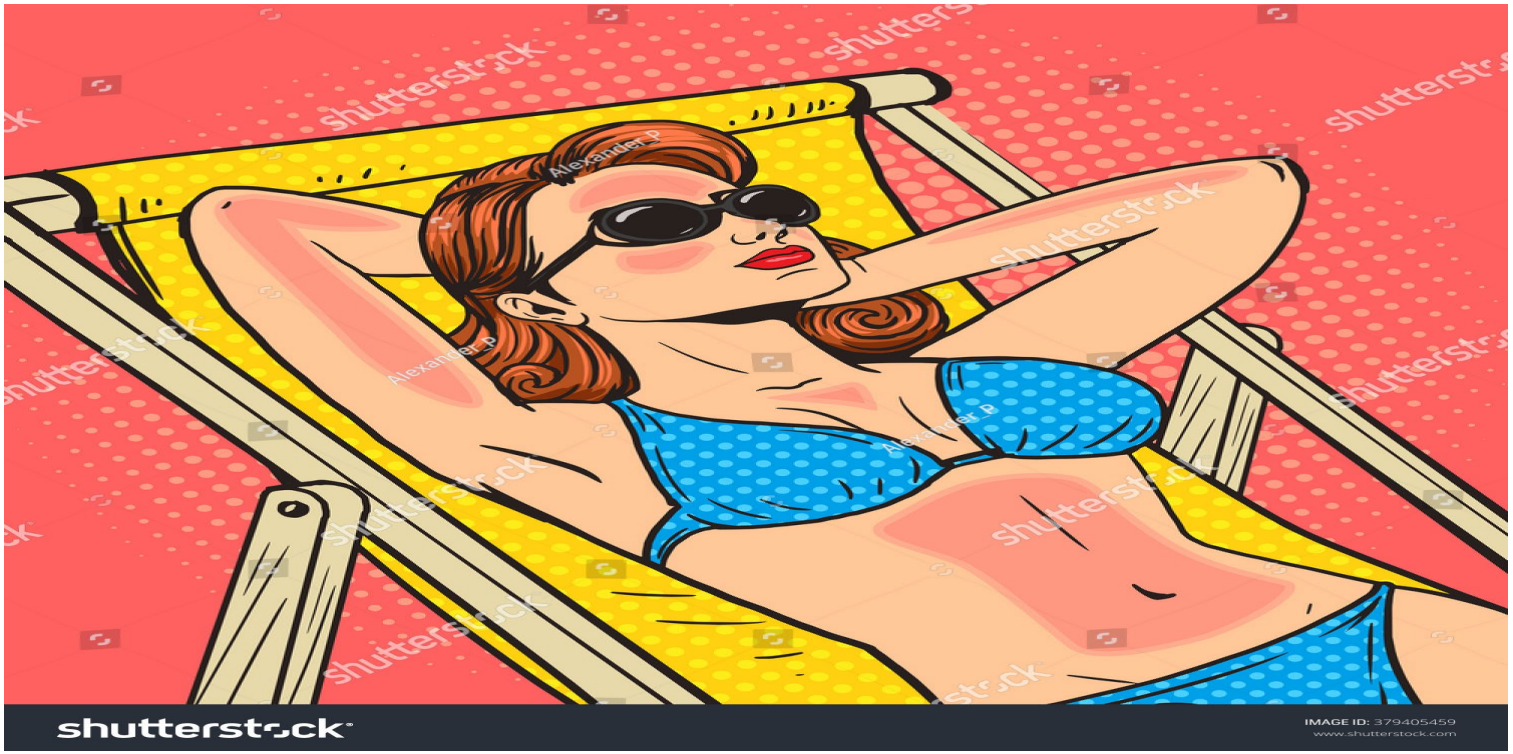
Burn Wound Rounds



Kimberly Burton, PAC

UCI Health

Burn Wound Rounds

No Financial Disclosures

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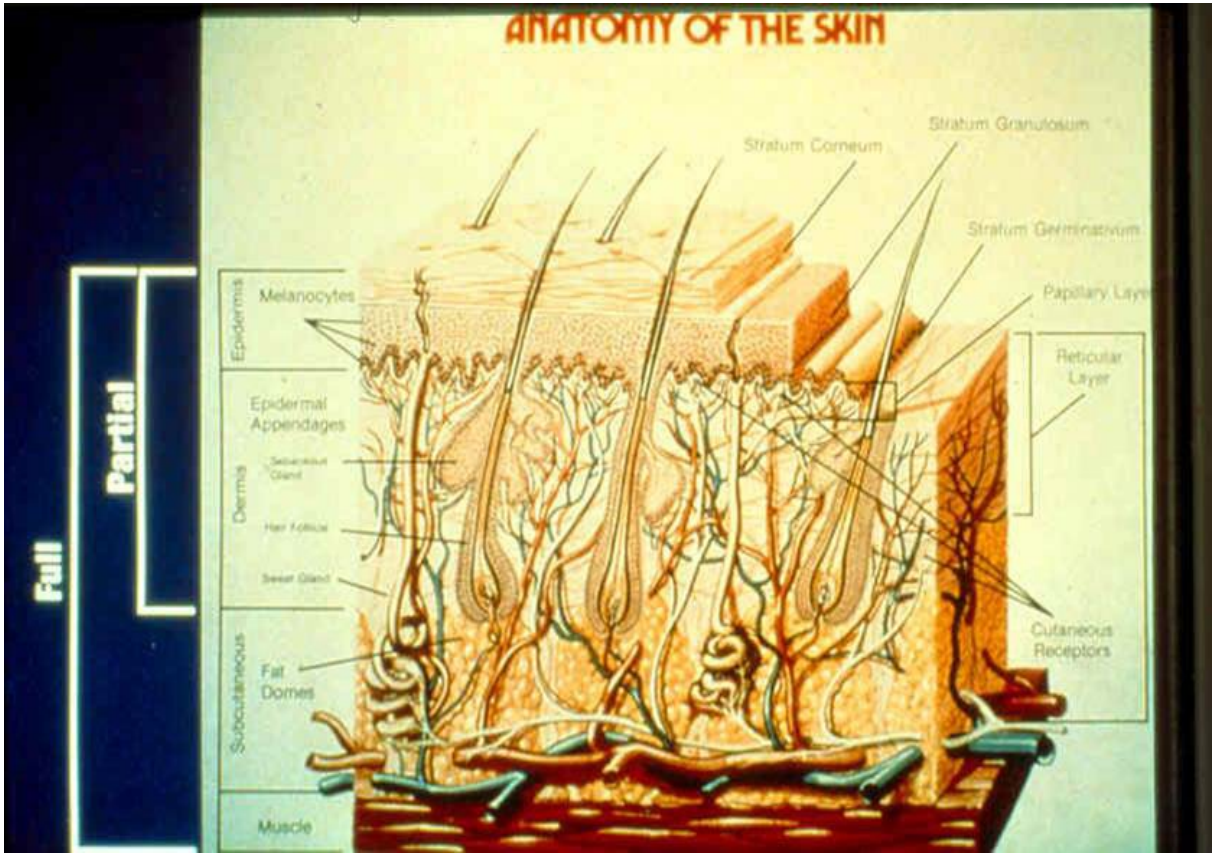
Burn Wound Rounds

7 year old boy sustained flame full thickness burns to face, bilateral arms, bilateral hands, chest, abdomen, back, bilateral buttocks, bilateral legs, from playing with gasoline and matches with 16 year old brother TBSA 75%

Burn Wound Rounds
Your Skin



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Burn Wound Rounds
New Terminology of Burn Depth

