Orthopedic Emergencies-
LONG BONE FRACTURES

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No Conflict

I have no commercial conflicts with this presentation.

Kevin Ware
Long bone fractures are attention getters...

Long bone fractures relatively rare in Sport-

- Important to recognize the issues that can prolong recovery

Agenda - 30 min

- Discuss long bone fractures and identify potential complications that may occur
- Understand the prognosis of long bone fractures
- Recommendations for return to participation for long bone fractures
Agenda

- Discuss fractures and what would make them possible emergencies
- Discuss the major long bone fractures cases and relevance to sport
- Review their prognosis and return to sport potential/timing

Implications of long bone fractures

WHY ARE LONG BONE FRACTURES EMERGENCIES?

- Blood Loss
- Neurovascular damage
- Fat embolism
- Long term loss of function
Physiologic events after long bone fractures and injuries

- **Local**
  - Immediate
  - Early
  - Delayed

- **Systemic**
  - Immediate
  - Early

**Immediate Potential Complications**

- **Systemic immediate complication**
  - Hypovolemic shock

- **Local immediate complication**
  - Injury to major vessels.
  - Injury to muscles and tendons.
  - Injury to joints.
  - Injury to nerves.

**Early Potential Complications**

- **Local**
  - Bleeding /shock
  - Compartment syndrome.
  - Infection if open

- **Systemic**
  - Hypovolemic shock
  - ARDS
  - Fat embolism syndrome
  - Deep vein thrombosis
  - Pulmonary Embolism
  - Crush syndrome
  - Septicemia
Late complications - loss of function

- Imperfect union of the fracture (Deformity)
- Delayed union
- Non union
- Mal union

Bleeding -

Can occur from

- Fracture site
- Arterial injury

Blood Loss from fracture site

- Femur ➞ 1000–1500 cc
- Tibia ➞ 500–1000 cc
- Humerus ➞ 250–500 cc
- Clavicle ➞ 100–250 cc

Categories of Hemorrhagic Shock

<table>
<thead>
<tr>
<th>Class</th>
<th>Blood Loss (cc)</th>
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<tbody>
<tr>
<td>I</td>
<td>&lt; 500</td>
</tr>
<tr>
<td>II</td>
<td>500–1500</td>
</tr>
<tr>
<td>III</td>
<td>1500–4000</td>
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<tr>
<td>IV</td>
<td>&gt; 4000</td>
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- Systolic Blood Pressure (SBP)
- Diastolic Blood Pressure (DBP)
- Central Venous Pressure (CVP)
- Urine Output (UO)

- Normal
- Decreased
- Noteable Decreased
- Severe Decreased
BLOOD VESSELS: VASCULAR INJURY

**Specific fractures**
- Clavicle.
- Supracondylar region of the elbow.
- Femoral shaft.
- Around the knee.

**Artery**
- Subclavian artery.
- Brachial artery.
- Femoral artery.
- Popliteal artery.

NERVE INJURY

- Nerve can damage in 3 ways:
  - Compressed.
  - Contused.
  - Stretched.

Adult Respiratory Distress

Known as: Shock lung or wet lung.
- Fluid overload.
- Edema and electrolyte retention 2nd to trauma contributes to it.
- Treatment is by oxygen and ventilation.
Fat Embolism Syndrome

- Mechanical blockage of blood vessels by circulating fat particles.
- Occurs following
  - Long bone fracture,
  - Pelvic fracture

Lungs and Brain especially susceptible to 2nd hit...

- Long bone fractures
- Hemorrhagic shock
- Vulnerable blood-brain barrier and pulmonary endothelium

Etiology Of Decompensation

- Linked to Inflammatory Cascade
  - Initiated by trauma
- Pt in Hypermetabolic state
  - Cytokine Storm
  - Elevated IL-10 & IL-6
    - IL-6: Pro-inflammatory
    - IL-10: Anti-inflammatory
- Risk of MOF (Multiple Organ Failure)
FES

Signs and symptoms
• appear 12-72 hours post injury
  − Change in mental status
  − Respiratory distress
  − Petechial of skin & mucosa.

Diagnostics:
• No specific labs test
  − Fat globules may be detected in blood, urine or sputum
  − PO2 drops to < 50 mm HG
  − Chest X Ray with diffuse “snowstorm” effect

Deep Venous Thrombosis & Pulmonary Embolism

• Formation of fibrin leads to development of a thrombus (fibrin clot)
  − Embolus can enter pulmonary circulation
  − perfusion distal to the embolus can be partially or completely occluded.

