

COMPARTMENT SYNDROME

Compartment syndrome occurs when pressure in a muscle compartment is greater than pressure in the capillaries, which leads to progressive muscle ischemia and oedema and left untreated can result in infarction of the compartment contents.

Whiteside' Theory: the development of a compartment syndrome depends not only on intra-compartment pressure but also depends on systemic blood pressure:

DBP - CP should be greater than 30

Ischemia and necrosis of the muscles occur even though the arterial pressure is still high enough to produce pulses; muscle and nerves can survive for up to 4 hours of ischaemia without irreversible damage; nerve kept ischaemic for under 4 hours will show neuropraxic damage, after 4 hours, nerves show irreversible damage.

Causes

The underlying reason for increasing pressure (proposed by Mubarak and Hargens, 1983), is increased fluid content or decreased compartment size.

- Increased fluid content can be caused by the following:
 - intensive muscle use (eg, tetany, vigorous exercise, seizures)
 - everyday exercise activities (eg, stationary bicycle use, horseback riding)
 - burns
 - intraarterial injection (frequently iatrogenic)
 - envenomation
 - decreased serum osmolarity (eg, nephrotic syndrome)
 - infiltrated infusion
 - haemorrhage (particularly from a large vessel injury)
- Decreased compartment size can be caused by the following:
 - military antishock trousers (MAST)
 - burns
 - casts
- Lying on a limb can cause CS. In 1979, Owen et al published a landmark study in which researchers measured intracompartmental pressures in various positions common in drug overdoses. Average pressures of 48 mm Hg with the head resting on forearm, 178 mm Hg when the forearm was under ribcage, and 72 mm Hg when one leg was folded under the other were reported.

History and Examination

- blood pressure (compartment syndrome is potentiated by hypotension)
- extreme pain out of proportion to the injury
- pain on passive ROM of the fingers or toes (stretch pain of the involved compartment usually earliest clinical sign). The patient will usually hold injured part in a position of flexion to maximally relax the fascia and reduce pain.
- pallor of the extremity,
- paralysis
- paresthesia (early loss of vibratory sensation)
- pulses
- the affected limb may begin to feel tense or hard, as if filling with fluid.

Common Sites of Involvement

- compartment syndrome of the upper extremity:
 - compartment syndrome of forearm: eg. Supracondylar #s
 - compartment syndrome of hand usually iatrogenic eg. IV line
- compartment syndrome of the lower extremity:
 - compartment syndrome of thigh uncommon as large volumes required to lead to pathological increase in interstitial pressure
 - compartment syndrome of the leg:
 - compartment syndrome from tibial #s
 - chronic compartment syndromes

Investigations

- Bloods: FBC, U+Es, CK
- Initial urinalysis: This may be positive for blood which may indicate myoglobin in the urine (rhabdomyolysis).
- urine myoglobin
- Serum myoglobin
- Prothrombin time (PT) and activated partial thromboplastin time (aPTT)
- XR of the affected extremity
- USS can help exclude differential diagnosis
- Compartment pressure measurement

Treatment

- Treat underlying cause.
- Ischemic injury is the basis for CS therefore administer oxygen.

- Keep extremity level with the body (decreases limb mean arterial pressure without changing intracompartmental pressure). Do not elevate the affected extremity. Styf and Wiger (1998) measured, after an elevation of 35 cm, a decrease in the mean arterial perfusion pressure of 23 mm Hg and no change in intracompartmental pressure.
- IV fluids.
- Fasciotomy remains the definitive therapy for CS because of its well-documented, limb-saving results.
- Hyperbaric oxygen (HBO) therapy is a logical choice for CS because it addresses the primary concern of ischemic injury. It reduces oedema through oxygen-induced vasoconstriction while maintaining oxygen perfusion and supports tissue healing in a similar mechanism by allowing oxygen delivery when perfusion pressure is low. HBO can improve wound healing, reduce amputation rate, and lower surgical procedure rate.

Complications:

- Permanent nerve damage
- reperfusion injury: need to address fluid loss, shock, acidosis, hyperkalaemia, myoglobinuria, renal failure
- Infection
- Loss of limb
- Death
- Cosmetic deformity from fasciotomy