PHAR:8251 Integrated Pharmacotherapy: Dermatology

Part 2 – Inpatient Management of Burns

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IOWA PHARMACY

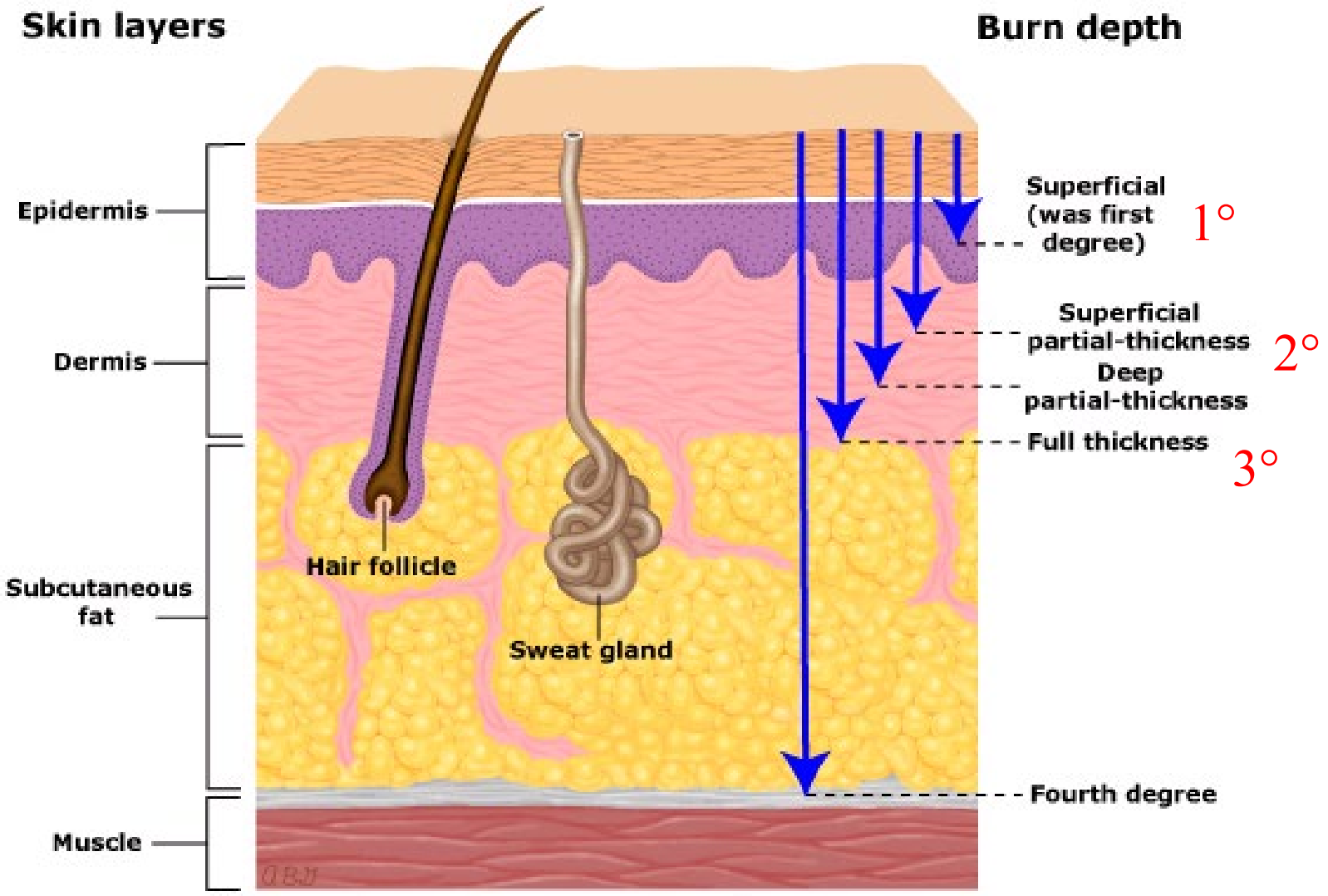
Learning Objectives

- Understand the pathophysiology of burns and resulting changes.
- Examine the process of burn-related shock and describe appropriate fluid and electrolyte resuscitation.
- Discuss the rational choice of anti-infectives and wound surveillance.

Learning Objectives

- Describe pain-management for both acute and chronic pain in burns.
- Describe appropriate methods of sedation. (Including conscious sedation.)
- Know how to triage a patient who comes into your pharmacy with a burn.

