

## CASE BASED DISCUSSIONS 17<sup>TH</sup> SEPTEMBER

### CASE ONE

A 19yo male is transported to your emergency department with presumed bilateral femur fractures after a fall from a motocross bike. There are no other apparent injuries.

Observations on arrival:

GCS 15, RR18, BP 120/70, HR100, Sats 98% o/a

He has his legs tied together with bed sheets. He is given IV ketamine 30mg for a transfer across from the ambulance stretcher to the resus bed.

#### 1. Discuss your initial management and investigations?

- Analgesia
- Look for other injuries high risk mechanism – likely MRCT trauma
- Determine if open or closed injuries
- Early immobilisation of fractures – portable CXR/PELVIS/FEMURS
- efast
- Neuro vascular assessment limbs
- Trauma bloods, Grp/Hold, ECG, VBG
- Consider traction early

#### 2. The patient is haemo-dynamically stable with no obvious abdo/chest/head injuries. Below is his bilateral femur fractures, discuss the injuries, potential complications, and management?



- Bilateral femur fractures
  - L proximal spiral fracture comminuted
  - R distal transverse oblique femur fracture
- Associated with other serious traumatic injuries
  - Pelvic and other distal fractures
  - Spine injuries
  - Organ injury
  - Potential neurovascular compromise
  - Haemorrhage up to 1.5L per thigh potential space
- Management
  - Analgesia, femoral nerve blocks x 2 (calculate max safe dosing!)
  - Early immobilisation and operative fixation
  - Traction
  - Imaging for vascular injury if clinical concerns

### 3. Discuss traction/immobilisation options in ED?

- Exclude obvious unstable pelvis fractures
  - Most obvious pelvic fractures on XR are contraindication to traction splinting
- Distal and proximal femoral fractures are relative contraindication
- Associated knee/leg fractures are relative contraindication
- Options traction – Hare splint, Sager splints



**4. Post MRCT he becomes confused with lowered GCS of 12, and de-saturates requiring high flow O2. The initial CT report does not demonstrate any other significant traumatic injuries. Discuss possible causes for this deterioration and what investigations you would do?**

- Review primary and secondary survey
  - Drugs given
  - Developed complications? Pneumothorax, pulm haemorrhage, pulm edema, ARDS etc
  - VBG/ABG
  - Rpt CXR
  - Consider rpt CT head
  
- Early recognition possible Fat embolism syndrome

Fat embolism syndrome (FES) typically manifests 24 to 72 hours after the initial insult, but may rarely occur as early as 12 hours or as late as two weeks after the inciting event [37]. Affected patients develop a classic triad: hypoxemia, neurologic abnormalities, and a petechial rash. None of these features are specific for FES.

Signs and symptoms

Respiratory abnormalities — Hypoxemia, dyspnea, and tachypnea are the most frequent early findings similar.

Neurologic abnormalities — Neurologic abnormalities are also common and typically manifest after respiratory abnormalities, Neurologic manifestations range from the development of an acute confusional state and altered level of consciousness to seizures and focal deficits

Petechial rash — The characteristic red-brown petechial rash may be the last component of the triad to develop and occurs in only 20 to 50

Other clinical and laboratory findings — A number of other less common and nonspecific manifestations of FES may also be present.

- Anemia and thrombocytopenia (one-third to two-thirds)
- Retinal scotomata (Purtscher's retinopathy)
- Lipiduria
- Fever
- Coagulation abnormalities, rarely disseminated intravascular coagulation (DIC)
- Myocardial depression
- Right ventricle dysfunction
- Hypotension
- Obstructive shock

**5. He rapidly deteriorates drops his GCS to 8.**

**Sats 90% on 15L, HR 130bpm, BGL 5, Temp 38, BP 100/60**

**How would you manage this situation?**

- Careful IVF bolus
- Prepare intubation – optimise pre oxygenation
- Pressors available
- Remember HOP Killers
- Look for seizure activity – use BDZ

RSI ventilation strategy similar to ARDS approach:

- Permissive hypercapnia pH > 7.2
- Low volume ventilation using PEEP 5-10cmH20
- Plateau pressure < 30cmH20
- Aim saturations 92 % adequate
- Conservative fluid use
- Adequate sedation and paralysis
  
- Vasopressor support for MAP and cardiac support
- Disposition ICU
  
- In severe cases may need ICP monitoring, ECMO etc
- Mortality 5-15%
- Most cases mild and transient

## CASE TWO

32yo man is brought to the department after collapsing during prolonged army training session. There has been 6 hours between collapse and being transported to the ED. Initially on attendance by the first aid team he had a lowered GCS of 12 and was hyperthermic at 38.5 Celsius. On route his GCS has improved to 15, and his temperature is now normalised to 37 after ice packs, evaporative cooling and IVF have been provided.

