Burns

Medical Academy named after S.I. Georgievsky of Vernadsky CFU

General Surgery Department

Frequency

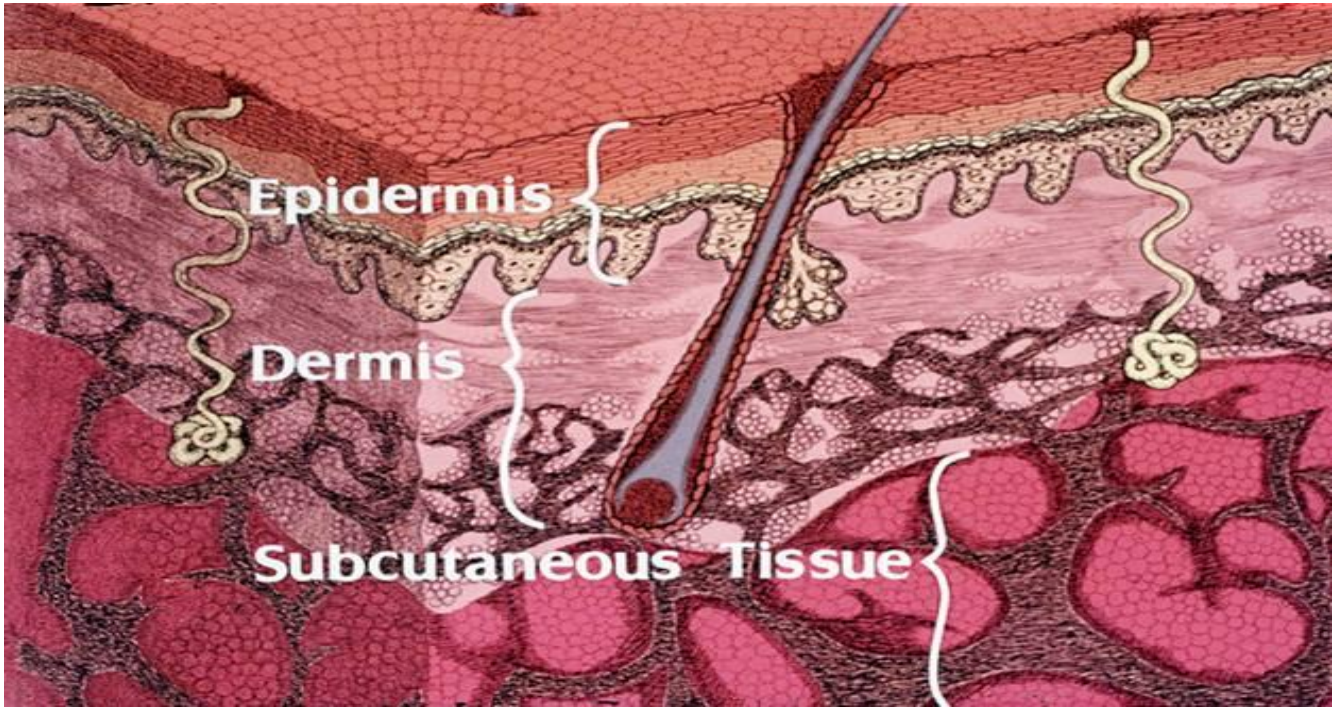
- **67% occur in males**
  - **Young adults (20-29 yr)**
  - **Children < 9 years of age**
  - **> 50 years of age fewest of serious burns**
- **Major causes of burns**
  - **Flame (37%)**
  - **Liquid (24%)**
  - **Children < 2 years of age**
    - **Liquids/hot surfaces**
- **5% die as a result of their**

INCIDENCE

- Approx. one million burn patients/annually in the United States
- 3-5% cases are life-threatening
- 60,000 hospitalized / 5,000 die
- Fires are the 5th most common cause of death from unintentional injury
- Deaths are highest among children < 5 yr. and adults > 65 yr.