Burn classification



Burn Depth	Skin Structures Involved	Presentation	Sensation	Healing Time
Superficial (First Degree)	Epidermis only	Dry, red, and blanches with pressure	Painful	3-7 days
Superficial partial-thickness (Second Degree)	Extends into superficial dermis	Moist, red, blisters, and blanches with pressure	Painful	1-2 weeks
Deep partial-thickness (Second Degree)	Extends into deep dermis	Moist, mottled or white, delayed blanching	Painful, discomfort	3-4 weeks, may develop scars, contractures
Full-thickness (Third Degree)	Extends through entire dermis	Dry, leathery, white/brown	Painless	Requires excision with grafting
Fourth Degree	Extends into SQ tissue, underlying muscle/bone	Dry, black, charred with eschar	Painless	May require amputation

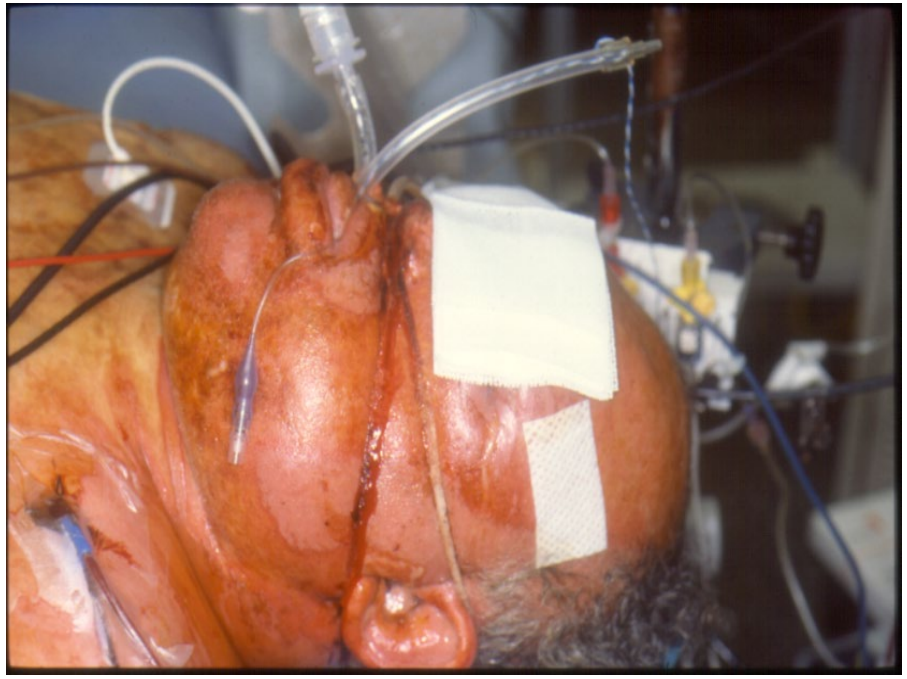
Adapted from Murphy CV, PSAP 2014 Critical and Urgent Care

Treatment

- General Procedures
- Fluid Resuscitation
- Infection Control
- Pain Management

Smoke Inhalation Injury

- Increased mortality.
- Increased fluid requirements during resuscitation.
- Increased risk for ventilator-associated pneumonia.



