

“IT’S GETTIN’ HOT IN HERE”THE REMIX

BURN CARE TREATMENT AND CHALLENGES

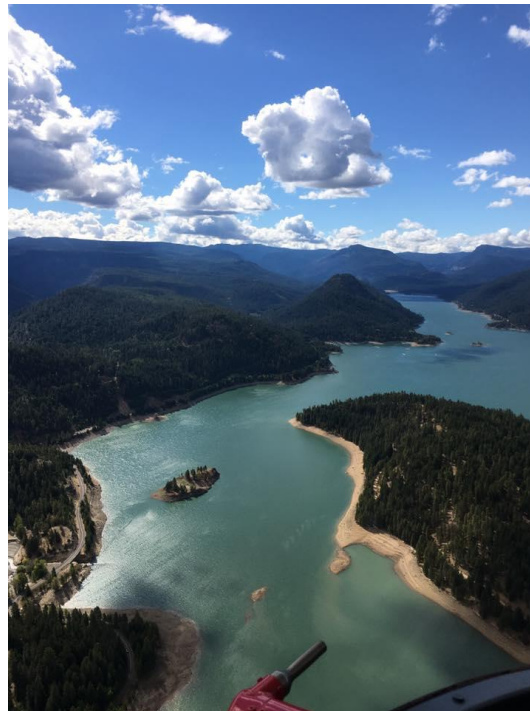
Suzy Beck, RN, BSN, CEN, EMT
Flight Nurse / Base Manager
Airlift Northwest - Yakima



OBJECTIVES

- Review epidemiology of burn injuries
- Identify the mechanisms of burn injury
- Discuss pathophysiological changes causing key signs and symptoms
- Describe assessment of the burn patient
- Discuss resuscitation priorities in the prehospital setting through the ED
- Define minimal criteria for transfer to a Regional Burn Center
- Discuss recent changes in burn therapy to positively impact patient morbidity and mortality

Disclosures



EPIDEMIOLOGY

- 2016 Burn Incidence Fact Sheet:
 - American Burn Association statistics compiled by review of:
 - Ongoing national health care and fire casualty surveys
 - Selected state health data systems
 - National Burn Repository (NBR) of the American Burn Association (ABA)

EPIDEMIOLOGY

- 486,000 burn injuries received medical treatment
- 3,275 Fire / smoke inhalation deaths
 - 2,745 deaths from residential fires
 - 310 from vehicle crash fires
 - 220 from other sources
 - One civilian fire death occurs every 2hr 41min
- 1:1,442 chance of a US resident dying from exposure to fire, flames, or smoke

EPIDEMIOLOGY

- 400,000 hospitalizations related to burn injury
 - 300,000 at hospital burn centers
 - Over 60% of estimated US hospitalizations related to burn injury were admitted to 128 burn centers
 - Burn centers now average over 200 annual admissions for burn injury / skin disorders

EPIDEMIOLOGY

- 2005-2014 Burn Admissions to Burn Center
 - Survival rate: 96.8%
 - ICU stay: 1 day per % of body burned in general
 - Gender:
 - 68% male
 - 32% female
 - Admission causes:
 - 43% fire / flame
 - 34% Scald
 - 9% Contact
 - 4% Electrical
 - 3% Chemical
 - 7% Other



EPIDEMIOLOGY

- Places of occurrence
 - 73% Home
 - 8% Occupational
 - 5% Street / Highway
 - 5% Recreational / sport
 - 9% Other



PATHOPHYSIOLOGY

- The Integumentary System
 - Skin
 - The largest organ in the body
 - Skin forms the entire external covering of the body,
 - It is continuous
 - Differs structurally from the mucous membranes lining the respiratory, digestive, and urogenital systems at their external openings. (Basic Human Anatomy, by Alexander P. Spence 2nd edition 1983)

PATHOPHYSIOLOGY

- Functions of skin:
 - Protection as a physical barrier from sun, microorganisms.
 - Body temperature regulation
 - Typical blood flow to skin is 400ml/minute
 - Under extreme conditions flow increases to up to 2500ml/minute
 - Excretion
 - Sweat

