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

<table>
<thead>
<tr>
<th>Criteria</th>
<th>2(^{\text{nd}}) Degree</th>
<th>3(^{\text{rd}}) Degree</th>
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<tbody>
<tr>
<td>Cause</td>
<td>Hot liquid</td>
<td>Flame</td>
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<tr>
<td></td>
<td>Flame</td>
<td>Electricity</td>
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<td>Chemicals</td>
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<td>Color</td>
<td>Pink or red</td>
<td>Dark brown</td>
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<td>Black</td>
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<td>Surface</td>
<td>Vesicles</td>
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<td>Inelastic</td>
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<td>Pinprick</td>
<td>Painful</td>
<td>Anesthetic</td>
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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
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/m²/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
- $\downarrow$ 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
- Sulfamyxalon
  - 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