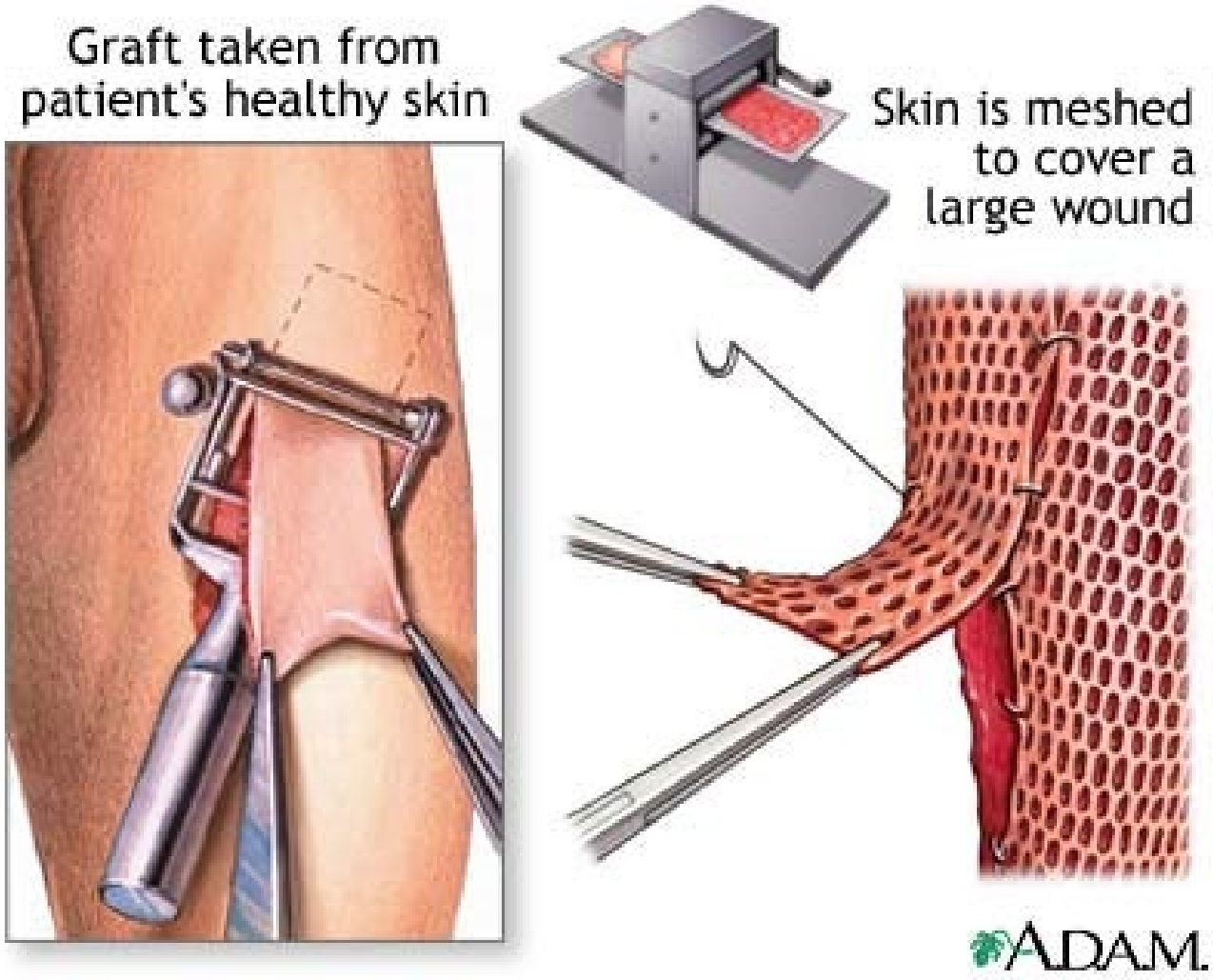
Smoke Inhalation Injury

- Additional complications
  - Cyanide poisoning
    - Treatment options:
      - Amyl nitrite
      - Sodium nitrite
      - Hydroxycobalamin
      - Sodium thiosulfate
  - Carbon monoxide poisoning
    - Treatment:
      - 100% oxygen
      - Hyperbaric oxygen (HBO)

