Aim for only 30-50cc/hr of UOP. “permissive oligouria”

- If UOP is 1cc/kg/hr: cut back fluids by 10-20%

- Kidneys can be replaced.
Burn Shock: Patients at risk have burns >20%

**Emergent Phase**
- Maximum at 12 h and lasts up to 72 h
- Capillary permeability is high via histamine, prostaglandins, vasoactive mediators
- Decreases cell membrane potential
- Proteins lost to interstitium
- Cellular swelling via Na influx
- Decreased cardiac output (TNF-α and calcium)
- Beware of drugs that drop pressure!
- In burned and unburned tissue

**Flow Phase**
- Usually starts after 48 hours
- Hypermetabolism
  - Increased O2 consumption
  - Increased CO2 production
- Increased gluconeogenesis
- Insulin resistance
- Decreased hematopoiesis
- Immunoparesis
- Muscle catabolism
Hypothermia

• Patients with a burn injury greater than 20% are at higher risk for hypothermia
  • Others at risk:
    • Children- due to a large body surface area relative to body size
    • Elderly- the body’s ability to regulate temperature Body’s Surfaces SENSE COLD CHANGES WITH AGE

• Hypothermia can lead to elevated blood pressures due to vaso-constriction

• Increase risk for mortality
  • 60% mortality if present on first evaluation

• Inappropriate normotension
• Inappropriate normouria
Burn Types

• Chemical burns
  • Tissue damage
    • Concentration, amount, manner, duration of contact, mechanism of chemical action
    • Initial skin changes minimal even when severe
  • 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
Cause of Injury

• Absorption through skin and mucous membranes
• Ingestion
• Inhalation
• Combination of any of the above
Chemical Burns

Courtesy of Roy Alson, MD
Petroleum Injuries

- Gasoline
- Diesel fuel
Petroleum Injuries

motor vehicle crashes

- Thorough assessment of the skin
- Possible multi-system toxicity within 6-24 hours:
  - pulmonary insufficiency
  - hepatic failure
  - renal failure
- Possible lead toxicity
Methamphetamine Injuries

- Numerous hazardous chemicals used in production of methamphetamine
- Patient less than truthful about how injury occurred
- Usually a combination of flame and chemical injuries
Methamphetamine Injuries

- Tachycardia (greater than expected with a similar size burn)
- Hyperthermia
- Agitated
- Paranoid
Treatment

- ABC’s
- Potential respiratory complications
- Obtain IV access
- Identify agent
- Contact poison control
- Decontamination
Summary

• Site safety and hazardous material control
• Remove clothing
• Irrigate with copious amounts of water
• Give required special consideration to ammonia, phenol, petroleum, and hydrofluoric acid
• Consult ophthalmologist for all eye injuries
• Burn center referral
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
Findings Suggesting Electrical Injury

- Loss of consciousness
- Paralysis or mummified extremity
- Loss of peripheral pulse
- Contact injury
- Myoglobinuria
Pathophysiology
Tissue Resistance

• Dry epidermis has the highest resistance to electrical flow/ 100,000 Ohms

• Current flow involves all of the tissues and follows the path of least resistance through underlying tissues
Body Conduction

• Low Voltage < 1000 volts
  • Delayed onset/migrating pain
  • Can cause fatal cardiac arrhythmia

• High Voltage > 1000 volts
  • Heats tissues immediately
  • Can cause deep tissue injuries
Initial Management

• STOP and confirm that the scene is safe
• All electrical hazards must be eliminated
• Do NOT become the next victim
Hourly Assessment

- Skin color
- Capillary refill
- Peripheral pulses
- Sensation and motor exam
Peripheral Circulation
High Voltage Injury

• Compartment syndrome may develop
• Fasciotomies often required at the burn center
Resuscitation

- 4 ml LR x kg x TBSA burn
- Insert urinary catheter
- Hemochromogens?
  - Maintain urinary output at 75-100 ml/hour
Electrical Burns

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

• Rhabdomyolysis
  • Breakdown of muscle releasing myoglobin
  • Renal failure from blocked tubules
  • Fluid resuscitation to maintain urine output of 1.0 – 1.5 cc/kg per hour or 75cc/hr to 100cc/hr
Electrical Burns

- **Management**
  - Safety
  - High-flow oxygen
  - Transport all electrical injuries to the nearest burn center
  - Large-bore IV access
  - Fluid administration needs often higher than thermal
  - Cardiac monitor
  - Treat arrhythmias
Electrical Burns
Burn Types

