Injuries to the Pelvis and Extremities

Presley Regional Trauma Center
Department of Surgery
University of Tennessee Health Science Center
Memphis, Tennessee
General

- Common – occur in 85% of blunt trauma
- Sign of substantial force
- Associated with potentially life- or limb-threatening injuries
- Improper management can have devastating consequences
Goal

- Bony union
- Muscle function
- Joint mobility
- Weight bearing
Evaluation and Assessment
Initial Priorities

- Life
- Limb
- Joint
- Function
Imaging

- Plain films
  - Two planes
  - Affected limb, joint above and below

- CT
  - Adjunct to plain films
  - Periarticular fractures and dislocations and pelvic fractures
Classification of Injuries
Fractures

- AO-ASIF fracture classification system
- Allows documentation of fractures
- Aids in assessing the severity of the fracture and determining appropriate tx
- Fracture is described by a five-place alphanumeric designation
• Bone injured
• Segment affected
• Fracture type
• Fracture group
• Fracture subgroup
Soft Tissue Injury

- Type and extent determined by:
  - Type of insult sustained
  - Degree and direction of force applied
  - Area affected
  - Extent of contamination
Gustillo and Anderson

- **Type I**
  - Wound < 1 cm, results from inside out perforation, little or no contamination, simple fracture type (A or B)

- **Type II**
  - Wound > 1 cm, associated with little or no contusion of surrounding tissues, no dead musculature, mod to severe fx type (B or C)
• Type III
  - Extensive soft tissue damage, with or without severe contamination, frequently in association with compromised vascular status, highly unstable fracture (C) as a result of comminution or segmental defects
  - Further divided into 3 subtypes
Type III Fractures

- **IIIA**
  - adequate soft tissue coverage of the bone is still possible

- **IIIB**
  - extensive soft tissue loss occurs with periosteal stripping and exposed bone, contamination is usually massive

- **IIIC**
  - arterial injury is present that requires repair
Closed Fractures - Grades

- 0: STI absent or minor, simple fx
- I: sup abrasion/contusion, simple or mod fx
- II: deep contaminated abrasions, localized skin or muscle contusion, mod to severe fx type
- III: extensive skin contusion, destruction of musculature, subq avulsion have occurred, severe and comminuted fx
Indications for Operative Tx

- Preservation of life
- Preservation of limb
- Articular incongruity
- Facilitation of early mobilization and rehab
- Inability to maintain reduction non-op
- Floating joint
- Additional fractures in other limbs
Timing and Planning

• Operative tx depends both on the condition of the patient and the particular combination of skeletal and soft tissue injuries

• Damage control strategy – minimize OR time and tissue insult
Damage Control Surgery
Goal

- Limit second hit imposed by the operation after experiencing the first hit imposed by the initial trauma
Three main phases:

- (1) resuscitative
- (2) intensive care
- (3) reconstructive
Focus

• Control bleeding

• Control GI contamination

• Temporary stabilization of fractures
Musculoskeletal DCS

- D&I of open wounds = washout
- Amputation if life-threatening
- Preserve osteochondral frags in open jnts
- Dislocations and diaphyseal fxs are reduced and stabilized with ex-fix
- Goal is to restore length, align long bones and jnts, reduce contamination and enable post-op wnd care
Management of Life-Threatening or Limb-Threatening Injuries
Pelvic Fractures

- Frequently associated with significant hemorrhage
- Significant arterial hemorrhage is present in 25% of unstable pelvic fx
- Bleeding originates either from the fractured bones or from torn arteries and veins
- Differentiate pelvic bleeding from another source
Pelvic Fractures

- Diagnose fracture
- External stabilization
- Approximate the fractured bones, reduce pelvic volume and decrease blood loss
- Minimize further damage to blood vessels and prevent clot dislodgement
Hemodynamic Instability

• Rule-out hemorrhage
• Only FOUR places to bleed to death in adult (children = five)
• Eliminate floor, chest and abdomen
• Pelvic fracture = most likely source
• Amenable to external stabilization?
• Arterial bleeding source is found in 73% of hypotensive patients who do not respond
## Estimated Blood Loss