Superficial = 1st Degree

Partial Thickness = 2nd Degree

- Superficial
- Deep

Full Thickness = 3rd Degree

Sub-Dermal = 4th Degree

Burn Wounds Rounds
Burn Depth

Factors

Temperature

Duration of contact

Dermal thickness

Blood supply

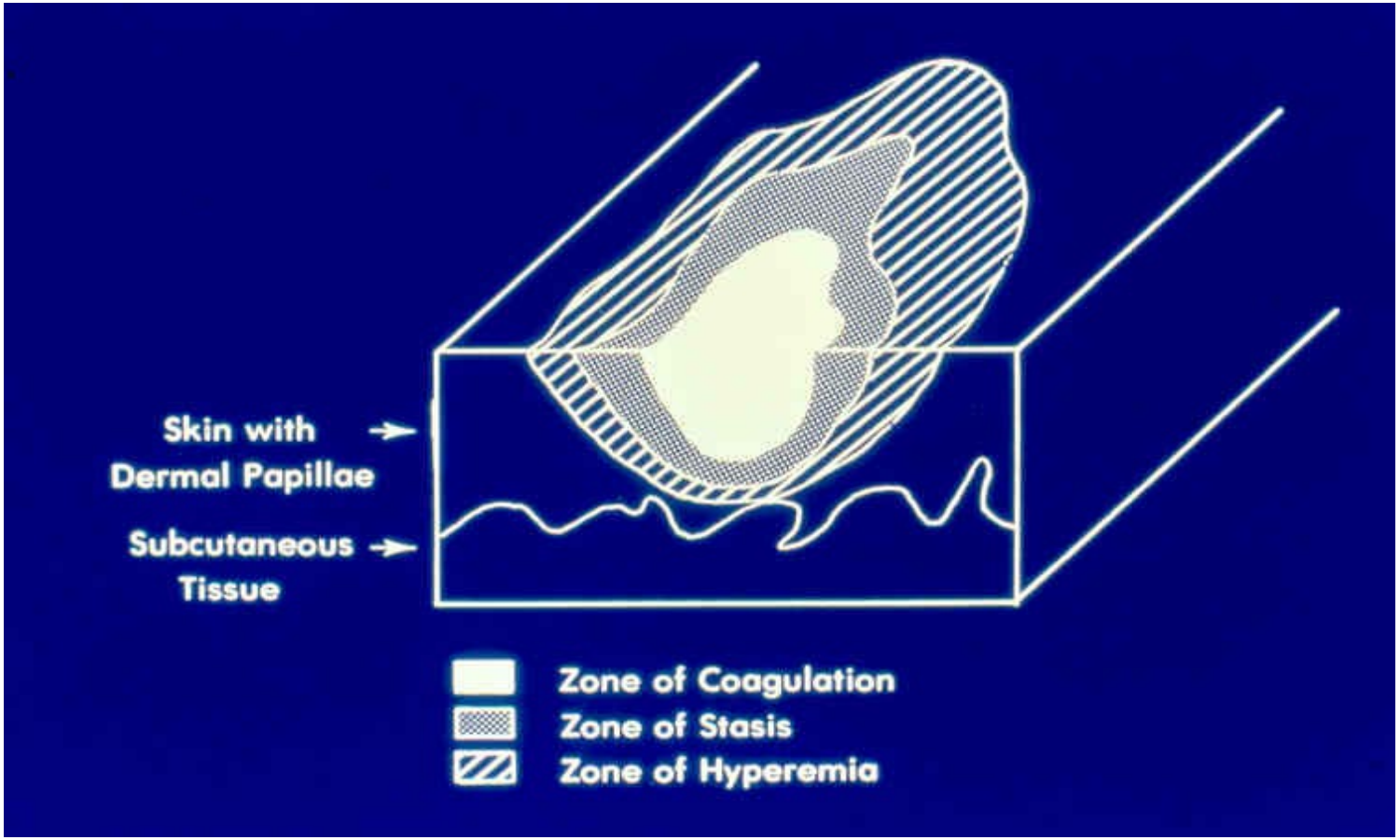
Special consideration: elderly and very young have thinner skin

Determinants of Burn Depth

Duration of contact can be short

Water Temperature	Time for a third degree burn to occur
100°F 37°C	Safe temperature for bathing
120°F 48°C	5 minutes
127°F 52°C	1 minute
130°F 54°C	10 second
140°F 60°C	3 seconds
155°F 68°C	**1 second**

Zones of Cellular Injury



Zones of Stasis

Superficial Partial Thickness First Degree Burns

Cause: Exposure to sunlight

Color: Red

Surface: Dry or small blisters

Sensation: Painful

Healing: 3-6 days

Partial Thickness Burns (2nd degree burn)

Cause: Exposure to hot liquid, flash, flame, or chemical agent

Color: Pink or mottled

Surface: Moist, weeping surface

Sensation: Painful +/- loss of sensation (pressure +, pinprick -)

Healing: Superficial - 10 to 21 days
Deep - >21 days +/- graft

Superficial Partial Thickness Burn

Deep-Partial Thickness Burn

Full Thickness Burns
(3rd degree burn)

Subdermal Burn

High-voltage electrical burns prolonged exposure to flame

Mummified, charred

Requires debridement, amputation, and possible flap

Determine Burn Severity

Amount of body surface area burned

Depth of injury

Age: Adult vs. pediatric

Pre-existing medical conditions

Associated trauma – trauma = priority!

Burns to face, hands, genitalia, feet

Circumferential

Estimate the Extent of the Burn

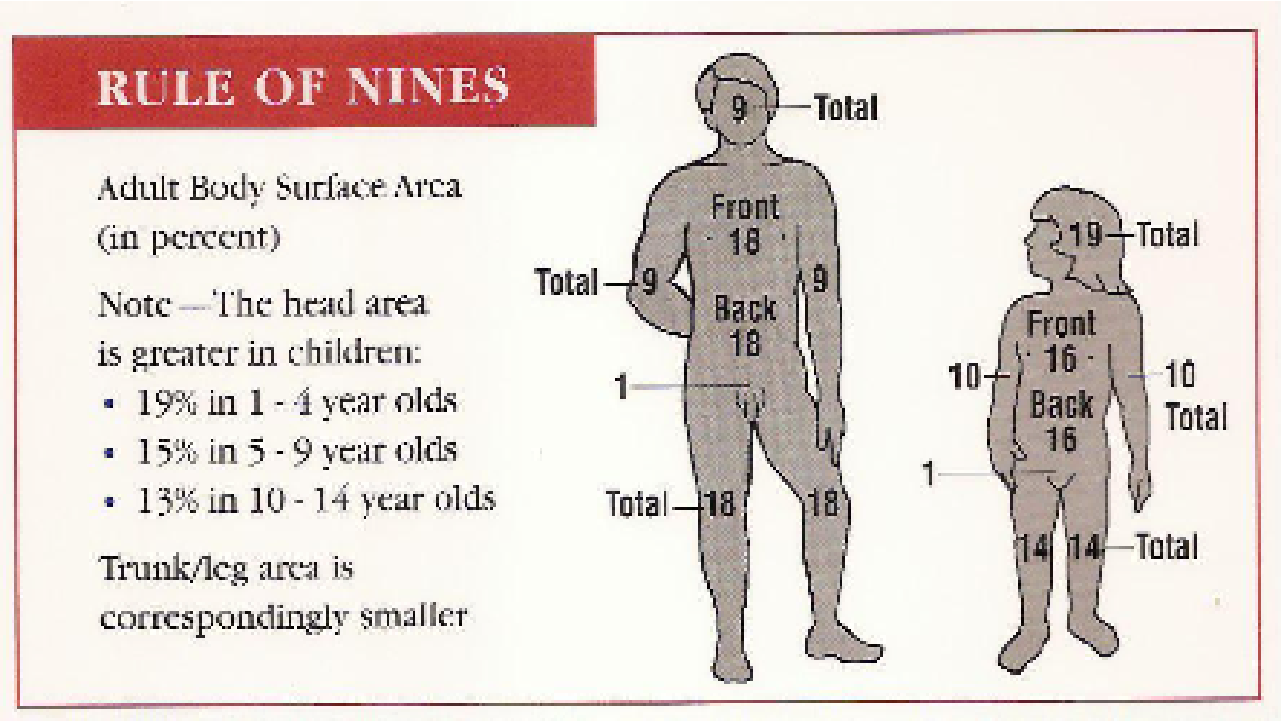
Total body surface area (TBSA) only estimated for partial or full thickness burns (2nd or 3rd degree)

Rule of nines

Lund and Browder chart

Modifications required for children vs. adults in all diagrams

Determine TBSA %



Extent of Burn

Patient's palmer surface (hand + fingers)

