London Health Sciences Centre
Southwest Ontario Regional Base Hospital Program

Paramedic Rounds
Trauma:
Burns/Crush Injuries

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Trauma's Trauma

Essential assessment,

recognition and treatment of

less common injury pathologies.

Objectives

- Understand the fundamentals of effective trauma triage and its application to ensure a proper destination decision every time
- Thorough, rapid assessment of obscure traumatic injuries
- Identify and prioritize critical pre-hospital management for burns and crush processes

General Standard of Care

- Scene Safety!!
- Remember that when trauma is present and load and go is determined, scene time should be <10 min unless extrication delays.
- Unsecured extremity fractures are a significant life threat and need to be managed accordingly.

Trauma Destination Policy

- Last updated in 2004….that's right it's been around that long.
- Outlines the conditions and assessment findings that warrant bypass to nearest Trauma center.
- Shall be followed unless adequate airway cannot be obtained or pt is VSA.

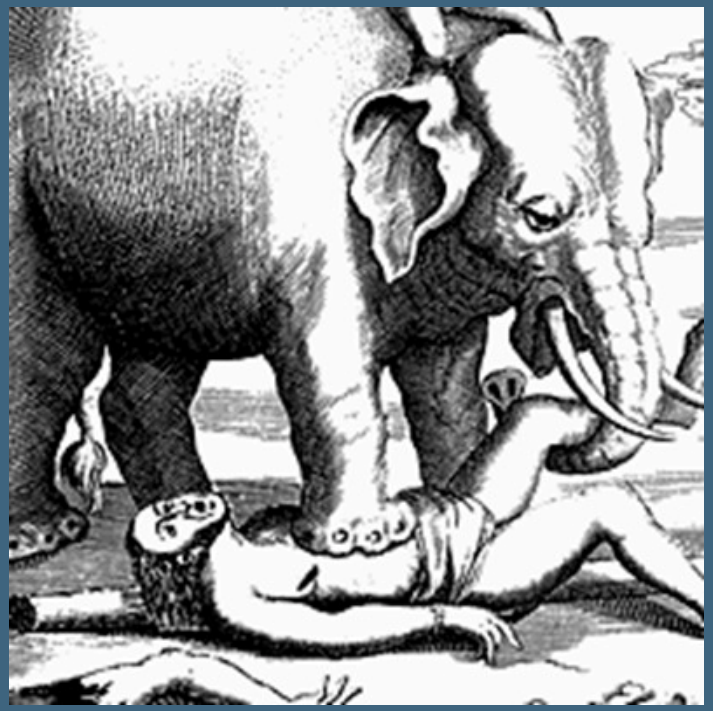
Pre-Hospital Index

Clinical Finding		Value
LOA	Normal Confused or combative No intelligible words	0 3 5
Respirations	Normal Laboured or shallow <10 per min/needs intubation	0 3 5
Pulse Rate	>119 51-119 <50	3 0 5
Best Available Pulse	Radial Pulse Femoral Pulse Carotid Pulse	0 3 5
Total		0-20

Look out Vic…Here we come!

- A PHI score >3 requires transport to Trauma Center
- Watch out for Mechanism of injury
  - MVC with
    - Occupant ejected
    - Rollover
    - Co-occupant fatality
  - Fall > 6 meters
  - Obvious limb paralysis
  - Pedestrians and cyclists that are felt by paramedic to have suffered significant injury

Crush Syndrome



- Occurs when a muscle mass has sustained a crushing force large enough to preclude perfusion
- Symptoms develop with reperfusion of ischemic and nerotic tissue

(17)

- What is the most common cause of crush syndrome in the United States?
- Skeletal muscle can generally tolerate warm ischemia for up to 2 hours without permanent damage
- 2–4 hours→irreversible damage
- Necrosis after 6 hours
- Maximal effect of crush mechanism will typically be seen after 24 hours

(13)

Pathophysiology

- Uncomplicated CS has limited systemic effects until crush mechanism is released and reperfusion takes place
- Rhabdomyolysis occurs and cell contents including potassium, calcium and myoglobin are released into systemic circulation
- Third space fluid loss at the injury site leads to rapid onset of hypovolemia, which can be severe if a large enough tissue mass is involved

