Burn Care: What Emergency Providers Need to Know

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I Have No Disclosures

Goals of Talk

- Burn Referral Criteria
- Smoke Inhalation
- Patients smoking on home oxygen
- Burn Wound
  - Identifying location of Burn
  - Determining Burn Depth
  - Identifying location of Burn
- Burn Resuscitation
- Care of small burns

ABA Referral Criteria

1. Partial thickness burns greater than 10% total body surface area (TBSA).
2. Burns that involve the face, hands, feet, genitalia, perineum, or major joints.
3. Third degree burns in any age group.
4. Electrical burns, including lightning injury.
5. Inhalation Injury.
6. Chemical Burns

ABA Referral Criteria

- 7. Burned children in hospitals without qualified personnel or equipment for their care
- 8. Any patient with a burn and trauma where the burn poses the greater risk of morbidity or mortality
- 9. Burn injury in patients who require special social, emotional, or rehabilitative intervention.

Basics of Burn Care

- Identify Smoke Inhalation
- Burn Resuscitation
- Evaluation of the Burn Wound
  - Location of Burns
  - Determine Burn Depth
  - Determine Burn size and Total Body Surface area
- Keep Patient Warm

Prehospital Care

EMS and Fire Fighters

- Remove patient from site of injury
- Stop the burning process
- Keep patient warm
- Transport to site definite care

Who needs IV Fluids: PreHospital Setting

- Burns greater than 20% TBSA with transport time of greater than 60 minutes
- Presence of hypovolemic shock or hemorrhagic shock if have associated injuries
- If need to give IV medications

Fluid Resuscitation in Pre-Hospital Setting

- These fluid rates can be utilized before estimating burn size.
- Lactated Ringers
  - 5 years and younger: 125 ml/hr.
  - 6 -13 years old: 250 ml/hr.
  - 14 years and older: 500 ml/hr.

Advanced Burn Life Support Provide Manual 2018 Update

Preparation for Burn Patient Arrival in ED

- Wear appropriate PPE
- Notification of Trauma team of patients arrival
- Makes sure Equipment for airway support present
- Have different methods available to establish IV access.
- Information on patients mechanism of burn and vitals prior to arrival

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Mechanism of Injury

- Determines risk of Inhalation Injury
- May indicate risk for associated trauma.
- May indicate risk for multiple injured

Burn Injured Patient is a Trauma Patient

DeBoer S and O'Connor A. Prehospital and Emergency department Burn Care. Crit. Care Nurse Clin N Am 16(2004)

ABC's of Initial Burn Care

Goals in ED

1. Perform Primary Survey to identify life threatening injuries
2. Evaluate for evidence of Smoke Inhalation and Carbon Monoxide Poisoning
3. Establish IV's and start resuscitation if burn size indicates.(20%A, 15%P)
4. During secondary survey assess location and depth of burns
5. Identify patients at risk for compartment syndrome
6. Contact burn center for transfer
7. Cover burns wounds with dry sheets (KEEP WARM)
8. Tetanus

Foley placement

1. Intubated patients
2. Resuscitation

Risk of Hypothermia

- Burns greater than 20%
- Polytrauma
- GCS < 8
- The need for extraction at the seen
- Age > 60

Keep Patients Dry and Warm

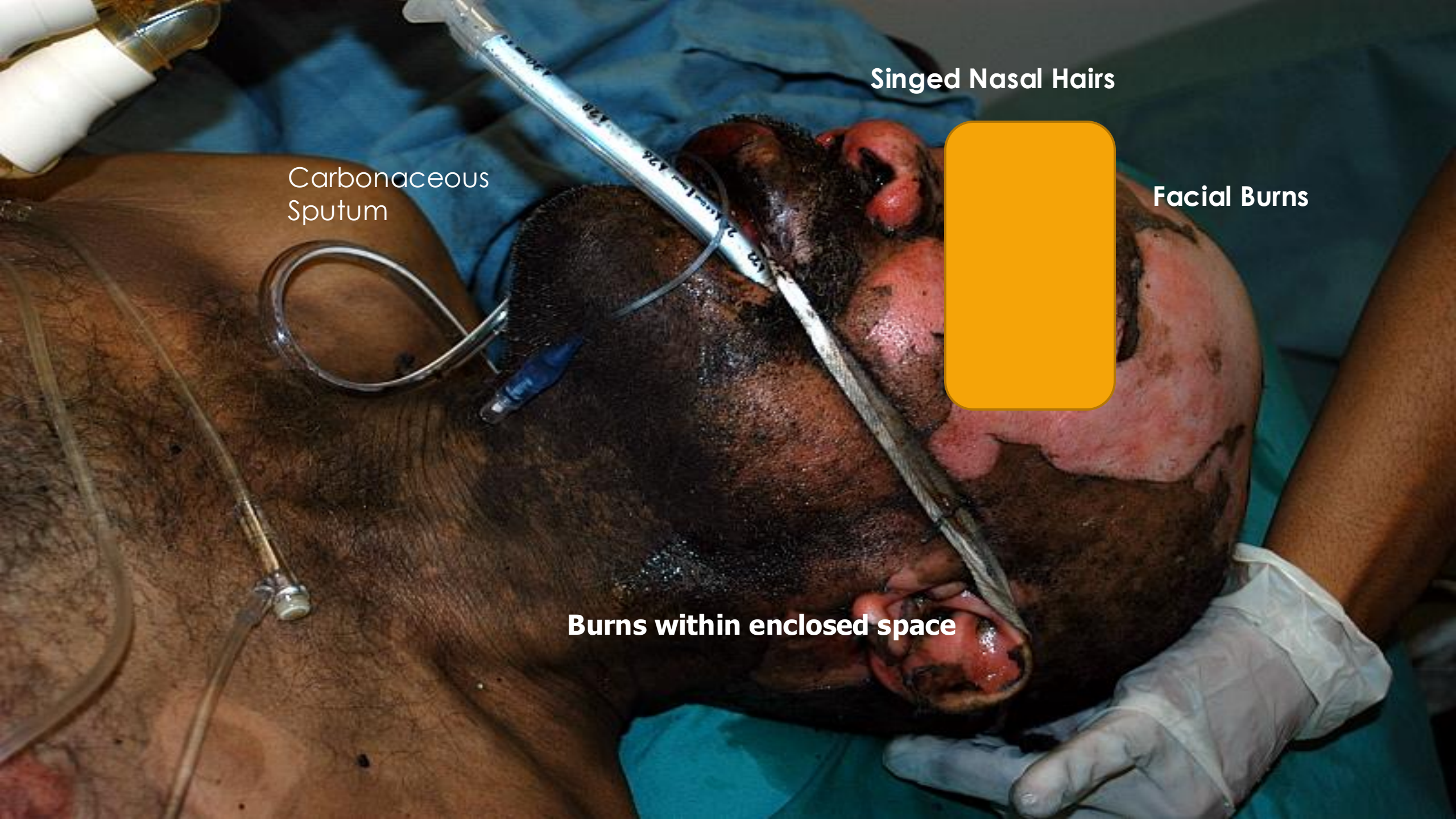
Weaver MD et al Risk Factors for Hypothermia in EMS treated Burn Patients. Prehospital Emergency Care Vol 18. 2014

Causes of Hypotension: Presentation

- Trauma
- Cyanide and Carbon Monoxide poisoning
- High Voltage Electrical Injuries
- Delayed presentation after injury
- Burn Injury precipitating Myocardial injury or MI
- Drugs
- ETOH

Pitfalls to Avoid during Initial Assessment

1. Overestimation of Burn Size
2. Including first degree burns in estimate of TBSA
3. Failure to identify Smoke Inhalation Injury
4. Giving fluid boluses
5. Missing associated injuries
6. Assuming hypotension is from burn injury
7. Failure to check temperature on presentation:


Singed Nasal Hairs
Facial Burns
Carbonaceous Sputum
Burns within enclosed space

Classification Of Smoke Inhalation Injury

- Airway injury above the Vocal cords
- Airway injury to distal airways and lungs
- Systemic toxicity
  - Cyanide poisoning
  - Carbon monoxide

