

Updates in Pediatric Burns

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Objectives

- Review the epidemiology of pediatric burns
- Discuss the latest guidelines/updates for the emergency management of pediatric burns
- Discuss advances in pediatric burn management

US Burn Statistics

- Approximately 500,000 burns yearly
 - 92% treated in ambulatory setting
 - 40,000 hospitalized
 - 25,000 treated in burn centers
- Mortality rate 5%
 - Improved care and prevention

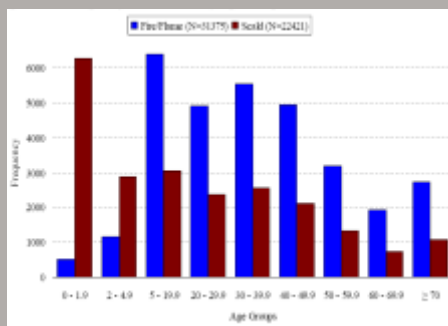
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US Burn Statistics - Pediatrics

- 31% of admissions
- 0.7-1.6% mortality rate
- High risk groups
 - 0-2 years
 - Adolescents
- 3rd /4th leading cause of accidental death
- Burns deaths - house fires

American Burn Association, National Burn Repository © 2006. Version 2.0

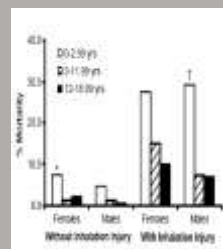
Frequency of Fire/Flame Burn by Age Group



American Burn Association, National Burn Repository © 2006. Version 2.0

Influence of Demographics and Inhalation Injury on Burn Mortality in Children

- Retrospective review
- 3179 children
- Admitted; 1985 to 2001
- 1246; TBSA burns ≥20%
- 350; assoc inhalation injury
- Examined; age, gender, burn size, inhalation injury



Barrow RE et al. Burns 2004 Feb 30:72-7

Top Emergency Priorities of Major Burn Care ABLS Highlights

- Airway
 - Oxygen
 - DL/bronchoscopy
- IV access
- Urinary catheter
- Nasogastric tube
- Labwork/CXR
- Wound assessment
 - Lund/Browder burn chart.
 - Circumferential extremity burns
- Maintain body temperature
- Suspected intentional injury
- Tetanus prophylaxis
- Transfer to burn center
- Non-adherent dressings with bacitracin or SSD

Airway & Breathing Signs/Symptoms of Inhalation Injury

- History of closed space confinement
- Altered level of consciousness
- Facial burns
- Singed nasal hair
- Respiratory distress
- Hoarseness
- Carbonaceous sputum
- Oropharyngeal edema, erythema, soot

J.A. Moylan, C.K. Chan, *Ann Surg*, 1978
H.H. Stone, J.D. Martin Jr., *Surg Gynecol Obstet*, 1969

Circulation: Shock and Fluid Resuscitation

- GOALS
 - Maintain tissue perfusion
 - Maintain organ function
 - Avoid complications of inadequate or excessive resuscitation
- CHALLENGES
 - Increased PVR
 - Decreased CO
 - Capillary leak
 - Electrolyte imbalances

Circulation: Shock and Fluid Resuscitation

- Parkland Formula (>20%TBSA)
 - $4 \text{ cc} \times \text{weight (kg)} \times \% \text{TBSA} = \text{total fluid volume}/24 \text{ hrs}$
 - Lactated Ringers
- < 30 kg; need maintenance IVF with dextrose
- 2nd 24 hours: hypotonic maintenance fluids/colloid

American Burn Association Practice Guidelines Burn Shock Resuscitation

- Crystalloid resuscitation → C
- Colloid resuscitation → A
- Pediatric resuscitation → C
- Monitoring of resuscitation → A

Pham TN, Cancio LC, Gibran NS.
J Burn Care Res 2008

Calculation of Total Body Surface Area

- Palmar Method
- Lund and Browder
- Rule of Nines**

Only includes partial and full-thickness burns

Body Part	Front	Back	Total
Head	9%	9%	18%
Neck	3%	3%	6%
Arm (each)	9%	9%	18%
Leg (each)	14%	14%	28%
Perineum	1%	1%	2%
Total	46%	46%	92%

Percent TBSA Scald Burn?