(17)

…more patho

- Lactic acid, which builds up from anaerobic metabolism during the crush period is instantaneously released into systemic circulation
- When acidosis is coupled with hyperkalemia they become an excellent recipe for arrhythmia (17)
- Hyperkalemia is second only to hypovolemia as the leading acute cause of death in CS patients (13)

Hyperkalemia

- Symptoms of Hyperkalemia typically present once serum values reach 6.5 mEq/L (19)
- S+S include GI complaints, muscle weakness leading to an ascending paralysis (20)
- Once serum levels reach 8.5 mEq/L respiratory paralysis or cardiac arrest are imminent (7)

ECG Changes

- Initial presentation with peaked T waves
- Increasing PR interval leading to loss of P wave
- Idioventricular rhythym, widened QRS with deep S waves and finally a “Sine wave will precede V-fib.

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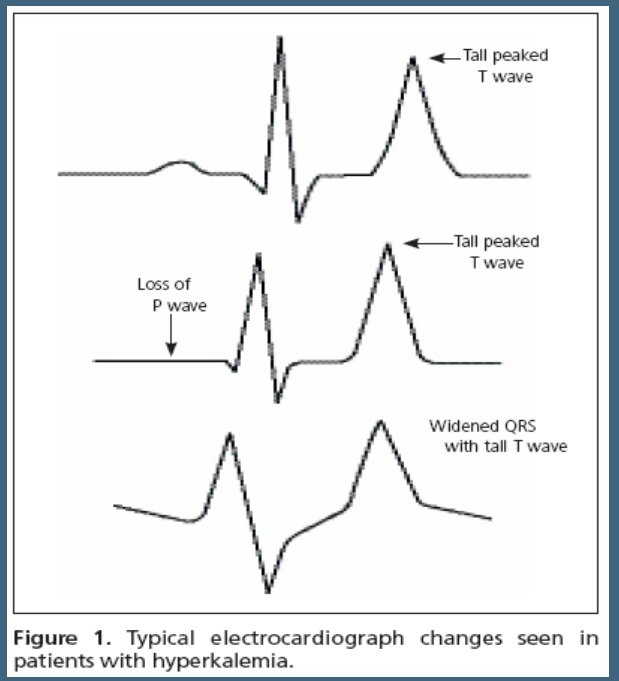
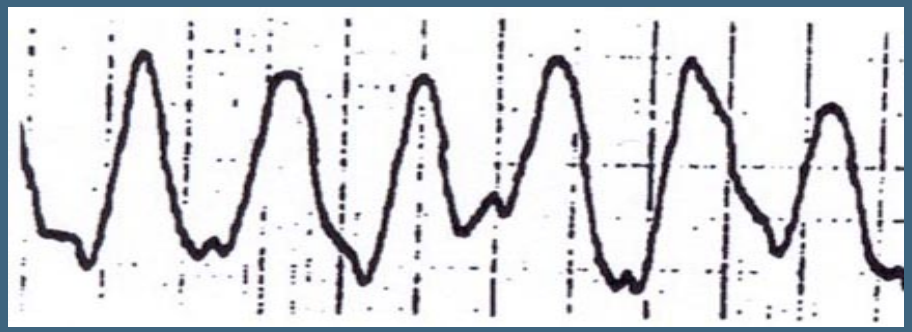


Figure 1. Typical electrocardiograph changes seen in patients with hyperkalemia.



On the bright side…

- Myoglobin is a protein molecule but is still small enough to be filtered by the glomerulus.
- If GFR remains high enough myoglobin can be flushed however a decrease in GFR coupled with the lactic acidosis causes the myoglobin to form a gel in the renal tubules and will lead to renal failure.