1% TBSA

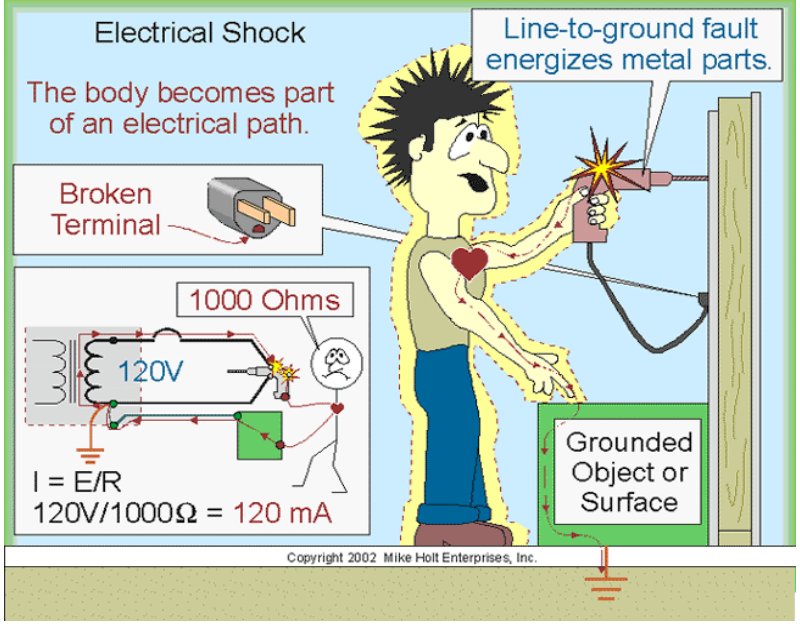
Electrical Injuries

High voltage > 1000 volts:

- Local tissue injury
- EKG – non-specific ST changes

Low voltage < 1000 volts:

- Local tissue injury
- Deep tissue destruction



Type if current

- Alternating / AC more dangerous causes tetany, respiratory muscle paralysis, death from ventricular fibrillation.
- Direct / DC

Sequelae:

Dysrhythmia

Compartment Syndrome

Myoglobinuria

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Electrical Injuries

Low Voltage Injury

Electrical Injury
High Voltage Injury

Myoglobinuria

- Electrical injury; extensive soft tissue injury
- Can lead to renal failure
- Diagnosis: Urinalysis, CPK, myoglobin

- Treatment:
  - Maintain high urine output 75-100 cc/hr
  - Mannitol as needed
  - Alkalinize urine (pH $\geq$ 6)

Chemical Burn Injuries

Exposure to noxious chemicals

- Alkalis – Industrial cleaners, fertilizers
- Acids – Industrial cleaners, rust removers
- Organic – phenols, petroleum

Severity of burn

- Substance, concentration, volume, duration

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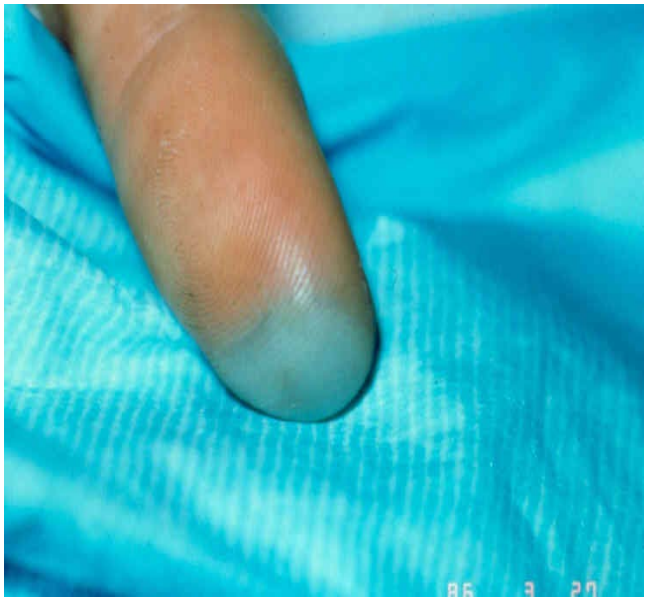
Chemical Burns



Treatment of Chemical Burns

- Protect yourself
- Definitive treatment – Remove the chemical
- Brush off powder agents
- Continuously irrigate with copious amounts of water while removing clothing 30-60 min
- *Avoid neutralizing agents* (heat production)
- General principle: If it still hurts, its still burning
- Burning process will continue until chemical is removed

Tar Burns

Contact burns – occur in roofers

Non-toxic

Treatment

- Cool with cold water
- Tar removal is not an emergency
- Adherent tar covered with petroleum-based ointment to facilitate emulsification and removal

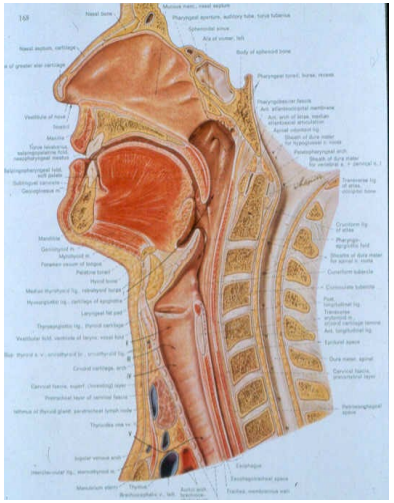
Inhalation Injury

60-70% burn mortalities

- Manifested in first five days after injury
- Significant cause of morbidity and mortality
- Significantly increases mortality

20-50% burn admissions

Types of Inhalation Injury



Supraglottic – most common

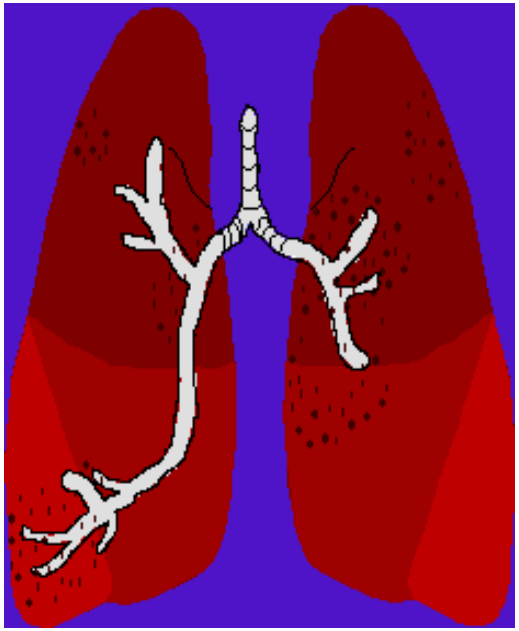
- Injury above the glottis

Infraglottic

- Injury below the glottis

Carbon monoxide poisoning

Inhalation injury doubles mortality



Inhalation Injury

Upper airway (above the glottis)

- Above the vocal cords
- Edema may occlude airway
- Early intubation is important
- Flash burns

Inhalation Injury

Lower airway (below the glottis)

- Almost always chemical injury
- Aldehydes, soot, sulfur oxides and phosgenes adhere to surface of smoke particles and diffuse deep into the lungs causing direct damage to epithelium of large airways
- Enclosed spaces, house fires