• Lightning injury
  • Extreme voltage
  • Short duration

• Mechanism
  • Direct contact
  • Indirect contact

• Associated symptoms
  • Superficial and partial-thickness burns
  • Cardiopulmonary arrest
Lightning Injury

Courtesy of David Effron, MD, FACEP
Burn Types

• Secondary transport
  • Monitor airway, respiratory, hemodynamic status
  • Monitor burn and associated injuries
  • Monitor urinary output (renal function)
  • Assessment of peripheral circulation
  • Fluid administration
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
Pediatric Burns

• Most commonly due to scald burns to hot liquids.
• Scald burns = 65% of all hospitalized burn injuries in children age 4 and under.
Pathophysiology
Body Surface Area

Relatively greater BSA/kg of body weight

EXAMPLE – 7 kg child
Wt = 10% of average 70kg adult
BSA = 33% of the adult BSA
Pathophysiology
Temperature Regulation

- Thinner skin leads to deeper burns
- Small muscle mass hampers ability to shiver
- Infants < 6 months old rely on metabolic temperature controls
- Monitor core temperature
- External protection, i.e., blankets, warm room
Scald
Child Abuse

- Consider it during initial evaluation: pattern of burns, conflicting stories...
  - Delays in seeking treatment.
  - Alterations in the history surrounding the event.
  - Pattern of burn inconsistent with the history.
  - Presence of old healed fractures.
  - Match object shapes
  - Clear lines without splatter or splash

- Incidence requiring hospitalization varies from 1% -39%.
- Parents, siblings and childcare have all been reported.
- Could occur in any socioeconomic level.
Child Abuse

• Common abuse burns:
  • Cigarette burns.
  • Some scald burns.
  • Hot iron contact burns.
• If doubt exists, complete radiological series should be obtained.
• And Social Work Consult should be obtained
Child Abuse

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  - Cigarette burns.
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Pediatric Burns

- Fluid Resuscitation (cont)
  - Urinary catheter (mainly with burns 20% TBSA or greater).
  - Hourly urinary output (U/O): 1 cc/kg/hr if < 40 kg
  - Increase fluid by 1/3 if U/O is < 1cc/kg/hr.
  - With U/O > 2cc/kg/h decrease IV fluids by 1/3.
Pediatric Burns

- Monitor GLUCOSE LEVEL in children < 2 years of age as they have smaller glycogen stores.
- Children < 10 Kg resuscitate with D5LR.
Burns and the elderly

• Elderly individuals are more vulnerable to burn injury due to their limited mobility coupled with their physical inability to react rapidly and reach safety when faced with danger.

• Skin’s integrity and function is eventually jeopardized by the process of aging through structural and biochemical processes, and manifests as impaired neurosensory perception, permeability, and compromised response to injury and repair capacity.

• > 65 have more comorbid medical conditions and double the mortality following a major burn injury than those under 65 years of age. They are at a higher risk for complications such as pulmonary edema, congestive heart failure and pneumonia.
Patients with a 20% TBSA or greater:

- The temperature of the room needs to be elevated to 80 degrees or greater and the door closed to maintain the temperature.
- Keep the patient covered with clean/dry/warm blankets.
- Expose one area at a time to minimize chill.
- Use the fluid warmer to administer fluids - be more cautious.
- Bair hugger.
- Monitor the patient's core temperature regularly.
- If transferring patient, ensure the transferring agency has the vehicle warmed appropriately.
DRESSING BEFORE TRANSFER?

A dressing is not needed prior to a patient transfer.
Do not apply any creams.

Apply a clean, dry sheet and blankets (they do not have to be sterile)

If the patient will not be transferred for an extended period of time, inquire with the burn attending for advisement.
FROSTBITE
Frostbite

- Like burns, but not like them
- Secondary injury is to be avoided
- Rewarm when plan is to stay warm
- Injury is on reperfusion
WHAT YOU DO MATTERS!!!!!!!!!!!!!!
Summary

• Safety is essential
• Early deaths are due to airway compromise
• Limit progression of depth and extent
• Keep patients warm
• Careful, systematic approach:
  • Identify and manage critical life-threatening problems and improve patient outcome
• Start resuscitation:
  • 125cc/hr, 250cc/hr, or 500cc/hr.
References