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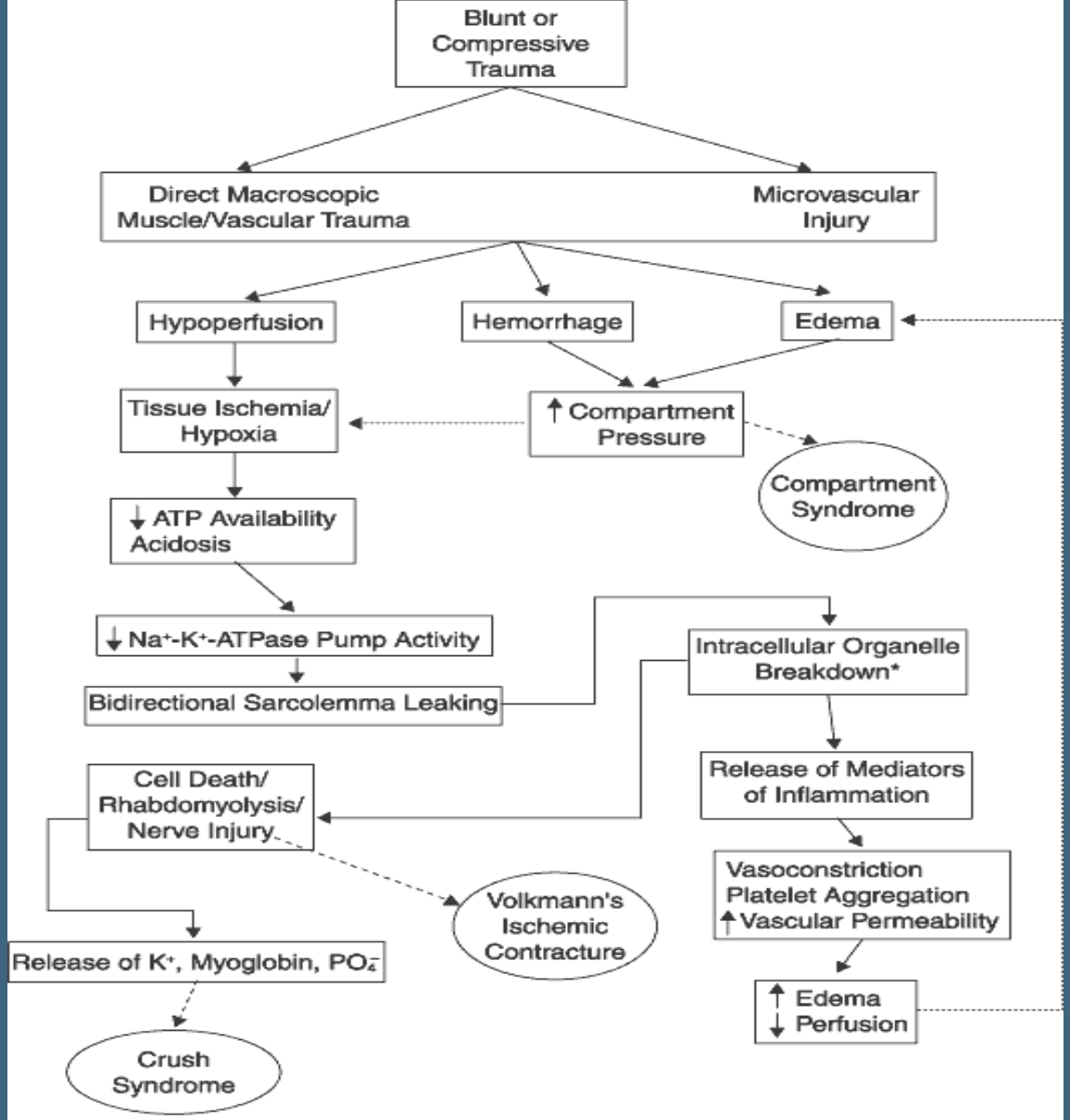
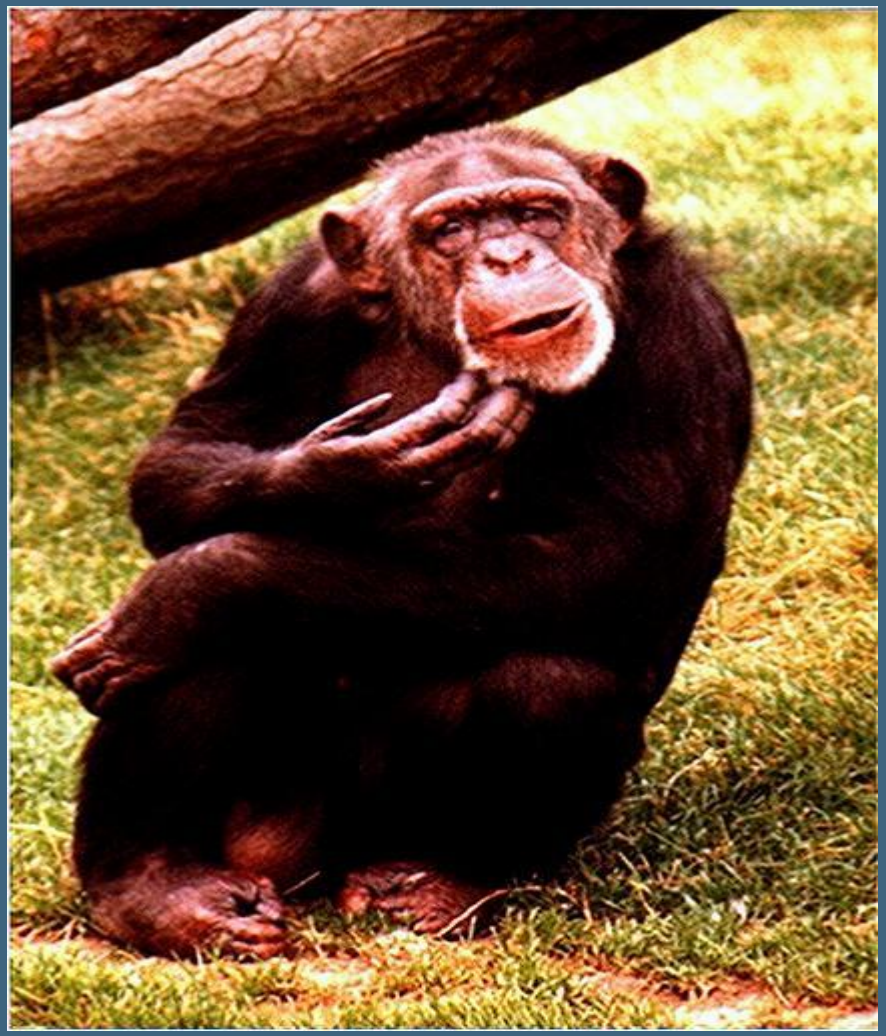