Inhalation Injury
Carbon Monoxide Poisoning

Most fire scene fatalities are due to asphyxiation and / or CO poisoning

CO binds to Hbg with an affinity 200 times greater than O2

Tissue hypoxia occurs

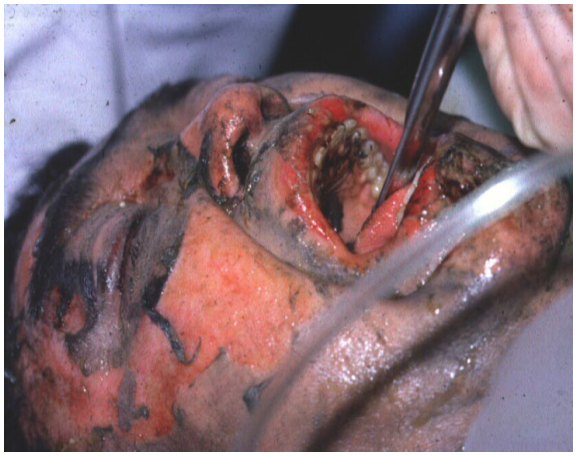
Oxygen saturation is usually normal

Treatment 100% non-rebreather: decreases half-life by five times

Inhalation Injury
Physical Examination

Carbonaceous sputum

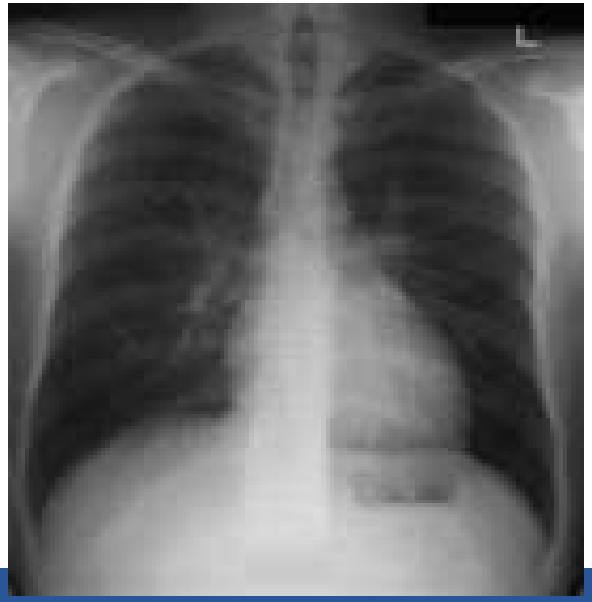
- Facial burns, singed nasal hairs
- Agitation (hypoxia)
- Tachypnea, intercostal retraction
- Hoarseness
- Rales, rhonchi, ↓ breath sounds
- Naso- Oro- pharyngeal erythema
- Inability to swallow



Inhalation Injury

Chest X-rays are normal with patients with Inhalation Injury within 24 -48 hours

Important to make sure Endotracheal tube is secured



Criteria for Intubation

High RR, low SaO2, high CO2

Enclosed space

Loss of consciousness

Carbonaceous sputum

Exposure to noxious chemicals

Inability to protect airway

TBSA > 40%

Inhalation Injury
Case Report

50 yr old man, homeless, fell asleep by fire

Rolled into fire

Pulled from flames by bystanders

Brought to UCIMC as critical trauma

Face, left hand and thigh direct contact with fire sustained very deep burns

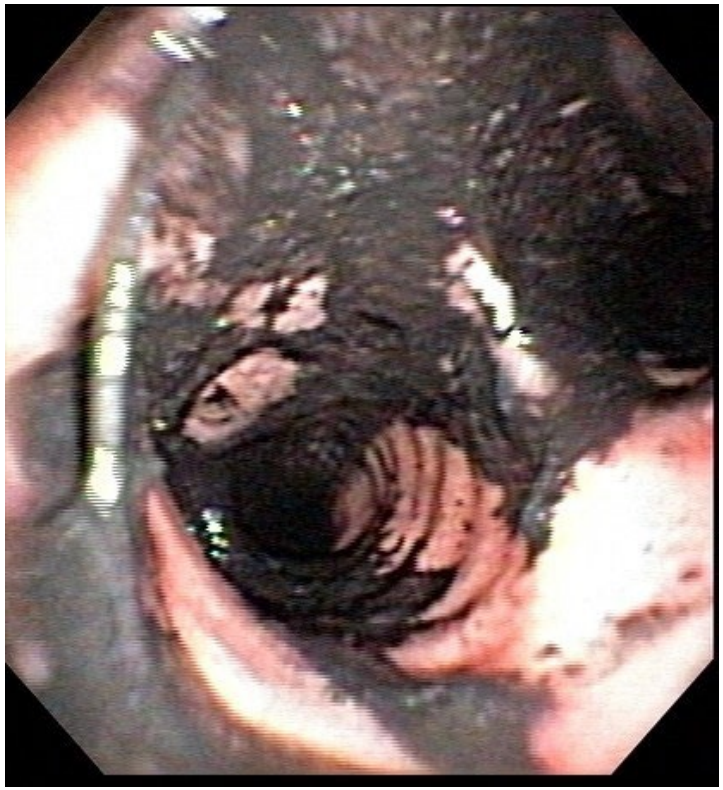
Severe Inhalation Injury

Inhalation Injury Case Report

Hospital Day: 1

Intubated in ED

- Resuscitation
- Bronchoscopy performed
- Severe smoke inhalation with soot



Inhalation Injury
Case Report

Hospital Day: 3

Patient becomes profoundly hypoxic

O2 Sats 75 – 80% on maximal vent settings: PEEP 15, PCV 1:1, PIPs > 40

- pH 7.32, pCO_2 52, pO_2 43, HCO_3 26, BE -1, O_2Sat 79%

High-Frequency Oscillating Vent initiated

- pH7.20, pCO_2 69, pO_2 72 , HCO_3 26 , BE -3, O_2Sat 91%

Nitric Oxide initiated 20 ppm

- pH 7.25, pCO_2 56, pO_2 183, HCO_3 24, BE -4, O_2sat 99%

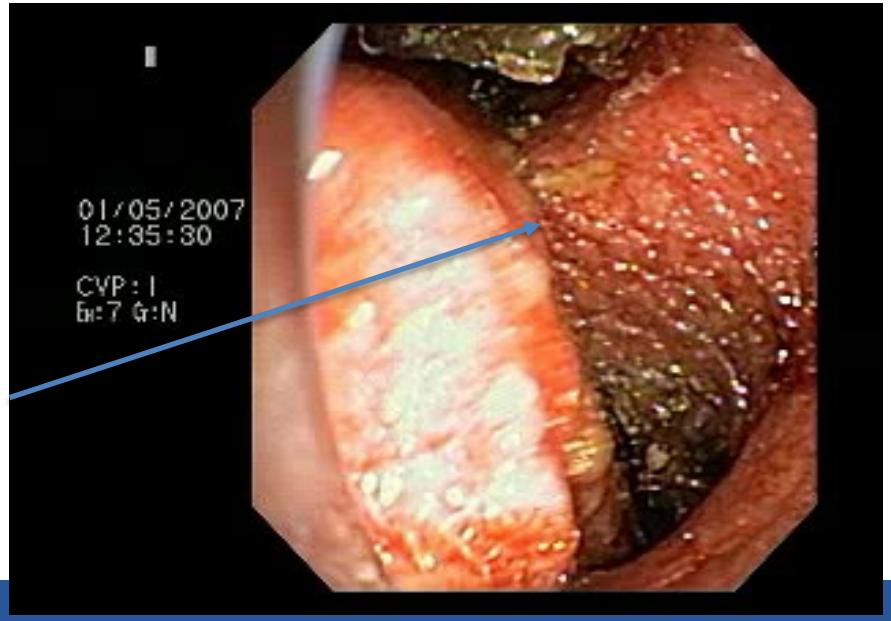
Inhalation Injury
Case Report

Hospital Day: 7

HFOV maintained

Extensive mucosal ulceration, sloughing, granulation

Serial bronchoscopy



Abnormal mucosa, edema, granulation

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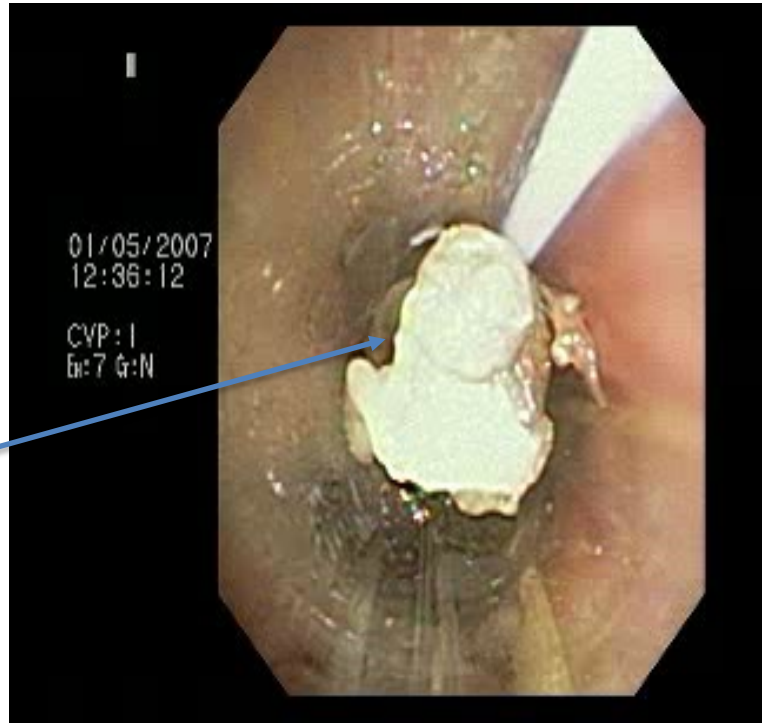
Inhalation Injury Case Study