### 1. Discuss potential complications and considerations of this presentation?

- Heat injuries
- Kidney, Brain, Muscle (Rhabdo), Liver
- Dehydration
- Metabolic disturbances – K etc
- Consider primary medical events causing collapse in work up

### 2. He is complaining of severe bilateral thigh pain since the collapse. There is no obvious traumatic injury. What is your concern and how would you investigate this?



- Recognised potential for acute compartment syndrome
  - Muscle tightness, pain on palpation, passive movement/stretch pain
  - Normal peripheral pulses and perfusion
  - Pallor/cold/loss pulses are very late findings!
  - Pain out of proportion is the most common initial symptom

Remember the 6P's:

- Pain (especially on passive stretching)
- Pallor
- Perishingly cold
- Pulselessness
- Paraesthesia

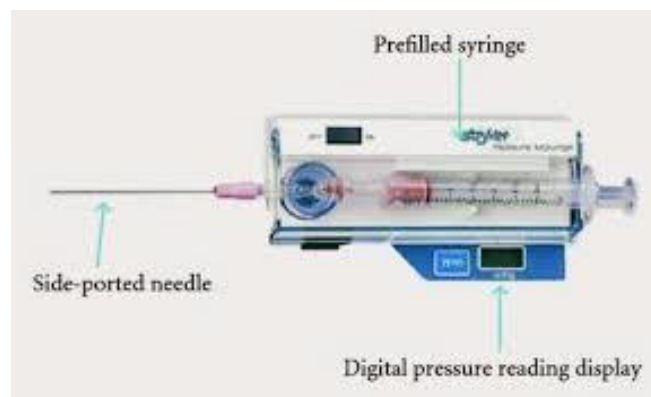
- Biochemical findings
  - Compartment syndrome clinical diagnosis
  - May be normal labs
  - Often associated with variably elevated CK, usually CK continues to rise over time
  - Potential associated Rhabdo +/- AKI

### 3. What are the causes for compartment syndrome and what is the pathophysiology?

- Fractures account for 75% of cases
- Soft tissue injury – crush, tight casts, exertion, heat injury, burns, envenomation's, tourniquet, seizures etc.
- Most commonly in volar forearm and anterior compartment of the leg
- Muscles are contained within inelastic fascial sheaths :
  - When injured muscles swell, a hematoma forms, or external compression is applied, the pressure within the fascial compartment increases.
  - If the pressure rises high enough, capillary pressure is exceeded and circulation is compromised.
  - This results in ischemic injury to the muscles and nerves within the fascial compartment.

### 4. How do we determine compartment pressures and what is abnormal?

- Commonly use a stryker device



- Normal tissue pressure ranges between zero and 10 mmHg.
- Capillary blood flow within the compartment may be compromised at pressures > 20 mmHg.

- Muscle and nerve fibers are at risk for ischemic necrosis at pressures >30 to 40mmHg.
- These pressures may still be tolerated — depending on the perfusion pressure, hence a recent trend towards using delta pressures, although most treatment recommendations are still based on absolute pressures.

### **A delta pressure < 30 mmHg**

- Delta pressure = diastolic blood pressure (DBP) — intracompartment pressure.
- A delta pressure <20 mmHg is a definite indication for fasciotomy, <30 mmHg may be a relative indication.

Other recommendations for fasciotomy include:

1. clinical signs of acute compartment syndrome
2. absolute pressure is >30 mmHg and the clinical picture is consistent with compartment syndrome

### **5. You get his lab results back. Interpret and discuss management?**

Cr 180, CK 20000, K5.8, Na 150

- Rhabdomyolysis with AKI and hyperkalaemia
  - Fluid bolus
  - Maintain U/O 1ml/kg/kr with N saline
  - ECG check for hyperkalaemic changes
  - K usually can be managed with fluid resuscitation and maintain U/O

### **➤ EARLY DEFINITIVE SURGICAL MANAGEMENT OF COMPARTMENT SYNDROME**

- Consider Sodium Bicarbonate (don't mix with saline) help urine alkalization prevent ppt of myoglobin in renal tubules
  - Adverse effects metabolic alkalosis, hypocalcaemia/hypophosphatemia, hypernatraemia, volume overload

### CASE THREE

A 22yo woman has fallen off her motocross bike at high speed. Seemingly she has sustained an isolated closed distal forearm/wrist injury. She is placed in resus given the mechanism of injury and her severe pain. Her observations are normal.