Source: Tintinalli JE, Kelen GD, Stapczynski JS: *Tintinalli's Emergency Medicine: A Comprehensive Study Guide*, 6th Edition: http://www.accessemergencymedicine.com

How are we going to treat this?



Field Treatment

- Maintain a high level of suspicion
- Consider additional resources. DM,Ornge, BHP patch
- In the case that a patient is hopelessly entangled, a trauma team may be requested to the site
- Literature suggests that all interventions be initiated prior to extrication, this is ideal however scene time should not be extended to do so (21)

More Field Tx

- Complete physical assessment and perform any necessary A/W or breathing interventions
- O2 via NRM whether pt appears to need it or not
- C-spine and board/KED if possible
- Establish multiple large bore IV's, unilateral if possible and don't forget EJ/IO possibilities
- Prepare for arrest and definite need for high volume 0.9% NaCl,
- consider patch to initiate bolus prior to removal of crushing force as preemptive treatment for hypovolemia (6)
- When all preparations are complete; extricate, Load and Go

Hyperkalemia management

- Potassium is of immediate concern and a patch for Sodium Bicarbonate should should be considered with large/prolonged crush injuries or with signs of hyperkalemia (6)
- Beta 2 agonists will encourage skeletal muscle uptake of potassium and could be considered as well, but are not ideal (20, 6)

Final Notes on Crush

- Crush syndrome may not necessarily jump up and smack you in the face. Remember that it can occur in small limbs with just a person's body weight to preclude perfusion
- When the destination policy is considered you may be treating these people for an extended time, management may become quite complex