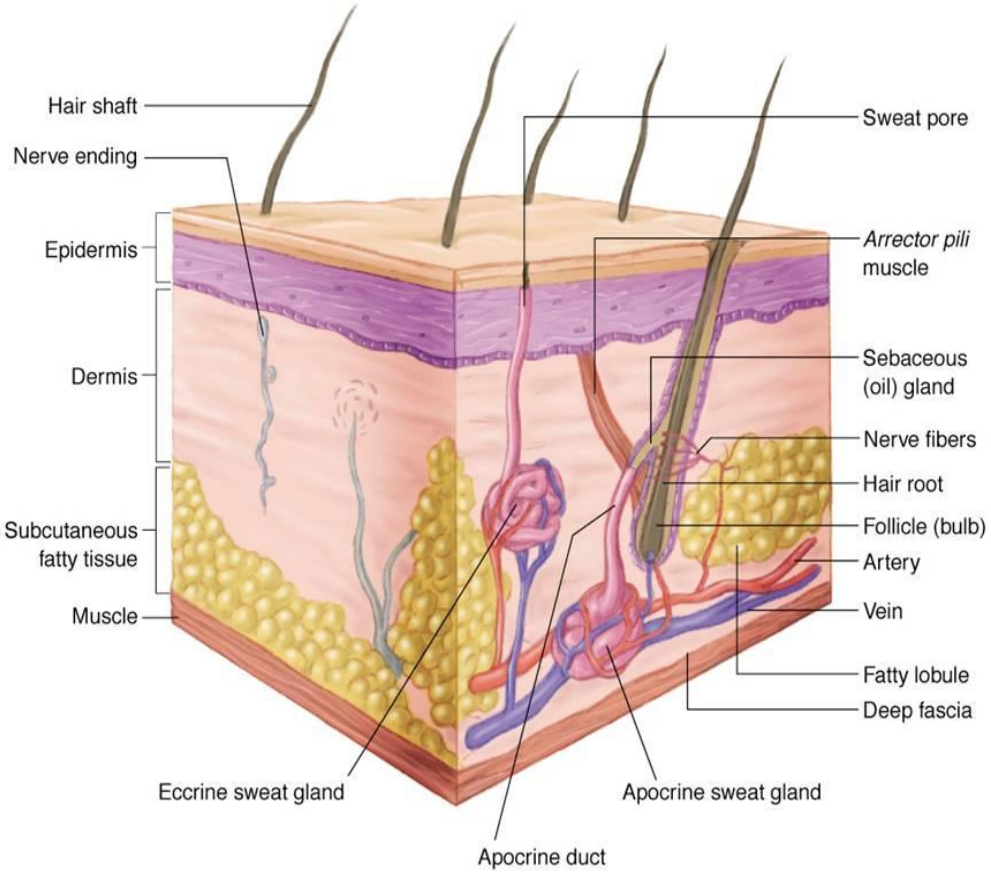
Functions

- Skin is the largest organ of the body 1,5—2 м^2
- Essential for:
  - Thermoregulation
  - Prevention of fluid loss by evaporation
  - Barrier against infection
  - Protection against environment provided by sensory information



Skin Anatomy and Function

- **Largest organ**
- **3 major tissue layers**
  - **Epidermis**
    - **Outermost layer**
  - **Dermis**
    - **Below epidermis**
    - **Vascular and nerves**
    - **Thickness**
      - **1-4mm (varies)**
  - **Subcutaneous tissue**
    - **Hair follicles**



Types of burn injuries

- Thermal: direct contact with heat (flame, scald, contact)
- Electrical
  A.C. – alternating current (residential)
  D.C. – direct current (industrial/lightening)
- Chemical
- Frostbite

Classification

- Burns are classified by depth, type and extent of injury
- Every aspect of burn treatment depends on assessment of the depth and extent

First degree burn

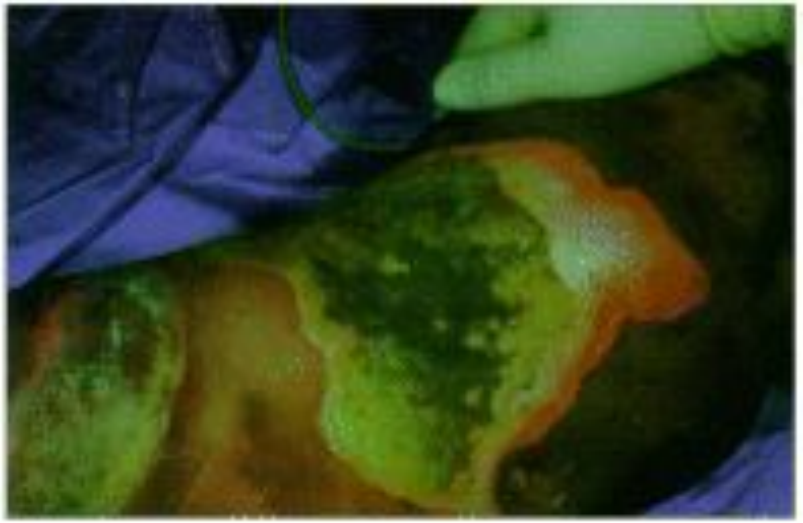
- Involves only the epidermis
- Tissue will blanch with pressure
- Tissue is erythematous and often painful
- Involves minimal tissu damage
- Sunburn

Second degree burn

- Referred to as partial-thickness burns
- Involve the epidermis and portions of the dermis
- Often involve other structures such as sweat glands, hair follicles, etc.
- Blisters and very painful
- Edema and decreased blood flow in tissue can convert to a full-thickness burn

Third degree burn

- Referred to as full-thickness burns
- Charred skin or translucent white color
- Coagulated vessels visible
- Area insensate – patient still c/o pain from surrounding second degree burn area
- Complete destruction of tissue and structures