6 month old female with scald burns from soup
Initial burn estimation prior to transport 24% TBSA

Extremity Burns

- ED Treatment:
 - **Maximal elevation**
 - Surgical Escharotomy
- What to transfer:
 - Deep PT/FT
 - Large area
 - Extensive swelling
 - Late presentation
 - Suspected abuse

Classification of Burn Injury

- Superficial (1st Degree)
- Superficial Partial Thickness (2nd Degree)
- Deep Partial Thickness (2nd Degree)
- Full Thickness (3rd Degree)
- Subdermal (4th Degree)

Superficial Burns

- Involves epidermis only – classic sunburn
- Appearance-
 - Erythematous
 - Dry
 - No blistering
- Extremely painful
- Healing 2-5 days without scarring

Superficial Partial Thickness Burns

- Involves epidermis and portion of dermis
- Appearance
 - Pink or mottled red
 - Moist with blistering
 - Good capillary refill
- Very painful
- Healing 5-21 days
- No surgical intervention

Deep Partial Thickness Burns

- Involve epidermis and most of dermis
- Appearance-
 - More mottled with a white waxy haze
- Somewhat painful
- Healing 21-35 days
- Possible surgical intervention

Full Thickness Burns

- Involves epidermis, dermis, and subcutaneous tissue
- Appearance-
 - Mixed white, cherry red, brown
 - Black/charred
 - Dry, leathery
- Painless due to nerve destruction
- Surgical intervention necessary

Mechanism of Burn Injury

- Scald
- Flame
- Contact
- Chemical
- Electrical
- Friction (abrasion)

Scald Injury

- Most common burn in children < 2 years old
- Causes
 - Tap water
 - Steam
 - Hot liquids
 - Intentional Immersion

Flame Injury

- 2nd most common cause of pediatric burns
- Causes
 - Housefires
 - Clothing Ignition
 - Flammable Liquids
 - Match/Lighter Play

Contact Burns

- Common in toddlers
- Causes
 - Hot surfaces
 - Tar
 - Grease
 - Molten Metals

Chemical Injury

- Toddlers
- Work related injury
- Causes
 - Contact with caustic substances
 - Household and industrial chemicals

Chemical Injury

- Tissue damage will continue until the chemical is removed or inactivated
- Tissue damage is dependent upon:
 - Strength or concentration
 - Quantity
 - Duration of Contact
 - Extent of Penetration (acid vs. alkali)
 - Mechanism of Action
- **Copious irrigation with clean water**

Electrical Injury

- Toddlers & Adolescents
- Work related injury
- Causes
 - Electric cords/outlets
 - High Tension Wires
- Types
 - Electrical Injury
 - Arc/ Flash Burn

Electrical Injury

- Low Voltage (<1000 volts)
 - Mimic thermal burns
 - Injury extending from the surface into the tissues (home injuries 110-220 volts)
- High Voltage (>1000 volts)
 - Both surface burns and areas of hidden destruction of deep tissue and structures (power lines, industrial)

Electrical Injury Low-Voltage Injury

- Burns are usually localized to point of contact or incandescent effect on metal jewelry
- 24 hour cardiac monitoring needed if:
 - Documented cardiac arrest
 - Cardiac arrhythmia on transport or in ED
 - Abnormal EKG in ED (other than sinus brady- or tachycardia)
 - Necessary for burn size/patient age

Initial Burn Wound Management

- Arrest the burning process
- Cool the burn
 - Advantages: dissipation of heat
 - Stabilization of mast cells to decrease histamine release and therefore decrease edema
 - Decrease in pain
- **NO ICE!!!**
- Limited cool compresses
- Remove clothing and jewelry, unless adherent/melted to burn wound