Deep Vein Thrombosis and Pulmonary Embolism

• DVT:
• Clinical manifestations
  − Unilateral swelling of thigh/lower leg
  − Discomfort in leg
  − Erythema
  − Warmth
  − Tenderness
DVT and PE Investigation

**Deep Venous Thrombosis**
- Contrast venography
- Doppler ultrasonogram

**Pulmonary Embolism**
- Pulmonary angiogram
- CT scan

Crush Injuries

- Traumatic rhabdomyolysis
- Compression of extremities
  - Causes muscle swelling
  - Neurological disturbances in the affected areas
- Characterized by major shock and renal failure after a crush injury to skeletal muscle

Compartment Syndrome - Risk Factors

A condition in which the circulation and function of tissues within a closed space compromised by an increased pressure within that space.

**Internal Factors**
- Bleeding
- Swelling/edema
- Training

**External Force**
- Tight cast
- Tight dressing
- Prolonged compression
- Crush injuries
acute compartment syndrome

Conditions that precipitate
- fracture.
- crush injuries.
  - bruised muscle. E.g. football player is hit in the leg with another player's helmet.
- Reestablished blood flow
- Anabolic steroid use. Taking steroids is a possible factor in compartment syndrome.

26/02/19

All fractures have the same effects
- bleeding
- Release of local mediators
- Initiation of the inflammatory response

26/02/19

Soccer, football players at higher risk of compartment syndrome

Acute tibia fractures in football, soccer players more likely to develop acute compartment syndrome
Bone healing problem

<table>
<thead>
<tr>
<th>Delayed Union</th>
<th>Nonunion</th>
<th>Malunion</th>
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<tbody>
<tr>
<td>No healing after 4 months</td>
<td>No healing after 6 months</td>
<td>Heals out of alignment</td>
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Emergency Medical Care

- Perform a primary assessment.
- Stabilize the patient’s ABCs.
- Perform a rapid scan or focus on a specific injury.
- Follow standard precautions.
- Suspect internal bleeding.

Splinting (1 of 7)

- A splint is a flexible or rigid device that is used to protect and maintain the position of an injured extremity.
  - Splint all fractures, dislocations, and sprains before moving the patient, unless he or she is in immediate danger.
  - Splinting reduces pain and makes it easier to transfer and transport the patient.
Splinting (2 of 7)

- Splinting will help to prevent:
  - Further damage to muscles, the spinal cord, peripheral nerves, and blood vessels
  - Laceration of the skin
  - Restriction of distal blood flow
  - Excessive bleeding of the tissues
  - Increased pain
  - Paralysis of extremities

Splinting (4 of 7)

- General principles of splinting
  - Remove clothing from the area.
  - Note and record the patient’s neurovascular status.
  - Cover all wounds with a dry, sterile dressing.
  - Do not move the patient before splinting an extremity, unless there is danger.

Splinting (5 of 7)

- General principles of splinting (cont’d)
  - Pad all rigid splints.
  - Maintain manual stabilization.
  - If you encounter resistance, splint the limb in its deformed position.
  - Stabilize all suspected spinal injuries in a neutral, in-line position.
  - When in doubt, splint.
Splinting (6 of 7)

- General principles of in-line traction splinting
  - Act of pulling on a body structure in the direction of its normal alignment
  - Goals of in-line traction:
    - To stabilize the fracture fragments
    - To align the limb sufficiently
    - To avoid potential neurovascular compromise

Splinting (7 of 7)

- In-line traction splinting (cont’d)
  - Imagine where the uninjured limb would lie, and pull gently along the line of that imaginary limb until the injured limb is in approximately that position.

Transportation

- Very few, if any, musculoskeletal injuries justify the use of excessive speed during transport.
  - A patient with a pulseless limb must be given a higher priority.
  - If the treatment facility is an hour or more away, transport by helicopter or immediate ground transportation.
You can help reduce the risk or duration of long-term disability by

• Preventing further injury
• Reducing the risk of wound infection
• Minimizing pain by the use of cold and analgesia
• Transporting patients to an appropriate medical facility

Pelvic fractures

Avulsion fractures common

• Not dangerous
courtesy of Dr Andrew Ho, Radiopaedia.org, rID: 28884

Pelvic fractures- non avulsion
Pelvis

Can bleed

Very vascular

Decelerates around object

Horse
Bicycle
Motorcycle
Fall
(sled)