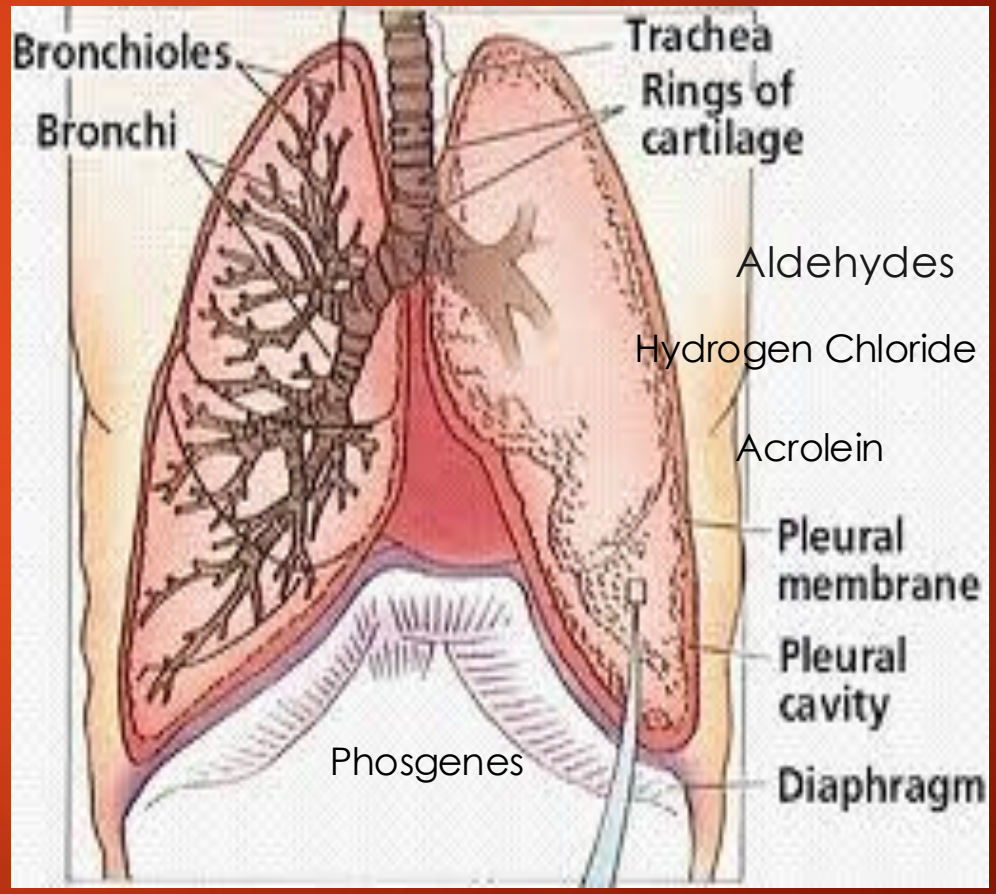
Upper airway injury

- Thermal Injury
  - Contact From Hot Gases
  - Contact From Hot Liquids
- Manifestation often delayed till After resuscitation is started
- Heat Absorptive capacity of upper airways prevents this type of injury to the lower airways

Dries et al: Scandinavian J of Trauma, Resuscitation, and Emergency Med. 2013

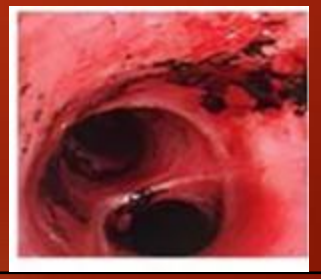
Lower airway and Lungs

- Mucosal separation
- Formation of airway edema
- Loss of clearance mechanism of ciliated epithelium
- Develops proximal to distal distribution



Herndon and Barret et al 2001

Bronchoscopic Findings

Grade (Injury)	Description	
0 (None)	Absence of carbonaceous deposits, erythema, edema, bronchorrhea, or obstruction	
1 (Mild)	Minor or patchy areas of carbonaceous deposits, erythema, edema, bronchorrhea, or obstruction	
2 (Moderate)	Moderate degree of carbonaceous deposits, erythema, edema, bronchorrhea, or obstruction	

Bronchoscopic Findings, continued

Grade (Injury)	Description	
3 (Severe)	Severe inflammation with friability; copious carbonaceous deposits, bronchorrhea, or obstruction	
4 (Massive)	Evidence of mucosal sloughing, tissue necrosis, and/or endoluminal obstruction	

Inhalation Injury Pathophysiology of Lung Involvement

- Flooding of the alveoli
  - Rise in pulmonary capillary pressure
  - Marked elevation in permeability to proteins
- Neutrophil
  - Release of oxygen free radicals
  - Adherence of PMNs to endothelium
- Adherence Molecules
  - Upregulated
  - Mediators: LTB4, IL-8, TXB2, and TNFa

Traber et a 2002, Sheridan et al 2002

Cyanide Poisoning and Carbon Monoxide Poisoning

- Autopsy study of 178 deaths from burns, fire , or Smoke Inhalation
  - 62% of victims had positive cyanide level
  - 72% of victims had elevated Carbon Monoxide Levels
- New Jersey Data base looking at fire deaths
  - 75% victims had elevated cyanide levels
  - 87% victims had elevated Carbon monoxide levles

Anseeuw et al. Cyanide inhalation: European Journal of Emergency Medicine 2013, Vol 20 No 1

Smoke Inhalation Injury

Cyanide Poisoning

- Blocks enzyme system for Oxidative phosphorylation in mitochondria
- No readily available way to measure cyanide levels
- Lactate is surrogate marker used for possible CN poisoning: > 8
- Confusion, coma, altered mental status

Carbon Monoxide Poisoning

- Blocks enzyme system for Oxidative phosphorylation in mitochondria
- Binds to Hgb displacing oxygen decreasing oxygen delivered to tissues
- Measures levels in venous or arterial blood level. (Normal level is 2 to 5%)
- Confusion, stupor, coma, seizures
- Carbon monoxide can be associated with myocardial injury

Lawson-Smith et al. Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine 2011, 19:14

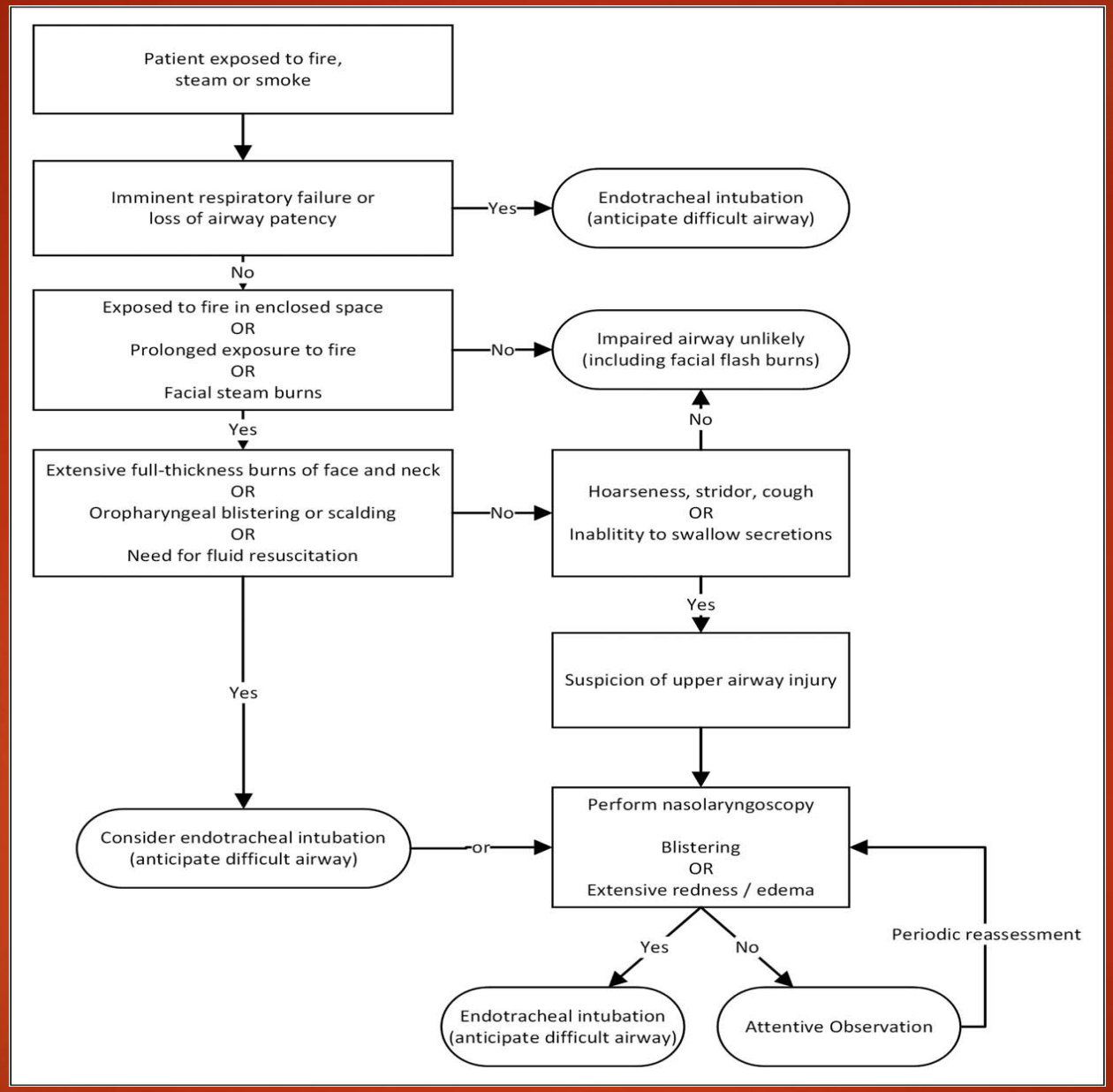
Treatment: Patients at Risk For Smoke Inhalation

