Acute Flame Burns
Pathophysiology:

- Skin $\rightarrow$ large water content $\rightarrow$ overheats and cools slowly $+$ heat continues to penetrate deeper layers (immediate cooling can reduce this, limited in large burns b/c can lower pt’s core temperature)
- 3 zones of injury:
  - Coagulation (central): nonviable + irreversible
  - Stasis (middle): Dilated vessels + capillary diffusion $\rightarrow$ in 24-48hrs can become occluded and convert into zone of coagulation OR reversed to viable tissue (cooling, fluids, acute care very important to save this area)
  - Hyperemia (outer): viable, edematous

- Circulation changes: initial increase in blood flow to area + arteriolar vasodilation (capillary permeability) $\rightarrow$ proteins leaked $\rightarrow$ edema (most at 8-12hrs) = “third-spacing”

Acute Management:

- History: source (flame, liquid, steam, chemical, electrical, etc), duration, location (closed space? $\rightarrow$ smoke inhalation), associated injuries/injury mechanism, intoxication (EtOH, drugs)

- ABCDE (stressing points associated w burns)
  - A: early intubation (airway edema esp with smoke inhalation; used humidified O2, bronchodilators to Tx spasm) *
  - B: maybe escharotomies for circumferential chest + abdominal wall burns
  - C: Large-bore (14-16G), ideally through non-burned tissues, central line
    Fluids $\rightarrow$ RL***, no glucose (hyperglycemic b/c stress response $\rightarrow$ +++osmotic diuresis)
  - D: baseline neuro (may detect CO poisoning**, important if need to sedate)
  - E: remove clothes, irrigate w NS, cover w nonadherent drg. to prevent hypothermia

- * Inhalation injury:
  - Why: smoke chemical irritants (ARDS), thermal injury (oropharyngeal + supraglottic edema)
  - Signs: Closed space, facial burns, singed facial hair, oral carbon deposits, hoarseness, wheezing
  - Evaluate: Nasopharyngoscopy (larynx, vocal cords); +/- bronchoscopy
  - (Note: low threshold for ophthalmology consult for facial burns)

- **CO poisoning:
  - Why: Binds to hemoglobin $\rightarrow$ O2 displaced/does not bind $\rightarrow$ less O2 delivery to body
  - Signs: Cherry red skin, hypoxemia (pulse oxymetry unreliable $\rightarrow$ cannot distinguish between different forms of hemoglobin = carbo-xyhemoglobin registered as 90% oxygenated hemoglobin and 10% desaturated hemoglobin $=$ overestimate the saturation), mental status change/depressed, persistent acidosis even if normovolemic; think cyanide toxicity (plastics)
  - Tx: 100% O2, hyperbaric therapy (esp if mental status change)

- ***Fluids:
  - Must repeatedly assess! No formula is perfect! $\rightarrow$ exam, urine output, central wedge pr., etc.
  - Parkland formula = (4cc) x (%TBSA) x (patient’s weight in kg) for 24hrs
    - Half in 1st 8 hours, rest in remaining 16hrs
  - RL at first, consider colloids after 8hrs if ++ fluid requirements (can also decrease the risk of abdominal compartment syndrome)
  - Adequate resus? $\rightarrow$ urine output
- Adults 0.5cc/kg/hr; kids 1cc/kg/hr
- Need 2cc/kg/hr in electrical or deep burns (3rd deg. including muscle) → myoglobin-induced acute tubular necrosis (can also alkalinize urine w bicarbonate)
- Follow electrolytes: Hyponatremia, hyperkalemia

- Analgesia
- Tetanus:
<table>
<thead>
<tr>
<th>Hx</th>
<th>Clean/Minor wound</th>
<th>Contaminated/Major wound</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;3 or ? doses</td>
<td>Toxoid</td>
<td>Toxoid + immunoglobulin</td>
</tr>
<tr>
<td>&gt; 3 doses</td>
<td>Toxoid if &gt;10yrs ago booster</td>
<td>Toxoid if &gt;10yrs ago booster</td>
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</tbody>
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- Prophylactic iv antibiotics not indicated

- Admit to burn center?
  - 10-40 yo: >3% total body surface area (TBSA) 3rd deg, >15% 2nd deg. [see below]
  - <10yo, >40yo: >10% 2nd or 3rd deg.
  - Burns to face, hands, feet, perineum, +/- joints
  - Circumferential extremity burns
  - Electrical burns

Burn wound assessment:

- Area:
  - Palm = 1%TBSA
  - Rule of 9s:
    - Head, arm, anterior leg, posterior leg = 9% each
    - Anterior + post. torso = 18% each
    - Kids: Head has greater TBSA%

- Depth: Can progress so initial assessment +/- accurate
  - 1st degree (superficial)
    - Epidermis; erythema; pain resolves 48-72hrs; no scar
  - 2nd degree (partial thickness)
    - Entire epidermis + variable dermis
      - Superficial: dermal appendages intact
      = heals ~3weeks, minimal-no scar
      - Deep: less pain than superficial, heals weeks-months, scarring → needs excision + graft
      - Painful (nerve endings exposed), red, edematous, blisters
  - 3rd degree (full thickness)
    - Full epidermis and dermis = no dermal appendages = no spontaneous regeneration
    - Can go deeper (4th degree → fascia, muscle, bone)
    - No pain (nerves fried), leathery/waxy/charred appearance, vessel thrombosis

Ref: Michigan Manual of Plastic Surgery by D.L. Brown and G.H. Borschel; Lippincott Williams & Wilkins 2004