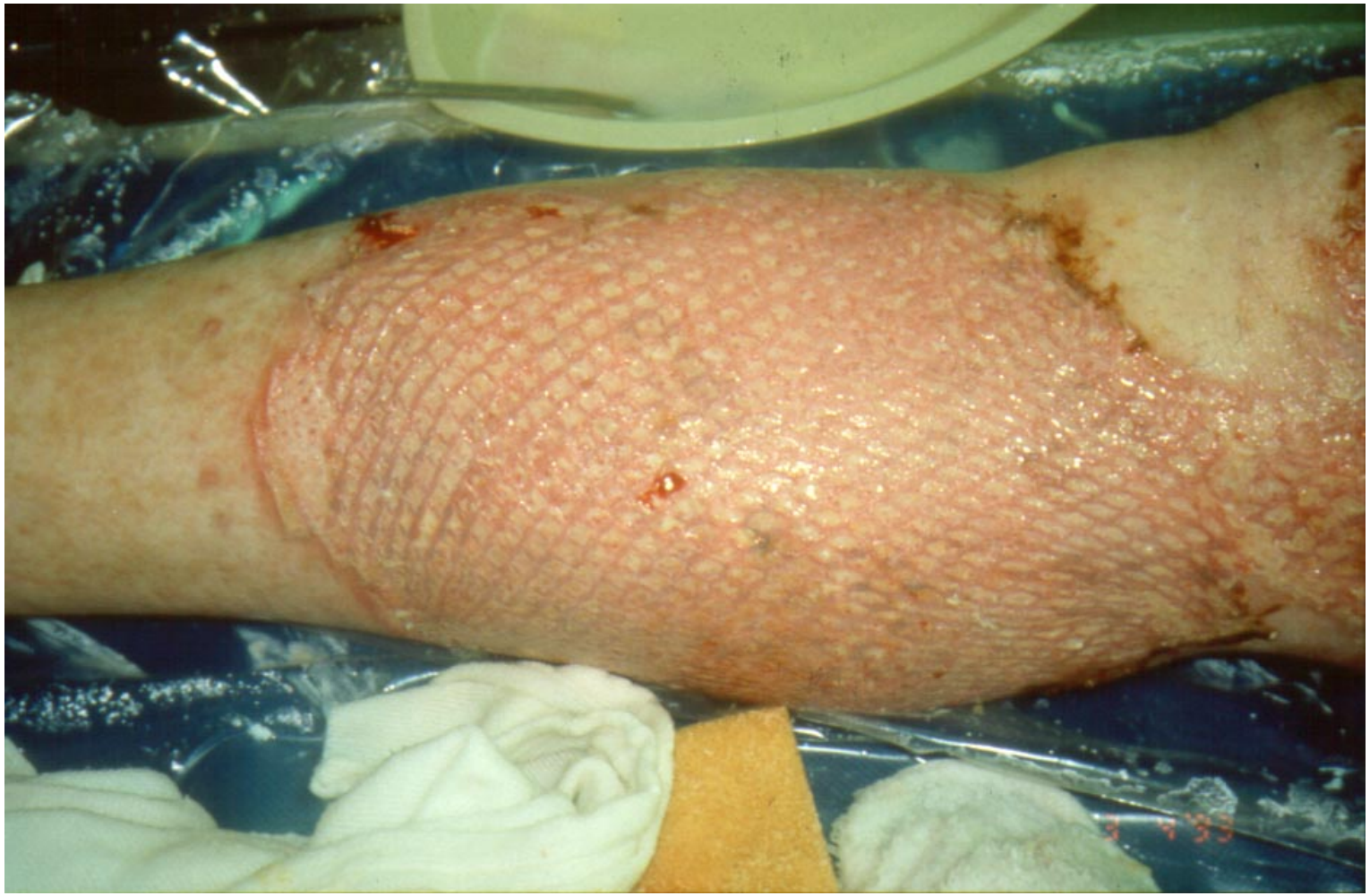
Surgical Intervention

- Partial thickness wounds (2°) the dermis and epidermis will regenerate, so they may require excision of the superficial dead tissue and a temporary covering.
  - Allogenic grafts (cadaver, pig)
  - Synthetic (Integra)
- Full-thickness wounds require excision and grafting.
  - Autologous grafts (split-thickness vs. full-thickness)
  - Donor sites

Split-thickness Skin Graft



Split-thickness Skin Graft



Fluid Resuscitation

Under-resuscitated

- Decreased perfusion
- Acute renal failure
- Death

Optimal

Supports end organ perfusion

Over-resuscitated

- Worsening edema formation
- Elevated compartment pressures
- ARDS, multi-organ dysfunction

Burn Shock

- Combination of distributive and hypovolemic shock.
  - Intravascular depletion.
  - Low pulmonary artery occlusion pressures.
  - Elevated systemic vascular resistance.
  - Depressed cardiac output
    - Decreased plasma volume
    - Increased afterload
    - Decreased contractility

Fluid Resuscitation

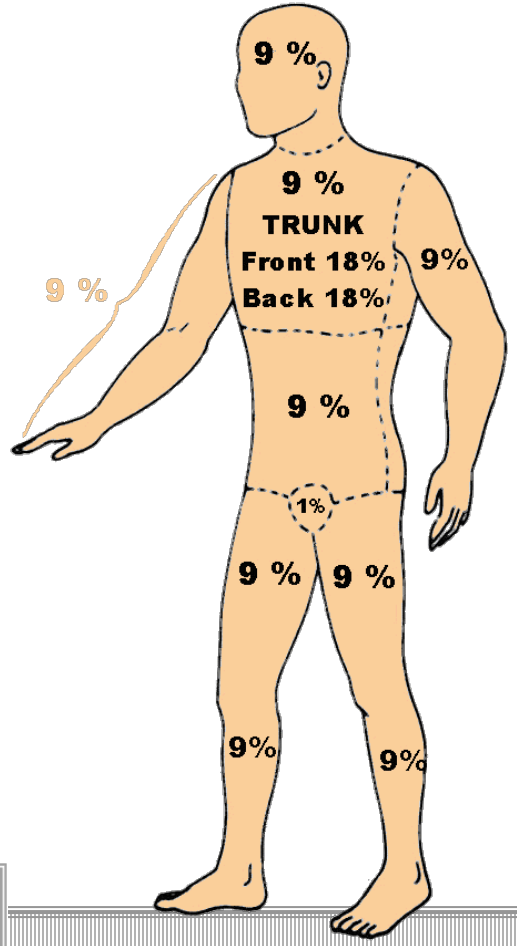
- Burns greater than 20% total body surface area (TBSA):
  - Associated with increased capillary permeability.
  - Intravascular volume deficits.
- Therefore, as a general rule, fluid resuscitation will usually be done if there are 2° burns on more then 10% of TBSA
- Crystalloids
  - Lactated Ringer's (LR)