- Place on Supplemental oxygen
- Evaluate respiratory status as Primary survey: Intubation
- CXR
- Pulse oximetry
- Blood gas
  - Lactate
  - Carbon Monoxide Level(HgCO)
- Elevated Lactate above 7.0 consider giving Hydroxycobolamine
- Elevated carbon monoxide level: keep on 100% oxygen

Indications for Intubation

- Full thickness face burn
- Stridor
- Respiratory distress
- Swelling on laryngoscopy
- Upper airway trauma
- Altered mentation
- Hypoxia/hypercarbia
- Hemodynamic instability
- Singed facial hair
- Suspected smoke inhalation
- Hoarseness

Bedluck JH et al: Defining the criteria for intubation of the Patient with Thermal Burn. 2018(Vol 44)



Gigengack et al. Advances in airway management and mechanical ventilation, www.co-anesthesiology.com.Dec. 2020 Vol 33;No 6

Flash Burns from Smoking on Home Oxygen

- Patient age: 50-75
- Associated chronic respiratory failure
- Suffer other comorbidities
- Most patients have been smoking on home O2 for a while before getting injured
- Characteristic of Burns: Burns usually small and located around nose.
- Can injure mucosa of nose
- Occasionally plastic may melt partially plugging nasal passages
- Advanced Directives

Singer et al Journal of Burn Research Vol. 41, Number 5

Smoking on Home Oxygen

Smoking on Home O2: Airway Management

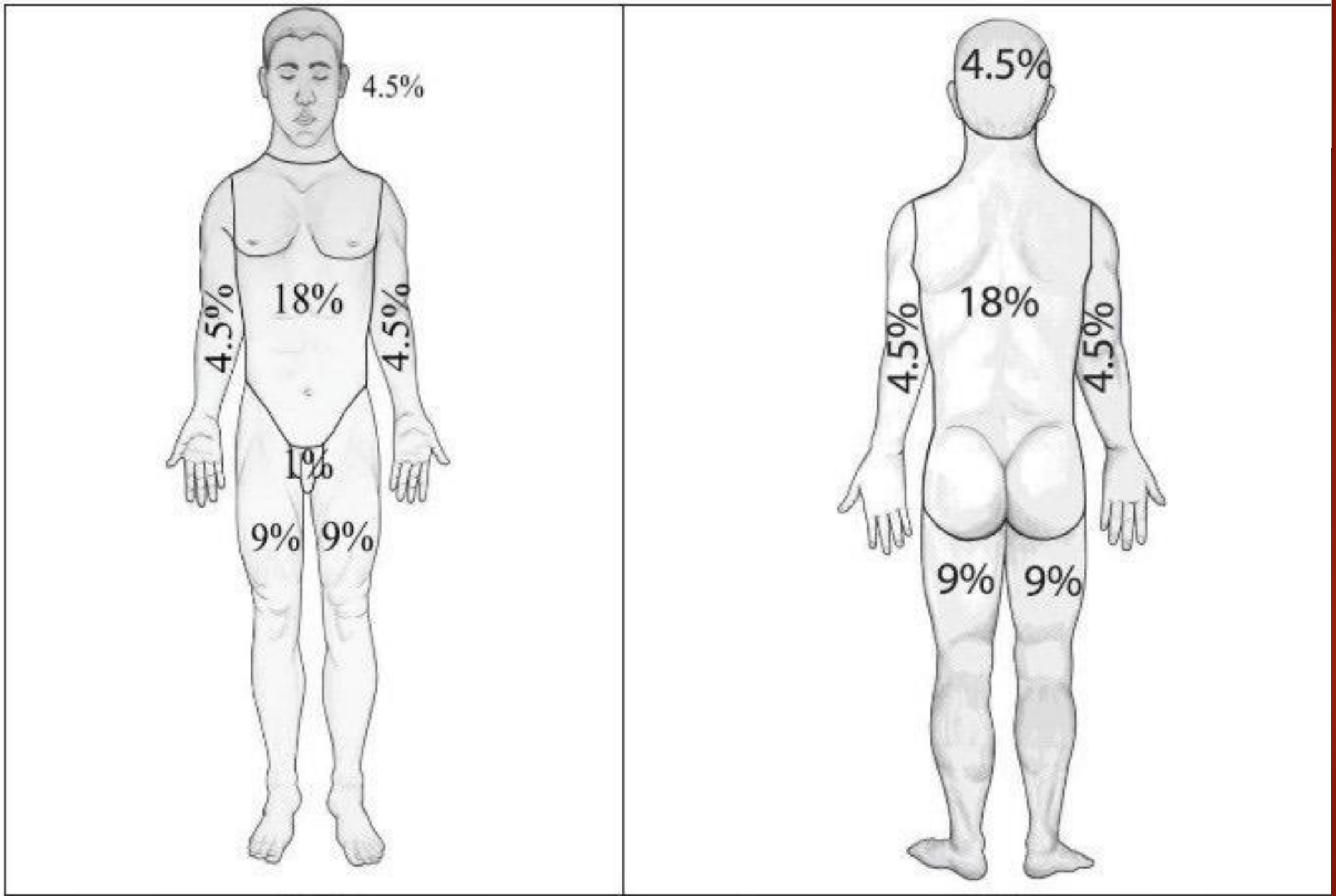
- Unless there is house fire associated with injury will not get smoke inhalation affecting distal airway and lungs.
- There is a remote risk upper airway involvement that would be identified by change in voice or hoarseness.
- Patient will not have normal blood gases secondary to chronic respiratory failure.
- Take care when considering intubation.
- Injury may exacerbate COPD

The Importance of Estimating Burn Size and Depth

- Destination of the injured patient
- Need to Initiate IV fluids for resuscitation
- Risk for Complications
  - Smoke inhalation
  - Hypothermia
  - Myoglobinuria
  - Compartment syndrome