1. **Discuss your approach to this patient?**

- High impact mechanism with distracting injury consider other trauma
- Full primary and secondary survey
- Early analgesia

2. **Below is the X ray of her injured wrist. Discuss the findings?**







**TRANS SCAPHOID PERILUNATE FRACTURE DISLOCATION**

- The classic scenario involves fall on outstretched hand causing high velocity forced hyperextension and ulnar deviation of the wrist

#### Epidemiology:

- Carpal injuries compose 2.5% of all encounters in the ED
- Perilunate/lunate dislocations compose about 10% of carpal injuries
- 25% of perilunate/lunate dislocations are missed on initial presentation

#### Physical Exam:

- Patients will often be tender and swollen in the volar aspect of the wrist but physical exam is unlikely to be diagnostic.
- Important to perform and document a comprehensive neurovascular exam on injured limb as volar displacement of lunate can cause compression of median nerve in the carpal tunnel.

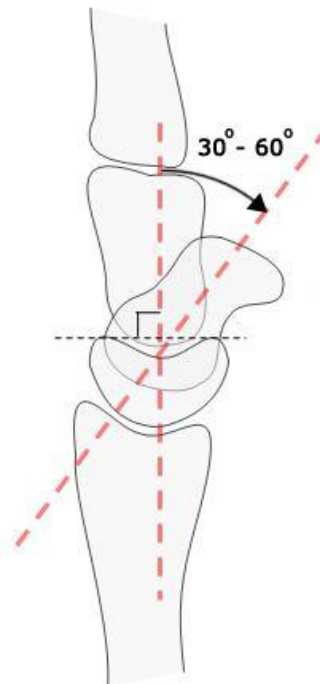
### 3. Describe and discuss the anatomy of the wrist and carpal bones in relation to lunate and peri-lunate injuries?

- On PA view of wrist evaluate the normal 3 carpal arcs known as Gilula's arcs. Normally, the arcs should be smooth running parallel to each other.



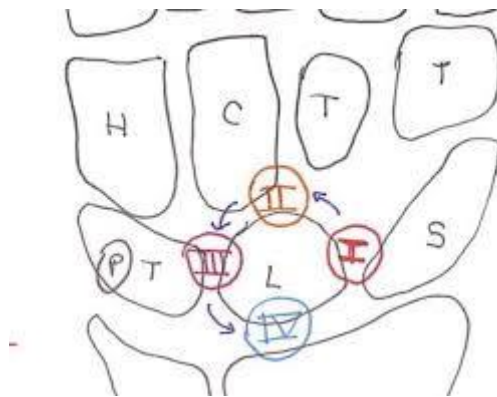
- Arc I, most proximal and largest arc, include the proximal surfaces of the scaphoid, lunate, triquetrum and pisiform
- Arc II spans the distal articular surfaces the formerly mentioned carpals.
- Arc III include the proximal surfaces of the capitate and hamate.

- On lateral of wrist should show normal C alignment radius-lunate and lunate-capitate with normal scapho-lunate angle 30-60 degrees



- Scapho-lunate angle:
  1. increased in scapholunate dissociation
  2. increased in dorsal intercalated segmental instability with increased capitolunate angle
  3. decreased in volar intercalated segmental instability with increased capitolunate angle

- MAYFIELD CLASSIFICATION OF PERILUNATE INSTABILITY



- **stage I: scapholunate dissociation** (rotatory subluxation of the scaphoid)
  - disruption of the scapholunate ligament with resultant Terry Thomas sign
  - exacerbated in clenched fist views



- **stage II: perilunate dislocation**
  - the lunate remains normally aligned with the distal radius, and the remaining carpal bones are dislocated (almost always dorsally)
  - the capitulunate joint is disrupted, and the lunate projects through the space of Poirier
  - 60% are associated with scaphoid fractures



- **stage III: midcarpal dislocation**
  - lunotriquetral interosseous ligament disruption or triquetral fracture
  - neither the capitate or the lunate is aligned with the distal radius



- **stage IV: lunate dislocation**
  - dorsal radiolunate ligament injury
  - dislocation of the lunate in a palmar direction
  - tipped teacup appearance



#### **4. How would you manage this patient's fracture?**





- Adequate analgesia
- Will require procedural sedation in ED for reduction unless rapid access to theatre for management
- Immediate closed reduction and splinting should take place with early operative referral:
  - General steps of closed reduction include traction followed by wrist extension, more traction, wrist flexion with volar pressure applied to rearticulate the lunate with the radius

## CASE FOUR

A 4yr old girl has fallen off the Monkey Bars. She has a swollen painful elbow.

### 1. Discuss your approach to this child?

- Child friendly age appropriate approach
  - Engage the parents/caregivers
  - Early analgesia (po, IN fentanyl)
  - Ensure temporary immobilisation
  - Emla/ametop
  - Medical history, medications and allergies
  - NBM status
- 
- Assessment of injury and associated injuries
4. Closed/open
  5. NV status
  6. Distal and proximal injury?