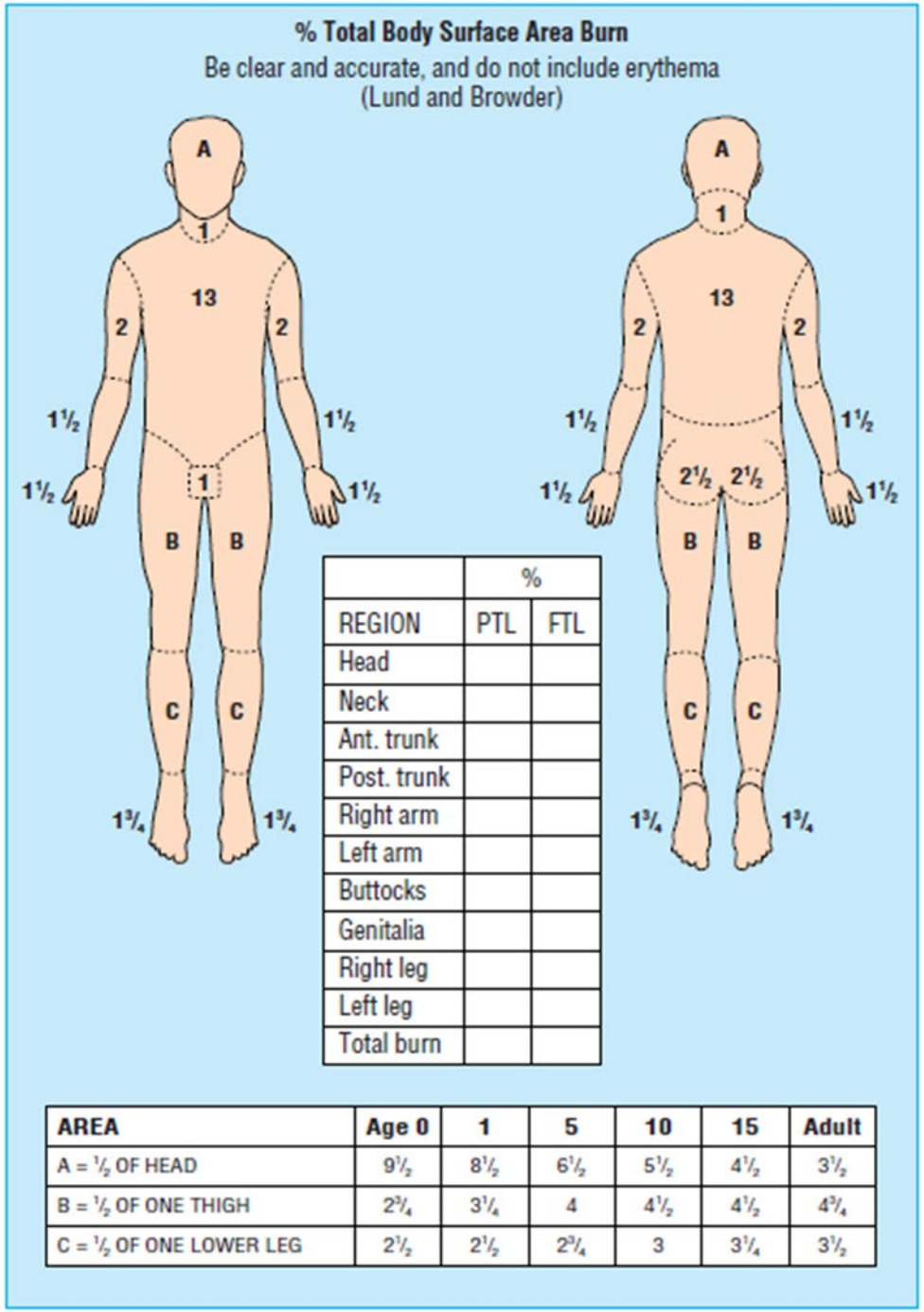
Fluid Resuscitation

- **Parenteral Intake**
  - **Determine body surface area burn (BSAB)**
  - **Determine patients body mass in Kg.**
  - **Use Lactated Ringers (LR) as the initial replacement fluid.**
  - **Select the correct resuscitation formula based on body mass.**

TBSA Burned

Rule of Nines Lund-Browder:





	%	
REGION	PTL	FTL
Head		
Neck		
Ant. trunk		
Post. trunk		
Right arm		
Left arm		
Buttocks		
Genitalia		
Right leg		
Left leg		
Total burn		

AREA	Age 0	1	5	10	15	Adult
A = ½ OF HEAD	9½	8½	6½	5½	4½	3½
B = ½ OF ONE THIGH	2¾	3¼	4	4½	4½	4¾
C = ½ OF ONE LOWER LEG	2½	2½	2¾	3	3¼	3½

Parkland Formula:

(if the patient is more than 30 Kg)

Volume = (% BSAB)(Body Mass Kg) 4 ml/Kg

- Give one-half of this in first 8 hours
- And remaining one-half in the next 16 hours after injury.

Parkland Formula:

(if the patient is more than 30 Kg)

- **Sample Calculation:**
  - (60% BSAB) (80 Kg) (4 ml/Kg) = 19,200 ml LR/24 hours
  - Give 9,600 ml over the first 8 hours or 1200 ml/hour
    (initial rate estimate, but titrate as necessary)
  - Give 9,600 ml over the next 16 hours or 600 ml/hour

Galveston Formula:

(if the patient is less than 30 Kg)

Volume = (BSA in m²)(2000 ml) +
(BSA in m²)(% BSAB) 50 ml

- **Give one-half of this in first 8 hours**
- **And remaining one-half in the next 16 hours after injury.**

$$BSA = (HT in\ cm)^{0.3964} \cdot (WT\ in\ Kg)^{0.5378} \cdot 0.024265$$

Galveston Formula:

(if the patient is less than 30 Kg)

- **Sample Calculation (BSAB=20%, 30 in, 18Kg Child):**
  - **(0.65 m^2)(2000 ml)+(0.65 m^2)(20) (50 ml) = 1950 ml LR/24 hours**
  - **Give 122 ml/Hr over the first 8 hours**
  - **Give 61 ml/Hr over the next 16 hours**

$$BSA = (HT\ in\ cm)^{0.3964} \cdot (WT\ in\ Kg)^{0.5378} \cdot 0.024265$$

Fluid Resuscitation

Please Note - These formulas only forecast well in seven of every 10 patients -- burns are not homogenous injuries and individuals do not respond in the same patterns. Therefore the patient's response will guide titration.