Wound Management

- Analgesia
- Sedation
- Cleansing
 - Mild soap and clean tap water, sterile water or saline
- Mechanical debridement
 - Moist gauze, scissors/forceps
- Topical agents
- Prophylactic systemic antibiotics not effective

Blister Management

- Small, unruptured → leave alone
 - Large, tense or flaccid → debride
 - Possible deep burn → debride
 - Volar palm → debride if obstructing finger movement
- **If wound is going to heal and blisters likely to stay intact, then leaving them alone = less pain, easier care
- **If blisters likely to rupture, debridement and dressings = less infection risk, cleaner healing

Dressings for Superficial and Partial Thickness Burns

- Objective; To assess the effects of burn wound dressings
- Methods; Cochrane review
- Results
 - 26 randomized studies, most with poor methods
 - Number of products appear to have benefits over others
- Conclusion; paucity of high quality RCTs, methodological shortcomings, limited evidence to assist clinician in choosing

Wasiak et al, Inter Emerg Med, 2009

Topical Agents

- Silver Sulfadiazine
- Mafenide Acetate
- Proteolytic agents
- Bacitracin ointment
- Silver coated barrier dressings
 - Acticoat®
 - Mepilex Ag®

Mafenide Acetate (Sulfamylon®)

- Water-soluble cream base
- Broad spectrum
- Minimal antifungal activity
- Excellent eschar penetration
- Carbonic anhydrase inhibitor
 - Hyperchloremic metabolic acidosis
 - Hyperventilation
- Current use/ED use
- Cartilage

Enzymatic Debridement

- Proteolytic enzymatic agents
 - Proteases; Bacillus subtilus, Collagenase®
- Acceptance –large burns
- Potential disadvantages
- Potential advantages

Mepilex Ag®

- Absorbent silicone foam with impregnated silver (Molnycke Health Care)
- Anti-microbial properties
- Stays in place well
- Absorbs wound drainage
- May be left in place for up to 7 days
- ED use
 - Pros/cons

Porcine Xenograft

- Porcine dermis
- Provides temporary wound closure
- Substantially reduces/narcotic use
- Limits evaporative loss/metabolic derangements
- Adheres to wound until healed, separates
- ED use
 - Pros/Cons

Aquacel Ag®

- Synthetic hydrofiber- silver impregnated
- Antimicrobial properties
- Forms a cooling gel-like substance
- Adherence/separation
- Length of use
- ED use
 - Pros/cons

Randomized Clinical Study of Hydrofiber Dressing With Silver or Silver Sulfadiazine in the Management of Partial-Thickness Burns

- Multicenter, prospective trial
- 84 patients, children and adults
- 5 to 40% TBSA burns
- Aquacel Ag: less pain/anxiety, less burning/stinging, fewer dressing changes, fewer procedural medications, less nursing time, lower total treatment costs
- Silvadene: greater flexibility and ease of movement

Caruso DM et al. J Burn Care Res 2006

American Burn Association Transfer Criteria

- >10%TBSA partial thickness burn
- Full-thickness burns in any age group
- Special Care areas: face, hands, feet, genitalia, perineum, or major joints
- Inhalation injury, Electrical injury, Chemical injury
- Suspected child abuse
- Pre-existing medical disorders
 - Complicate management, prolong recovery, affect mortality
- Burn injury in patients who will require special social, emotional, or rehabilitative intervention

Guidelines for the Operation of Burn Centers, Resources for Optimal Care of the Injured Patient, Committee on Trauma, American College of Surgeons, 2006

Conditions for Ambulatory Care

- Percentage guidelines
- No fluid resuscitation
- Adequate pain control
- Wound care arrangement completed
- Adequate follow-up
- No social risk factors

Take Home Tips

- ABCDE's
- Assess the burn/stop the burn
- Not just silver sulfadiazine or bacitracin anymore!
- Variety of advanced products for burn management
 - Doctor/parent/child friendly
- Work with burn surgeon

References/Suggested Reading

American Burn Association, National Burn Repository © 2006. Version 2.0

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