

## Compartment Syndrome

### Definition of compartment syndrome

- The condition where elevated pressure within a confined space can lead to damage of its contents
- This can occur in other areas of the body (e.g. abdominal compartment syndrome, raised intracranial pressure) but in this situation it refers to the elevation of pressure within a discrete myofascial compartment leading to irreversible injury to its contents (particularly muscles and nerves)

### Epidemiology of compartment syndrome

- Compartment syndrome is most common in patients under 35 years of age, with a gender preponderance towards men, often following fractures of the tibial diaphysis
- It is most often seen in the leg, followed by the forearm
- It can also affect the hand and foot and rarely the upper arm or thigh

### Causes of compartment syndrome

- Extraneous forces that constrict the size of the compartment
  - Closure of fascial defects
  - Tight plaster casts
  - compression bandages
  - Pneumatic anti-shock garments or burns
- Intrinsic changes that alter the compartment's contents
  - Haemorrhage following soft tissue injury/fracture
  - Post-operative swelling and oedema
  - Post-ischaemic swelling
    - e.g. after tourniquet use intraoperatively or in pre-hospital care

### Presentation of compartment syndrome

- The 'six Ps' are often stated as the diagnostic criteria for compartment syndrome
  - Pain, pallor, pressure, paraesthesiae, paralysis and pulselessness
    - Although they are often present, if one waits for these to develop (particularly paralysis and pulselessness) it is most likely too late
- The first sign, in an alert responsive patient without distracting injury, is *pain out of proportion to the injury*
- On examination, the most reliable sign is severe pain on passive stretch of the involved muscles within the affected compartment.
  - One can also see that the compartment in question is also swollen to a high intensity.

### Differential diagnosis of compartment syndrome

- Deep vein thrombosis
  - Due to the similar presentation with pain and swelling in the lower leg
- Cellulitis
  - Presenting with pain and often lower-limb swelling. Check for temperature and inflammatory markers.
  - There should not be pain on passive stretch of muscles.
- Peripheral vascular disease/ischaemic limb

- These are included together as they are part of a spectrum of disease. They often present with the 4 Ps due to inhibition of blood supply, but the compartment is often soft and there is often coexisting vascular disease.
- Septic Arthritis
  - This can often present with excruciating lower limb pain with swelling
  - Look for raised inflammatory markers, pyrexia or a joint effusion to differentiate between this and compartment syndrome.
- Rhabdomyolysis
  - This also often follows trauma. It also presents with muscle pain but also a picture of more generalised malaise
  - Look for dark urine, deteriorating renal function and raised creatinine kinase
  - Consultant a renal physician if acute renal failure in this context

### Diagnosis of compartment syndrome

- Compartment syndrome is a clinical diagnosis on the basis of the above clinical picture together with an evaluation of the clinical likelihood.
  - It is often difficult to ascertain in those who have a reduced conscious state (e.g. intubated poly-trauma patients on ITU)
  - For this reason there are other diagnostic criteria that can be used:
- Measurement of intra-compartmental pressure
  - If the pressure exceeds 30mmHg then compartment syndrome is likely

If this exceeds 40mmHg or rises to within 20mmHg of the patient's diastolic blood pressure (i.e. above 50 for a patient with a diastolic pressure of 70), urgent fasciotomy should be carried out as a limb/life saving measure.

### Initial management of compartment syndrome

- Initial management centres around early appreciation of risk of compartment syndrome, together with close monitoring. Monitoring includes:
  - Pain out of proportion to injury
  - Checking compartment pressures in those unable to respond to pain
    - e.g. patients who have blocks, patients with a reduced Glasgow Coma Score
- Remove any constrictive dressings or split them down to the skin
- Hold the limb at the level of the heart (not above) to promote arterial inflow
- If there is any suspicion of compartment syndrome there should be a low threshold for urgent referral and assessment by an orthopaedic specialist
  - They may wish to perform formal compartment pressure monitoring using specialist equipment

### Further management of compartment syndrome

- Urgent fasciotomy
  - The release of the restrictive fascial compartment with both the skin and fascia left open to decompress the structures within
  - The skin can be grafted at a later date by a centre with a plastic surgery department

### Complications of compartment syndrome

- If left untreated, the end result is necrosis of the muscles
- This leads to an ischaemic contracture depending on the compartment involved and loss of the movements generated by the muscle group in question

- This is known as Volkmann's contracture in the forearm, wherein the muscles of the flexor compartment contract resulting in a claw like deformity of the hand

### **Prognosis following compartment syndrome**

- Prognosis is highly dependent on time to intervention
- If dealt with within 6 hours, with an urgent fasciotomy the outcomes are excellent
- If delayed up to 12 hours only 68% of patients have a normal limb function
- Beyond this the rates of normal limb function are just 8%

### **Common questions about compartment syndrome**

- *How many compartments are in the leg?*
  - There are four compartments: anterior, lateral and both deep and superficial posterior.
- *How many compartments are in the forearm?*
  - There are three compartments: superficial volar, deep volar and dorsal.
- *What is chronic compartment syndrome?*
  - This has focused on acute compartment syndrome as it is a true medical emergency. Chronic compartment syndrome is a chronic exertional syndrome often induced by exercise. It is most commonly in the anterior compartment of the leg in athletes. To diagnose it the resting pressure in the compartment should exceed 15mmHg, exceed 30mmHg on exercising and have prolonged pressure elevation after stopping exercise.
- *Where else can you get compartment syndrome?*
  - It is most often seen in the leg, followed by the forearm. It can also affect the hand and foot and rarely the upper arm or thigh.
- *What is typical about the pain of compartment syndrome?*
  - It is typically out of proportion to the procedure or amount of analgesia that the patient has had.
- *What are the 6 P's of compartment syndrome?*
  - Pain, pallor, pressure, paraesthesiae, paralysis and pulselessness.
- *What is the simplest treatment you can perform for a suspected compartment syndrome?*
  - Remove tight dressings or plaster and elevate to the level of the heart
- *What are the key diagnostic criteria and definitive treatment of compartment syndrome?*
  - A compartment pressure measurement exceeding 30mmHg then compartment syndrome seems likely. If this exceeds 40mmHg or rises to within 20mmHg of the patient's diastolic blood pressure (i.e. above 50 for a patient with a diastolic pressure of 70), the definitive treatment of urgent fasciotomy is indicated.