Burn Injuries

Dr. Thuc The Bach
Dr. Melanie Walker
Huntington Memorial Hospital
Pasadena, California

Basic Demographics

- Hard to estimate statistics for Vietnam
- 2 million burns require medical attention each year in the USA

Basic demographics

- 14,000 deaths
- Most deaths are due to smoke inhalation
- House fires responsible for 50% of deaths

Anatomy and Physiology of Skin

- Skin is the largest organ of the body
  - 0.25 m^2 in children
  - 1.8 m^2 in adults
- It is also the most exposed organ

Skin Layers

- Epidermis
  - Tough protective barrier
- Dermis
  - Contains blood vessels, nerve endings
  - Prevents water loss due to evaporation
  - Prevents loss of body heat

Functions of Skin

- Protection Heat regulation
- Sensory perception
- Excretion
- Vitamin D production
- Expression
  - important with body image
  - fear of disfigurement

Depth of Burns

- May be difficult to determine
- In some cases, may not be known until after healing has occurred

Traditional Classification

- 1st degree
- 2nd degree
- 3rd degree

Traditional Classification

Criteria	2nd Degree	3rd Degree
Cause	Hot liquid Flame	Flame Electricity Chemicals
Color	Pink or red	Dark brown Black Charred
Surface	Vesicles	Dry Inelastic
Pinprick	Painful	Anesthetic

Alternative Classification

- Partial Thickness
  - Superficial
  - Deep
- Full thickness

Partial Thickness

- Characterized by varying depth from epidermis (outer layer of skin) to the dermis (middle layer of skin)
  - Superficial - includes only the epidermis
  - Deep - involve entire epidermis and part of the dermis
  - Generally heals spontaneously

Full Thickness

- Includes destruction of epidermis and the entire dermis as well as possible damage to the SQ, muscle and bone
  - Requires skin graft

Determining Severity of Injury

- Size (surface area)
- Depth
- Age
- Prior status of health of victim
- Location of burn
- Severity of associated injury

Pathology of Burns

- Burns will cause rapid loss of intravascular fluid and protein
- Volume loss is greatest in first 6-8 hours

Metabolic Response to Burns

As with any other major injury:

- Body ↑ secretions of catecholamine, cortisone, ADH, aldosterone and glucagon
- Profound hypermetabolic state that requires excess nutrients and oxygen
- Evaporative water loss from burn wounds may reach 300 cc/m^2/h (normal = 15)
- Heat loss may reach 580 Kcal/hour

Fighting the Metabolic Response

- Aggressive nutritional support
- Rapid wound closure
- Control pain and stress
- Prevent sepsis

Hypovolemic State: First 48°

- Rapid fluid shifts
- Capillary permeability with burns increases with vasodilation
- Fluid loss deep in wounds
- Metabolic acidosis
- Protein loss
- Hemoconcentration - Hct increases
- Low blood volume, oliguria
- Hyponatremia
- ↓ K -- damaged cells release K

Diuretic Phase: 48-72° After Injury

- Capillary membrane integrity returns
- Edema fluid shifts back into vessels - blood volume increases
- Hemodilution - low Hct, decreased potassium as it moves back into the cell or is excreted in urine with the diuresis
- Fluid overload can occur due to increased intravascular volume
- Metabolic acidosis - HCO3 loss in urine, increase in fat metabolism
- Increase in renal blood flow - result in diuresis (unless renal damage)

General Indications for Fluid Resuscitation

- Burns > 20% of BSA with adults
- Burns > 10% of BSA with children
- Age > 65 or < 2

Acute Resuscitation

- Airway
- Breathing
- Circulation
- Analgesia

Acute Resuscitation

- Assessment:
- Objective
  - how burn occurred, when
  - Duration
  - type of agent
- Subjective:
  - previous medical problems
  - size and depth of burn
  - age
  - body part involved
  - mechanism of injury

Acute Resuscitation

- Ventilation
- Esharotomy
- Establish IV access with large bore IV catheters
- Foley catheter
- Nasogastric tube
- Routine labs (blood count, electrolytes)