Palm of Hand and Fingers

- Useful for scattered Burns over multiple areas
- Especially for burns less than 10%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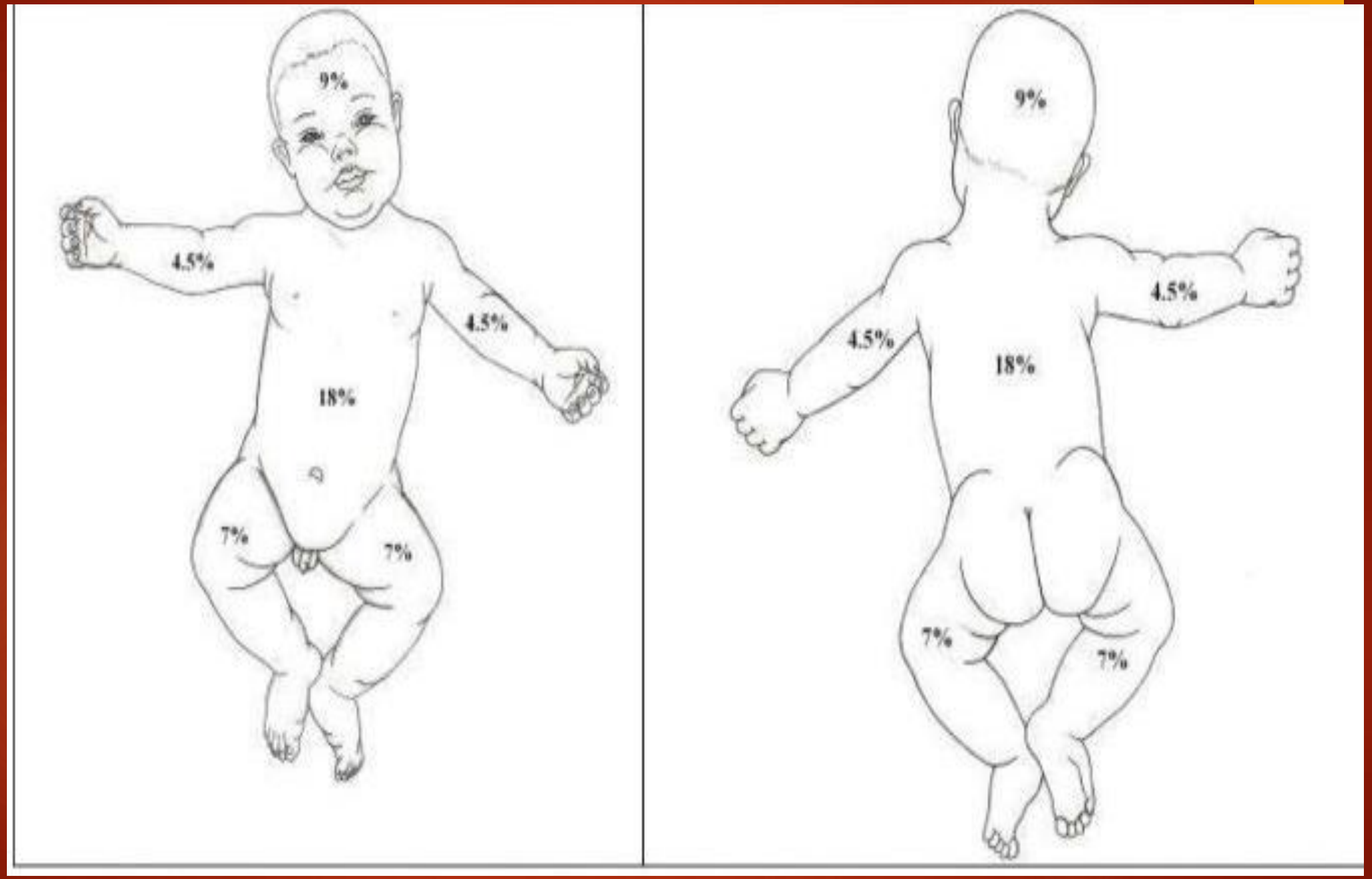
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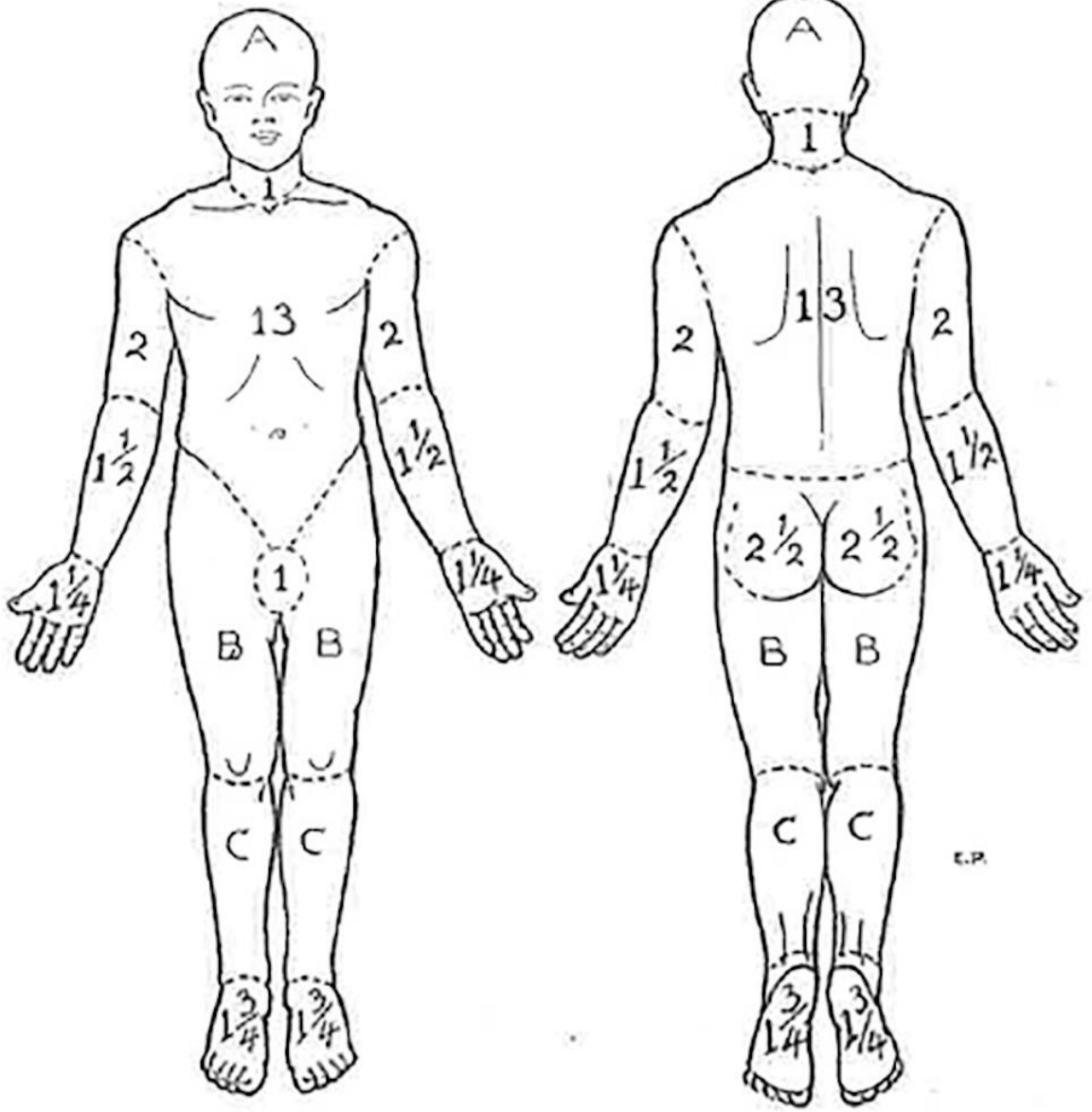
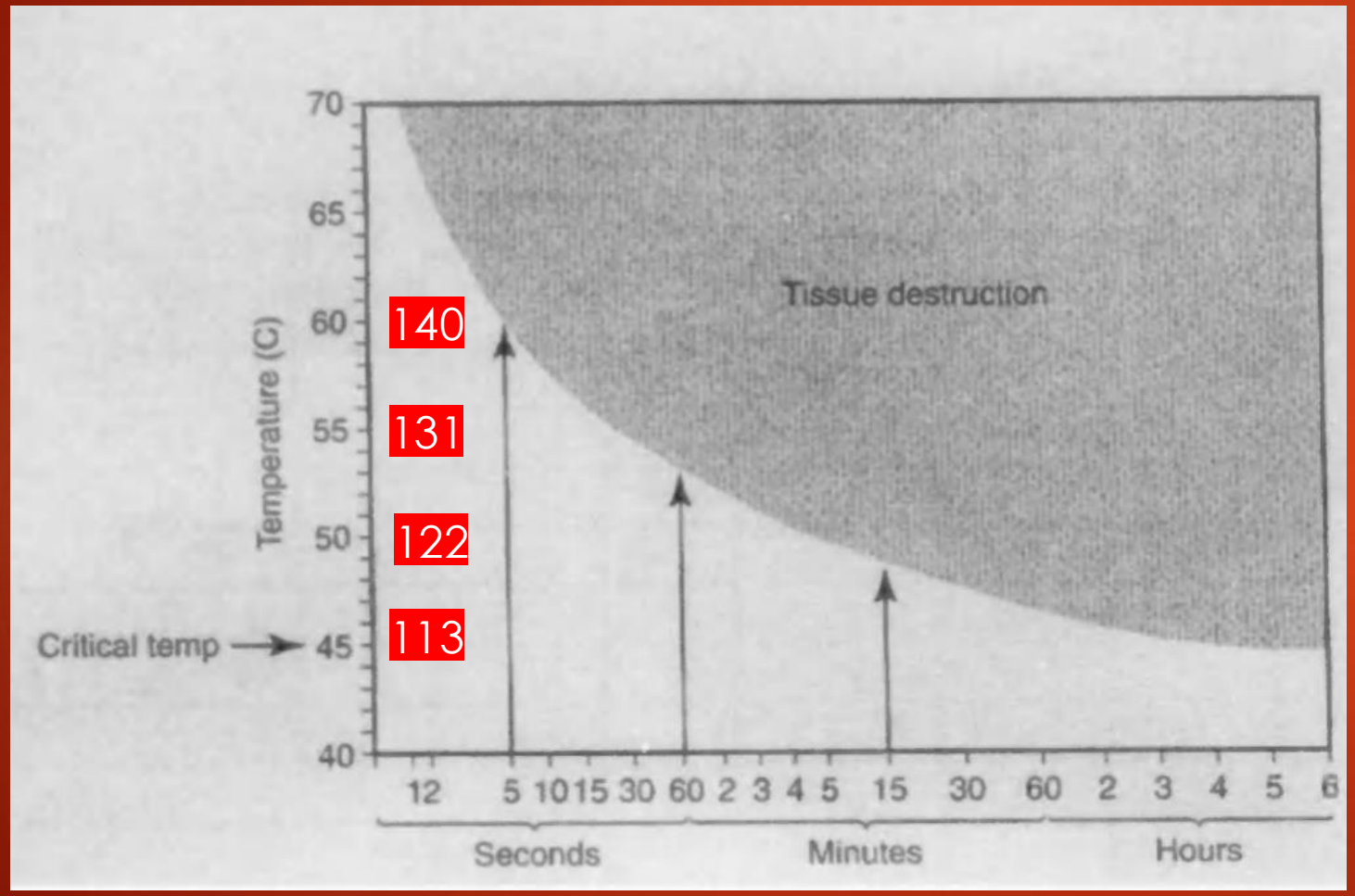