Hospital Day:11

Mucous plugs

Warning sign

- Rising pCO2
- Immediate bronch

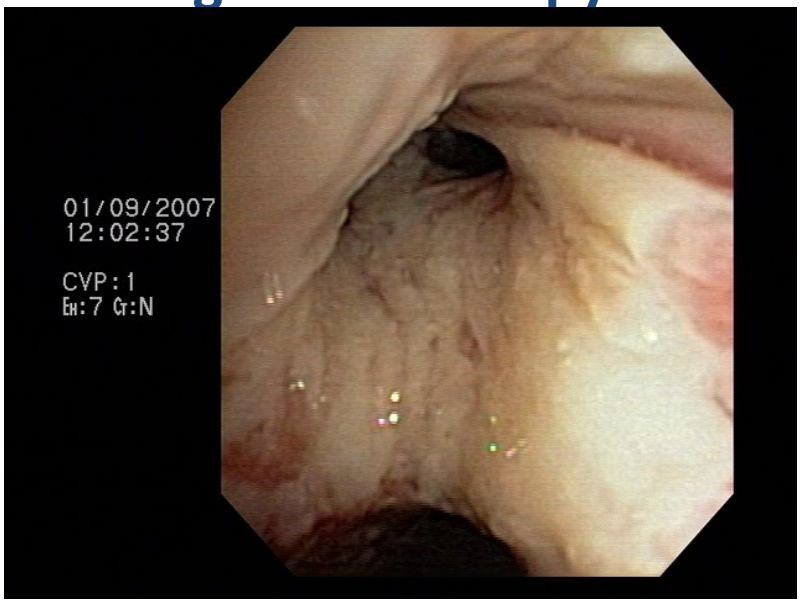


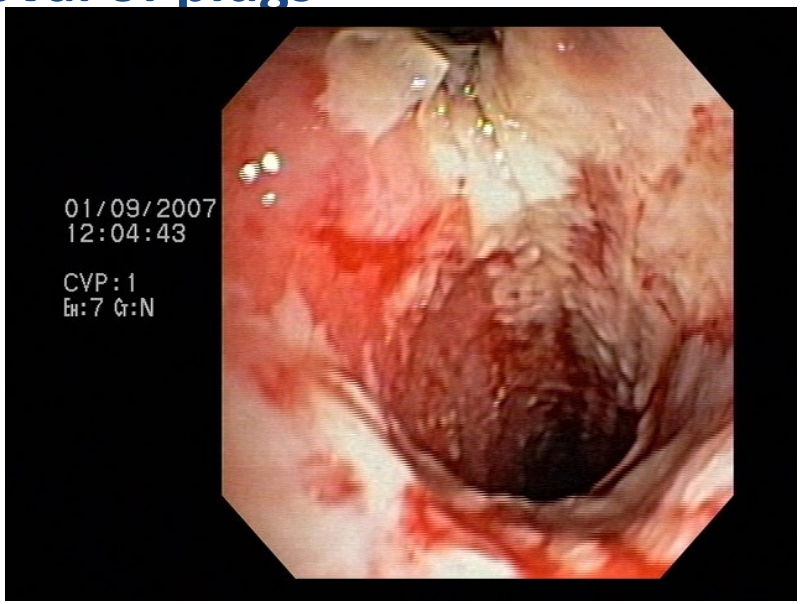
Mucous plug in endotracheal tube

Inhalation Injury Case Study

Hospital 11

Following bronchoscopy with removal of plugs





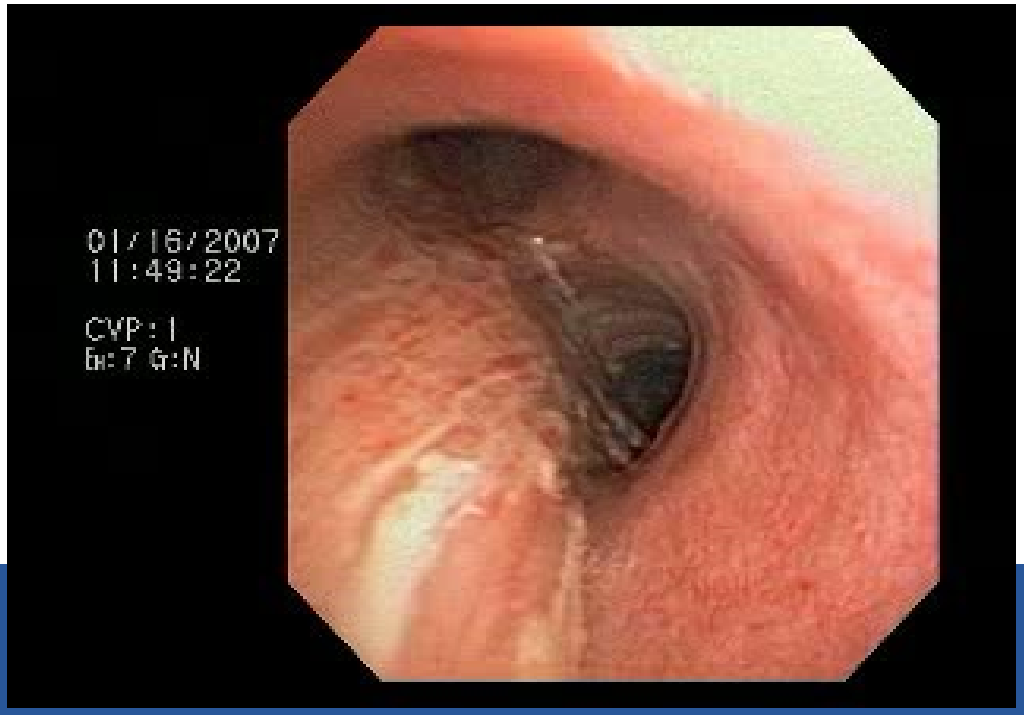
Inhalation Injury
Hospital Course: Day 18 Healing

Patient transitioned from HFOV ~ 3 weeks

Required tracheotomy once on standard vent

Weaned from ventilator

Discharged from hospital after 4 months



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Fluid Resuscitation

- Prehospital and during primary in-hospital triage
- **If burn clearly exceeds 20% TBSA, use the following <u>initial LR fluid rates:</u>**
  - 5 years old and younger: 125 ml per hour
  - 6 - 13 years old: 250 ml per hour
  - 14 years and older: 500 ml per hour (considered as adults)

Adjusted Fluid Rates

(once weight and TBSA are known)

Category	Age and weight	Adjusted fluid rate
Flame or scald	Adults and older children (≥14 years old)	2 ml LR x kg x % TBSA
	Children (<14 years old)	3 ml LR x kg x % TBSA
	Infants and young children (≤30kg)	3 ml LR x kg x % TBSA Plus D_5LR at maintenance rate
Electrical injury	All ages	4 ml LR x kg x % TBSA

Fluid Resuscitation
Pediatrics

- 4ml/hour for each kg up to 10 kg
- 2ml/hour for each kg from 11 - 20 kg
- 1 ml/hour for each kg > 20kg

Fluid Resuscitation
Urine Output

Adults and older children (> 30kg)

0.5 ml/kg/hour (30 - 50 ml/hour)

Smaller children (up to 30kg)

1 ml/kg/hour

Indwelling bladder catheter
Incrementally increase or decrease

Fluid Resuscitation
Case Study

Patient is 80% TBSA, baby weight 19kg

1. For resuscitation fluid, at what rate would you like to run the fluid

Fluid Resuscitation
Case Study

Calculate the maintenance fluids for 24 hours

Fluid Resuscitation

Two large bore IVs anywhere (even through burns)

Fluid of choice – LR

Anticipate increased fluid needs for trauma, electrical injury, resuscitation delay, prior dehydration, ETOH, very deep burns, peds. patients R/T larger surface area – evaporative loss

Fluid Resuscitation Complications

Fluid Overload (pediatric and elderly, patients with existing cardiac disease)

Exaggerates edema formation

Compromises local blood supply

Patient population requiring increased fluid resuscitation:

Inhalation injury, Deep burns, electrical injuries, Delay time to resuscitation, Multiple organ dysfunction

Prehospital Care

Stop the burning process

- Remove clothing from affected areas, irrigate 20-30 min
- Flush area in contact with chemicals with copious amounts of water
- Remove contact with electrical source

Universal precautions

Prevent hypothermia (clean dry sheet)

Warm IV fluids when possible

Pain management

Initial Management

Airway (jaw lift, chin thrust, oral airway)

Breathing (breath sounds, 15 liters oxygen)

Circulation (pulses, perfusion)

C-spine (stabilize as necessary)

Cardiac (electrical injuries)

Disability (AVPU)

Expose and Examine

Fluid Resuscitation (IV access, burn OK), infuse with warm fluids.