Thermal Burns

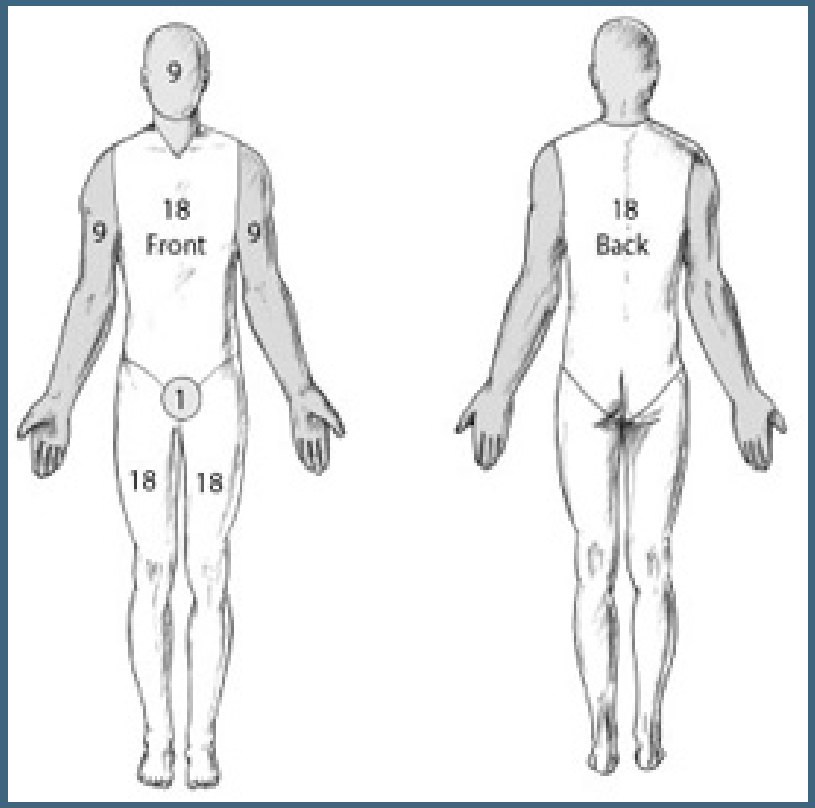
Assessment of Burns
Why do It?

- Crucial early step in treatment planning (2)
- Treatment plan based on assessment
- Hospital needs to know type of burn
  - Thermal
    - Scolds, flame, contact
  - Inhalation
    - Closed space, open space, thermal, smoke
  - Electrical
    - Voltage, Amps
  - Chemical
    - Type

TBSA and Depth of Burn

- Initial estimation of the surface area burned & depth of injury is essential (2,6)
- Total body surface area (TBSA) burned
  - more important during initial assessment
  - The most important predictors of clinical outcome (2)
  - % TBSA affect is used to calculate the pts fluid
- Depth of injury
  - a concern for surgical tx

Rule of Nines

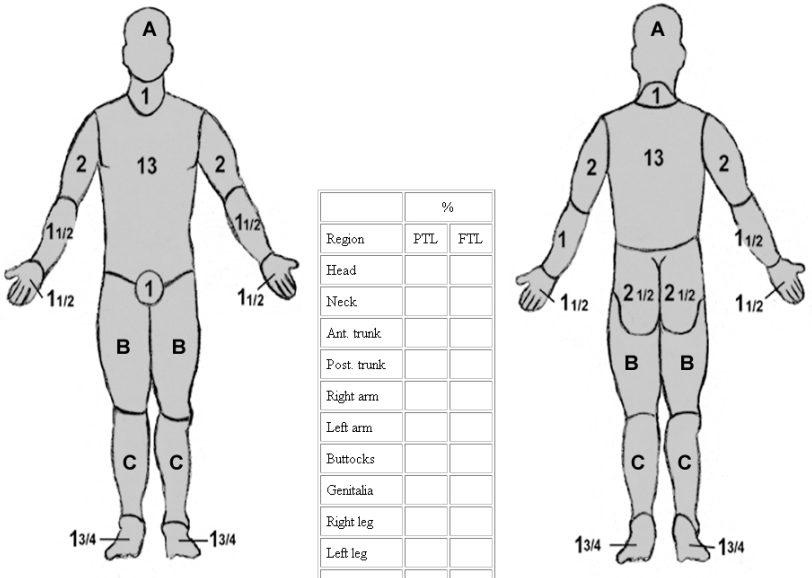


- Quick estimate of burn size
- Usually over estimate of burn size (2)
- Under the age 15 yrs underestimating the head surface area and overestimating the extremities in children

Pediatric % TBSA

% Total body surface area burn

Be clear and accurate, and do not include erythema.



