It is our duty to each learner to honor your right to expect that your continuing medical education experience includes content and a learning environment that is free of commercial influence and conflicts of interest. To this end, UTCOMC requires program planners, speakers, and staff to disclose and resolve any relevant financial relationships with companies whose products may be discussed during the activity or who may support this program. For information on how any conflicts listed below were resolved, please contact the Surgery CME coordinator at 423-778-7695.

Hunter Rooks, MD, reports having no financial relationships with commercial interests relevant to this presentation.
Outline

• Case Presentation
• Anatomical Considerations
• Presentation
• Diagnostics
• Treatment

Case

• Level III Trauma Activation
• Chief Complaint: Right Hip Pain
• HPI: 45 y/o male 24 hr history of intoxication, assault, and subsequent prolonged immobilization. Presented to ED ~24 hours later with R hip pain, LLE lack of sensation & paralysis
• PMHx: HTN, Snakebite, MVC
• SHx: burr holes
• Medications & Allergies: none
• SoHx: Tobacco 1 PPD, EtOH 6 pack every other day, History of IV drug use
Physical Exam

- Vitals: T: 97.8°F, BP: 140/103, HR: 124, RR 20, O₂: 93% (RA)
- Labs
  - Urine: Hb +, myoglobin +
  - Serum myoglobin: 33500 (Normal <223)
  - CPK: 43600 (normal <5000)
  - CKMB: 300 (normal <6)
- GCS 15
- Pulses 2+ Bilateral Radial & Pedal
- RLE Hip Ecchymosis
- LLE
  - Buttock tense, ecchymotic, shiny skin
  - Insensate Sciatic distribution
  - Extremity Paralysis
  - Pain with Passive ROM Hip adduction, extension

Compartment Measurements

- Arterial line
- Stryker needle
- Gluteus maximus compartment: 50 mmHg
- Gluteus medius & minimus Compartment: 70 mmHg
- Diastolic BP 100, ΔP=30
Imaging

- MRI
  - Mild Spinal Stenosis L4-5

- CT Abdomen Pelvis
  - Significant Edema in Left Buttock
  - Enlargement of Gluteus Maximus, medius, minimus

Diagnosis

Gluteal Compartment Syndrome
Plan: Emergent Gluteal Fasciotomy
Anatomy

- What is a Compartment?
- Compartment Syndrome
  - “Compartment syndrome is the excessive swelling of tissue within a closed space, to the degree that the pressure exceeds the capillary bed perfusion pressure and effective blood flow is cut off.”
  - Cameron’s Current Surgical Therapy

Known Locations

**Common**
- Lower Extremity
- Upper Extremity
- Abdomen

**Uncommon**
- Thigh
- Hand
- Foot
- Gluteal
- Eye
- Chest
Causes

• Trauma
• Crush injuries
• Bleeding
• Insect/snake bites
• Constrictive dressings
• Prolonged immobilization
• Reperfusion
• Burns

Pathophysiology

• Local swelling
• Blood flow decreases as compartment pressure approaches diastolic pressure
• Early: venous outflow
• Late: arterial inflow
• Tissue hypoperfusion, ischemia, and necrosis
• Worsening edema
**Diagnosis**

**Subjective**
- Early
  - Pain with Passive stretch
  - Pain out of proportion
- “6 Ps”
  - Pain
  - Pallor
  - Poikilothermia
  - Pulseless
  - Paresthesias
  - Paralysis

**Objective**
- Compartment Pressure > 30 mmHg
- ΔP < 30
  - ΔP = Diastolic Pressure – Measured Pressure
- Laboratory Abnormalities
  - CPK: > 1000–5000
  - Renal function
  - Urine myoglobin
  - Potassium
  - Lactic acid

**Treatment**
- Fasciotomy
  - Full thickness incision through skin and deep fascia confining muscle
- Viability Assessment
  - “4 Cs”
    - Color: (red vs dusky)
    - Contractility
    - Consistency (intact vs friable)
    - Capacity to bleed
- Debridement
- 2nd Look
- Delayed Primary Closure vs Grafting
- Delayed Presentation (>48 hrs)
  - Increased infective risk with fasciotomy
  - Unlikely functional recovery
- Supportive Management
  - Rhabdomyolysis
  - Renal injury
  - Myonecrosis