<table>
<thead>
<tr>
<th>Injury Description</th>
<th>Blood Loss (Units)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facial fractures</td>
<td>1</td>
</tr>
<tr>
<td>Humerus fracture</td>
<td>1</td>
</tr>
<tr>
<td>Multiple rib fractures</td>
<td>1 – 2</td>
</tr>
<tr>
<td>Pekvic rami fractures</td>
<td>1 – 2</td>
</tr>
<tr>
<td>Tibial fracture</td>
<td>1 – 2</td>
</tr>
<tr>
<td>Femur fracture</td>
<td>2</td>
</tr>
<tr>
<td>Sacroiliac disruption</td>
<td>2 – 10</td>
</tr>
</tbody>
</table>
Role for CT

- Can identify active hemorrhage
- Extravasation of contrast (blush)
- Large RP hematoma
- Abrupt cutoff of a pelvic vessel

**STRONGLY consider angio+embolization**
General Management of Fractures
Fixation Methods

- Non-operatively – external splinting
- Surgically – screws, wires, plates, nails, ex-fix
- Absolute stability
- Relative stability
Absolute Stability

- Reduces strain at fracture site
- Allows bone healing without visible callus formation
Relative Stability

- Allow small interfragmentary movements to occur when a load is applied across a fracture site.
- Such movements stimulate callus formation and bone union through inflammation, soft callus, hard callus and remodeling.
Open Fractures

- 3 to 5% of all fx and 10 to 15% of long bone fx are open
- Implies higher energy
- Stripping of muscle, periosteum and ligaments
- Influences rate of healing, incidence of nonunion and risk of infection
Open Fractures

- PE
- NV status
- Muscle function
- Compartment syndrome
Treatment Goals

- Prevent infection
- Adequate soft tissue coverage
- Allow bone healing
- Promote early and full functional recovery
Management

- Aggressive debridement
- Open wound treatment
- Stabilization
- Antibiotics
- Time to OR within 6 hours of injury
Antibiotics

- Ancef for 48 to 72 hours
- Prolonged administration is **NOT** necessary
- For grade III open fxs, add gentamicin
- PCN for those injuries at risk for Clostridium
Reduction and Stabilization

- Improves circulation
- Promotes healing of bone and soft tissue
- Reduces inflammation, bleeding and dead space
- Increases revascularization of devitalized tissue
- Earlier mobilization
Management

• Internal fixation is preferred
• Every attempt should be made to cover bones, joint surfaces, implants, tendons, nerves and blood vessels
• Skin coverage and soft tissue reconstruction should be achieved within 1 week
Mangled Extremity

- Decision to amputate
- MESS ≥ 7
- Should be based on overall condition, level of NV function and expected functional result
- Does not need to be made immediately unless limb is life-threatening
Compartment Syndrome

- High-pressure swelling within a fascial compartment
- Hemorrhage + edema in the damaged soft tissues
- High index of suspicion = key to Dx
- Clinical Dx = tense, swollen extremity + pain with PROM
Five Ps

- Pain
- Pallor
- Paraesthesia
- Paralysis
- Pulselessness
Compartments Pressures

- Helpful in patients who are not alert or difficult to examine.
- There is no agreement on what constitutes the critical pressure threshold for Dx.
- Difference in DBP and the pressure in the involved compartment = delta pressure or $\Delta p$

$\Delta p < 30$ mmHg
Crush Syndrome

- Traumatic rhabdomyolysis
- Rhabdomyolysis
- Myoglobinuria
- Subsequent renal failure
- Prolonged compression of muscle tissue
- Associated with prolonged extrication
Pathophysiology

- Muscle breakdown from direct pressure
- Impaired muscle perfusion leading to ischemia and necrosis
- Release of myoglobin
- Extrication and subsequent reperfusion of necrotic and ischemic muscle
Pathophysiology

- Toxic reactive oxygen metabolites
- Failure of ion pumps
- Increased permeability of cell membranes and microvasculature
- $K^+$, lactic acid and myoglobin are released into circulation $\rightarrow$ ARF, DIC and death
Treatment

- Should begin at time of extrication
- IV hydration
- Cardiac monitoring
- Forced diuresis
- Alkalization of the urine
- Rule-out compartment syndrome
Importance
Judgment

- Management algorithm for the hemodynamically unstable patient with a pelvic fracture

- Fracture + Vascular injury – What’s first?

- Open pelvic fractures – To divert or not and when
• Keep patient safe from ortho and anesthesia

• Will operate until patient is dead or DND

• Life over Limb

• To paraphrase Dr Mangiante – not everyone needs to walk