PATHOPHYSIOLOGY

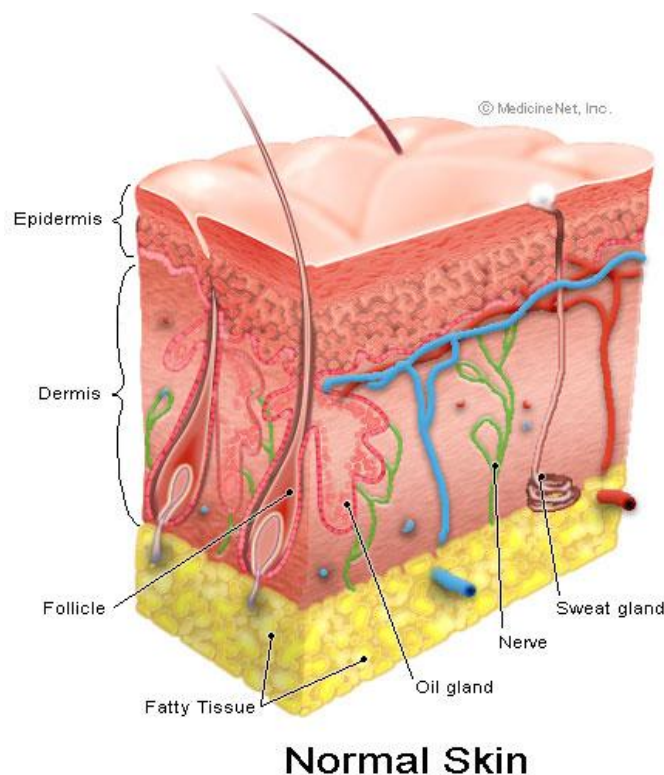
- Functions of Skin (cont'd)
 - Sensation
 - Vitamin D production
- What happens when skin is not intact due to a burn?
 - Loss of body fluids (hypovolemia)
 - Open to infection (sepsis)
 - Loss heat (hypothermia)
 - Sensation changes (increases/decreases)

PATHOPHYSIOLOGY

- Two main layers:
 - Epidermis
 - Quite thin, with a few exceptions.
 - Usually measures 0.12mm
 - There are no blood vessels in the epidermis
 - Nourishment is provided by diffusion from capillary beds in the dermis
 - Dermis
 - Under the epidermis (ah-ha!)
 - A dense irregular layer of connective tissue
 - It contains:
 - Blood vessels
 - Nerves
 - Lymph vessels
 - Hair follicles
 - Sebaceous glands
 - Sweat glands

PATHOPHYSIOLOGY ▪ Hypodermis

- Not considered part of the skin
 - Attaches the skin to underlying structures.
 - Subcutaneous tissue or superficial fascia
 - “In some regions, such as over the abdomen and the buttocks, the accumulation of fat in subcutaneous tissue can become quite extensive” Basic Human Anatomy, 1983



MECHANISMS OF INJURY

- Most common causes of burn injury / death:
 - Thermal Energy
 - Fire / Flame
 - Flash
 - Scalds
 - Contact



MECHANISMS OF INJURY



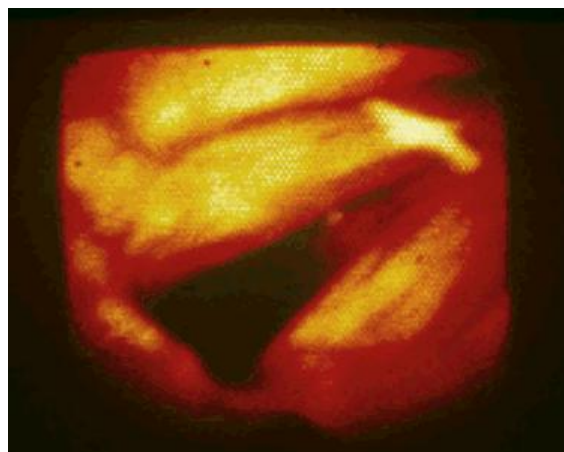
- Chemical Energy
 - Exposure to chemical irritants
 - Caused by direct contact with caustic agent
 - Amount of damage is influenced by
 - Length of contact
 - Concentration of chemical
 - Amount of chemical
 - Type of chemical in general
 - » Acid exposure produces coagulation necrosis
 - » Alkali exposure produces liquefaction necrosis

MECHANISMS OF INJURY

- Electrical Energy
 - Contact with electrical power source
 - Injury determined by type of current, voltage, and duration of contact
 - May have contact points
 - “entrance/exit” sites may be full thickness and/or charred or yellow
 - May have no visible external wound
 - AC vs. DC current
 - AC may cause tetany due to increased exposure to current
 - May cause myoglobinuria and EKG abnormalities



MECHANISMS OF INJURY



■ Inhalation Injuries

- Inhalation of heated gases in enclosed spaces
- Inhalation of chemical toxins
 - Cyanokits
- Inhalation of carbon monoxide
 - Carboxyhemoglobin >30 can cause permanent neurologic dysfunction
 - Causes additional hypotension by direct vasodilation

Carboxyhemoglobin Level (% of Total)	Patient Symptoms
0-10	Usually none
10-20	Mild headache, atypical dyspnea
20-30	Throbbing headache, impaired concentration
30-40	Severe headache, impaired thinking
40-50	Confusion, lethargy, syncope
50-60	Respiratory failure, seizures
>70	Coma, rapidly fatal