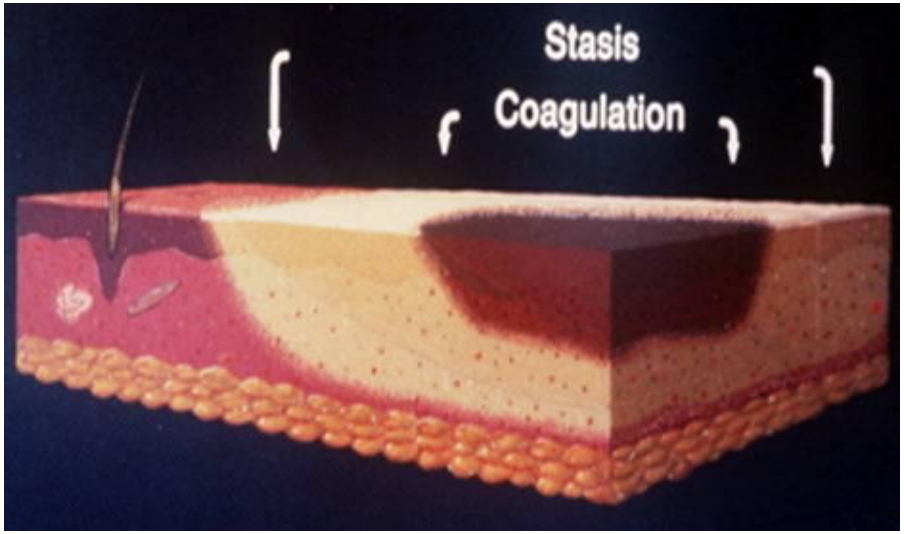


Fourth degree burn

- Involves subcutaneous tissue, tendons and bone

Zones of Burn Wounds

- Zone of Coagulation
  - devitalized, necrotic, white, no circulation
- Zone of Stasis 'circulation sluggish'
  - may covert to full thickness, mottled red
- Zone of Hyperemia
  - outer rim, good blood flow, red



Burn extent

% BSA involved ↑ morbidity ↑

Burn extent is calculated only on individuals with second and third degree burns

Palmar surface = 1% of the BSA

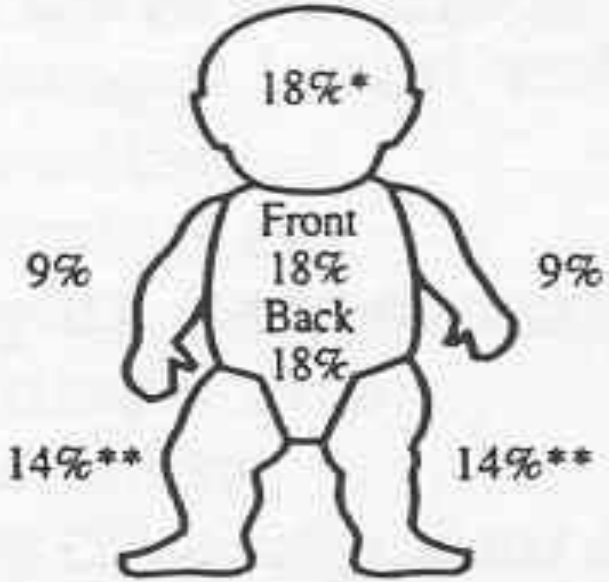
Measurement charts

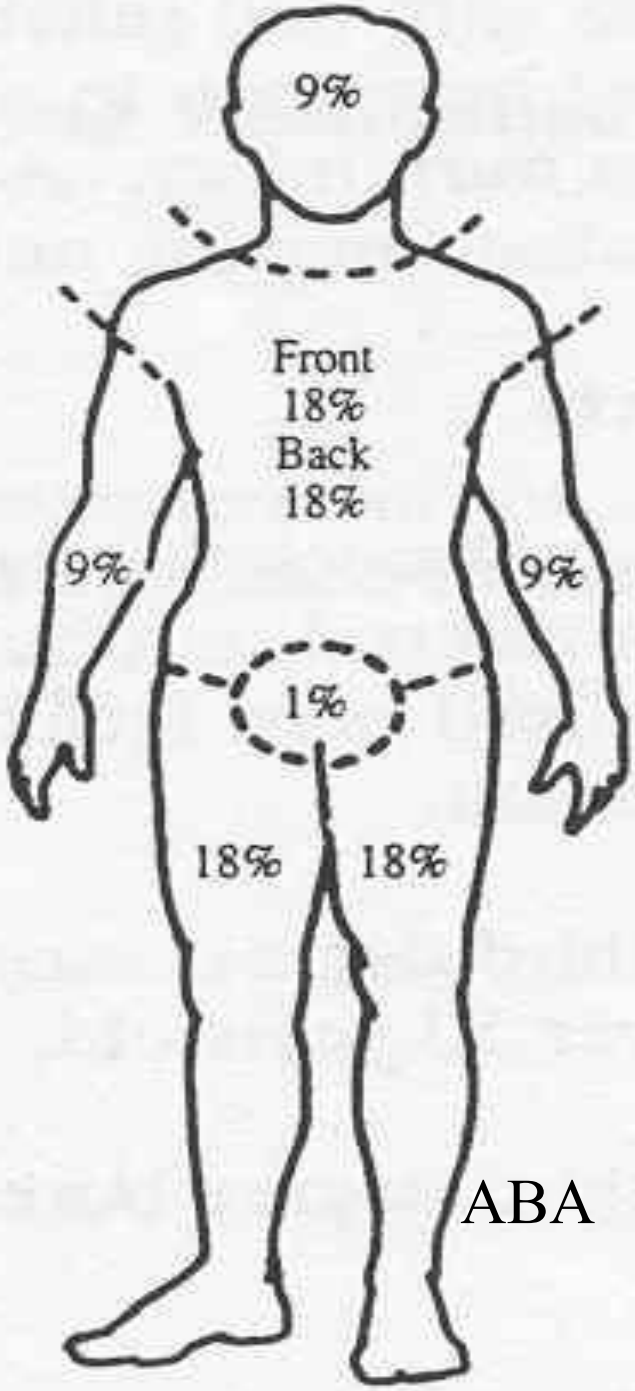
- **Rule of Nines:**
  Quick estimate of percent of burn

- **Rule of Palms:**
  Good for estimating small patches of burn wound

RULE OF 9's

(For calculating percentage of body burned)

