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Update on Burn Care and Resuscitation

Objectives

- Identify the components for initial evaluation of a burn victim
- Be able to estimate surface area involved
- Distinguish the different depths of burn injury
- Understand the American Burn Association criteria for referral to a burn unit.

Financial disclosure

- None
Topics to be covered

- Burn epidemiology and outcomes
- Initial evaluation and management
- Burn injury classification
  - Burn type
  - Burn size
  - Burn depth
- Resuscitation
- Wound care

Burn Epidemiology and Outcomes

Burn Epidemiology
World Wide

- Millions of people are burned each year
- 1/3 of these are in children
- Greater than 80% of these burns are preventable
- More than 200,000 die of their injuries each year

Burn Epidemiology
United States

- Burn injuries receiving medical treatment: 450,000 per year
- Fire and burn death: 3,400 per year
- Patients hospitalized: 40,000 total with 30,000 in burn centers

American Burn Association, 2013
Burn Centers

- 127 burn centers with about 1700 beds, admitting an average of 200 patients per year.
- Other 4500 hospitals each admit 3 per year
- Oregon Burn Center admits close to 300 patients with burn or skin disorders.

What Are the Causes?

- Majority of burn injuries are caused by:
  - Lack of knowledge
  - Poor judgment
  - Very few are true accidents
Causes of death from major burn injuries:

- Early
  - Burn shock
  - Failure of resuscitation
- Delayed
  - Wound sepsis
  - Multi-organ failure
  - Respiratory insufficiency

Historical Perspective

- Burns a depressing field until the later part of 20th century
- Percent of total body surface area burn for expected 50% mortality (1952)

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Effects of burn injury

- Early
  - Pain
  - Major illness
- Prolonged hospitalization
- Delayed
  - Long recovery
  - Disfigurement, and loss of function
  - Psycho-social impact

Burn Impact; Morbidity

Initial Evaluation

First
- Forget the skin
- Do not get overwhelmed by the looks or the smell of the burn
- Think systematically and remain objective

Next do the Primary Survey
- Airway
- Breathing
- Circulation
- Disability
- Exposure

Airway
- Evaluate
- Control for
  - Unstable victim, Inhalation injury, large burn, ……
  - Protect the cervical spine
- Oral tracheal intubation is preferred.
- Largest appropriate endo-tracheal tube that can be safely inserted should be used
Initial Evaluation

**Breathing**
- Listen
- Administer high flow oxygen
- Monitor quality and depth of breathing

**Circulation**
- Evaluate blood pressure and pulse
- Establish IV access
  - Two large bore IV in unburned areas
  - Intra osseous OK but be aware.

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Intra- osseous Infusion

**Disability**-If not alert and oriented consider;
- Associated Injuries?
- CO poisoning?
- Substance abuse?
- Hypoxia?
- Pre-existing medical condition
Initial Evaluation

- **Exposure**
  - Remove all clothing and jewelry
  - Keep patient warm
    - Warm room
    - Keep patient covered; dry sheets, blankets
    - Warm IV fluids

Secondary Survey

- After resuscitation efforts are well established.
- Do a head-to-toe evaluation
- Obtain history & physical exam.
- Radiographic & laboratory studies

Get Information

- Gather and record as much information as possible
  - Patient
  - Family
  - First responders
  - Transport team

Burn Evaluation

- Classify the type of burn injury
- Estimate the extent of burn injury
- Estimate the depth of burn injury
ABA Transfer Criteria

- 2nd degree burns > 10%
- Burns to hands, face, feet, genitals, major joints
- 3rd degree burns
- Electrical burns
- Chemical burns
- Inhalation injuries
- Burns with pre-existing medical condition
- Burns accompanied by trauma where the burn is the greater risk to life
- Burns to children in hospitals without pediatric services
- Patients with special social, emotional or rehabilitative needs

Types of Burn Injury

- Thermal
- Electrical
- Chemical
- Inhalation

Flame Burn
Scald Burn

Contact burns

Electrical Burns

Chemical Burns

Nitric acid

Hydrofluoric Acid

Alkali
Frost bite

Flame Facial Burn

5 Hours Later

Depth of Burn Injury

Burn Depth

- Superficial
- Partial thickness
- Full thickness
- Deep into underlying tissue
Your Skin--It's Got You Covered!