BURN DEPTH ASSESSMENT

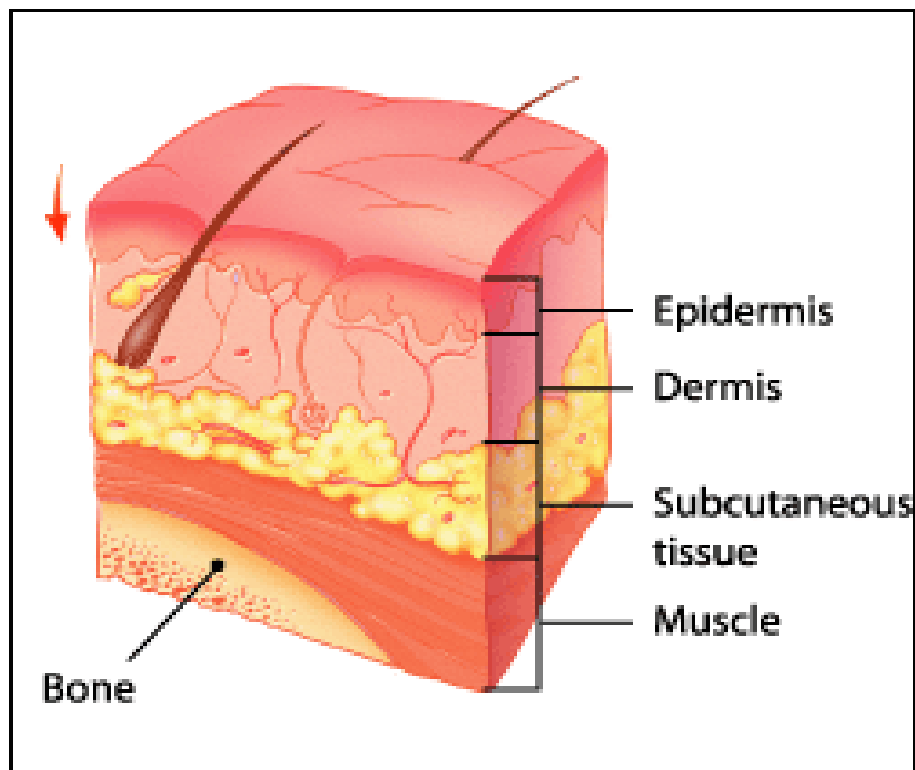
- Superficial Thickness
 - Red burns that blanch with pressure
 - Not included in burn fluid resuscitation
 - Usually heals within 3 weeks
- Partial Thickness
 - Superficial partial thickness
 - Blistering wounds that blanch with pressure
 - Typically moist and weeping
 - Very painful
 - Deep partial thickness
 - Easily unroofed blisters with waxy appearance
 - Does not blanch with pressure
 - Generally heals in 3 to 6 weeks or may require grafting

BURN DEPTH ASSESSMENT

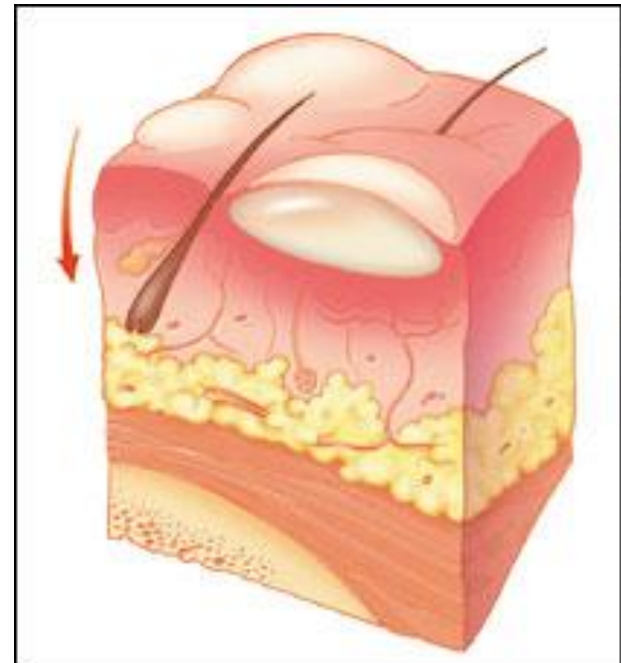
- Full Thickness
 - Insensate
 - Waxy white or leathery gray in color
 - Needs grafting, no dermal elements remain

- Full Thickness Plus
 - Involves the deepest tissues beneath the skin
 - Muscle
 - Tendon
 - Bone
 - May need amputation, plastic and reconstructive surgery is required