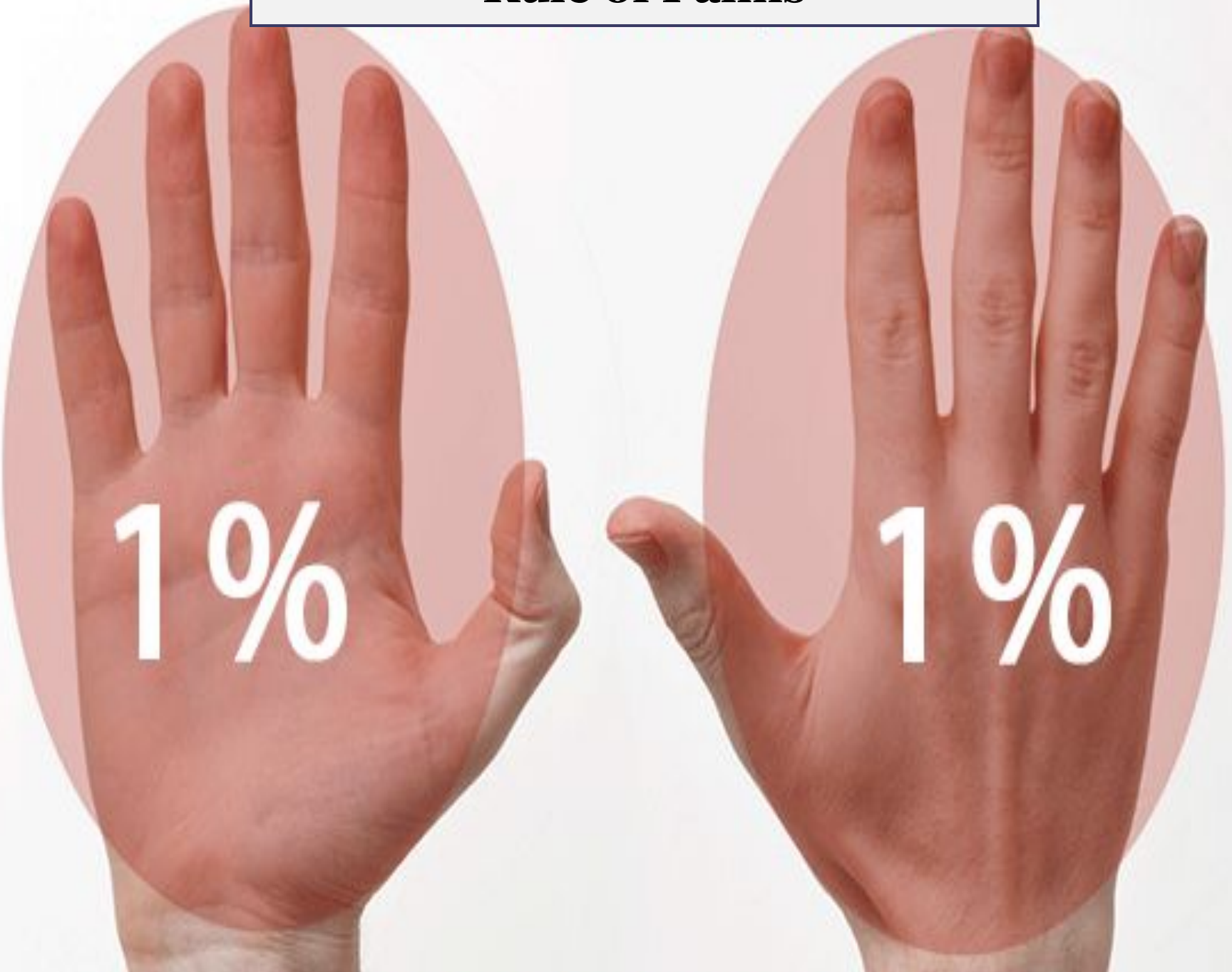




*Subtract 1% from head for each year over one year of age.
**Add 1/2% to each leg for each year over one year of age.

ABA

Rule of Palms



Lab studies

Severe burns:

- CBC
- Chemistry profile
- Coagulation profile
- creatine phosphokinase and urine myoglobin (with electrical injuries)
- 12 Lead EKG

Examination by doctors

Imaging studies

- X-Ray
- Plain Films / CT scan: Dependent upon history and physical findings

Criteria for burn center admission

- **Full-thickness > 5% BSA**
- **Partial-thickness > 10% BSA**
- **Any full-thickness or partial-thickness burn involving critical areas (face, hands, feet, genitals, perineum, skin over major joint)**
- **Children with severe burns**
- **Circumferential burns of thorax or extremities**
- **Significant chemical injury, electrical burns, lightening injury, co-existing major trauma or significant pre-existing medical conditions**
- **Presence of inhalation injury**

Initial patient treatment

- Stop the burning process
- Consider burn patient as a multiple trauma patient until determined otherwise
- Perform ABCDE assessment
- Avoid hypothermia!
- Remove constricting clothing and jewelry