Superficial Burn

- Intact skin
- Red appearance
- Painful
- Burn depth within epidermis
- Usually heals in 5-10 days

Partial Thickness Burn

- Burn through the epidermis and into the dermis
- Blistered but this may be delayed
- Loose or sloughed epidermis
- Moist, red to non-blanching and white appearance
- Subcutaneous edema may be present
Partial Thickness Burn

Full Thickness Burn

- Burned through epidermis, dermis, and subcutaneous tissue
- Dry appearance
- May be red, white, black, or brown in color
- Leathery in appearance

Full Thickness Burn
Burn Beyond Skin

- Burned through epidermis, dermis, subcutaneous tissue, muscle, and bone
- Charred appearance
- May appear cracked
- Immobility of area

Extent of Injury Estimation
Burn Size Estimation

Lund and Browder
Developed their burn diagram in 1944
SG&O 1944; 79:352
Knaysi proposed the rule of nine
NY presentation 1967

Burn Size Estimation, What Is New?

- Computerized estimation systems
  - Sage II provides reproducible age-specific burn diagram
    - [www.sagediagram.com](http://www.sagediagram.com)
  - 3-D Burn Vision provides a three dimensional rotating model
    - [Electric power research institute, concord CA](http://electricpowerresearchinstitute.org)
  - Surface laser scanning

Inhalation Injury

- Present in >20% of burn victims with flame burns.
- Causes
  - Hot air or steam upper airway burn
  - Carbon monoxide (CO)
  - Toxic substances, and smoke particles
- Increases
  - ICU stay
  - Fluid resuscitation requirement (2x)
  - Mortality (2X)

Treatment of Burns
Inhalation Injury Diagnosis

- **History:**
  - Closed space injury
  - Obtunded patient at the scene
  - Suspected inhalation of steam or smoke
- **Exam:**
  - Facial burns, sooth on face and airway
  - Singed hair
  - Hoarseness or wheezing

- **Findings:**
  - Early
    - Upper airway edema
    - Bronchospasm
  - Late
    - Sloughed endobronchial lining
    - Small airway obstruction
    - Alveolar flooding
    - Pulmonary fibrosis

- **Tests**
  - Bronchoscopy
  - Bronchoalveolar lavage
  - Xenon-133 or t-99 scanning

- **Labs:**
  - Carboxyhemoglobin level
  - Pao2/fio2
  - A-a gradient
  - PFT

- **None can predict clinical course**

Inhalation Injury Treatment

- **Chemical**
  - Ketorolac, surfactant
  - Perflubron liquid ventilation
  - Dimethyl sulfoxide
  - Heparin, Antithrombine III, nitric oxide

- **Mechanical**
  - Prone positioning
  - Percussive, and oscillatory ventilation
  - ECMO
  - Low volume pressure controlled ventilation

**Supportive Care**
Volumetric Diffusive Respirator (VDR)

Resuscitation

- Burn shock is hypovolemic and cardiogenic
  - Decreased Cardiac output up to 24 hrs.
  - Extra cellular fluid reduction due to leak from injured skin
  - Total body capillary permeability with max edema 8-24 hr. post injury,
  - Decreased plasma volume
  - Many mediators implicated including histamine and bradykinin

Resuscitation

- Goals
  - Initial assessment and stabilization
  - Replace the lost intravascular volume with crystalloid
  - Maintain adequate tissue perfusion and organ function
  - Minimize complications from organ failure and over-resuscitation
Under Resuscitation

- Will lead to increase fluid needs to catch up
- Organ dysfunction
  - Renal failure
  - Burn injury progression and wound conversion

Resuscitation History

- Baxter and Shires proposed the Parkland formula
- Interstitial and intracellular edema
- Disruption of NA-K pump
  - *Ann NY Acad Sci* 1968;150:874
- \(2-4 \text{ ml L.R} \times \text{TBSA(%)} \times \text{ weight (kg)} \times 2 \times 8\)
- Short version \(\text{TBSA(%)} \times \text{ weight (kg)} \times 4\)

Resuscitation Goal

- Maintain tissue perfusion and organ function while avoiding inadequate or excessive fluid therapy
Over Resuscitation

- Pulmonary edema and respiratory failure
- Body edema, organ dysfunction
  - Gut dysmotility
  - Compartment syndromes

Abdominal Compartment Syndrome

- Also known as intra-abdominal hypertension
- A constellation consisting of cardiovascular, pulmonary, and renal compromise produced by increased intra-abdominal pressure

Definition
- Pressure >25 mmHg
- Tense abdomen
- Decreased pulmonary compliance
- Oliguria

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Resuscitation Fluids

- Crystalloid
  - LR most common
  - Majority of patients need more than what is calculated by the formula
    - Saffle et al J am Coll Surg 2003;196(2):267