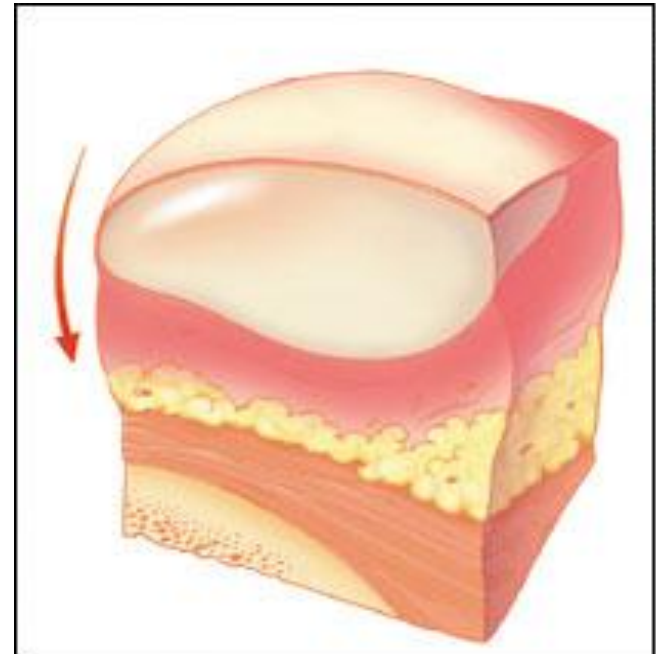
SUPERFICIAL THICKNESS



SUPERFICIAL PARTIAL THICKNESS

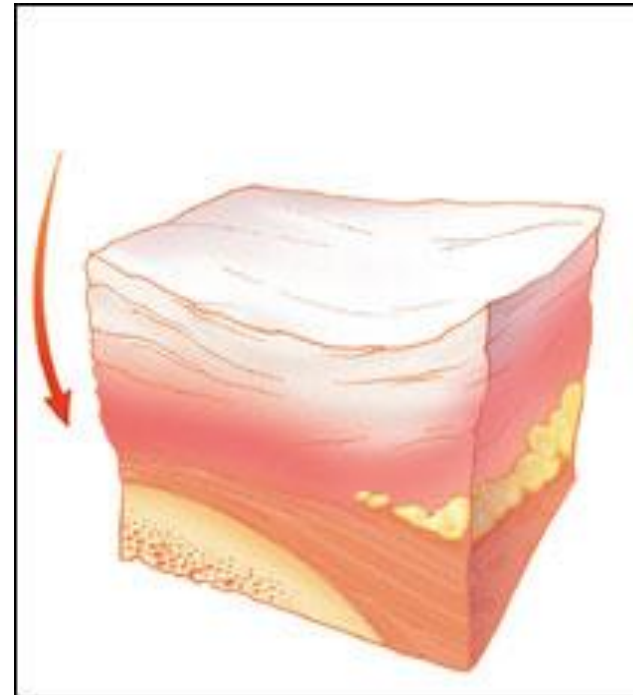


DEEP PARTIAL THICKNESS



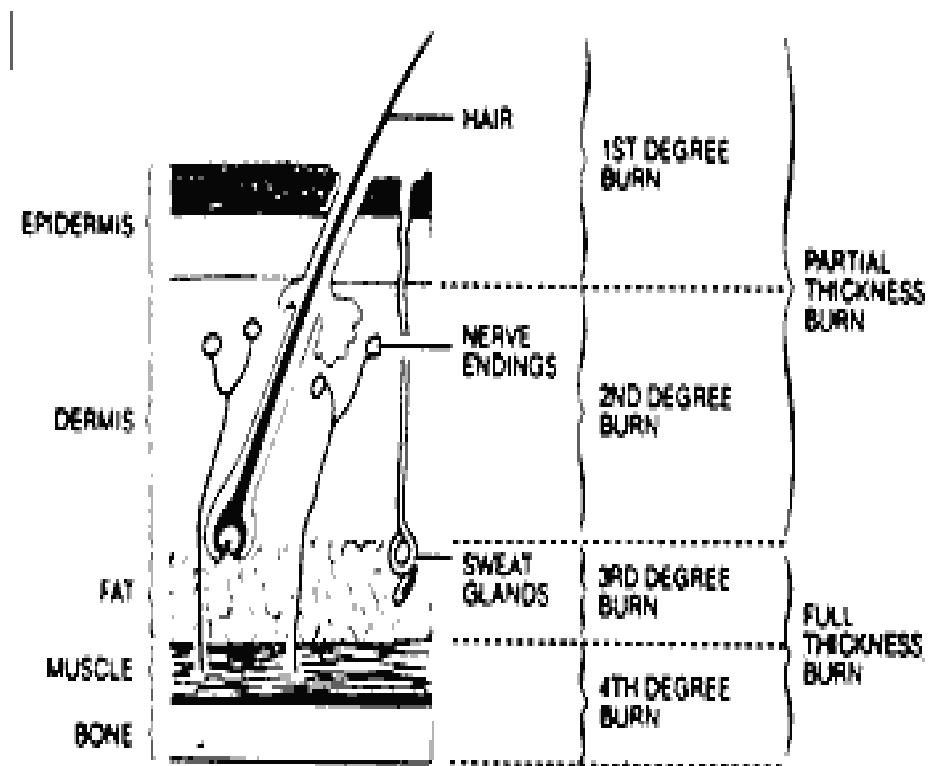
© 2000 Marcia Hartssock

FULL THICKNESS

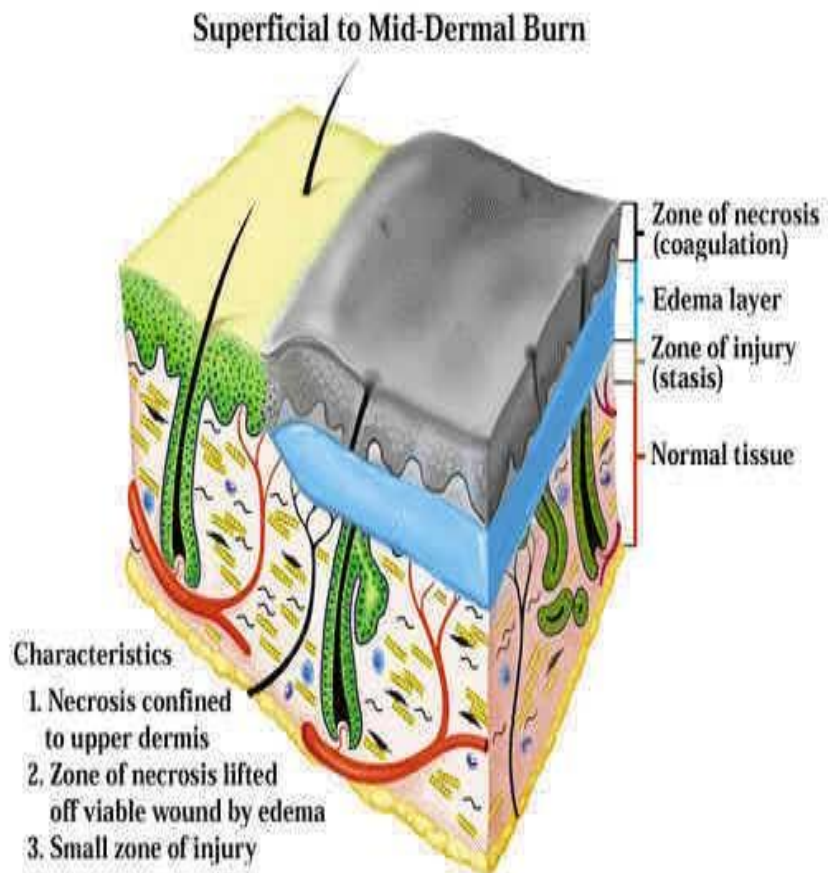


© 2000 Marcia Hartssock

FULL THICKNESS PLUS



BURN DEPTH ASSESSMENT



- Burn Zones:
 - Zone of Coagulation
 - Occurs at the center where tissue is not viable
 - Zone of Stasis
 - Capillary occlusion
 - Diminished perfusion
 - Edema occurs 24-48 hours after the injury
 - Viable depending upon care
 - Zone of Hyperemia
 - Increased flow related to the inflammatory response
 - Viable with good care and no infection

PATHOPHYSIOLOGY

- Cellular response:
 - Loss of cellular membrane integrity
 - Cellular membrane becomes permeable
 - Fluids and electrolytes flow freely across damaged cell membrane
 - Third spacing and interstitial edema result
 - Relative hypovolemia occurs
 - Hemoconcentration resulting in elevated hematocrit
 - Increased blood viscosity
 - Increased peripheral resistance
 - Actual number of red blood cells is decreased because of hemolysis and thrombus formation

PATHOPHYSIOLOGY

- Systemic response
 - Leaky cellular membranes cause
 - Local tissue edema
 - Strong potential for airway obstruction
 - Hypoxia and hypoxemia
 - Shock (aahh!)



