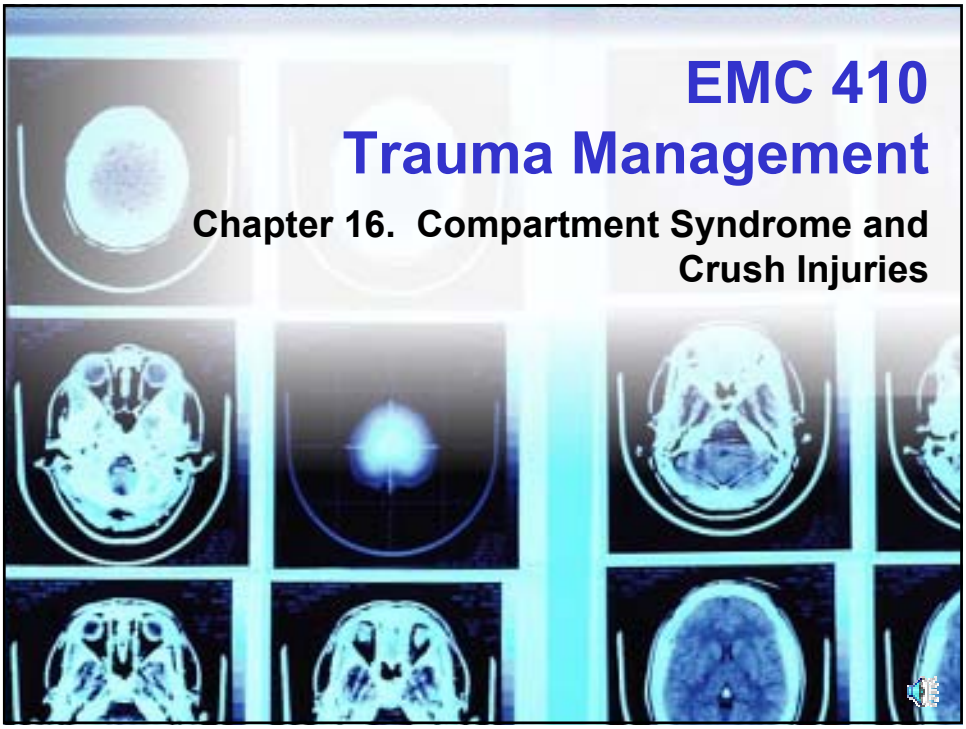


EMC 410
Trauma Management

Chapter 16. Compartment Syndrome and Crush Injuries

Unit Objectives

- **Upon completion of this chapter, you should be able to:**
  - Describe the epidemiology and etiology of crush injury and compartment syndrome.
  - Define compartment syndrome and crush syndrome.
  - List the injuries most commonly associated with compartment syndrome.
  - Describe the anatomical features common to the locations that develop compartment syndrome.
  - Discuss the role of reperfusion as a contributing factor in compartment syndrome.
  - Describe the basic surgical procedure used for pressure release in compartment syndrome.

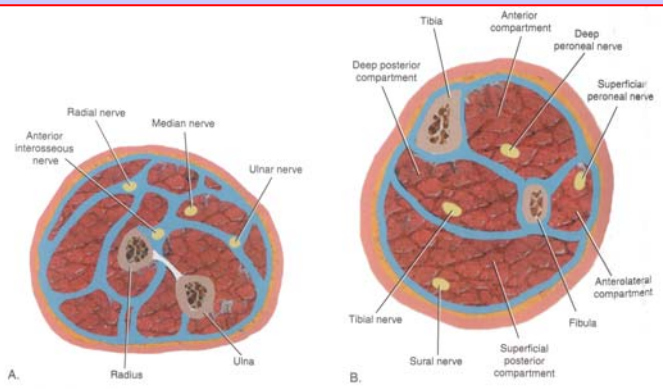
Unit Objectives continued

- Describe the clinical presentation of compartment syndrome.
- Describe what actions should be taken when compartment syndrome is suspected in the field.
- Discuss the complications of crush injury.
- Describe the mechanisms of injury in crush injury.
- List the signs and symptoms of crush injury.