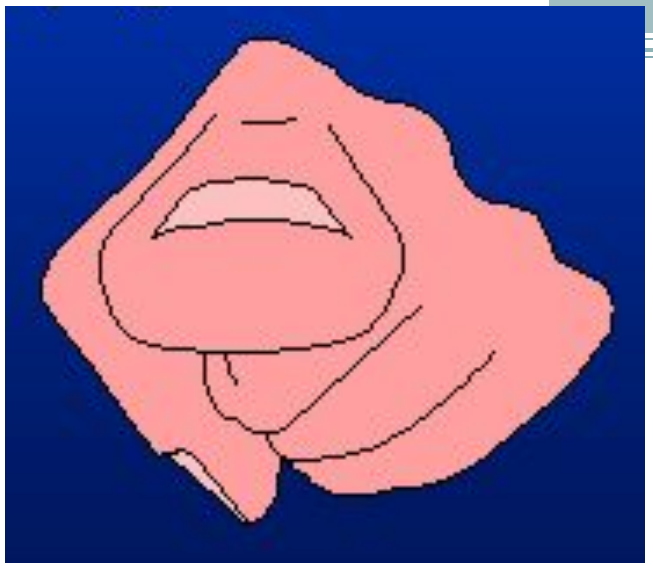
Airway
Breathing
Circulation
Depth of Burn
Extent of Injury(s

Details of the incident

- Cause of the burn
- Time of injury
- Place of the occurrence (closed space, presence of chemicals, noxious fumes)
- Likelihood of associated trauma (explosion,…)
- Pre-hospital interventions

Care of small burns

What can YOU do?



Care of small burns

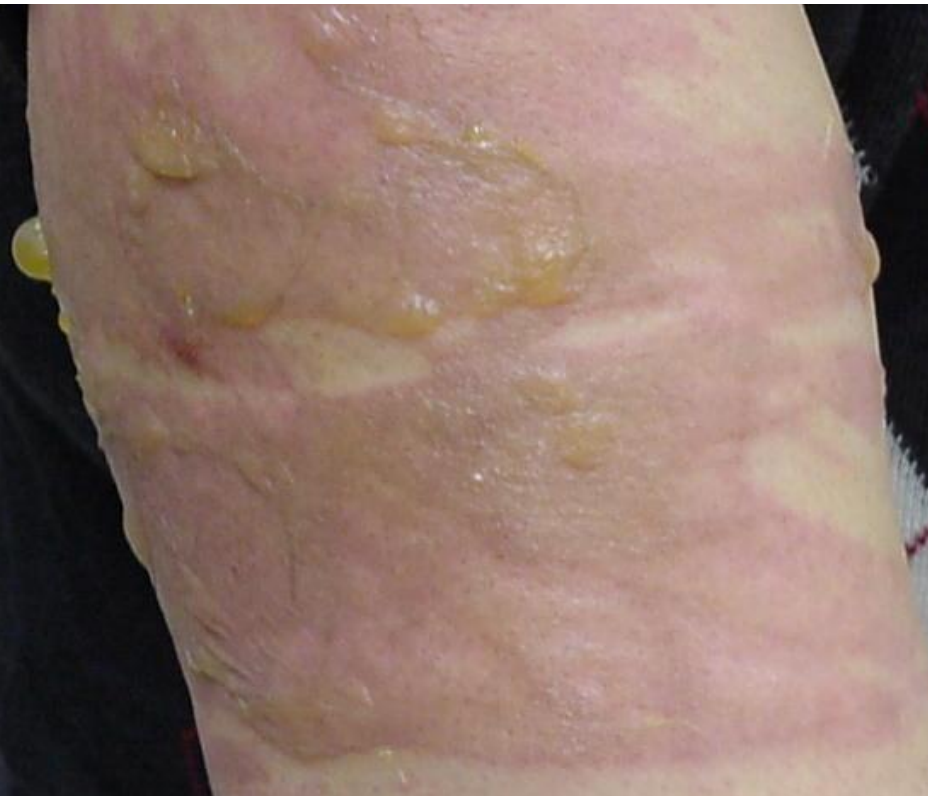
- Clean entire limb with soap and water (also under nails).
- Apply antibiotic cream (no PO or IV antibiotic).
- Dress limb in position of function, elevate it.
- No hurry to remove blisters unless infection occurs.
- Give pain meds as needed (PO, IM, or IV)
- Rinse daily in clean water; in shower is very practical.
- Gently wipe off with clean gauze.

Blisters

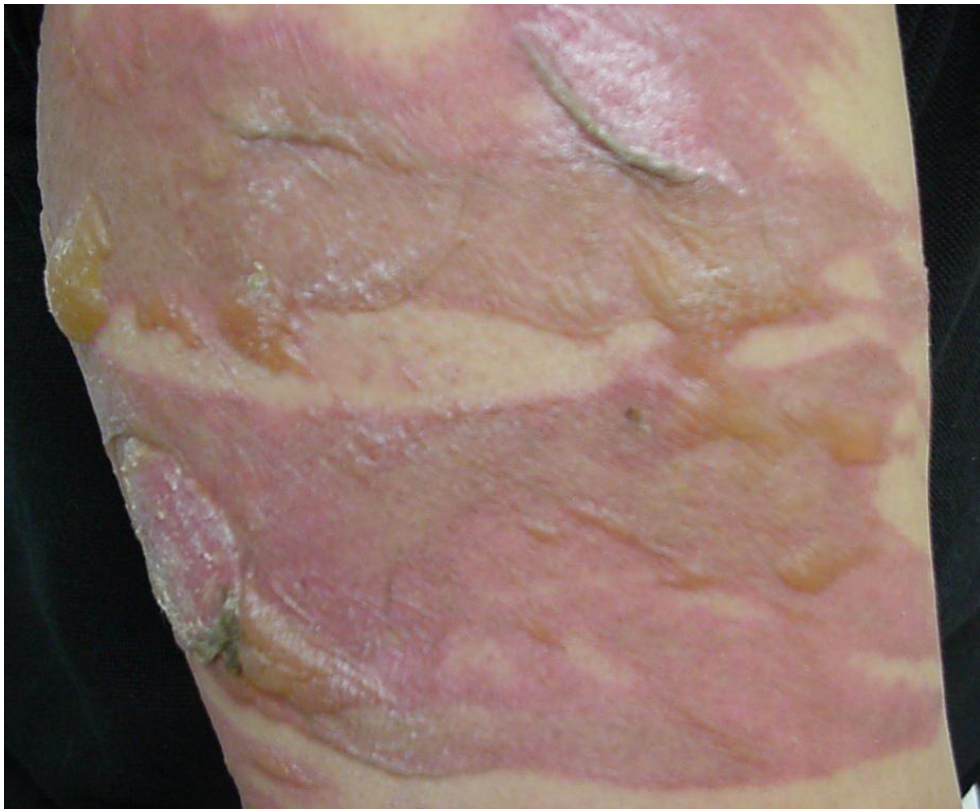
- In the pre-hospital setting, there is no hurry to remove blisters.
- Leaving the blister intact initially is less painful and requires fewer dressing changes.
- The blister will either break on its own, or the fluid will be resorbed.

