ORTHO ‘BAD STUFF’

Robert V. Cantu, MD
Assistant Professor of Orthopaedic Surgery
Dartmouth-Hitchcock Medical Center
Outline

- Open Fractures
- Compartment Syndrome
- Pelvic Fractures
- Hip Dislocation
- Knee Dislocation
- Vascular Injury with Extremity Fracture
- Spine Injury
- Scapulothoracic Dissociation
- Survey results and questions

“Hey, I’m no orthopedic surgeon — know what I’m sayin’? But this can’t be good.”
Epidemiology

- Accidental injury is #1 cause of death for people age 1-44 years
- Typical day sees 170,000 people injured with 400 deaths
- Overall annual cost over 200 billion
Polytrauma Patient

- Syndrome of injuries with ISS>17

- Polytrauma patients susceptible to systemic reaction to injuries that can lead to dysfunction/failure of uninjured organs

- “Trimodal mortality”- scene, within 24 hrs, 2nd-3rd week
Open Fractures

- First step is identification
- ER treatment includes tetanus booster and IV antibiotics
- Wrap wound with sterile gauze and splint extremity
Gustillo and Anderson

- **Grade 1**: skin opening of 1cm or less, minimal muscle contusion, usually inside out mechanism

- **Grade 2**: skin laceration 1-10cm, extensive soft tissue damage

- **Grade 3a**: extensive soft tissue laceration (10cm) but adequate bone coverage

- **Grade 3b**: extensive soft tissue injury with periosteal stripping requiring flap advancement or free flap

- **Grade 3c**: vascular injury requiring repair
Type 1

- Wound less than 1cm
- Usually an ‘in to out’ wound
- Tetanus booster plus 1gm IV ancef
Type 2

- Wound between 1-10 cm
- Tetanus booster and 1gm IV Ancef
Type 3

- IIIa: wound greater than 10cm, significant periosteal loss

- Tetanus booster, 1gm IV
  Ancef, single dose IV
  gentamycin
III B

- Wound greater than 10cm, significant wound contamination, barnyard injury, wound requires soft tissue flap coverage

- Tetanus booster, IV Ancef, IV Gent, IV Penicillin
III C

- Open fracture with vascular injury requiring repair
- True emergency
- If vascular repair not performed within 6 hours, amputation rate >90%
Timing of I+D For Open Fractures

- “There is universal agreement that open fractures require emergency treatment” (Gustillo and Anderson JBJS 1976)

- One study 1102 patients no difference in infection rate <12 hrs vs >12 hrs (Patzakis CORR 1989)

- 104 open tibia fractures in children no difference <6 hrs vs >7 hrs (Kreder J ped Orthop 1995)

- 554 open fractures in children, no difference <6 hrs vs. >7 hrs (Skaggs JBJS 2005)
Timing of Wound Closure

- 119 open fractures immediate vs. delayed closure- no difference in infection rate (Delong J Trauma 1999)

- 532 patients requiring microsurgical flap coverage open fracture-flap <72 hrs had 6% infxn rate, flap >72 hrs had 30% infxn rate (Gopal JBJS[Br] 2000)

- Only 18% of infections due to organism cultured at initial surgery (Patzakis JOT 2000)
"OK, Mr. Gridley! Time to start your rehab!"
Compartment Syndrome

- Rise in pressure within a fascial compartment which if untreated leads to decreased perfusion and eventual muscle necrosis
Causes

- Limb fracture (45%)
- Soft tissue trauma
- Prolonged compression limb
- Burns
- Post-ischemic swelling
- IV infiltration
- Other
Acute vs. Chronic

- Acute seen after injury or ischemia
- Chronic seen in athletes (leg most commonly). Elevated pressures with exercise, resolve with rest.
Diagnosis

- Hallmark is pain out of proportion to injury
Diagnosis

- 5 P’s: Pain, Pallor, Paresthesias, Paralysis, Pulselessness
Diagnosis

- **Swollen/tense** muscle compartments
- May or may not have decreased sensation in extremity
- Serial exams important
Pain

- Typically pain increased on passive stretch of involved muscle compartment(s)
Labs

- Elevated CPK’s indicative of muscle damage
- Renal function (BUN, creatinine) may be impaired if rhabdomyolysis
- Acidosis secondary to muscle ischemia
Timing

- Muscle shows functional changes after 2-4 hours ischemic time, with cell death occurring after 4-12 hours*

- *Whitesides 1975
Measurement

- Required if diagnosis in question
- Multiple devices available
Slit Catheter

- Hand held monitoring device
Where to Measure

- Pressures highest at level of fracture
Measurement - What’s too High

- > 30 mm Hg (Rorabeck et al.)
- > 45 mm Hg (Matsen et al.)
- Within 30 mm Hg of diastolic pressure (Whitesides et al.)
Treatment

- Immediate surgical decompression of involved compartments
24 yo Male Snowboarding Accident
Acute Quadriceps Compartment Syndrome