**Supportive Management**
- Rhabdomyolysis
- Renal injury
- Myonecrosis
Contraindications

- Non-viable extremity
- Crush injury

Upper Extremity

- Forearm
  - 2nd most common location
  - Crush injury, fracture
- 3 Compartments
  - Volar, Dorsal, Mobile Wad
- Fasciotomy
  - Release of deep flexors
  - Carpal tunnel, Guyon canal release
  - Extensors
- Upper Arm
  - Uncommon
  - Anterior, Posterior, Deltoid
  - Anterior & Posterior or Single lateral incision
Hand

- 10 Compartments
- Cause
  - Crush injuries
  - Fractures
- Presentation
  - Swollen
  - IP flexion, MCP extension
  - Increased pain with passive stretch of intrinsic muscles

Lower Extremity

- Lower Leg
  - Most common location
- Treatment
  - 4 compartment fasciotomy

![Diagram of Hand]![Diagram of Lower Extremity]
Thigh

- Uncommon
- Anterior, Medial, Posterior
- Anterior compartment most common
  - Femur, vascular trauma
  - Iatrogenic: post intramedullary nailing

Foot

- Uncommon
- Fractures
  - Calcaneus, Lisfranc
  - Crush injuries, trauma
- Clinical Diagnosis
  - +/- elevated ICP
Gluteal Compartment Syndrome

- Common Etiology
  - Prolonged Immobility
  - Intoxication
  - Local Trauma
- Pain out of proportion
- Sciatic nerve distribution deficits
- Dx: $\Delta P < 30$

Treatment
- Gluteal Fasciotomy
  - Kocher-Langenbeck
  - Modified Gibson
Literature Reviewed

• Documented Causes:
  • Trauma
  • Hip arthroplasty
  • Iatrogenic vascular injury
  • Pelvic fractures
  • Lateral decubitus or lithotomy positioning in the operating room
  • Overuse or exertion
  • Epidural analgesic infusion
  • Anticoagulation
  • Bone marrow biopsy

• Associations
  • Alcohol & drug use
  • Immobilization

Our Treatment

• Day 1
  • Modified Gibson Fasciotomy
    • Color: Dusky
    • Contractility: minimal at inferior aspect
    • Consistency: non-friable
    • Capacity to bleed: none
  • Packed wet

• Day 3
  • Wound check

• Day 4
  • Able to flex LLE at knee
  • No movement/sensation distally
Our Treatment

- **Day 5**
  - Wound check

- **Day 7**
  - Ambulating
  - Operation: Primary Closure
  - Discharged Home

Compartment Syndrome vs Crush Injury

**Crush Injury**
- Continuous or prolonged pressure
  - Natural disasters
  - Prolonged immobilization under the influence
- Examination
  - Initial paralysis
  - Rapidly ensuing swelling
- Treatment
  - Supportive care
  - Surgical release < 6-12 hrs

**Compartment Syndrome**
- Compartment syndrome
  - Elevated pressure ➔ muscle damage
- Crush Syndrome
  - Muscle damage ➔ elevated pressure
Compartment Syndrome Triaging

• **Mechanism**
  - Trauma
  - Crush injuries
  - Bleeding
  - Prolonged immobility
  - Burns

• **Physical Exam**
  - Tense Compartments
  - Early
    - Pain with Passive stretch
    - Pain out of proportion
  - “6 Ps”
    - Pain
    - Pallor
    - Poikilothermia
    - Pulseless
    - Paresthesias
    - Paralysis

Compartment Syndrome Triaging

• **Pre-Hospital**
  - IV Fluids
  - Communication

• **Hospital Period**
  - Changes in clinical exam
  - Lab abnormalities
    - Elevated Creatinine
    - Hyperkalemia
    - Elevated CPK
    - UA positive for hemoglobin/myoglobin
References

- Published online 2014 Jun 7. doi: 10.1007/s11420-014-9386-8
- Published online 2012 Dec 17. doi: 10.1136/bcr-2012-007710.
- Yadav, Umesh. https://www.slideshare.net/umeshyadav5682/approach-to-hip-joint
- Compartiment Syndrome Of The Gluteal Region - Everything You Need To Know - Dr. Nabil Ebraheim, https://www.youtube.com/watch?v=qQuZnry5xOg

Thank You