- Hypertonic saline
  - Complicated
  - May reduce volume of resuscitation
  - No consensus on the osmolarity of the solution
  - Higher mortality in some studies

Resuscitation Fluids

- Albumin
  - Three schools
    - 1. Should not be used because it leaks and makes edema worse
    - 2. Should be given from the beginning
    - 3. Should be given 8-12 hrs post burn
  - Albumin is used by majority of burn surgeons in 8-12 hours in large burns
    - Sheridan RL, Crit care med 2002;30(11):z300

- Dextran
  - Guarded initial favorable results
Resuscitation Fluids

- The debate goes on
  - Which formula
  - Which fluid, or combination of fluids
- As both under resuscitation and over resuscitation are detrimental to patient, continuous titration of volume must be made according to the patient’s clinical response.

Indication for Resuscitation

- Burn injury less than 10% body surface
  - Oral fluids should be adequate
- Burn injury 10%-15%
  - Oral fluids plus maintenance intravenous fluids should be given
- Burn injury >15%
  - Intravenous fluid resuscitation should be initiate

Resuscitation
American Burn Association Practice Guidelines, 2008

- Fluid resuscitation, regardless of solution type or estimated need, should be titrated to maintain a urine output
  - 0.5–1.0 mL/kg/h in adults
  - 1.0–1.5 mL/kg/h in children
- Increased volume requirements can be anticipated in patients with full-thickness injuries, inhalation injury, and a delay in resuscitation
- Hypertonic saline should be reserved to providers experienced in this approach.
- Plasma sodium concentrations should be closely monitored to avoid excessive hypernatremia.
- Option: the addition of colloid-containing fluid following burn injury, especially after the first 12 to 24 hours post burn may decrease overall fluid requirements.

Blisters; To Remove or Not to Remove!

- To remove
  - The fluid has pro-inflammatory metabolites
  - It adversely affects neutrophil chemotaxis
  - May provide a medium of growth for bacteria
  - Tense blisters may impair movement
- Not to remove
  - Covered dermis less painful
  - Intact blisters rarely get infected
- No consensus in management

Burn Wound Dressing

- Characteristics of a good dressing
  - Well tolerated
  - Allows drainage
  - Barrier against environment
  - Does not allow drying and desiccation
  - Easy to remove
  - Simple
  - Inexpensive

Common topical agents and dressings

- Petroleum gauze
- Bacitracin zinc / double antibiotic ointment
- Xeroform
- Silver sulfadiazine (Silvadene)
- Mafenide Acetate

Silver Sulfadiazine (Silvadene)
Wound Care

- Superficial burn
  - Lotion or Bacitracin applied frequently
- Partial thickness and deeper burns
  - Bacitracin – Xeroform especially on the face
  - SSD – gauze all areas except face

Wound Care

- Large surface area burns
  - Cover with dry dressing
  - Prevent hypothermia
  - Transfer to emergency room / burn unit

Topical Agents; What Is New?
Topical Agents; What Is New?

Silver

- Acticoat (Smith and Nephew)
- Silver nanocrystal technology
- Releases silver ions when moistened
- Pain less and may reduce pain
- Very good spectrum of activity
- Can be left for 3-7 days

Mepilex Ag (Molnlycke)
- Foam dressing with Safetac®, silicone technology
- Minimizes pain at dressing changes
- Rapid and sustained antimicrobial activity
- Gentle adherence, conformable and soft
- Does not slip under dressing retention and can be cut to size

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Other silver containing dressings
- Acticoat Flex, Mepitel Ag
- Silvasorb & Arglaes (Medline)
- Actisorb (Johnson & Johnson)
- Silverlon (Argentum)
Topical Agents; What Is New?

- Honey
  - The high osmotic promotes outflow of wound fluid
  - Helps soften and liquefy necrotic tissue
  - Aids in autolytic
  - Low pH

Multidisciplinary Team

- Physicians, residents, Students and NP’s
- Nurses
- Physical and Occupational therapy
- Pharmacy/Dietitian
- Social Worker/Chaplain services
- Rehabilitation and Psychology
- Child life and art therapy

Burn Care

- Other important factors
  - Nutritional support and modification of hypermetabolism
  - Pain and anxiety management
  - Scar management
  - Therapy
  - Reconstruction and rehabilitation
  - Funding and work force issues

Summary

- Evaluate, stabilize, resuscitate, Use LR
- Call when you need us
- Easy dressings, keep warm
OBC
503- 413- 4232
888- 598- 4232