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

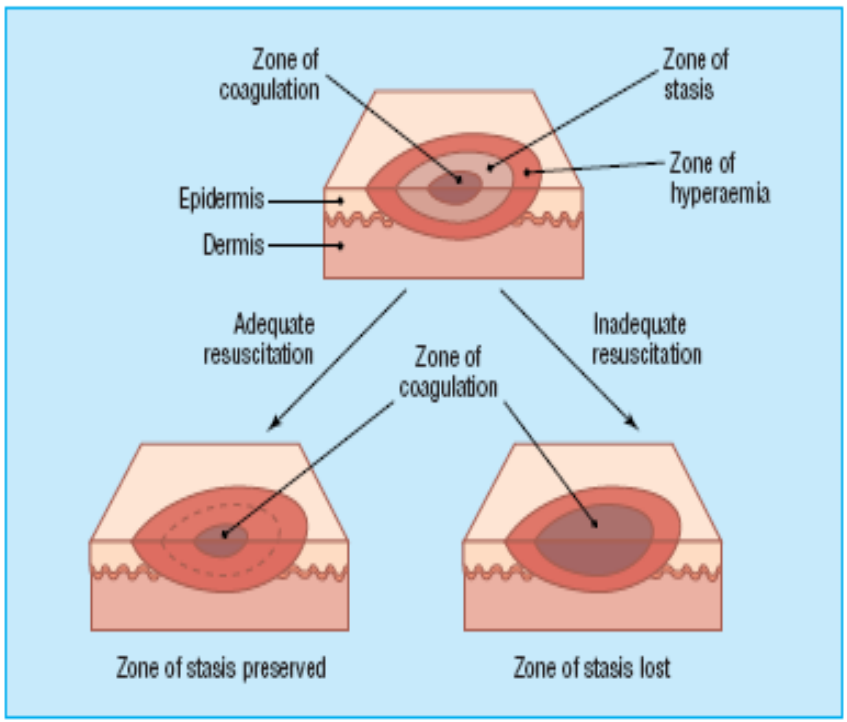
AREA	Age 0	1	5	10	15	Adult
A = 1/2 of head	9 1/2	8 1/2	6 1/2	5 1/2	4 1/2	3 1/2
B = 1/2 of one thigh	2 3/4	3 1/4	4	4 1/2	4 1/2	4 3/4
C = 1/2 of one Lower leg	2 1/2	2 1/2	2 3/4	3	3 1/4	3 1/2

- Lund and Browder chart
- More accurate for Pediatric (14)
- Difficult to use in field
- Can use rule of nine's over 9 yrs old (14)

Burn Depth

- Degree's of Burn
  - Superficial epidermal 1st-degree
  - Superficial partial thickness 2nd-degree
  - Deep partial-thickness 2nd degree
  - Full thickness subdermal 3rd degree
- Burns are dynamic wounds
  - are in a state of change for up to 72hrs (2, 8)
  - may be influenced resuscitation conditions (15)

Local Response



Jackson's burns zones and the effects of adequate and inadequate resuscitation

- Three Zones (8)
- Zone of Coagulation
- Zone Of Stasis
  - Potentially salvageable
- Zone Of Hyperaemia
- They are 3 dimensional and constantly changing

Three Zones

Clinical image of burn zones. There is central necrosis, surrounded by the zones of stasis and of hyperaemia