Epidemiology and Etiology

- **Compartment syndrome (CS) is most often seen as a complication of trauma**
  - Closed tibial fracture is most frequent cause
  - May also be seen in open fractures
  - Other causes include crush injuries, snake bites, vascular injuries, electrical injuries, compression from immobility, fracture casting, infiltration of intravenous fluids, and extreme exercising

Anatomy and Physiology



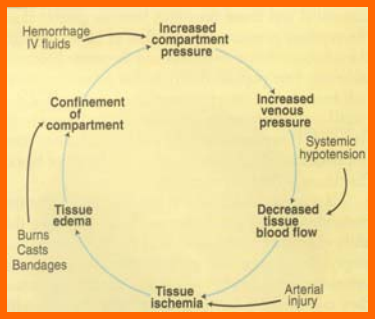
- **Osteofascial compartments**
  - Inelastic tissue connects with bone forming compartments
  - Compartments contain muscle, nerves, and vessels
  - The upper arms have an anterior and posterior compartment
  - The forearms have anterior, lateral, and posterior compartments
  - The thighs have anterior, medial, and posterior compartments
  - The lower legs have anterior, lateral, superficial posterior and deep posterior compartments
  - Fascial compartments are also found in the gluteal region

Anatomy and Physiology continued

- **Microcirculation and perfusion**
  - Blood flow across the capillary wall is based on 3 factors:
    - Cell wall permeability
    - Hydrostatic pressure
    - Oncotic pressure
  - This arrangement allows for fluid filtration at the arterial side and fluid absorption at the venous side

Pathophysiology

- **Compartment syndrome**
  - Requires tissue within a fixed compartment with minimal capacity to expand and an increase in pressure within the compartment
  - Intracompartmental pressure may be increased by bleeding or edema, or external pressure
  - When pressure rises above a critical point, the microcirculation fails and tissue perfusion decreases
  - Decreased tissue perfusion leads to ischemia, which in turn leads to increased cell wall permeability. Protein leaks out of the vessels leading to edema. The edema worsens intracompartmental pressure setting up a vicious cycle of swelling-ischemia-swelling.



Pathophysiology continued

- **Compartment syndrome continued**
  - Normal intramuscular capillary pressure is 25 mm Hg; CS begins at 30-40 mm Hg for > 4 hours. Recovery unlikely after 8 hours.
  - Tissue destruction is a function of both pressure and time
  - Nervous system tissue is particularly vulnerable to CS, leading to sensory deficits, motor dysfunction, and pain.
  - Injured muscle cells leak myoglobin and electrolytes leading to electrolyte imbalance, myoglobinuria, and renal damage.
  - Abdominal CS may also result in cardiopulmonary compromise.

Pathophysiology continued

- **Crush injuries**
  - Typically refers to blunt, compressive trauma to the extremities that may result in crush syndrome
  - MOI includes patients trapped under debris of collapsed buildings or under vehicles
  - Patient presents with minimal pain, sensory deficit, flaccid paralysis, intact pulses and no edema.
  - Later, patient presents with striking edema with intact pulses and systemic changes of crush syndrome.
  - Compartment pressures are initially normal, unlike compartment syndrome

Pathophysiology continued

- **Crush syndrome**
  - Collection of systemic complications of soft tissue injury including rhabdomyolysis, electrolyte disturbances, hypovolemia, renal failure, acidosis, and DIC
  - Cell membrane damage releases potassium, creatinine, CPK, phosphate, and lactic acid into the blood
  - Resulting electrolyte imbalance causes fluid shift into the interstitial space
  - Electrolyte imbalance may also result in cardiac dysrhythmias
  - Myoglobinuria results in renal failure
  - Reperfusion plays a role in the development of crush syndrome.

Focused Assessment

- **Crush syndrome**
  - History
  - Pain out of proportion to the injury
  - Pain on passive stretch of the muscle in the involved compartment
  - Decreases sensation and motor function of affected extremity
  - Presence of distal pulses and capillary refill is variable
  - 5 P's of ischemia
    - Pain, pallor, paresthesia, pulselessness, and paralysis
  - Serial assessment of pulses, CRT, skin color, temperature, sensory and motor function, and passive range of motion
  - Myoglobinuria

Treatment

- ABCs
- Control of hemorrhage
- Splinting of affected extremity
- Aggressive IV fluid therapy (1.5 liters/hour)
- Remove any constricting items
- Maintain extremity at heart level
- 2 amps sodium bicarbonate prior to releasing pressure
- Fasciotomy at the hospital is sometimes necessary