- 24 yo male weight lifter using high-dose creatine following 3 hour lower extremity work out
"The doctor says the pin can come out in three months."
Pelvic Fractures
Ligamentous Anatomy
Patients with pelvic fractures who present hypotensive ...
Mortality increased from 3% to 38%

Acute Mortality Pelvic Fractures

- Early external fixation and patient mobilization shown to decrease mortality

- One study showed mortality decreased from 41% to 21% in patients with admission SBP < 100 mm Hg

Riemer et al. J. of Trauma 1993
## Associated Injuries

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Burgess and Young Classification

- Lateral Compression
- Anteroposterior compression
- Vertical Shear
- Combined
Acute pelvic stabilization

- MAST/PASG device
  - classic transport device
- Sheets
- External Fixation
- Newer devices
  - pelvic binders
Pelvic Binder
MAST Trousers

- Use of pneumatic trousers first reported in 1909 by Crile
- Re-introduced in 1972 as ‘military’ trousers
- Can contract vascular bed adding 750-1,000cc blood to central circulation
- Contra-indicated in pulmonary edema

Brotman et al. J. of Trauma 1982
Hip Dislocation
Diagnosis

- Typically high energy injury
- With posterior dislocation, leg shortened and internally rotated
- With anterior dislocation leg may be shortened and externally rotated
Treatment

- Urgent reduction
- Proper pain medication/relaxation necessary for reduction
- Avoid repeated attempts in ED
Reduction Posterior Dislocation

- Stabilize pelvis

- Flex hip, adduction, traction with gentle internal/external rotation
Reduction Anterior Dislocation

- Stabilize pelvis
- Axial traction and internal rotation
Irreducible Dislocation
Long Term Complications

- AVN most debilitating
Knee Dislocation

- **Dislocation**
  - 3 of 4 ligaments\(^1,2,3\)
    - Bicruciate

- **Intact PCL**
  - Meyers 1975
  - Shelbourne 1992
  - Cooper 1992

- **Radiographic**
Position Classification of Knee Dislocations

- Anterior
- Posterior
- Lateral
- Medial
- Rotatory
  - Posterolateral

Kennedy 1963
Mechanism of Knee Dislocation

- **Anterior**
  - Most common
  - Frequent vascular injury (traction)

- **Posterior**
  - Highest incidence vascular injury (complete tear)
  - Highest incidence extensor mechanism disruption

- **Posterolateral**
  - Irreducible
  - Highest incidence Common Peroneal Nerve injury

Schenck 1994
Associated Injuries

- **Meniscus** (≈100)%
- **Vascular** (32%)%
- **Nerve** (20-30%)
- **Fractures** (≈60%)%

1 - Siliski 1998, 2 - Green 1975, 3 - Fanelli 1999, 4 - Meyers 1975
Popliteal Artery Injury

- Overall Incidence: 32%\(^1\)
- Mechanism
  - Stretching / Rupture
    - Hyperextension
    - Anterior dislocation
    - Tethered artery
  - Intimal Damage
    - Direct contusion
    - Posterior dislocation
  - Delayed Thrombus
- Never Blame Spasm
Initial Evaluation / Management

- **History**
  - Mechanism

- **Physical Exam**
  - Gross deformity
  - Compare to opposite knee
  - Clue!
    - Coexist Varus/Valgus instability in full extension
      - ACL/PCL injury
  - Neurovascular
Diagnosis of Popliteal Artery Injury

- **Historical**
  - A-gram for everyone

- **Recent**
  - Symmetrical distal pulses
  - ABI > 0.85
  - Serial Exam by Vascular Surgeon

Cole & Harner 1999
Technique of Closed Reduction

- **Anterior**
  - Traction & elevation distal femur

- **Posterior**
  - Traction & extension of prox tibia

- **Lateral/Medial**
  - Traction & translation

- **Rotational**
  - Traction & derotation
Vascular Injury with Extremity Fracture
Diagnosis

- Always consider with penetrating trauma
- With blunt trauma typically high energy injury
- Physical exam: palpate distal pulses
Ankle Brachial Index

- Measurement systolic pressure of injured extremity compared to uninjured

- If ratio < 0.9 then consider vascular consult and angiogram
Treatment

- Vascular injury first priority

- Can perform temporary skeletal stabilization prior to vascular repair

- Alternative is vascular shunt, then orthopedic repair, followed by definitive vascular repair
Spine Injury

- Assume multiple trauma patient has spine injury until proven otherwise

- Cannot clear spine clinically when distracting injury present (ie. femur fracture)
Epidemiology of Spine Injuries

- Vehicular trauma, falls, gunshot/knife wounds, sports/recreation account for most injuries

- Bimodal distribution: highest prevalence between 15-24 yrs, second peak after 55 years
Spine Imaging

- If any question image entire spine
- CT scan more sensitive than plain films
- MRI for neurologic injury
Spine Injury