RELATIVE PERCENTAGES OF AREAS AFFECTED BY GROWTH

Area	Age 10	15	Adult
A = ½ of Head	5½	4½	3½
B = ½ of One Thigh	4¼	4¾	4¾
C = ½ of One Leg	5	3¼	3½

% BURN BY AREAS

Relationship between Tissue Injury and Temperature



1. Flash Burns
2. Flame Burns
3. Scald Burns
4. Contact Burns
5. Electrical Injuries
6. Chemical Burns

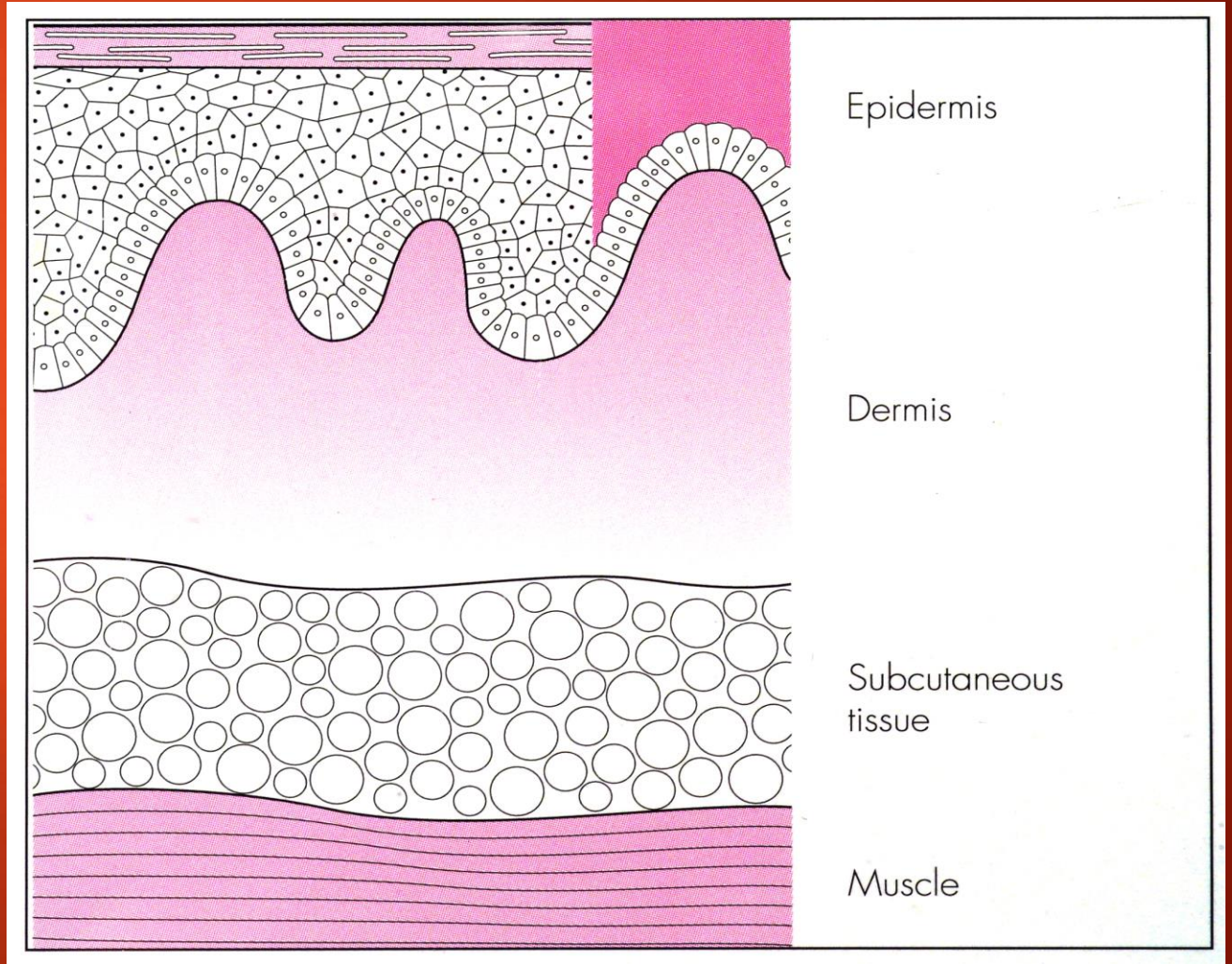
Deboer S et al Crit Careof N Am 2004(16)

Patient Factors that affect Depth of injury

- Location of burn on patient
- Extremes of Age(Thinner Dermis)
- Patients with altered sensation
  - Diabetics
  - Multiple Sclerosis
  - Patients with neuropathy
- Seizure patients
- Patients with altered sensation from drugs or alcohol

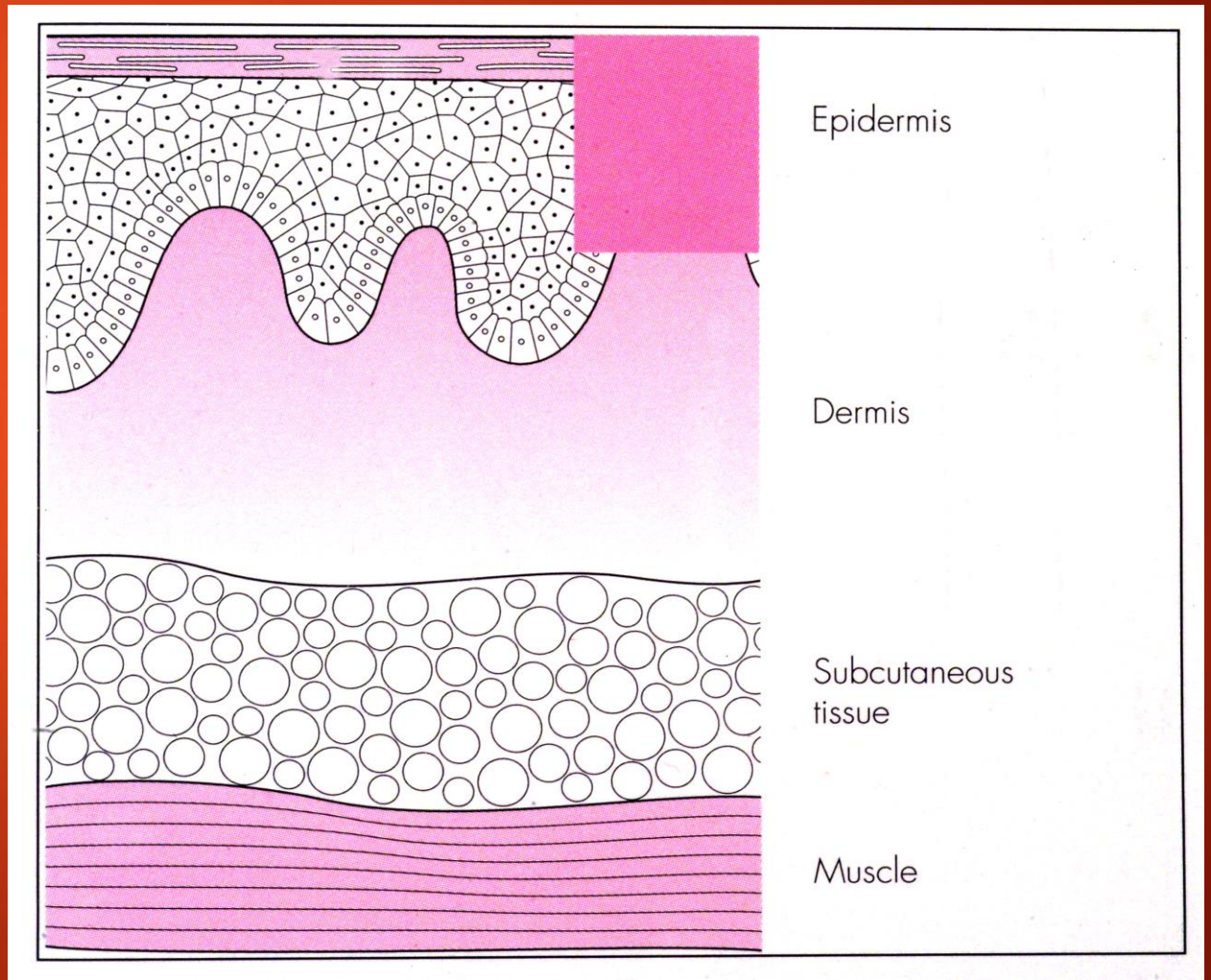
First Degree Burn or Superficial Burn

- These injuries do not penetrate past epidermis
- Are not a requirement for transfer to burn center
- Can be secondary to flash burns
- Not Counted in Estimation of TBSA