Blisters break on their own

Upper arm burn day 1



day 2



Burn “looks worse” the next day because of blisters breaking and oozing

Upper arm burn

- Blisters show probable partial thickness burn.
- Area without blister might be deeper partial thickness.

Debride blister using simple instruments

After debridement

Before and after debridement

- Removing the blister leaves a weeping, very tender wound, that requires much care.

Silver sulfadiazene

Arm burn 7 days – note the exudate

Burns of special areas of the body

- Face
- Mouth
- Neck
- Hands and feet
- Genitalia

Face

- Be VERY concerned for the airway!!
- Eyelids, lips and ears often swell.
- In fact, they look even worse the next day.
- But they will start to improve daily after that.
- Cleanse eyes with warm water or saline.
- Apply antibiotic ointment or liquid tears until lids are no longer swollen shut.
- Bacitracin cream/ointment will serve

Hands and feet

This is rather deep and might require grafting.

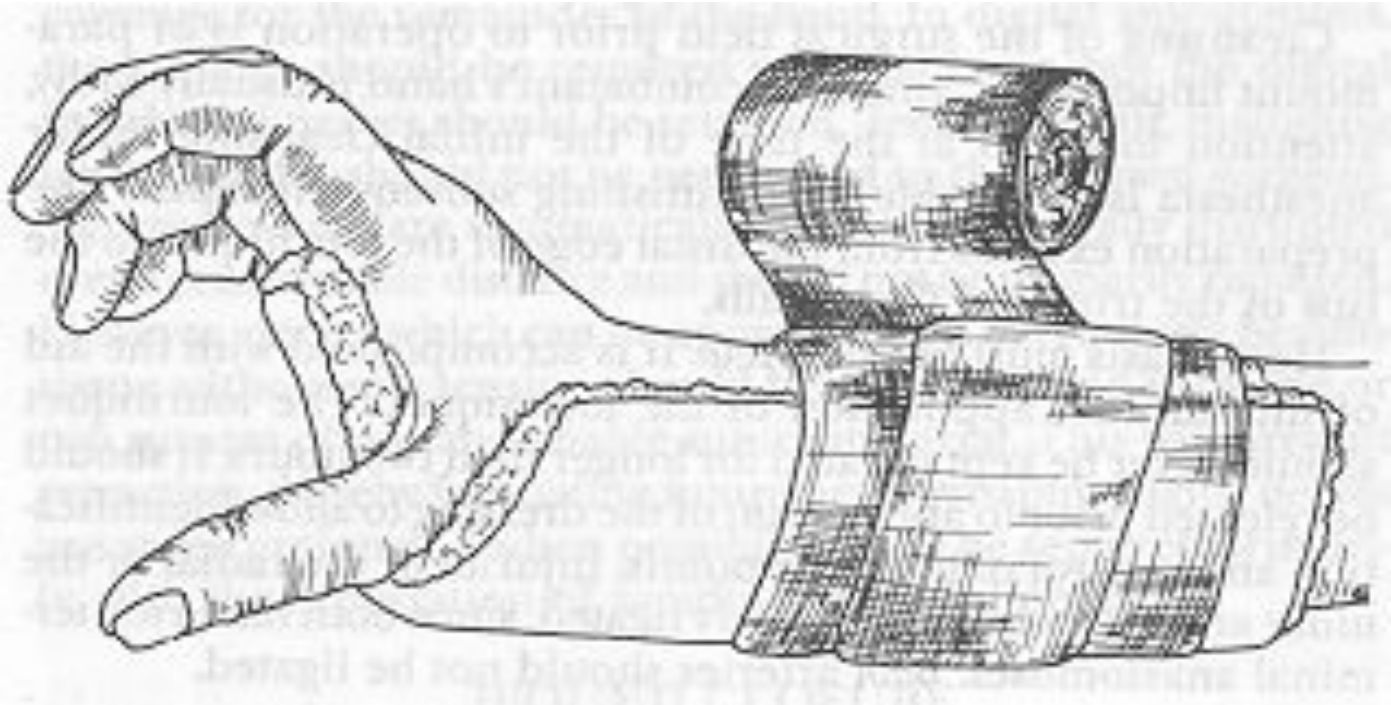
But initial management is basic.

