Emergency day: Critical period of limb injuries

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Topics

- Initial management
- Multiple injuries
- Open fracture
- Pelvic ring fracture
- Fractures and dislocations
- Cast and Splint
- Cast care
- Compartment syndrome
- Fat embolism
- Tendon injuries
- Peripheral nerve injuries
- Arterial injuries
Initial management

- Primary survey
- Secondary survey
Secondary survey - Ortho

- Careful history taking and physical examination
Secondary survey-Ortho

- Careful history taking and physical examination
  - Predict x-ray findings with a high degree of accuracy
  - If a fracture is suspected clinically, but x-ray appears negative, the patient initially should be managed with immobilization as though a fracture were present
Secondary survey - Ortho

- Careful history taking and physical examination
- Palpate the extremities
- Palpate the spine
- Pelvic compression
- Active movement of the extremities
- Specific test for each part
Secondary survey - Ortho

- Plain radiographs

- Special imaging techniques
  - Rarely use in emergency settings
  - Bone scan
  - CT scan
  - MRI
Criteria for adequate radiographic studies exist; inadequate studies should not be accepted.

X-ray studies should be performed before attempting most reduction except when a delay would be potentially harmful to the patient or in some field situation
Plain radiographs

- Lateral crosstable C-spine
- Chest AP
- Pelvis AP
- Specific part
Orthopaedic management

1. Irrigation and wound closure
2. Pressure dressing for vascular injury
3. Immobilization
Immobilization

- Pain relieve
- Prevent further damage
Immobilization

- Collar for neck injury
- Splint for extremities
- Pelvic wrapping for pelvic injury

(may simply use bed sheet)
Early death from orthopaedic conditions

- Bleeding from pelvic fracture
- Pulmonary failure from femoral and pelvic fracture
- Early stabilization is needed
Multiple injuries

- Recussitation
- First manage
  - Dislocation
  - Fracture with vascular injury
  - Open fracture
- Do definite fracture stabilization later
- Aware deep vein thrombosis and pulmonary embolism
Open fracture

- Fracture that connected to the external environment
- Higher rate of infection
- Early surgery within the first twenty-four hours (as early as possible)
Open fracture

ER management:
- Remove and irrigate gross contamination with NSS
- Stop active bleeding – pressure dressing, do not ligate vessels
- Splint without reduction, unless vascular compromise is present
- Begin IV ATB (1st generation cephalosporin) and tetanus toxoid
Open fracture

Definite management:
- Debridement
- Stabilize the bone
- Wound closure
- Antibiotic
Pelvic ring injury

- Life threatening
- Up to 40% of patients with an unstable pelvic ring injury die from their injuries, and hemodynamic instability is the main predictor of death.
Pelvic ring injury

- Pelvic compression test
  - From anterior
  - From lateral
- PR – floating prostate, bleeding
- PV – bleeding
- Neurologic examination
Pelvic ring injury

- IV fluid
- Urinary catheter
- Pelvic wrapping
- X-ray
Pelvic ring injury

Young classification
- Lateral compression (LC)
- Anterior-posterior compression (APC)
- Vertical shear (VS)
- Combined
Pelvic ring injury

Instability

- Displacement of posterior part of pelvis > 1 cm
- Symphysis diastasis > 2.5 cm
- Vertical shear > 2 cm
- Any neurologic injury
Hemodynamic assessment after pelvic wrapping

- If hemodynamic is continue severely unstable -> **laparotomy**
- If hemodynamic is partially control -> search for intraperitoneal bleeding (FAST, DPL, CT)
  ---> evidence of intraperitoneal bleeding

Yes → **Laparotomy**
No → **Angiography** (& embolization)
Pelvic ring injury

Type of external fixator

- Open anterior – external fixator
- Open posterior or vertical shear – C-clamp
Fractures and dislocations

Clinical diagnosis
- Pain, swelling, deformity
- Tender, false motion, crepitus
- Distal neurovascular status
Fractures and dislocations

Clinical diagnosis

- Pain, swelling, deformity
- Tender, false motion, crepitus
- Distal neurovascular status
Fractures and dislocations

Radiographic diagnosis

- At least 2 views
  - (commonly AP, lateral)
- Additional:
  - Oblique view
  - Compare 2 sides
  - Stress view
  - Special view
Fractures and dislocations

Closed reduction

Reducible

Maintain reduction

Able

Non-operative (Cast, splint, traction)

Irreducible

Operative

Unable
Fractures and dislocations
Common fractures

- Distal radius fracture
- Forearm fracture
- Humeral fracture
- Tibial fracture
- Femoral fracture
- Femoral neck fracture
Common dislocations

- Elbow dislocation
- Shoulder dislocation
- Hip dislocation
Common dislocation

- Elbow dislocation
- Shoulder dislocation
- Hip dislocation
Common dislocations

- Elbow dislocation
- Shoulder dislocation
- Hip dislocation
## Nerye injuries accompanying dislocation

<table>
<thead>
<tr>
<th>Orthopedic injury</th>
<th>Nerve injury</th>
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<tbody>
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Children are different from adults

- Different in anatomy, physiology and bone property
- Less dislocation
- Physeal injuries occur more commonly than ligamentous disruption because of the relative ligamentous strength compared with the ease of disrupting the physis
Children are different from adults

Specific injuries in children:
- Physeal injuries
- Buckle fracture
- Greenstick fracture
- Plastic deformation
Physeal injuries
Greenstick
Buckle or torus
Plastic deformation
Common children fractures

- Entire distal humeral physeal injury
- Supracondylar fracture
- Lateral condyle fracture
- Femoral fracture
Type of casts and slabs