Superficial Burn-Second Degree or Superficial Partial Thickness Burn

1. Painful
2. Blistering of the skin
3. Underlying dermis blanches
4. Burn Injury type included in TBSA

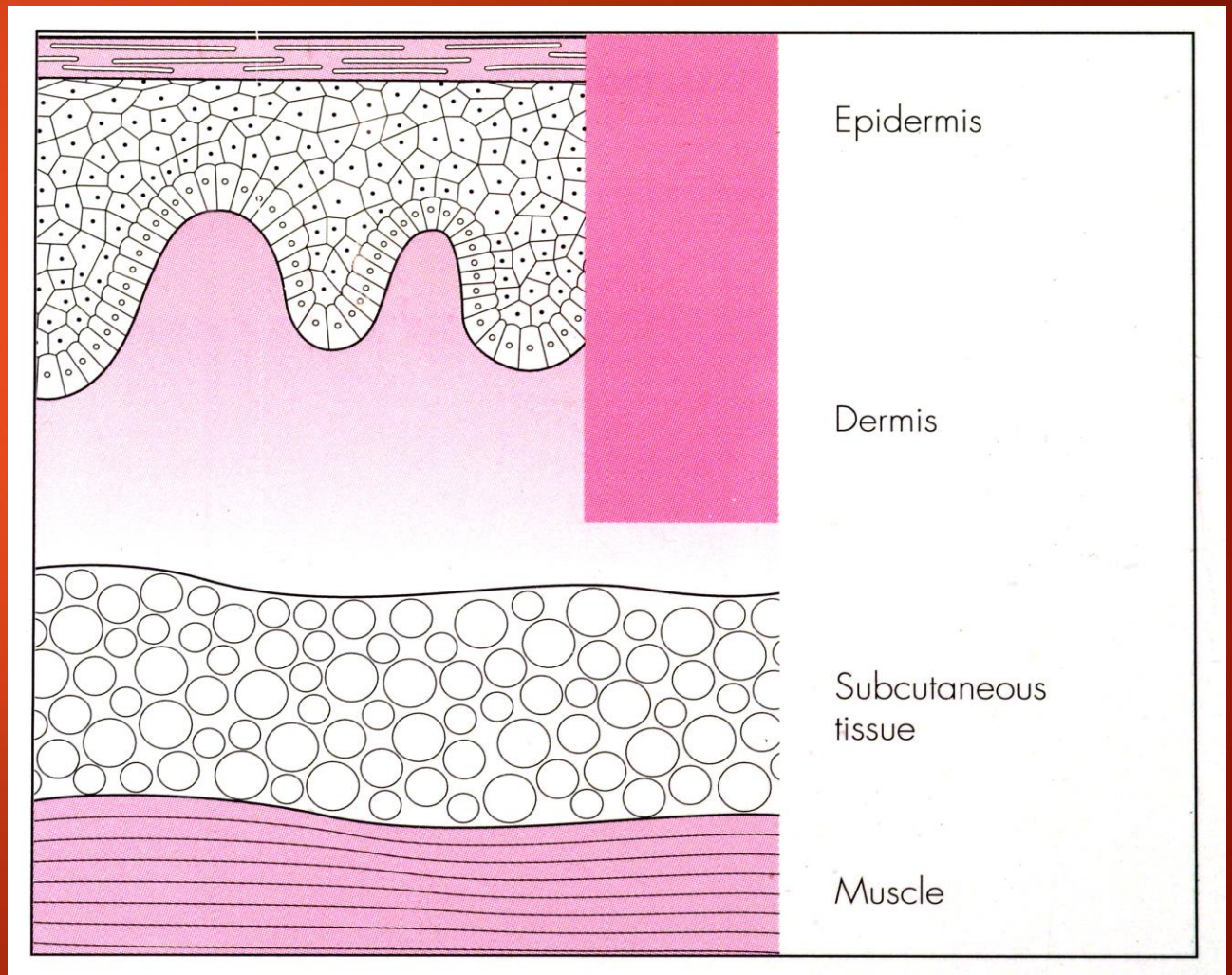


Patient with Scald Burn with Ramen Noodles

Deep Second Degree Burn

Deep Partial Thickness Burns

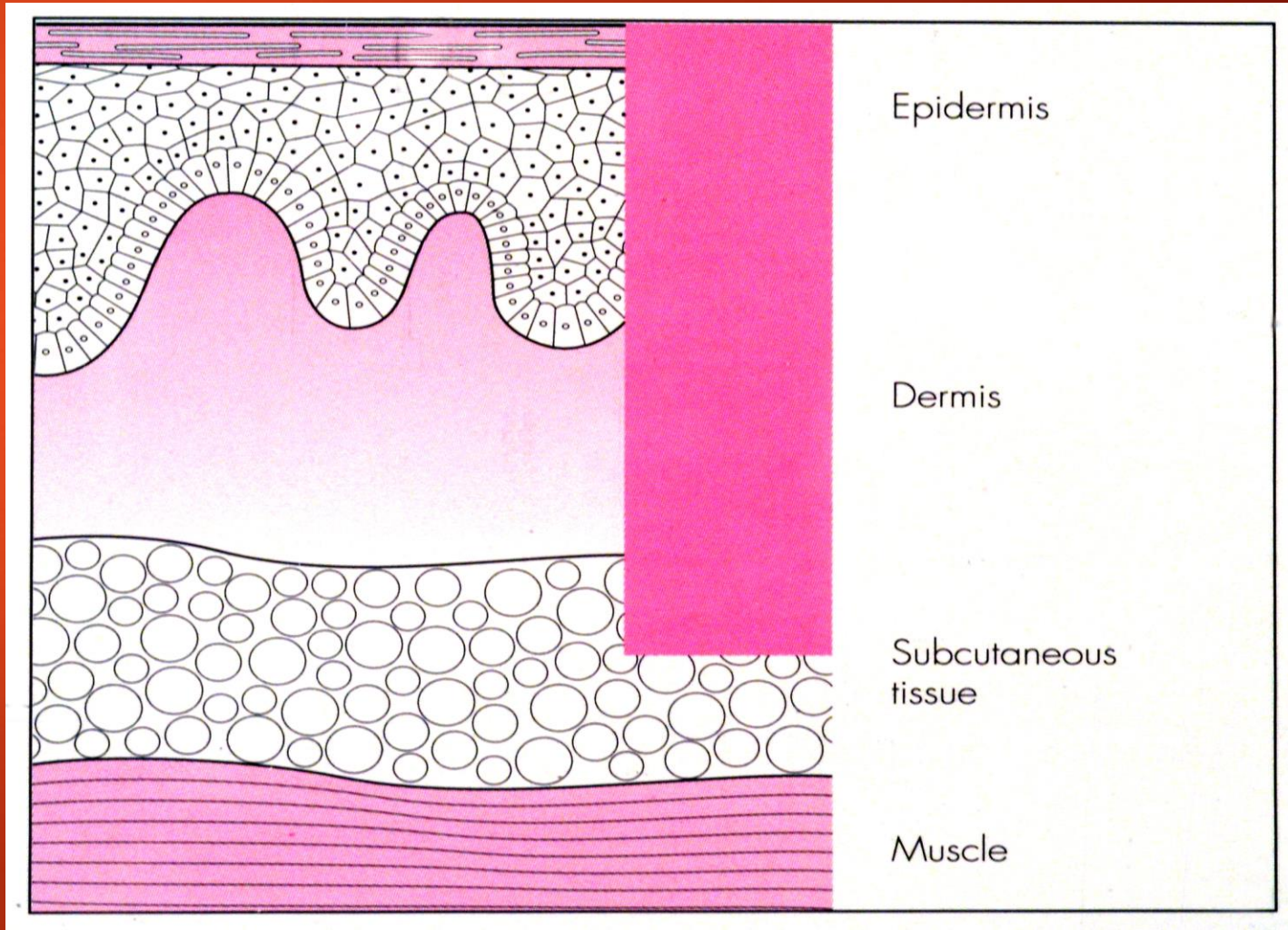
1. May have decreased pain
2. Blister
3. Underlying dermis white
4. Dermis does not blanch
5. Included in TBSA estimation



Third Degree Burn

Full Thickness Burns

1. Burn with decreased sensation
2. Do not blister
3. Skin feel like an Eschar
4. Count toward TBSA
5. Risk for compartment syndrome