Colloids

- Hetastarch (Hespan) > 25% BSAB
  - At a rate of 1 liter/24 hour (40 ml/hour) in adults. Children (30 Kg or less and with burns of more than 25% BSAB) at a proportionally lower rate.
- Mannitol for hemoglobinuria or myoglobinuria on admission.
  - Give Mannitol 0.25 gm/Kg body mass as an initial IV bolus. Then give Mannitol infusion at 0.05 gm/Kg/hour until the urine is clear.

Titration Guidelines

- **Hourly urine output < goal**
  - First hour - rate by 10%
  - Second hour - rate by another 10%, notify the physician.
- **Hourly urine output > goal**
  - For 2 consecutive hours, ↓ rate by 10% of the initial rate.
  - Continue to titrate down by 10% of the original rate every hour as long as urine output exceeds hourly goal.

Fluid Resuscitation

- Pediatric considerations
  - Require more fluid than adults with similar burn size
    - BSA-to-weight ratio higher than adults
  - Glucose homeostasis
    - Hepatic glycogen stores in young children are depleted after 12-14 hours of fasting
      - Include dextrose source in fluids
      - Early enteral nutrition

Oral Intake

- For BSAB ≥ 20%, insert NG.
- Patients are N.P.O. until they are completely resuscitated.
- Begin intragastric feedings in adults at 20 ml/hour.
- Begin PO fluids when IV rate at maintenance, advance diet as tolerated.

Infection

- Sources for infection
  - Wounds
    - Early Cellulitis
      - *Staphylococcus sp., Streptococcus sp.*
      - Antibiotics
        - Penicillin + Clindamycin
    - Later wound infections
      - *Pseudomonas*, mold, etc.
  - Bloodstream
    - Central lines
  - Ventilator-associated pneumonia
    - MRSA + *Pseudomonas* coverage
  - No indication for systemic antibiotic prophylaxis

Wound Surveillance

- Admission surveillance cultures.
- Routine weekly surveillance cultures.
- Cultures should be obtained whenever the wound has abnormal drainage or color.

Topical Antibiotics

- Wounds will be initially dressed with silver sulfadiazine (Silvadene).
  - Cream is standard and should routinely be used.
  - But, use a slurry of silver sulfadiazine on gauze (wet dressing) on fresh grafts.
- Sulfamylon will be used to cover wounds with significant eschar.
- When wounds have sufficiently closed, triple antibiotic can be used.

Prophylactic Use of Systemic Antibiotics.

- Prior to going to the OR and for 24 hours afterwards.
- A single antibiotic should be used.
  - For Coag negative staph (CNS) use vancomycin.
  - For gram negatives use gentamicin.
  - If there is no growth on any culture use cefazolin.

Treatment of Wound Infections

- Culture and sensitivity results.
- Empiric therapy.
- Treatment of wound infections is not restricted to 5 to 7 days.