PATHOPHYSIOLOGY

- The amount of fluid loss depends upon:
 - Patient's age
 - Burn size and depth
 - Intravascular pressures
 - Time elapsed since burn



PATHOPHYSIOLOGY

- Pain response
 - A very subjective factor but is dependent on degree or depth of burn
 - Nerve endings may be exposed or destroyed
 - Wound may have varying degrees of burn in small area
 - Deep somatic pain response is possible from ischemic or inflammatory response

RESUSCITATION PHILOSOPHY

- “To maintain circulating volume in the simplest, safest, and cheapest manner. The goal is to have, 48 hours after the burn, an alert patient who is neither in cardiac, pulmonary, or renal failure, nor a replica of the Michelin man or Pillsbury doughboy”
- Dr. David Heimbach, Professor of Surgery, Harborview Medical Center Burn Unit

PREHOSPITAL TREATMENT PRIORITIES

- “When, where, how, and what else.....”
 - Be aware of “the rest of the story”
 - **ASSURE SCENE SAFETY FIRST... EVERY TIME**
 - Severe burns are distracting
 - Don’t miss underlying traumatic injuries



PREHOSPITAL TREATMENT PRIORITIES

- Mechanism of Injury
 - Circumstances surrounding event
 - Time of burn (TOB)
 - Assess for potential for:
 - Smoke inhalation
 - Inside
 - Outside
 - Hazardous material exposure
 - Think Meth lab



PREHOSPITAL TREATMENT PRIORITIES

- Assess potential for related trauma:
 - Explosive forces involved
 - Falls from height
- Assess electrical injuries for:
 - Voltage, AC/DC current
 - Pathway of current through the body
- PMH
 - Meds
 - Allergies
 - Underlying medical conditions



PREHOSPITAL TREATMENT PRIORITIES

- Stop the burning process
 - Removal of all clothing
 - Removal of all jewelry
 - Decon as indicated
- Protect the spine if trauma is known / suspected
 - MVCs
 - Falls from height
 - High voltage exposure
 - Explosive forces

PREHOSPITAL TREATMENT PRIORITIES



- Primary Survey:
 - Control obvious bleeding sources
 - Airway
 - Singed facial or nasal hair
 - Carbonaceous sputum
 - Mucosal redness or swelling
 - Difficulty with secretions
 - Difficulty with swallowing
 - Hoarseness or change in voice

PREHOSPITAL TREATMENT PRIORITIES

- Breathing
 - Chest expansion and symmetry
 - Rate and rhythm
 - Tracheal position
 - Presence of circumferential burns
- Circulation
 - Presence of pulse
 - Quality of pulse
 - Capillary refill if able
 - Pediatric patients especially
 - Control obvious bleeding sources



PREHOSPITAL TREATMENT PRIORITIES

– Circulation (cont'd):

- Assess need for IV resuscitation
 - <15% Peds / <20% Adults
 - » Can tolerate oral hydration
 - 15-40%
 - » Establish one large bore line
 - » Add second line if long transport is indicated
 - > 40%
 - » Establish 2 large bore IVs
 - » Use warmed Lactated Ringers
 - » Through burned tissue is OK

PREHOSPITAL TREATMENT PRIORITIES

- New ABA Prehospital fluid resuscitation guidelines being rolled out:
 - < 5 years of age, fluids @ 125ml/hr
 - 5-13 years of age, fluids @ 250ml/hr
 - >13 years of age, fluids @ 500ml/hr

TREATMENT PRIORITIES

- Deficits / Do a Neuro
 - AVPU
 - GCS
 - Extremity sensation and motor function
 - Pupil check
 - Note any obvious burns to eyes
- Expose / Environment
 - Estimate weight and obvious burned areas
 - Rule of Nines
 - Palm of hand estimates
 - Resource cards
 - Control environmental temperature
 - High risk for hypothermia with large burns
 - Can use cooling for small burns <10-15%

UTILIZATION OF AIR ASSETS

- Location
 - Latitude / longitude
 - Physical address
- LZ command and radio frequency
- Indication of MCI
 - Additional resource allocation
 - Safety with multiple aircraft
- Patient Weight
 - Known or estimated
- Type of injury or medical problem
- Indication of hazardous materials



We Bring The ICU To You

- **Adult / Pediatric Critical Care RN Specialty Team**
 - BLS, ACLS, PALS, NRP, ATCN, CFRN, CCRN, CEN, EMT-B
- **Advanced airway adjuncts**
- **Non-invasive / Invasive ventilator management**
- **PRBC / FFP / TXA on every aircraft**
- **I-Stat: Labs in flight**
- **3% Saline**



ED TREATMENT PRIORITIES



- **STAFF SAFETY**
 - Decon if needed
- Reassess primary survey and intervene as needed
 - Airway
 - Breathing
 - Circulation
 - Disability
- Diagnostics
 - H/H
 - Electrolytes / Lactate
 - ABG's and carboxyhemoglobin
 - X-Rays / CT scans
 - EKG for electrical burns

ED TREATMENT PRIORITIES

- Surgical intervention for significant trauma, if available



ED TREATMENT PRIORITIES

- Expose / Environment
 - Begin burn calculation for Modified Baxter formula
 - 3 ml x kg x % of burn
 - **DO NOT** over resuscitate
- NG tube
 - For > 20% burns
 - Keeps stomach empty during transport to burn center
 - Helps prevent ileus formation
 - Can be used for enteral feedings