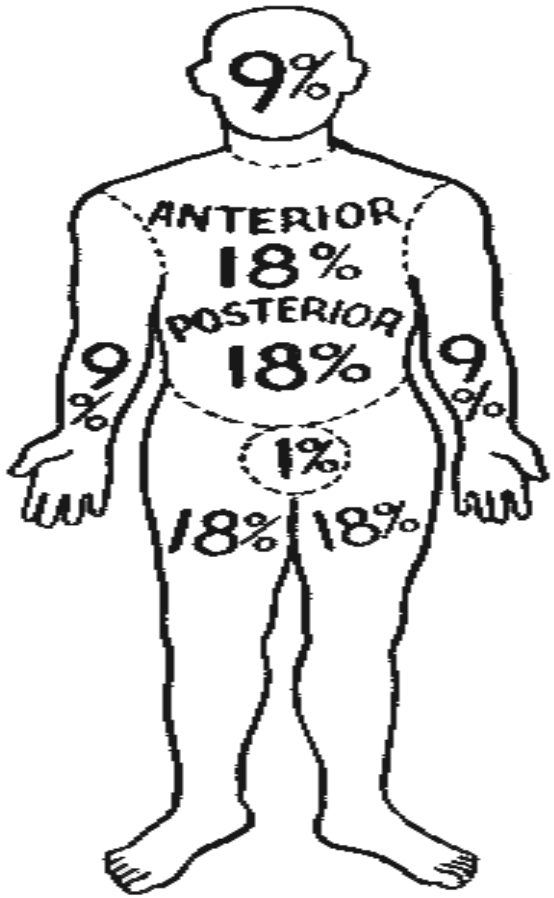
Acute Resuscitation

- Replace fluid loss with large amount of crystalloid
  - 3-4 cc/kg of body weight PER % burns
- Carefully observe:
  - Urine output
  - State of consciousness
  - Blood pressure

Parkland Formula

- First 24°:
  - 4 mL Lactated Ringer's X weight in kg X % total body surface area burned
- 50% of fluid in first 8°
- 50% over next 16°
- Keep urinary output .5 – 1 mL/kg/°

Rule of 9: Estimating % Burns



Signs of Adequate Fluid Resuscitation

- Clear sensorium
- Pulse < 120 beats per minute
- Urine output for adults 30 - 50 cc/hour
- Systolic blood pressure > 100 mm Hg
- Blood pH within normal range 7.35 - 7.45

Acute Resuscitation: Crystalloids

- Isotonic
  - most common are lactated Ringers or NaCl (0.9%)
  - these do not generate a difference in osmotic pressure between the intravascular and interstitial spaces
  - subsequently LARGE amounts of fluid are required

Acute Resuscitation: Crystalloids

- Hypertonic salt solutions
  - create an osmotic pull of fluid from the interstitial space back to the depleted intravascular space
  - helps decrease the amount of fluid needed during resuscitation
  - decreases the development of edema, pulmonary edema, and CHF

Acute Resuscitation: Colloids

- Replacement begins during the second 24° following the burn to replace intravascular volume
- Once capillary permeability significantly decreases

Post-Resuscitation Period: The Second 24 Hours

- IV fluid should consist of glucose in water and plasma to maintain adequate circulating volume
- Calorie and protein needs may be twice normal
  - Oral feeding if possible
  - Parenteral (IV) feeding may be necessary

Post-Resuscitation Period

- Antibiotic use is controversial
- Vitamin C
- Vitamin A

Wound Care Principals

- Goals
  - close wound
  - prevent infection
  - reduce scarring and contractures
  - provide for comfort
- Wound cleaning
- Debridement
  - mechanical
  - surgical
- Topical antibacterial therapy

Topical Antibacterial Agents

- Silvadene cream
  - Transient leukopenia
- Sulfamyalon
  - Metabolic acidosis
  - Pain
- Silver nitrate
  - Water toxicity

Dressing the Burn: Open Technique

- Partial thickness
  - exudate dries in 48 to 72 hours forming a hard crust
  - epithelialization occurs beneath the crust and may take 14 to 21 days to heal
  - crust then falls off spontaneously
- Full thickness
  - dead skin is dehydrated and converted to black leathery escar in 48 to 72 hours
  - loose escar is gradually removed

Dressing the Burn: Closed Technique

- Wound is washed and sterile dressings changed each shift or daily
- Dressing consists of gauze wraps and ointments if available

Dressing the Burn: Semi-Open Technique

- Consists of covering the wound with topical antimicrobial agents and gauze
- Advantages:
  - speeds debridement
  - develops granulation tissues faster
  - makes skin grafting possible sooner

Biological Dressings

- Homografts
  - same species (cadaver skin)
  - temporary coverage
- Heterografts
  - another species (pig skin)
  - temporary coverage
- Autografts
  - patients own skin
  - permanent coverage

Wound Care: Grafting

- Indications for grafting
  - full thickness burns
  - priority areas
  - wound bed pink, firm, free of exudate
  - bacterial count < 100,000/gram of tissue
- Care of grafts - assess

Rehabilitation

- Care of healing skin
  - Wash daily
  - Keep clean and dry
- Pressure garments
  - Prevent scaring and contractures
- Promote mobility

Inhalation Injuries

- Major cause of death from burn injury
- Direct inhalation of dry heat cause
  - Burn injury of upper airway
  - Rarely occurs below the level of the vocal cords
- Treatment
  - Endotracheal intubation
  - Tracheostomy

Inhalation Injury: Carbon Monoxide

- Should be considered when accident occurs in a closed space
- Symptoms
  - Headache
  - Confusion, Hallucination
  - Mild dyspnea
  - Coma
- Treatment
  - 100% oxygen