Fourth Degree Burn: Molten Metal

Third Degree Burn: Flame Burns Circumferential Burns

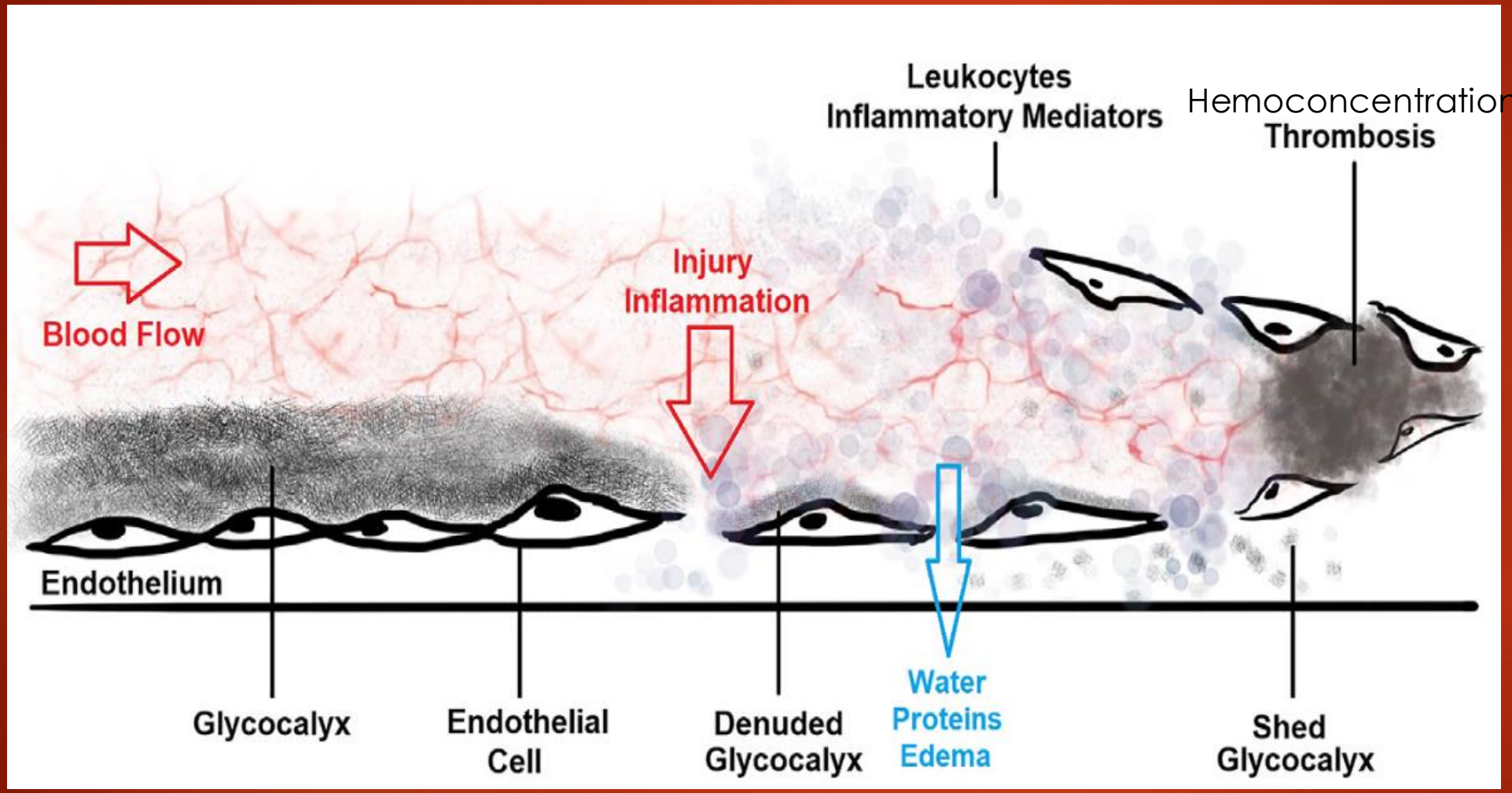
- These injuries are at risk for compartment syndrome
- Need to evaluate compartments
- Need to do neuro and pulse exam
- This type of injury would require transfer to a burn unit.

Burn Shock

- Represents a small number of patients we see : 10% burns admitted
  - Adults with TBSA > 20% 2nd and 3rd degree burns
  - Children with TBSA > 15% 2nd and 3rd degree burns
- Golden 24 hrs in management of the resuscitation
  - Maintain organ perfusion
  - Avoid over fluid resuscitation that can lead to complications

Avoid Fluid Boluses

Modern Understanding of Endothelial Injury



Dries et al:

Differential Response

Normal Skin

VS

Burned Wound

Tejiram et al Surg Clin N Am 103 (2023) 403–413

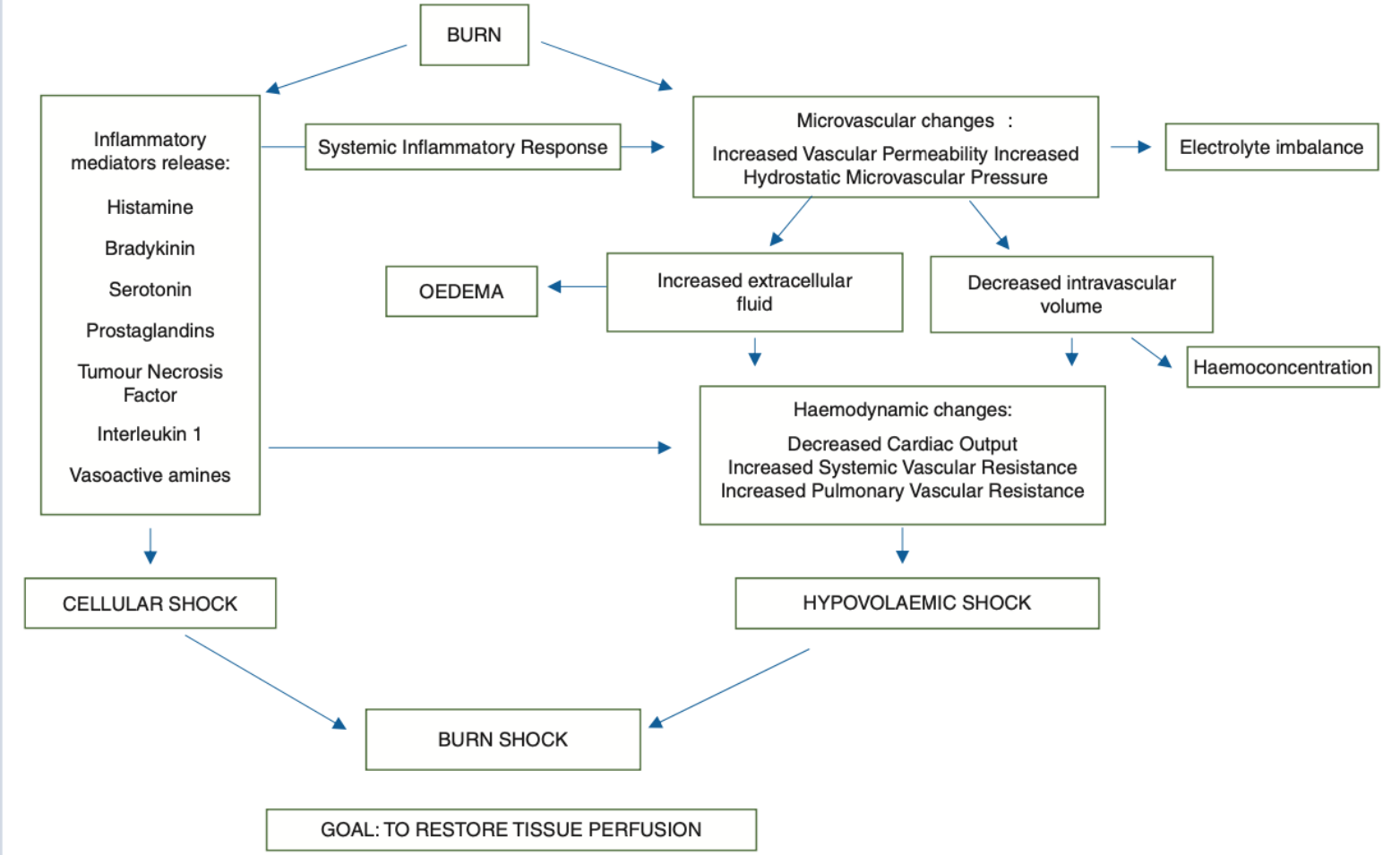
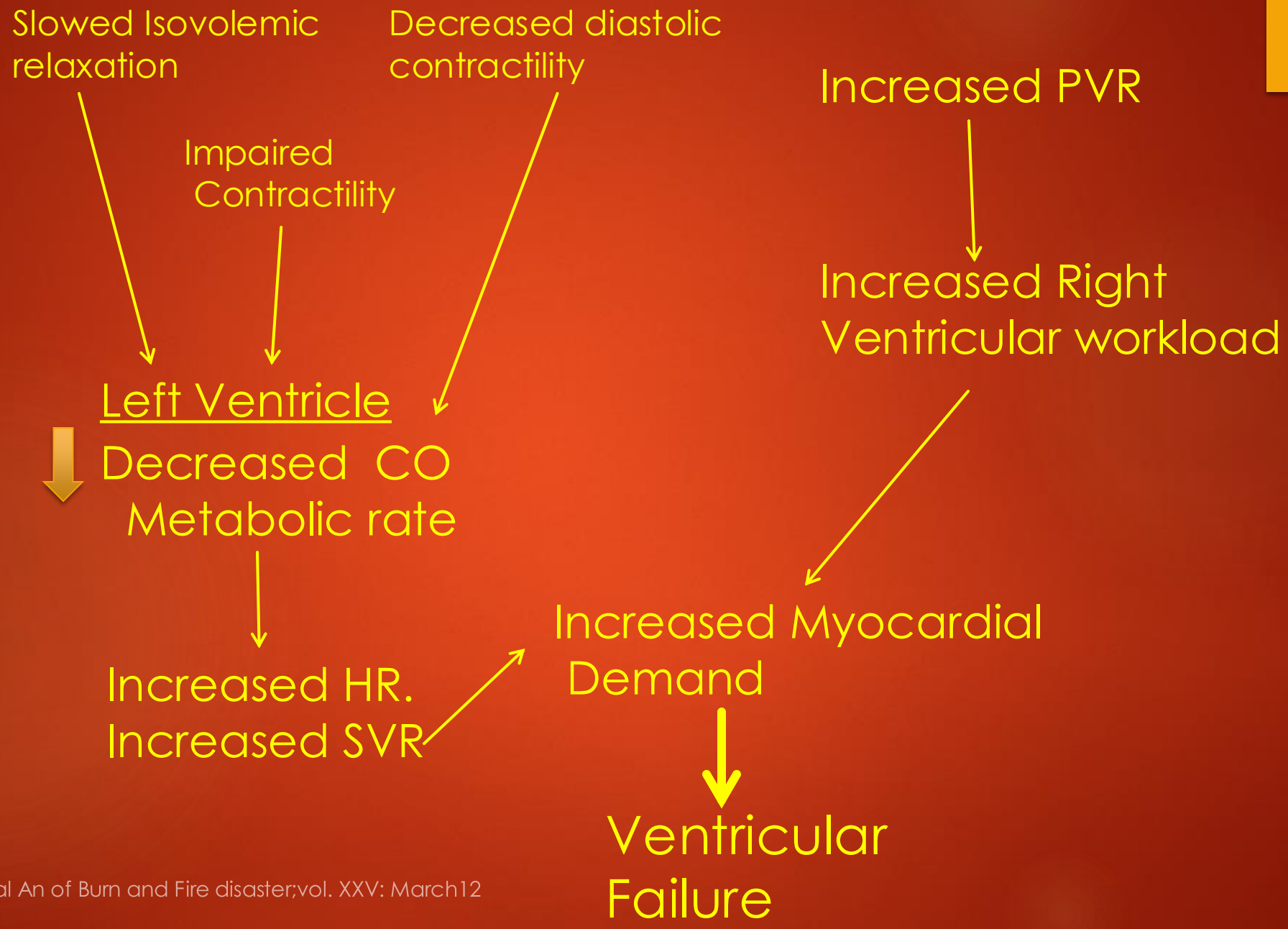