Secondary Survey

Secondary Survey

- Head to Toe Survey
- Evaluate the Burn wounds
- Vitals
- Patient History (PMHX, Allergies, Medications, Last Meal, Events, Tetanus Preceding The Injury)

After everything is stable and if able Woods Lamp and looking in the ears is another important part the physical exam

History and Physical

History:

Unconscious?

Noxious Chemicals?

Enclosed Space?

Medical History

"AMPLE"

A llergies (Sulfa)

M edications

P revious Illnesses (PMH), Tetanus status

L ast Meal or Drink

E vents Preceding Injury

Risks of Hypothermia

No need to wash

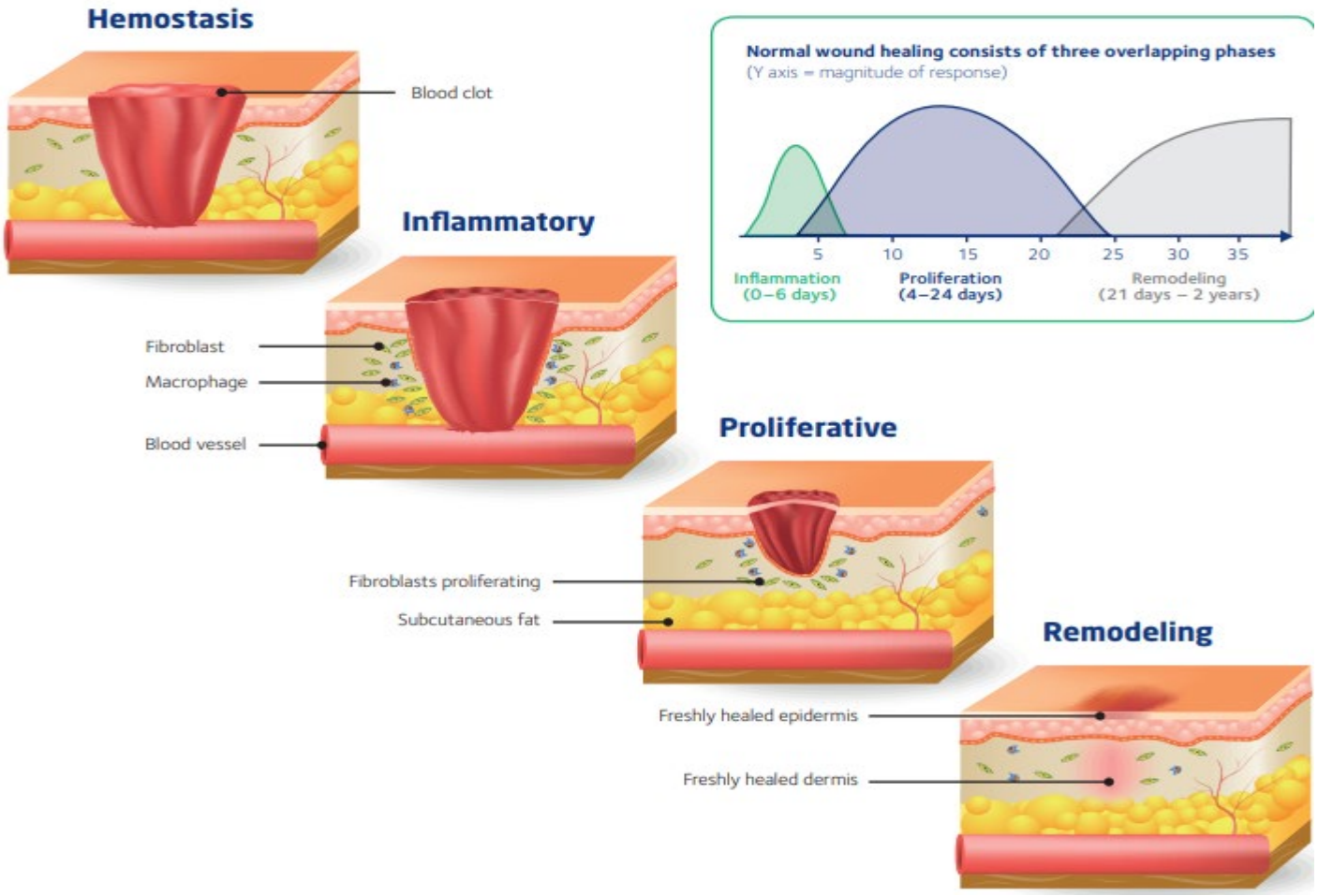
Cold water soaks only effective if applied within 10 minutes of burn, may decrease tissue damage

Continuous flushing with water in chemical burns

Cover with a warm, dry blanket for burns *less than 20% TBSA*

Warming blankets and warmed fluids for burns *greater than 20% TBSA*

Normal Reparative Wound Healing Process



Burn Dressings

Burns > 20% clean dry sheet

Burns < 20% Vaseline gauze (cuts pain) or dry dressing

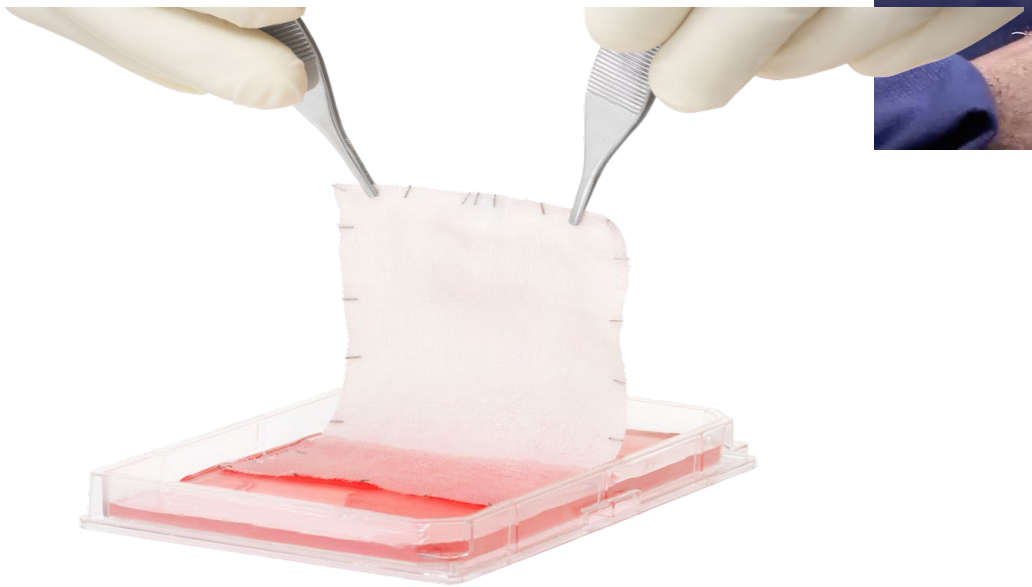
Remove blisters if patient is **not** being admitted to burn unit, and dress with recommended topicals. (i.e. Santyl-collagenase/ bacitracin/ SSD cream)