ED TREATMENT PRIORITIES

- Foley catheter
 - For > 15% burns
 - Adequate urine output
 - 0.5ml/kg/hr adults averaged over 2 hours
 - » 30-50ml/hr
 - 1ml/kg/hr peds < 30kg
 - If urine is pigmented, increase output up to 100ml/hr



ED TREATMENT PRIORITIES



- Prepare for transport to Regional Burn Center as indicated



ED TREATMENT PRIORITIES

- Minimum Criteria to Transfer to a Burn Center per the American Burn Association:
 - Partial thickness burns > 10% TBSA
 - Third degree burns in any age group
 - Circumferential burns of extremity or chest
 - Burns involving face, hands, feet, genitalia, perineum, or major joints
 - Electrical burns, including lightning injuries

ED TREATMENT PRIORITIES

- Minimum Criteria to Transfer to a Burn Center (cont'd)
 - Chemical burn
 - Inhalation injury
 - Burn patients with associated trauma or pre-existing illness
 - Any burn patient in whom concomitant trauma increases the morbidity and mortality
 - Children with burns seen in hospitals without qualified personnel or equipment for their care
 - Burn injury in patients who will require special social and emotional or long term rehab support, including cases involving suspected child abuse and neglect

STABILIZATION FOR TRANSPORT

- Airway, Breathing, Circulation
 - Secure airway with endotracheal tube if airway, facial or neck involvement
 - Secure if smoke inhalation, error on the side of intubation
 - If you think it may be...tube it!
 - Deliver 100% oxygen to all burns via NRB if not intubated
 - Will dilute carboxyhemoglobin
 - Use of Cyanokits should be avoided until consultation with Burn Center
 - Monitor oxygen saturation / ETCO₂
 - Unreliable sats with carbon monoxide injuries
 - Consider with medical control need for escharotomy if circumferential chest burn compromises chest expansion

STABILIZATION FOR TRANSPORT



- Note quality of peripheral pulses
- Check for cap refill
 - Recheck q15 minutes
- Escharotomy may be necessary
 - If pulses disappear
 - If ventilation of patient with circumferential chest burns is not possible

STABILIZATION FOR TRANSPORT

- Pulmonary edema usually indicates an increase in systemic capillary permeability and not CHF
 - Manage patient with:
 - Intubation with ALI protocols
 - Peep
 - Decrease IVF resuscitation by ~10% per hour temporarily if peep unsuccessful
 - DO NOT GIVE DIURETICS

STABILIZATION FOR TRANSPORT

- Assess ongoing fluid resuscitation
 - Warmed LR
 - Use of NS is discouraged in large volumes
 - Contributes to hyperchloremia which worsens acidosis
 - Contributes to hyponatremia
 - No dextrose solutions except for maintenance in pediatrics
 - IV pump to keep control rate to avoid “fluid creep”

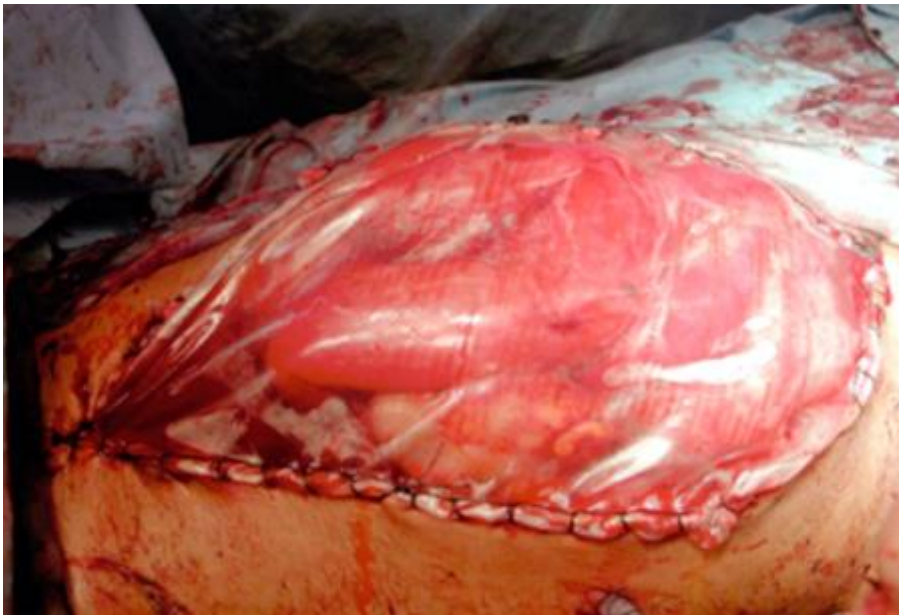
STABILIZATION FOR TRANSPORT

- Use the Modified Baxter formula
 - 3ml/kg/TBSA over 24 hour period
 - 4ml/kg/TBSA for electrical burn injuries
 - 1/2 given in first 8 hours
 - 1/2 given over following 16 hours from time of burn
- For example:
 - 50%TBSA, 50KG
 - $3\text{ml} \times 50\text{kg} \times 50\% = 7500\text{ml}$ to infuse over 24 hour
 - $7500/2=3750\text{ml}$ over 8 hours since TOB
 - The final 3750ml over following 16 hours