Pelvic ring disruption—mortal

• Potential for Severe hemorrhage with mortality of 50–60%
• Hallmark for survival: rapid recognition and control of retroperitoneal hemorrhage

Femur fractures

Clinical Presentation

Physical exam findings
- Shortening of the thigh
- Swelling
- Deformity
- Severe pain

Physical examination
- Palpation of the pelvis, hip, and knee
- Circumferential examination of soft-tissue
- Assessment of distal neurologic and vascular integrity
- Rule out of compartment syndrome of the calf and thigh
- Examination for thromboembolic disease
- Examination for concomitant injuries
- Quaternary survey: all other bone palpated for tenderness (see first, second, and third phases of ATLS)
Associated injuries

Rehabilitation and Postoperative Management

- Postoperatively, active range motion of surrounding joints is encouraged.
- Weight bearing is typically as tolerated.

Femur Fractures

- Functional recovery after long-bone fractures usually depends on concomitant injuries and the general health of the patient.
- Femur fractures are rarely seen in sports.
- 1 year return to sport.

Femur Fractures in Professional Athletes: A Case Series
Sikka et al.

Functional limitations that impaired outcomes after femur fractures included hip-abductor weakness, quadriceps femoris muscle weakness, and anterior knee pain.

Soft Tissue- 26 yo struck by boat w femur /acet
Locking plate subcutaneously as ex fix

Return to OR when swelling down
Tibia

- Typically occurs with high energy injuries
- Can occur with direct contact with foot planted
  - Theisman
  - Ware

Prognosis - tibia

- 91.5% of patients with tibial shaft fractures treated surgically returned to sports, only 75% in different studies returned to the same level of play.
  - Surgery was associated with some complications, including knee pain after surgery, compartment syndrome, infection and blood clots.

- 66.7% treated nonsurgically returned to sports.
  - Time required to return was much greater for nonsurgically treated fractures.
  - Displacement of the fracture can occur with nonoperative treatment.

Robertson GAJ and Wood AM. Return to Sport After Tibial Shaft Fractures: A Systematic Review. Sports Health. Published online August 18, 2015
Injuries of the Clavicle and Scapula (1 of 3)

- The clavicle is one of the most commonly fractured bones in the body.
  - Occur most often in children
  - Pain in the shoulder
  - Will hold the arm across the front of the body.

Injuries of the Clavicle and Scapula (3 of 3)

- These fractures can be splinted effectively with a sling and swathe.

Clavicle

- Clavicle fractures comprises up to 10% of all sport-related fractures, with around 30% of all clavicle fractures occurring during sport.
- Currently, most patients are able to return to manual work after fracture consolidation at average of 16 weeks.
- Study results demonstrate that high-end athletes can safely return to at-risk sports much sooner than the average delays seen with non-athletes.
Dislocations of the Shoulder

- The humeral head most commonly dislocates anteriorly.
- Shoulder dislocations are very painful.
  - Stabilization is difficult because any attempt to bring the arm in toward the chest wall produces pain.
  - Splint the joint in whatever position is more comfortable for the patient.

Fig. 3 (a) Return Times to sport for mid-shaft clavicle fractures; (b) return times to sport for lateral clavicle ...

Fractures of the Humerus

- Occur either proximally, in the midshaft, or distally at the elbow
- Consider applying traction to realign the fracture fragments before splinting them.
  - Splint the arm with a sling and swathe.
In non contact situations usually due to muscle imbalance

imbalance exists between

• the internal rotators
  ‒ latissimus dorsi,
  ‒ pectoralis major,
  ‒ subscapularis
• external rotators
  ‒ (rotator cuff).

• the rotational torque force on the humerus during the acceleration phase of overhead throwing is sufficient to cause a spontaneous fracture.

24 yo pitcher- fractures humerus during game

postop
After hardware removal

Humerus – return to sport

- Proximal humerus
  - Older population: 53 yrs
  - Most avoided return to overhead sports
- Humerus shaft
  - 12-16 weeks

Prognosis

- Return to sport after long bone fractures often season ending injury
- Typical return to sport - minimum 16 weeks
  - Significantly affected by injury to
    - Nerves
    - Muscle

Summary

- Long bone fractures can be possible medical emergencies
  - recognition important
- Major long bone fractures relatively rare in sport
- Long bone fractures have a good prognosis but return to sport can be prolonged