- Incidence of non-contiguous spine fracture about 10%
Spinal Cord Injury

- Aggressive resuscitation to prevent hypoxia, hypovolemic
- Document detailed exam
- Serial exams - by same person if possible
Spinal Cord Injury

- Consider steroid protocol - methylprednisolone
  20mg/kg loading dose
  then 5.4mg/kg per hr x 24 hours
Ligamentous Injury

11° 3.5mm
Related Points

- Of unconscious trauma patients, 5-10% have significant c-spine injury

- If patient’s car requires towing, 1 in 300 chance serious c-spine injury

- If patient ejected from car 1 in 8 risk
Aspiration of gastric contents and shock are two most common causes of pre-hospital death in SCI patients

In spinal cord injured patients 35% incidence of concomitant fractures (11% missed) (Vaccaro, ICL-1997)
Scapulothoracic Dissociation

Fig. IV-100. THE LEFT SCAPULA, DORSAL SURFACE.

Fig. IV-101. THE LEFT SCAPULA, COSTAL SURFACE.
Scapulothoracic Dissociation
Scapulothoracic Dissociation

- Traumatic disruption of scapula from posterior chest wall
- Referred to as “closed traumatic forequarter amputation”
- Neurovascular injury common
Scapulothoracic Dissociation

- Left scapulothoracic dissociation with subclavian artery disruption
Scapulothoracic Dissociation
Continued

- Treatment focused on care of neurovascular injury

- If vascular injury then emergency arteriogram followed by repair. Brachial plexus explored at same time.
A Few More Points
Results of ED Survey

Orthopaedic on call coverage

- Always have coverage: 0.64
- Sometimes have coverage: 0.28
- Never have coverage: 0.08
Is your coverage adequate?

- Daytime coverage: 0.64
- Nighttime coverage: 0.52
- Weekend coverage: 0.48

Percent of time

Orthopaedic on call coverage
Survey

- “Do you think orthopedists are reluctant to come in when you feel they should?”
  Yes - 55%

- “How often does your on-call orthopedist come in when you ask to have a patient evaluated?”
  Always - 29%
Survey

“Has ease of arranging a patient transfer for orthopedic injury to DHMC changed over the past 5 years?”

A. Much better
B. No change
C. Much worse
Which of the following has been most closely associated with nonunion after femoral nailing?

1. Use of NSAIDs
2. Comminuted fractures
3. Early weightbearing
4. Smoking
5. Static interlocked nail
#74 reference:

Giannoudis PV, MacDonald DA, Matthews SJ, Smith RM, Furlong AI, De Boer P.

We assessed factors which may affect union in 32 patients with nonunion of a fracture of the diaphysis of the femur and 67 comparable patients whose fracture had united. These included gender, age, smoking habit, the use of non-steroidal anti-inflammatory drugs (NSAIDs) the type of fracture (AO classification), soft-tissue injury (open or closed), the type of nail, the mode of locking, reaming of non-reaming, infection, failure of the implant, distraction at the fracture site, and the time to full weight-bearing. Patients with severe head injuries were excluded. Both groups were comparable with regard to gender, Injury Severity Score and soft-tissue injury. There was no relationship between the rate of union and the type of implant, mode of locking, reaming, distraction or smoking. There were fewer cases of nonunion in more comminuted fractures (type C) and in patients who were able to bear weight early. There was a marked association between nonunion and the use of NSAIDs after injury (p = 0.000001) and delayed healing was noted in patients who took NSAIDs and whose fractures had united.

Heterotopic ossification prophylaxis with indomethacin increases the risk of long-bone nonunion.
Burd TA, Hughes MS, Aulgur IO.

Department of Orthopaedic Surgery, The University of Missouri Hospital and Clinics, University of Missouri, Columbia 65212, USA.
Indomethacin is commonly administered for the prophylaxis of heterotopic ossification (HO) after the surgical treatment of acetabular fractures. Non-steroidal anti-inflammatory drugs such as indomethacin, have been associated with delayed healing of fractures and mechanically weaker callus. Our aim was to determine if patients with an acetabular fracture, who received indomethacin for prophylaxis against HO, were at risk of delayed healing or nonunion of any associated fractures of long bones. We reviewed 282 patients who had had open reduction and internal fixation of an acetabular fracture. Patients at risk of HO were randomised to receive either radiation therapy (XRT) or indomethacin. Of these patients, 112 had sustained at least one concomitant fracture of a long bone; 36 needed no prophylaxis, 38 received focal radiation and 38 received indomethacin. Fifteen patients developed 16 nonunions. When comparing patients who received indomethacin with those who did not, a significant difference was noted in the rate of nonunion (26% v 7%; p = 0.004). Patients with concurrent fractures of the acetabulum and long bones who receive indomethacin have a significantly greater risk of nonunion of the fractures of the long bones when compared with those who receive XRT or no prophylaxis.