STABILIZATION FOR TRANSPORT

- Fluid rate and volume is adjusted to pt condition and urine output
 - Adult burns
 - Urine output target 0.5ml/kg/hr averaged over 2 hours
 - If urine output is low
 - Increase IVF rate by only 10% per hour
 - Don't bolus but dial up your IVF for average urine output
 - » Boluses can increase edema via the leaky capillary bed.
 - DO NOT GIVE DIURETICS
 - Plasmaphoresis consideration after 12 hours
 - More output is not necessarily better
 - Decrease IVF by only 10% if output averages >50ml/hr over 2 hours

STABILIZATION FOR TRANSPORT



- Too much fluid
 - Called “Fluid Creep”
 - Evidenced by
 - Increased capillary leak leading to total body edema
 - Increases need for mechanical ventilation
 - Adds mechanical ventilation days
 - Adds to overall ICU days
 - Adds to potential for abdominal and extremity compartment syndrome

STABILIZATION FOR TRANSPORT

- Pharmacological
 - Pain meds & sedation
 - IV never IM due to malabsorption
 - Current tetanus immunization needed
- Nonpharmacological



STABILIZATION FOR TRANSPORT

- Wound care is generally started at HMC unless pt is >12 hours post burn
- Transport patient in clean dry dressings, sheets and blankets
 - DO NOT TRANSPORT A WET PATIENT



HMC REGIONAL BURN CENTER



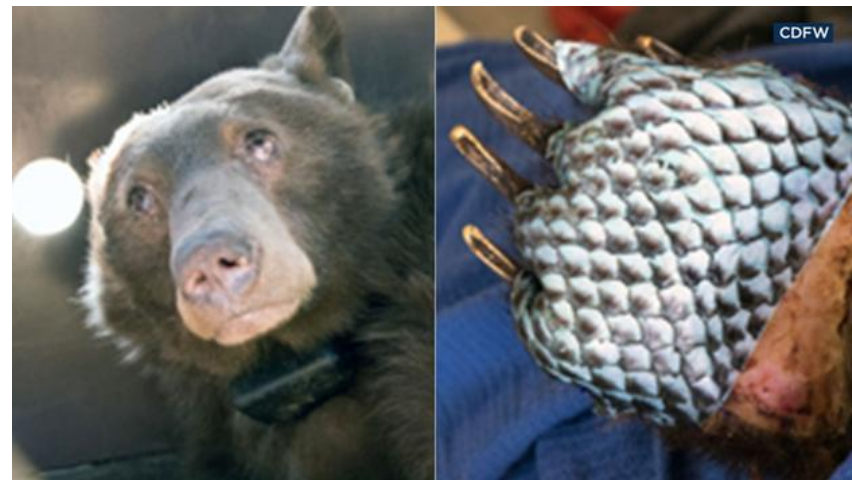
- Appropriate transfer to and treatment at hospitals with the resources and equipment to handle burn injuries has increased overall morbidity and mortality

HMC REGIONAL BURN CENTER

- Ongoing Burn Research
 - Fluid resuscitation models:
 - Use of Plasmapheresis if failing Parkland formula after 12 hours of resuscitation
 - Removal of blood from the body and centrifuging it
 - Packed cells are then suspended in a physiological solution.
 - They may be re-injected into the donor, or into a patient who requires the red cells rather than whole blood.

HMC REGIONAL BURN CENTER

- Ongoing burn research
 - Stem cell guns
 - Takes extended amount of time to grow
 - Expensive
 - Very fragile and easy to tear
 - Tilapia skin



HMC REGIONAL BURN CENTER

- Aggressive management of ALI and ARDS
- Advances in associated complications of burn trauma
 - MODS
 - SIRS
 - Sepsis
- DVT prophylaxis
- Custom fitted pressure garments
 - Jobst garment
- Psychological support and reintegration into patterns of life.

AIRLIFT NORTHWEST[®]



IN WASHINGTON: Arlington, Bellingham, Olympia, Seattle, Yakima

IN ALASKA: Juneau



Contact Information:

Airlift Northwest Yakima
3108 W Washington Avenue
Yakima, WA 98903
(509) 823-4877

Suzy Beck, RN, BSN, CEN, EMT
Flight Nurse/Base Manager
(509) 496-1409
Suzanne.Beck@airliftnw.org