Zone of Stasis

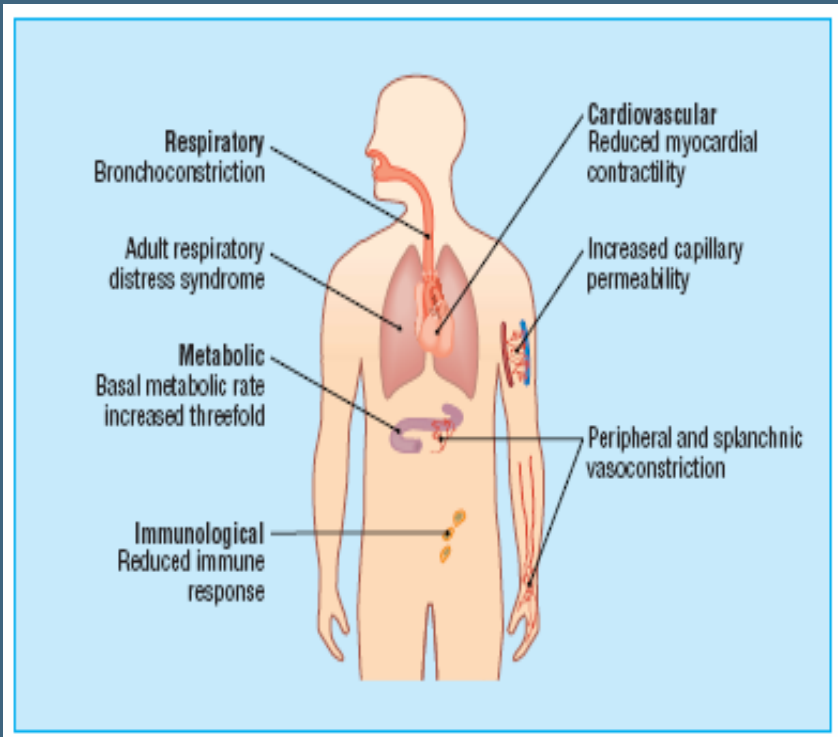
- Goal is to increase tissue perfusion
- Inflammation
  - Immunologic responses
    - altered macrophage function along with activation of platelets & leukocytes (2)
- Active edema formation (Fluid Shift)
  - 12 to 24hrs post burn, local mircocirculation is compromised due to permeability vasodilation and increased microvascular permeability (2)
  - Increase hydrostatic pressure results in leakage of water, protein, and electrolytes (14, 20)
- Causes reduction in perfusion
  - leading to more local tissue ischemia

Local Response

- Electrolyte imbalances
  - Major burn with cell necrosis = Release of K^+ into ECF from injured cells (11, 9,7)
  - cellular energy levels fall after burn injury (2)
    - sodium and potassium pump is altered
    - resting cell membrane potential decreases
    - cellular accumulation of sodium, calcium, and water
    - a loss of cellular potassium.

Systemic Response

- 20 to 30 % = systemic effect
- Pain
  - Stimulation of the skin nociceptors (10,18)
- Vascular Changes (8, 16, 11)
  - Capillary permeability ↑
  - Loss of proteins and fluids into interstitial (↓intravascular oncotic pressure)
  - Peripheral, renal and splanchnic vasoconstriction
  - Hypotension



Systemic changes that occur after a burn injury

Systemic Effect

- Cardiac output
  - CO= ↓in arterial pressure + ↑HR
  - Altered CO & Stroke Volume
  - 15 to 20% Burn = Hypovolemic shock! (15)
  - Burn Shock
- Metabolic response
  - Basal metabolic rate increase up to 3 times (8)
  - Poor perfusion = anaerobic environment
  - Metabolic acidosis
- Respiratory
  - Histamine release = Bronchoconstriction (8)
  - Hyperventilation, and respiratory alkalosis (2)

Prehospital Treatment

- Stop the burn process
  - BLS: >10-15% 2nd degree: wet dressing for transport times <30min
  - Lonnecker, S. & Schooder, V. (2001) state hypothermia is not a problem of the non-anaesthetized and cold water treated pts
- Hypovolemic shock
  - **Patch** for Fluid and fluid and more fluid
  - Parkland Formula
    - 4cc/kg x % TBSA
    - First half in 8 hours
    - Second half in 16 hours
  - Elderly = Limited Cardiac Reserves
    - Beware of increased workload & CHF

Treatment Continue

- Pain Management
  - Morphine VS Fentanyl
  - Which would be appropriate in this case?
  - **Patch** for the increase doses of pain medication
- Hyperkalemia
  - It can happen with major burns (9, 7)
  - Large amount of K+ in ECF
  - With the uses of succinylcholine
  - Peak T waves or Widen QRS complex with peak T waves

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