Dressings should not impede circulation.

Leave tips of fingers exposed.

Keep limb elevated.

Hands and feet



- Allow use of the hands in dressings by day.
- Splint in functional position by night.
- Keep elevated to reduce swelling.

Hands and feet

- Fingers might develop contractures if active measures are not taken to prevent them.

Genitalia

- Shower daily, rinse off old cream, apply new cream.
- Insert Foley catheter if unable to urinate due to swelling.

Large Burns

Causes of death in burn patients

- Airway
  - Facial edema, and/or airway edema
- Breathing
  - Toxic inhalation (CO, +/- CN)
  - Respiratory failure due to smoke injury or ARDS

Edema Formation

- Amount of edema can be immense (even without facial burns)
- Depression of mental status can worsen problem
- Edema peaks at 12 to 24 hours
- Pediatric patients even more concerning

Causes of death in burn patients

- Circulation: “failure of resuscitation”
  - Cardiovascular collapse, or acute MI
  - Acute renal failure
  - Other end organ failure
- Missed non-thermal injury

Patients with larger burns

First assess

- CBA's
- "Disability" (brief neuro exam)

Later

- Examine rest of patient
- Calculate IV fluids
- Treat burn

Airway considerations

- **Upper airway injury (above the glottis):** Area buffers the heat of smoke – thermal injury is usually confined to the larynx and upper trachea.

- **Lower airway/alveolar injury (below the glottis):**
  - Caused by the inhalation of steam or chemical smoke.
  - Presents as ARDS (Adult respiratory distress syndrome) often after 24-72 hours

Criteria for intubation

- Changes in voice
- Wheezing / labored respirations
- Excessive, continuous coughing
- Altered mental status
- Carbonaceous sputum
- Singed facial or nasal hairs
- Facial burns
- Oro-pharyngeal edema / stridor
- Assume inhalation injury in any patient confined in a fire environment
- Extensive burns of the face / neck
- Eyes swollen shut
- Burns of 50% TBSA or greater

Ventilatory therapies

- Rapid Sequence Intubation
- Pain Management, Sedation and Paralysis
- PEEP (positive end expiratory pressure)
- High concentration oxygen
- Avoid barotrauma
- Hyperbaric oxygen

Ventilatory therapies

- Burn patients with **Acute respiratory distress syndrome** (ARDS) requiring PEEP (positive end expiratory pressure) > 14 cm for adequate ventilation should receive prophylactic tube thoracostomy.

Circumferential burns of the chest

- Eschar - burned, inflexible, necrotic tissue
- Compromises ventilatory motion
- Escharotomy may be necessary
- Performed through non-sensitive, full-thickness eschar

Carbon Monoxide Intoxication

Carbon monoxide has a binding affinity for hemoglobin which is 210-240 times greater than that of oxygen.

Results in decreased oxygen delivery to tissues, leading to cerebral and myocardial hypoxia.

Cardiac arrhythmias are the most common fatal occurrence.

Signs and Symptoms of Carbon Monoxide Intoxication

- Usually symptoms not present until 15% of the hemoglobin is bound to carbon monoxide rather than to oxygen.

- Early symptoms are neurological in nature due to impairment in cerebral oxygenation

Signs and Symptoms of Carbon Monoxide Intoxication

- Confused, irritable, restless
- Headache
- Tachycardia, arrhythmias or infarction
- Vomiting / incontinence
- Dilated pupils
- Bounding pulse
- Pale or cyanotic complexion
- Overall cherry red color – rarely seen

Carboxyhemoglobin Levels/Symptoms

0 – 5	Normal value
15 – 20	Headache, confusion
20 – 40	Disorientation, fatigue, nausea, visual changes
40 - 60	Hallucinations, coma, shock state
> 60	Mortality > 50%

Management of Carbon Monoxide Intoxication

- Remove patient from source of exposure.
- Administer 100% high flow oxygen

Half life of Carboxyhemoglobin in patients:

- Breathing room air 120-200 minutes
- Breathing 100% O2 30 minutes

Circulation considerations

- Formation of edema is the greatest initial volume loss
- Burns 30% or <
  Edema is limited to the burned region
- Burns >30%
  Edema develops in all body tissues, including non-burned areas.

Circulation considerations

- Capillary permeability increased
- Protein molecules are now able to cross the membrane
- Reduced intravascular volume
- Loss of Na+ into burn tissue increases osmotic pressure → this continues to draw the fluid from the vasculature leading to further edema formation

↓

Hypovolemic shock

Circulation considerations

- Loss of plasma volume is greatest during the first 4 – 6 hours, decreasing substantially in 8 –24 hours if adequate perfusion is maintained.

Fluid resuscitation

- **Goal:** Maintain perfusion to vital organs
- Based on the TBSA, body weight and whether patient is adult/child
- Fluid overload should be avoided – difficult to retrieve settled fluid in tissues and may facilitate organ hypoperfusion

Fluid resuscitation

- Lactated Ringers - preferred solution
- Contains Na+ - restoration of Na+ loss is essential
- Free of glucose – high levels of circulating stress hormones may cause glucose intolerance

Fluid resuscitation

- Burned patients have large insensible fluid losses
- Fluid volumes may increase in patients with co-existing trauma
- Vascular access: Two large bore peripheral lines (if possible) or central line.