Hypermetabolism

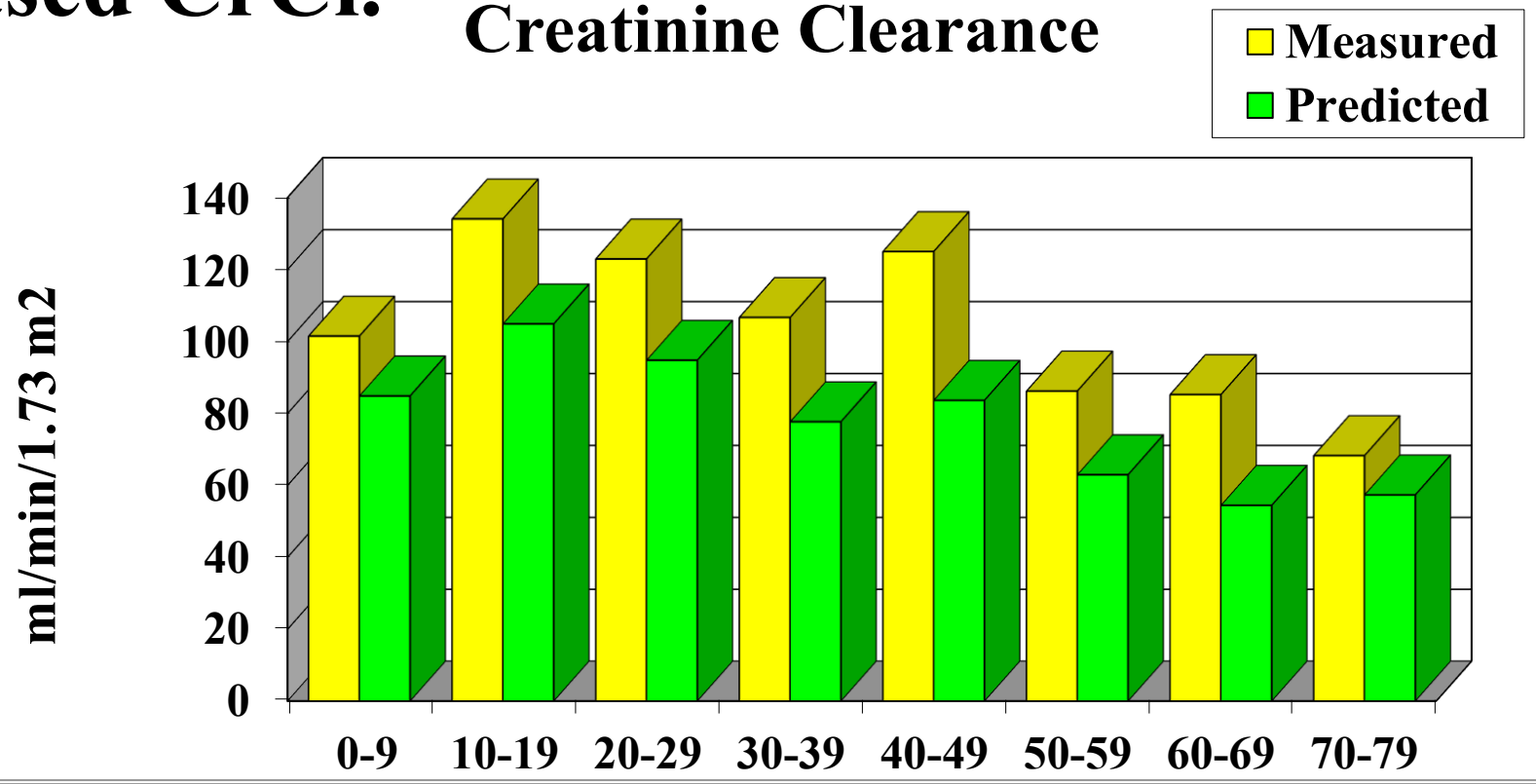
- Begins 48 hours after injury.
  - It is a proinflammatory state promotes gluconeogenesis, glycogenolysis and insulin resistance.
- Resting energy expenditure increases up to 180-200% of the basal metabolic rate.
- If untreated, can lead to:
  - Muscle wasting
  - Delays in wound healing
  - Increased risk of infection

Drug Dosing in Hypermetabolic States

- Data is often limited, but there may be:
  - Increased volume of distribution.
  - Increased clearance.
  - Shortened half-life.

Creatinine Clearance

- Burn patients are hypermetabolic and have an increased CrCl.



Monitoring of Antibiotics

- Vancomycin and aminoglycoside dosages must be selected appropriately for the patients size, renal function and extent of burn.
- Renal function should be monitored at least every 3 days.
- Serum drug levels do not need to be monitored when the antibiotics are used prophylactically.

Pain Management

- Assessment of pain
  - Pain ratings are expected to be 3 or less on the VAS, alternatively use the faces scale.
- Give the maximum amount of pain medication ordered.

Wong Baker
Faces Pain Scale

Pain Management

- Types of Pain
  - Procedural pain
    - Hydrotherapy, therapy
    - Intense, burning, sharp pains
  - Anxiety associated with procedural pain
    - Correlation between pain, physiological distress, and physical and psychological outcomes.
    - Anxiety and distress significantly related to overall pain.

Pain Management

- Types of Pain
  - Background pain
    - Prolonged duration, constant nature
    - Mild to moderate intensity
  - Breakthrough pain
    - Transient worsening of pain most frequently associated with movement

Pain Management

- **Phases of Burn Pain Management**
  - **Acute phase**
    - Fluid shifts, physiological response
    - Procedural pain
  - **Healing phase**
    - Maintaining clean wound bed → procedural pain
  - **Rehabilitation phase**
    - Inflammatory response subsides
    - Aggressive PT/OT, stretching, etc.

Fluid Resuscitation and Immediate Postop Period

- Morphine
  - IV 0.1 mg/kg Q2-4H
  - PCA
  - Oral 0.3 mg/kg Q2-4H
- Midazolam – Not post-op
  - IV 0.03 mg/kg

Wound Care Phase

- MS Contin will be given every 8-12 hours around the clock.
  - Adults: 30 - 60 mg Q12H
  - Children (8-16): 15 - 30 mg Q12H
- MSIR will be given before each hydrotherapy and on a PRN basis.
  - Dosage: 0.3 mg/kg Q2-4H
  - It is given 15 – 30 minutes prior to planned painful events.