Neuro Testing Maneuvers for Elbow Dislocation		
"Peace sign" against resistance	Ulnar nerve	
"Hitchhiker" / Thumbs up	Radial nerve	
"Power to the people"	Median nerve	
OK sign	Median nerve (anterior interosseous)	

1. Describe the xray below and discuss grading of these injuries including potential associated complications?

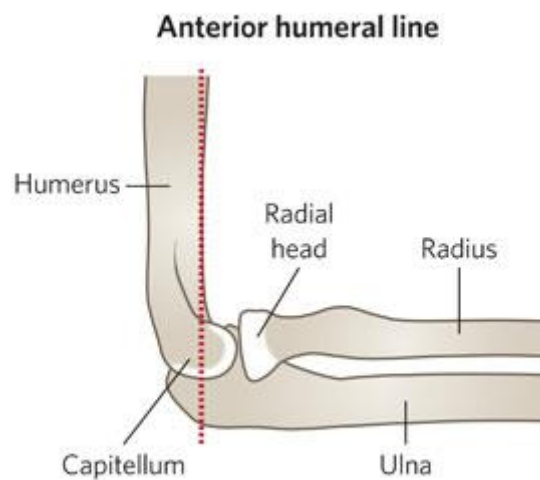


### GRADE II SUPRACONDYLAR FRACTURE

- Always do an AP x-ray as well

### GARTLAND CLASSIFICATION

The Gartland type classification is based on the lateral x-ray, identifying where the capitellum sits in relation to a line drawn down the anterior aspect of the humerus - the *anterior humeral line*.





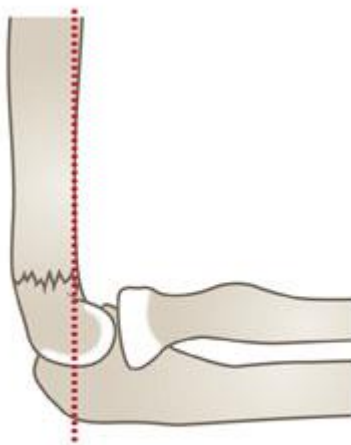
In a normal elbow, a line drawn on a lateral view along the anterior surface of the humerus should pass through the middle third of the capitellum. To assess this accurately, the view must be a true lateral view of the elbow.

If it passes through the anterior third of the capitellum or misses the capitellum completely, the fracture is displaced posteriorly.

**Gartland classification for extension fractures**

**ED management**

**Follow-up**

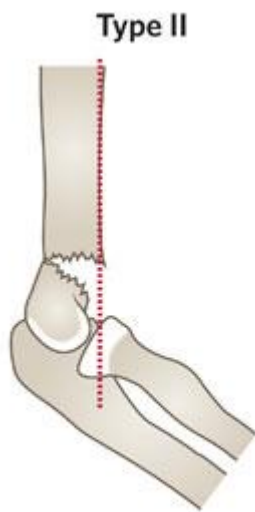


**Type I**

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Immobilisation in an above-elbow backslab in 90 degrees elbow flexion with sling for 3 weeks. The backslab and sling should be worn under clothing (e.g. loose fitting shirt) and not through the sleeve

**TIP:** Avoid putting on a short, flimsy backslab. The backslab should extend as high above the elbow as possible (i.e. close to the axilla) and down to the metacarpophalangeal joints (MCP) joints.



**Type II**

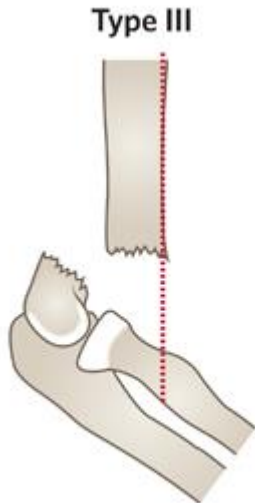
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Refer to the nearest orthopaedic on call service for advice

A gentle reduction can be achieved by an anterior push on the distal fragment as the elbow is flexed to 90 degrees

Note the exception is type II injuries with coronal plane deformity (see radiological assessment). These must always be managed by orthopaedics

Fracture clinic within 7 days post-injury with x-ray of distal humerus in backslab



Refer to the nearest orthopaedic on call service

Requires urgent reduction and percutaneous pin fixation

To be organised by orthopaedic service

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- Gartland type II injuries rarely have neurovascular problems but may result in malunion (gunstock deformity/cubitus varus) and need a corrective osteotomy.
- Gartland type III injuries have the highest risk of neurovascular injury. However, with appropriate management, Volkmann's ischaemia can be avoided and permanent nerve injury is very rare.

### 3. How would you manage this fracture?

- Ensure no coronal plane displacement – if so usually manage surgically



- Reduction under procedural sedation (nitrous or ketamine dependent age/child)
  - Gentle anterior reduction with flexion of elbow to 90 degrees
  - Avoid excess flexion beyond 90 as increased risk swelling, vascular compromise which can have greater impact on functional outcome than minor displacement.