- Extremity
  - Short
  - Long
  - Cylinder
  - Spica (thumb, shoulder, hip)

- Body
  - Minerva
  - Body jacket
Cast care

- Elevate the limb
- Frequently move
- Let the cast dry for 1 day (do not cover)
- Do not get wet
- Do not put anything inside
- Weight bearing or not
- Expected cast period
Cast care

Bad signs, need to come back urgently
- Pain out of proportion
- Markedly swelling
- Pale or congested
- Loss of sensation
- Discharge or bleeding
- Wet cast
Mangled extremity

If either of the following criteria present, immediate amputation is better:

1. Loss of arterial inflow for longer than 6 hours, particularly in the present of a crush injury that disrupts collateral vessels.
2. Disruption of posterior tibial nerve.
Thank you
Time
Compartment syndrome

- Surgical emergency
- Most common in tibial fracture
Compartment syndrome

Early signs

- Tight
- Escalating pain
- Pain with passive stretch of the involved muscle
Compartment syndrome

Late signs - 6P
- Pain
- Pallor
- Pulselessness
- Paresthesia
- Paralysis
- Poikilothermia
Compartment syndrome

- Intracompartment pressure
- Adjunction to clinical examination, **NOT** diagnostic
  - >30mmHg or
  - >30mmHg difference between intracompartmental pressure and diastolic blood pressure

- indication for fasciotomy?
Management

- Remove any cast or bandage around the limb immediately – all layers should be clear down to skin
Management

- Fasciotomy
- Emergency
Management

- Delay $> 12$ hr. often results in irreversible muscle and nerve damage in that compartment.
- If left untreated, acute compartment syndrome can lead to more severe conditions including rhabdomyolysis and kidney failure.
Management

- While the patient is awaiting definitive treatment, the affected part should not be elevated above the level of the heart because this maneuver does not improve venous outflow and reduces arterial inflow.
Fat embolism

- Fat embolism – presence of fat globules in the lung parenchyma and peripheral circulation
- Common as a subclinical event after long bone fractures
Fat embolism syndrome

- Serious manifestation of fat embolism
- Common after long bone fracture in young adults (tibia/fibula) and hip fractures in elderly
- Syndrome usually appear in 1-2 days after an acute injury or after IM nailing
Fat embolism syndrome

- Respiratory distress syndrome is the earliest, most common, and serious manifestation.
- Neurologic involvement, manifest as restlessness, confusion, or deteriorating mental status, is also an early sign, as are thrombocytopenia and petechial rash.
Tendon injury

- Flexor tendons in hand – common and important
- 2 tendons in each digit: FDS, FDP
- Digital flexor sheath
Tendon injury

- Zones of flexor tendon injury
- Zone II – no man’s land
- Stiffness VS. rupture
Tendon injury

- Diagnosis
  - Position
  - Passive tenodesis
  - Active motion

- Suspect digital nerve injury when there is FDP tear
Tendon injury

- Repair strong enough (Core+epitendinous stitches)
- Early range of motion exercise
Tendon injury

- Repair strong enough (Core+epitendinous stitches)
- Early range of motion exercise
Peripheral nerve injury

- **Diagnosis**
  - Location of wound
  - Sensory
  - Motor
## Peripheral nerve injury

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<td>Lateral tibial plateau</td>
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Peripheral nerve injury

- ** Neuralpraxia  
  - the least severe form of nerve injury, with complete recovery  
  - actual structure of the nerve remains intact, but there is an interruption in conduction of the impulse

- ** Axonotemesis  
  - disruption of the neuronal axon, but with maintenance of the myelin sheath  
  - Mainly seen in crush injury  
  - the axon may regenerate, leading to recovery

- ** Neurotremesis  
  - Not only the axon, but the encapsulating connective tissue lose their continuity  
  - Regeneration
Peripheral nerve injury

- Neurotmesis needs repair
- Primary nerve repair
- Secondary nerve repair (delay)
  - Severe contamination
  - Blast effect
Arterial injury

Diagnosis

- Hard signs
- Soft signs
- Other issues of observation
Arterial injury

Hard signs
- 6 P (pain, pallor, pulselessness, paresthesia, paralysis, poikilothermia)
- Massive bleeding
- Rapidly expanding hematoma
- Palpable thrill or audible bruit over a hematoma
Arterial injury

Other issues of observation

- No pulse detected, observe
  - Position of extremity
  - Deformity of long bone or joint
  - Capillary refill time
    - < 1 sec = congestion
    - > 3 sec = poor perfusion

- Arteriography may need if pulse absent after reduction
Investigation

- Localization of the defect is necessary (duplex ultrasound, arteriogram)
- Except: patients with impending limb loss from arterial occlusion or significant external bleeding from an extremity, immediate surgery without preliminary arteriography of the injured extremity is justified
Management

- Non-operative VS. operative

- Patient with soft signs and distal arterial pulse may have 3%-25% arterial injuries but may not need surgery
Management

- Non-operative
  - Observe
    - Non-occlusive arterial injuries (spasm, intimal flap, subintimal or intramural hematoma)
    - Careful arteriographic follow-up is necessary
  - Therapeutic embolization
    - Isolated traumatic aneurysms of branches of the axillary, brachial, superficial femoral, or popliteal arteries of the profunda femoris, or of one of the named arteries in the shank
Management

- Operative
  - Lateral arteriorrhaphy or venorrhaphy
  - Patch angioplasty
  - Panel or spiral vein graft
  - Resection of injured segment
    - End-to-end anastomosis
    - Interposition graft
    - Polytetrafluoroethylene
    - Dacron
  - By pass graft
    - In situ
    - Extra-anatomic
  - Ligation
Thank you