Conscious Sedation

- It is the combination of an opioid (for pain relief) and a benzodiazepine (for sedation) to the extent that:
  - The patient will relax and appear to be asleep,
  - Yet, the patient is alert enough to respond to commands and cooperate with the care giver.
  - An added benefit is that because of the amnestic effect of many benzodiazepines, the patient will not remember the procedure.
- Midazolam
  - IV 0.03 mg/Kg 2-3 minutes before
  - Oral 0.3-0.5 mg/Kg 20-30 minutes before

Wound Care Phase

- 2 % Topical Lidocaine
- Tylenol
  - Dosage: Children 10 - 15 mg/kg/dose Q4H prn
  - Dosage: Adults: 650 mg Q4H prn
- Morphine Allergies
  - Meperidine
  - Hydromorphone
- Do not use NSAIDs.

Non-pharmacologic Approach to Pain Management

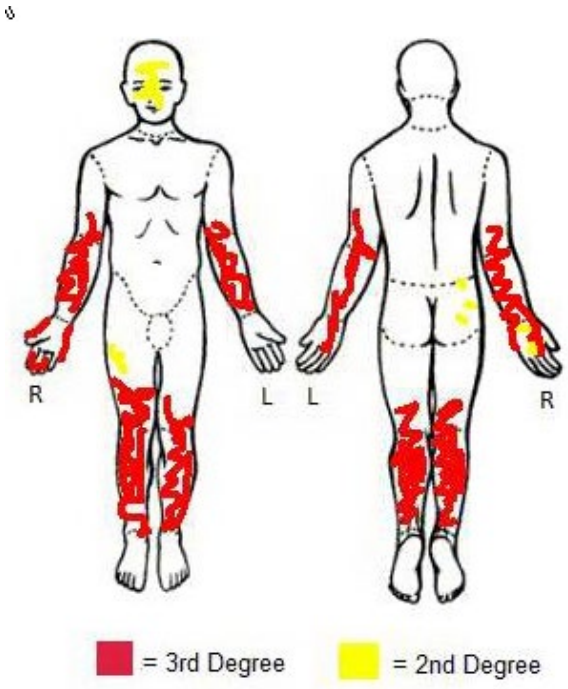
- Distraction Techniques
  - Classic Example - Lamaze
  - Audio/Video
  - Prayer and Meditation
- Hypnosis

Discharge/Rehab Phase

- MS Contin and Midazolam should be discontinued at least 2 days before planned discharge.
- MSIR should be continued for pain associated with PT and dressing changes.
- Outpatient prescriptions for MSIR.

Case Example #1

- DB is a 27-year-old male who is admitted with a 32% TBSA burn after falling into a campfire.
- He has no past medical history and no known allergies.
- He is 65 inches tall and weighs 75 kg



Case Example #1

- Using the Parkland formula, calculate DB's fluid resuscitation needs:
  (%BSAB)(Body mass kg)(4 ml/LR)
- (32% BSAB)(75 kg)(4 ml/LR) = 9600 ml over 24 hours
- Give 4800 ml over first 8 hours = 600 ml/hr

Case Example #1

- On hospital day #2, DB is scheduled to have a dressing change. What would be an appropriate medication to give to DB prior to this procedure?
  - Morphine immediate release 30 mg 1 hour prior
  - Morphine extended release 30 mg 1 hour prior
  - Acetaminophen 650 mg 1 hour prior
  - Methadone 5 mg 1 hour prior

Case Example #1

- On hospital day #4, DB has increased redness, warmth, and tenderness that has developed on his right thigh. He was febrile overnight and his white blood cells have increased to 15,000 cfu/ml. What is your diagnosis?

  - Cellulitis

Case Example #1

- **What organism(s) is most likely causing cellulitis on DB right now?**
  - *Streptococcus sp.*
  - *Staphylococcus sp.*
  - *E. coli*
  - *Aspergillus sp.*

Case Study #2

- 21 Y.O. WM was asleep at home when the house caught fire. How should the patient be fluid resuscitated?
  - The paramedic examines the victim, estimates his weight at 80 Kg and reports that both legs are burned, and the right side of his face. What fluid and what rate do you recommend over the radio?

Case Study #2

- **Using the Rule of Nines:**
  - **BSAB is approximately 40%**
- **Parkland Formula:**

  (40 %)(80 Kg)(4 ml/Kg) = 12,800 ml
  - **Give 6400 ml over 8 hours (800 ml/hr)**
  - **Give 6400 ml over 16 hours (400 ml/hr)**
  - **Use Lactated Ringers**

Case Study #3

- Once the patient is at the Burn Treatment Center and fluid resuscitation is complete, he underwent skin grafting. During his recovery period he needs pain management. What drugs and what dose what you use for this patient?

Case Study #3

- For background pain:
  - MS Contin 30 mg Q12H
- For procedure pain & breakthrough pain:
  - MSIR 25 mg Q2-4H prn
  - Midazolam PO 25-40 mg prn
  - Acetaminophen 650 mg Q4H prn