Fig 1 Burn shock pathophysiology.

Guilabert et al; British Journal of Anaesthesia, 117 (3): 284–96 (2016)



GS Abu-Sittah et al An of Burn and Fire disaster;vol. XXV: March12

Burn Shock
Estimation Fluid Requirements

- Adults (Burns greater than 20% TBSA 2nd and 3rd degree)
  - Consensus formula: Lactated Ringers 2 ml/Kg per %BSA burned
    - ½ given 1st 8 hours
    - 2nd half given next 16 hours
- Monitor Response of fluid resuscitation
  - Urine output
  - Vital signs
- Include only 2nd and 3rd Degree Burns in TBSA Estimation

AVOID FLUID BOLUS

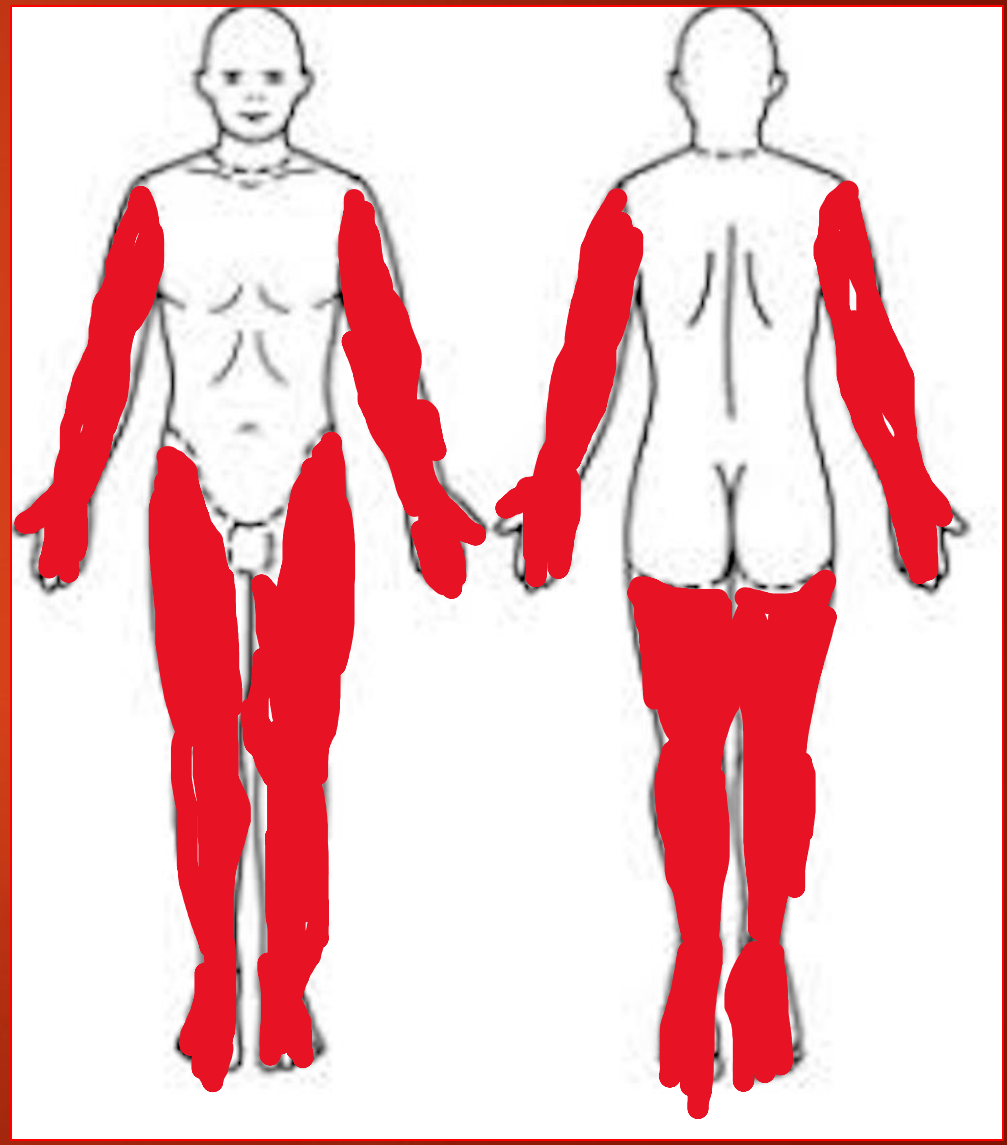
Estimate Fluid rate of LR

1. Weight in Kg
2. TBSA of 2nd and 3rd degree burns

TBSA = 9 +9+18 +18= 54%

2 X54 X100 Kg= 10,800 for 24 hrs

Hourly rate fluids= 10,800/16= 675 ml/hr




BARD
APPROXIMATE
VOLUME
ml

Burn Resuscitation
Myoglobinuria and Hemoglobinuria

- Pathophysiology
  - Muscle injury
  - Hemolysis
- Patients at risk
  - High voltage injury
  - LOC
  - Prehospital cardiac arrest
  - Full thickness burns
  - Compartment syndrome requiring fasciotomy
  - Abnormal EKG
  - CPK level >1,000 u/L

Scald Burns
Flash Burns
Grease Burns
All first degree burns

Burns that based on size and depth
Could be managed in clinic setting

Management of Minor Burns

- Make sure patients tetanus is up to date
- Wash the wound: can use diluted chlorahexadine
- Remove all blistered skin
- Apply dressing
- Patient will need small dose of IV narcotics for debridement
- Patient will need follow up within a couple of days for wound evaluation.

Gomez R et al: Management of Burn Wounds in Emergency Department. Emergen Clin of N AM 2007(25)

Important Points to Review

- Preparation
- Burn patients are a trauma patient:
- Remember to look for inhalation injury
- Avoid Fluid boluses when initiating resuscitation
- Do not include first degree burns in burn estimate of size
- Do not forget to evaluate patients with circumferential burns or electrical injuries for compartment syndrome.
- Protect patient from hypothermia
- Initiate transfer to burn center as soon as possible