Burn Dressings

Burn Wound Rounds

Burn Wound Rounds
Epidermal Cultured Autograft

Epicel



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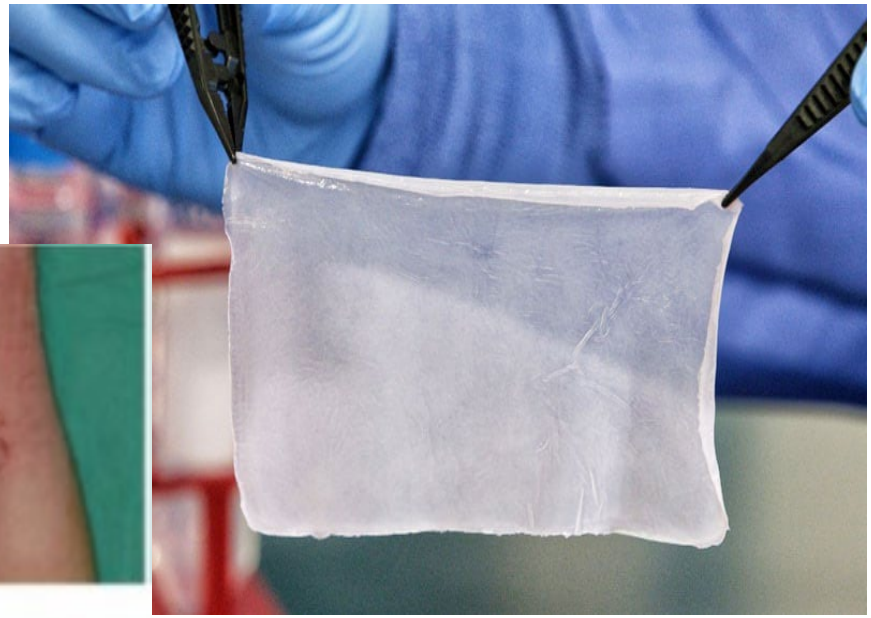
BTM
Biodegradeable Temporising Matrix