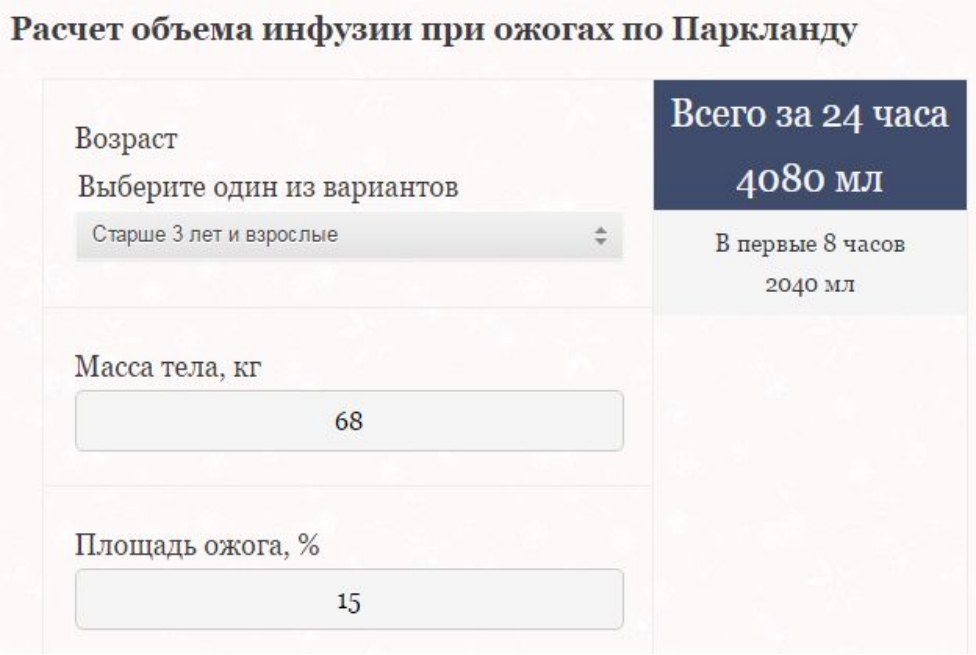
Fluid resuscitation

- Fluid requirement calculations for infusion rates are based on the time from injury, not from the time fluid resuscitation is initiated.

Assessing adequacy of resuscitation

- **Peripheral blood pressure:** may be difficult to obtain
- **Urine Output:** Best indicator unless Acute Renal Failure occurs
- **A-line:** May be inaccurate due to vasospasm
- **CVP (**Central venous pressure**):** Better indicator of fluid status
- **Heart rate:** Valuable in early post burn period – should be around 120/min.
- **Invasive cardiac monitoring:** Indicated in a minority of patients (elderly or pre-existing cardiac disease)

Parkland Formula

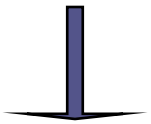


- **4 x <u>% burn</u> x <u>body wt. In kg</u>.**
- ½ of calculated fluid is administered in the first 8 hours
- Balance is given over the remaining 16 hours.
- Maintain urine output at 0.5 cc/kg/hr.
- ARF may result from myoglobinuria
- Increased fluid volume, mannitol bolus and $NaHCO_3$ into each liter of LR to alkalinize the urine may be indicated

Effects of hypothermia

- Hypothermia may lead to acidosis/coagulopathy
- Hypothermia causes peripheral vasoconstriction and impairs oxygen delivery to the tissues
- Metabolism changes from aerobic to anaerobic

serum lactate



serum pH

Prevention of hypothermia

- Cover patients with a dry sheet – keep head covered
- Pre-warm trauma room
- Administer warmed IV solutions
- Avoid application of saline-soaked dressings
- Avoid prolonged irrigation
- Remove wet / bloody clothing and sheets
- Avoid application of antimicrobial creams
- Continual monitoring of core temperature via foley or SCG temperature probe

Pain management

Adequate analgesia imperative!

DOC: Morphine Sulfate

Dose: Adults: 0.1 – 0.2 mg/kg IVP

Children: 0.1 – 0.2 mg/kg/dose IVP / IO

Other pain medications commonly used:

- Demerol
- Vicodin ES
- NSAIDs

Antibiotics

- Prophylactic antibiotics are not indicated in the early postburn period.

Other considerations

- Check tetanus status – administer Td as appropriate
- Debride and treat open blisters or blisters located in areas that are likely to rupture
- Debridement of intact blisters is controversial

Special considerations

Electrical burns: are thermal injuries resulting from high intensity heat. The skin injury area may appear small, but the underlying tissue damage may be extensive.

Additionally, there may be brain or heart damage or musculoskeletal injuries associated with the electrical injuries.

Safely remove the person from the source of the electricity.

Special considerations

Chemical burns- Most often caused by strong acids or alkalis. Unlike thermal burns, they can cause progressive injury until the agent is inactivated.

a. Flush the injured area with a copious amount of water while at the scene of the incident. Don't delay or waste time looking for or using a neutralizing agent. These may in fact worsen the injury by producing heat or causing direct injury themselves.

Burn Injury: Summary

- Many risk factors age dependent
- Pediatricians primary role: prevention
- High risk of multiple organ system effects, prolonged hospitalization
- Initial care: ABCs, then surgical issues
  - special attention to airway, hemodynamics
- Chronic care issues: scarring, lean mass loss

Thanks for your attention