

# Why all clinicians should beware compartment syndrome

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⇒ **COMPARTMENT SYNDROME** is a condition which may affect the upper or lower limb, leading to severe damage to the tissues and long-term disability. In a compartment syndrome, an injury to the muscles, usually in the lower limb, leads to swelling of those muscles.

These are contained within a tough fascial compartment, which is inextensible. If enough swelling occurs within the fascial compartment, the pressure increases inside the compartment.

Initially, veins within the compartment are compressed, preventing blood leaving the muscles and causing a further rise in pressure within the compartment. If the rise in pressure is great enough it prevents blood entering, leading to ischaemia of the muscle.

Unless this is treated promptly (within a few hours) it starts to cause permanent damage to the muscles and nerves within the compartment, which increases the longer treatment is delayed.

## Mechanisms of development of compartment syndrome

The usual factor leading to a compartment syndrome is direct injury by external force, leading to a fracture of the lower limb – although direct trauma to a muscle group may also lead to swelling sufficient to cause a compartment syndrome to develop. In the lower limb, fractures below the knee are a common source of the problem. There are four fascial compartments in the leg below the knee and the most commonly-affected is the anterior tibial compartment.

In vascular surgery, operations to restore blood flow to the limb after a period of limb ischaemia often lead to substantial muscle swelling, sufficient to provoke a compartment syndrome. It is common practice, in cases where severe limb ischaemia has affected a limb prior to restoration of blood flow, to perform ‘fasciotomy’ operations, to open up the fibrous covering of the muscles surgically and prevent pressure rising within the muscle compartment. Cosmetically, that requires long incisions in the calf, but these usually heal reasonably well and severe damage to the nerves and muscles of the limb is avoided.

Iatrogenic causes of compartment syndrome are occasionally seen. In the lower limb these may arise following protracted abdominal operations on the gastrointestinal or urological systems with the lower limbs elevated.

The circulatory system of the human body was not intended to provide an adequate blood flow to the lower limbs when the legs are substantially higher than the heart. The blood pressure in the legs falls and that may lead to limb ischaemia for the duration of the operation. The muscles of the leg swell when the limbs are levelled at the end of the operation and that may lead to the development of a compartment syndrome, most commonly affecting the anterior tibial compartment.

In the upper limb, the radial artery at the wrist is commonly cannulated by specialists in intensive care in order to measure the blood pressure reliably. In addition, cardiologists commonly use this artery to gain access to the vascular system during coronary angiography and investigation of the heart. Bleeding from the point of puncture of the artery may lead to a compartment syndrome affecting the flexor compartment of the forearm.

## Clinical consequences of compartment syndrome

The outcome of a compartment syndrome depends on the severity of the ischaemic damage. The muscles and nerves of the body are very

sensitive to damage from ischaemia and urgent treatment, within 12 hours of the onset of symptoms, is required if permanent disability is to be avoided. Muscle dies following severe ischaemic damage and it is slowly converted to fibrotic scar tissue, which no longer has the ability to contract. The affected muscle groups are weakened or paralysed.

Nerve damage leads to loss of function: the muscles supplied by the nerves are paralysed and sensation is lost in the affected regions. More troublesome is severe neuropathic pain which may arise from ischaemic nerve damage, leading to permanent severe pain in the affected limb.

## Diagnosis and treatment

The clinical features of compartment syndrome include severe pain in the affected muscle groups, swelling of the muscles and paralysis of the affected region, with loss of sensation in affected nerves. Where severe pain arises in a muscle group, disproportionate to the treatment or injury, compartment syndrome should be suspected.

The window of opportunity for treatment is fairly brief. It has been shown that treatment within 12 hours of the onset of symptoms is likely to lead to complete resolution of symptoms, with no significant sequelae. After that, persistent paralysis and pain may affect the damaged region.

The diagnosis relies on clinical recognition of the problem. Symptomatic treatment of unexplained pain in the limb is not appropriate, since strong analgesia will abolish the pain but allow severe damage to the limb to evolve. Emergency ‘fasciotomy’ is required to incise the affected muscle groups and widely lay open the muscle coverings.

If the treatment is not accomplished within 12 hours of the onset of symptoms, it is probably best not to undertake any surgical treatment. The damaged muscles die and necrotic tissue discharges from the wound for a lengthy period, necessitating several subsequent operations to remove dead tissue.

## Prevention of damage

Clinicians in all medical specialisms should be aware that compartment syndrome may arise from a number of different clinical situations. The specialisms where compartment syndrome may arise are emergency medicine, trauma and orthopaedics and vascular surgery. As noted above, compartment syndrome may also be seen by intensivists and cardiologists. However, I consider that doctors from all specialisms should be familiar with the clinical features of compartment syndrome, so they can make an urgent referral to an orthopaedic or vascular surgeon when the diagnosis is suspected.

Expedient treatment of a compartment syndrome will lead to resolution of the problem without residual damage. Delayed management is likely to lead to permanent troublesome problems with the affected limb and may be considered to be substandard management.

In situations where iatrogenic injury has been caused during operations with the limbs elevated or after cannulation of the radial artery in the forearm, the onset of the compartment syndrome occurs in hospital. Failure to rapidly recognise the diagnosis and arrange for emergency fasciotomy may lead to long-term disability and may comprise substandard treatment. □

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**19 years**

Defendant instructions

Claimant instructions

Single joint expert

Court experience

**Areas of experience:**

- Surgery of veins and arteries
- Sclerotherapy & laser ablation of varicose veins
- Varicose veins
- Deep vein thrombosis
- Pulmonary embolism
- Leg ulcer
- Lymphoedema
- Peripheral ischaemia
- Injury to blood vessels
- Medical negligence and personal injury

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