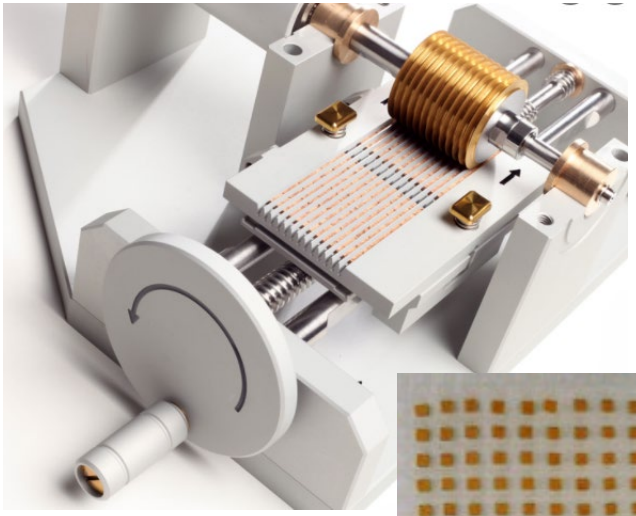
Integra

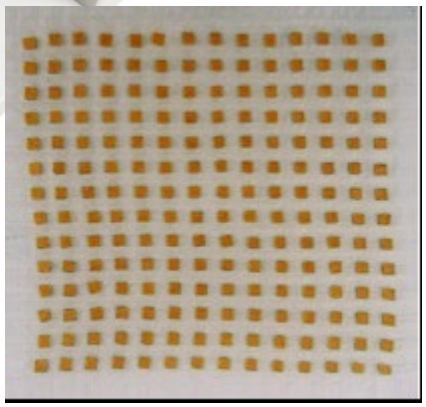
Burn Wound Rounds
Strata Graft

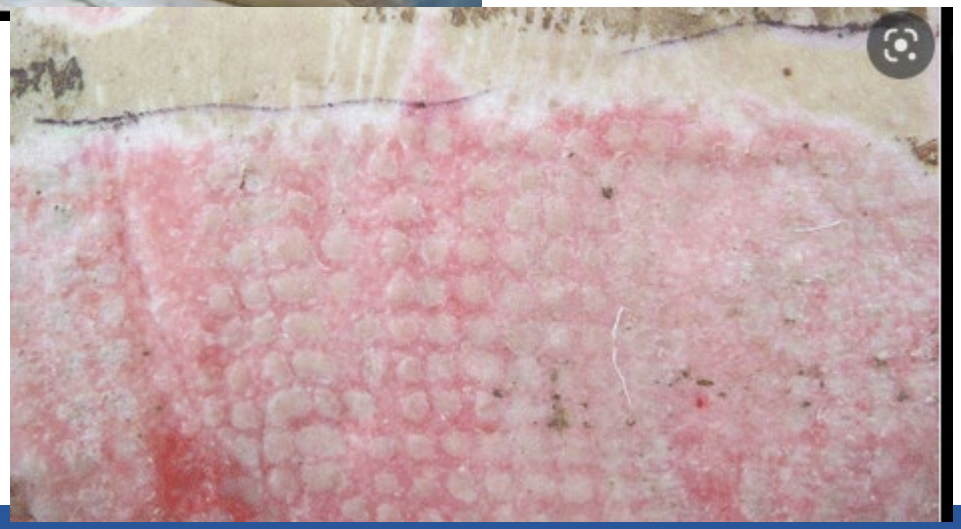


Burn Wound Rounds

Meek Skin Graft

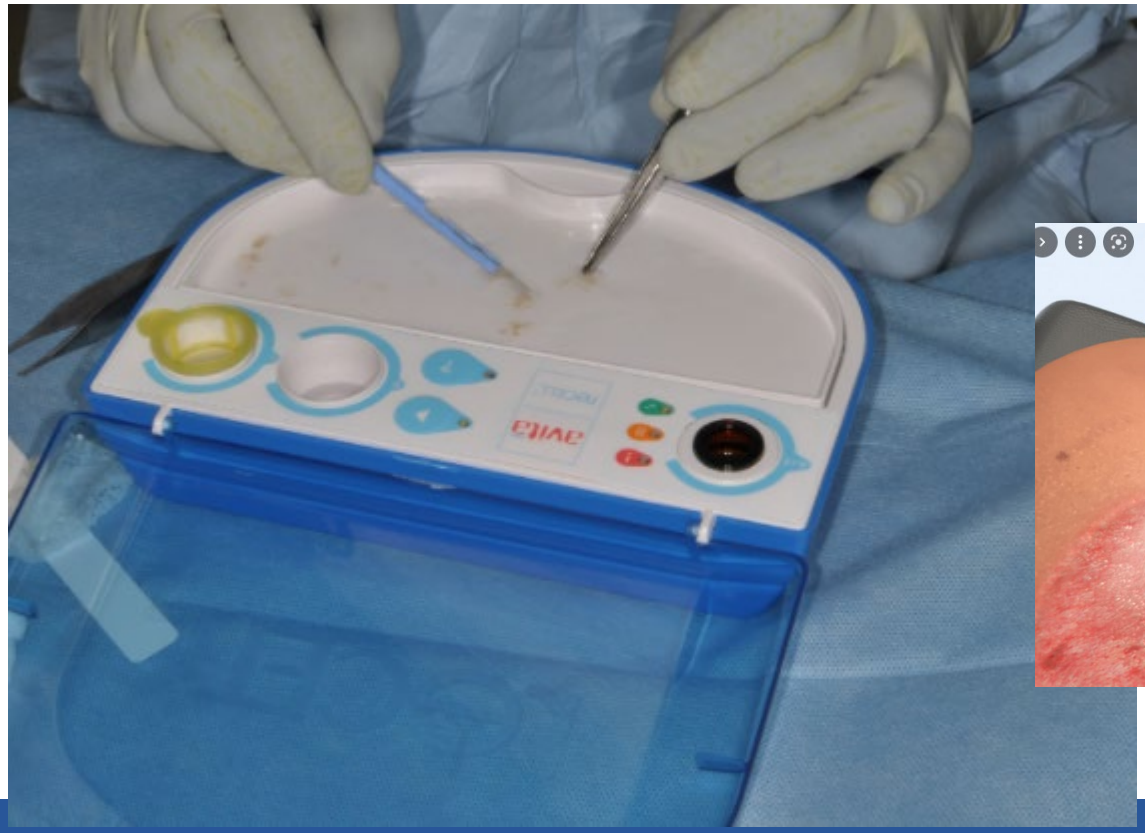






Burn Wound Rounds

Recell



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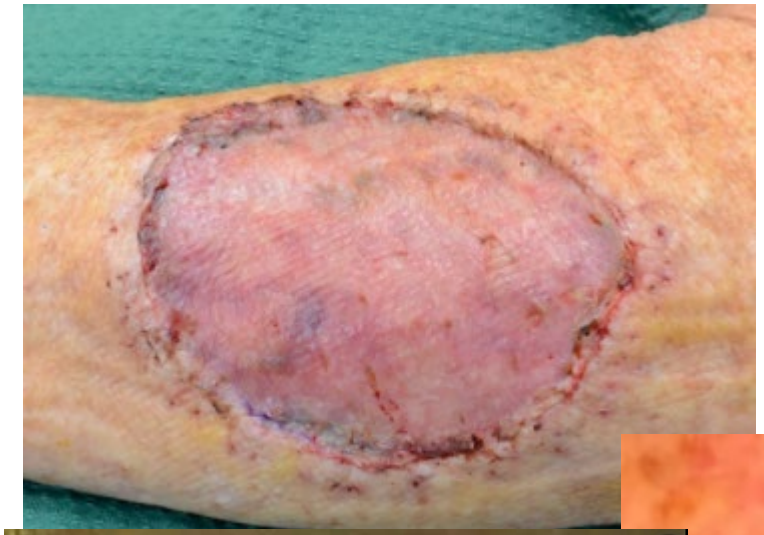
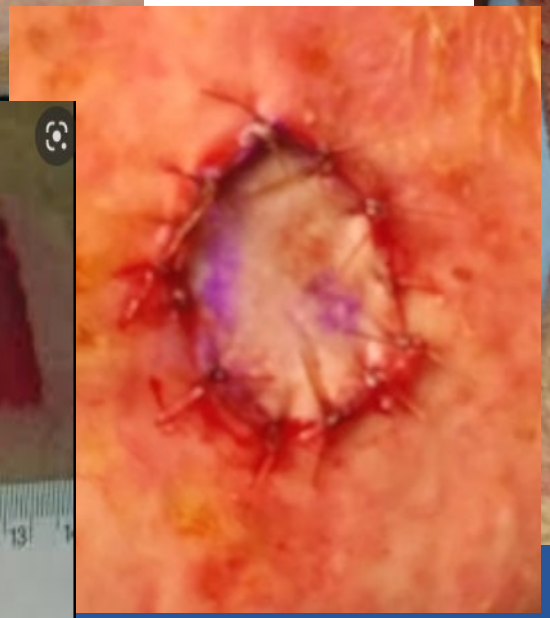
Burn Wound Rounds
Nexobrid

Burn Wound Rounds
Split thickness skin grafts and donor sites





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Burn Wound Rounds
Graft Loss

Infection

Uncontrolled diabetes

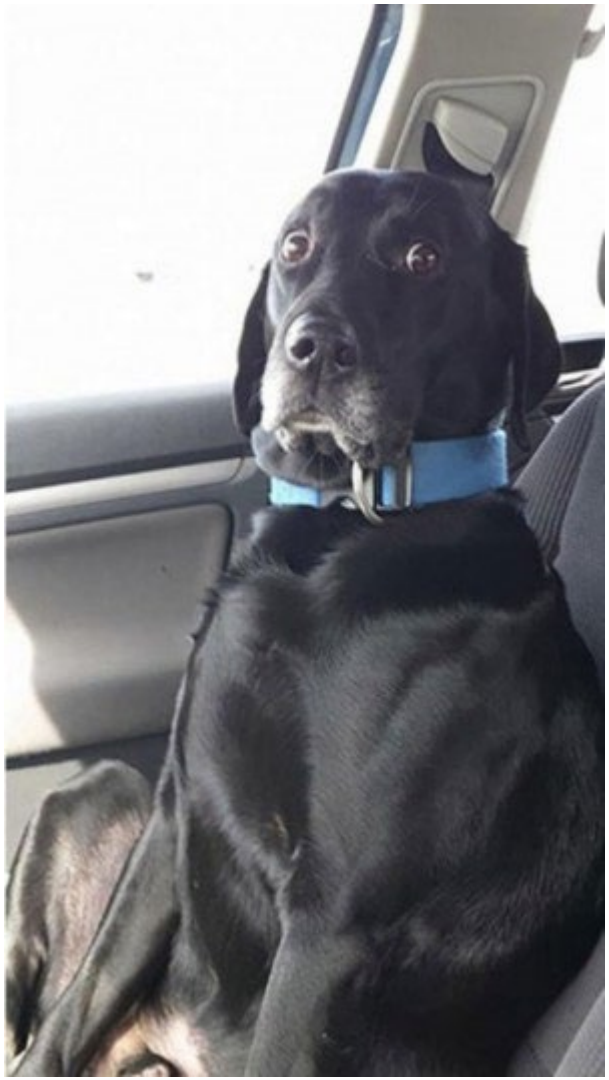
Hematoma

Wound bed not well prepared for graft

Any trauma to the skin graft

Poor nutrition

Poor circulation



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Burn Wound Rounds

Burn Wound Rounds

Rehabilitation- ARU

Burn Wound Rounds

Outpatient Referrals

- Patient must have an appointment to be seen in clinic
- Referrals to Hydrotherapy Clinic for burn and wounds
- Cannot have same day ER/outpatient visits
-Patient is usually, but not always, seen on the next business day. Delays are usually due to insurance authorizations.
-Please prescribe enough pain medicine/topicals for these delays. Train caregiver in dressing changes.
-Have patient call the clinic the next business day in the morning for an appt., 456-66170
- Fax an order for treatment to 456-5979

Burn Wound Rounds

Burn recovery resources

- School Reentry
- Burn Support Group
- Peer Burn Support Services
- Pet Therapy Services
- World Burn Congress yearly
- Pediatric burn camps, Angel Faces with Barbara Quayle

Burn Wounds Rounds

Twilight Picnic

Yearly Burn Patient Christmas Party

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Burn –Wound Rounds

Burn Prevention- Education to the community

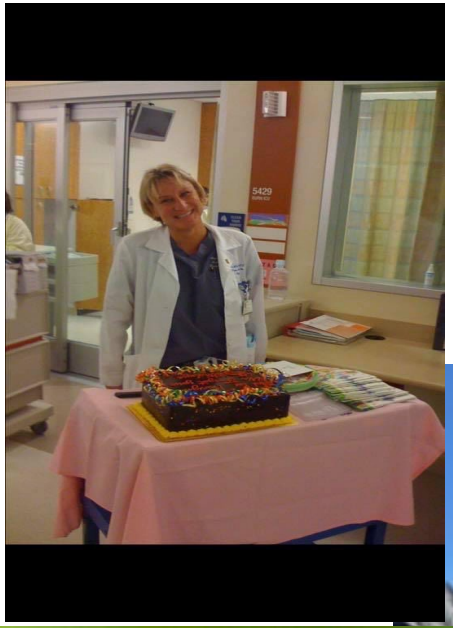
Disaster-Austere preparedness

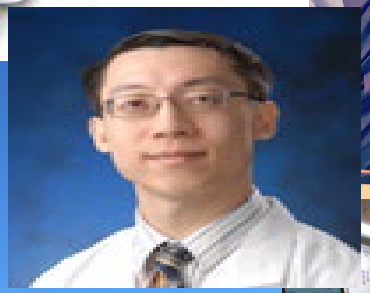
The Specialized Burn Team

Burn and Specialty Surgeons
Pediatric Intensivist
Nursing Staff
Nursing Educator
Physical and Occupational Therapists
Dietician
Speech Pathologist
Epidemiology and Infection Control Nurse
Respiratory Therapists
Psychologist
Child Life Specialist
Pharmacist
Research Physicians
Case Manager
Social Worker
Outpatient clinic staff
Acupuncture

Burn Wound Rounds

Special Thanks to the physicians and burn team





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The UCI Medical Center Burn Unit

Dedicated to
the human spirit and
the lives we touch.