

Compartment syndrome of the lower leg

Compartment syndrome is a ***condition where there is an increase in intramuscular pressure and subsequent ischemia of the given area***. The causes of compartment syndrome can be different, but in most cases it is a post-traumatic condition. To a lesser extent, the development of the syndrome may occur during unusual and long-term loading of muscles with tight fascia. An example of the most common non-traumatic compartment syndrome is a syndrome of the tibialis anterior muscle, also known as lower leg compartment syndrome.

Fascias

Fascia is a type of fibrous connective tissue; they cover organs, muscles, protect and separate individual structures from each other, they are an integral part of the locomotor system. With their arrangement and construction, they significantly help the transfer of muscle contraction to bone structures and thus the execution of the movement itself. The fibers of the fascia are oriented in the direction of the course of the muscle fibers and also in the direction of their action. The structure of the fascia also includes **myofibroblasts**, cells whose structure and function stand on the border between ligament and smooth muscle. These cells are capable of contraction; thanks to them, it is possible to change the tension of the fascia to a certain extent. ^[1]

Fascia pathology

The activity of myofibroblasts and their tendency to shorten can lead to retraction and subsequent thickening of the ligament. Myofibroblasts are innervated by sympathetic fibers, due to which retraction of the cord can also occur due to nociceptive afferentation. Any restriction, shortening or trauma to the fascia also affects other soft tissues and can reflexively limit movement. As a result of retraction of the fascia, there may be a significant increase in intramuscular pressure, as a result of which the blood supply to the oppressed area will rapidly deteriorate, thus causing compartment syndrome, due to which even ischemia may occur in the given muscle.

Anatomy

The skeleton of the lower leg consists of 2 parallel bones – **the tibia and the fibula**. Both of these bones articulate together in the proximal and distal parts of the lower leg. The load-bearing function of the lower leg is mainly carried out by the tibia, which is the larger of the two bones, however, the fibula, due to its structure (it is formed by a relatively thick shell of compact bone tissue and a small marrow cavity), significantly supports the tibia in this function. **Tibialis anterior muscle** is located in the ventral group of lower leg muscles, it is the most medial of these muscles. Its beginning is located on the lateral surface of the tibia and the adjacent part of the interosseous fibrous membrane. In its course, it goes caudally under the retinaculum musculorum extensorum and attaches to the medial cuneiform bone. The main function of the tibialis anterior muscle is dorsiflexion and supination of the leg. ^[2]

Syndrome of the tibialis anterior muscle

The development of compartment syndrome also occurs when the exercise is overloaded, especially with a firm and less pliable fascia, in the case of the lower leg it is the tibialis anterior muscle. A working muscle has full demands for blood circulation, it increases the total volume of extracellular as well as intracellular fluid and thus the increase in the need for interfascial space - covered to a certain extent by the elasticity of the fascia. The bottom of the tibialis anterior muscle bed is formed by a solid and strong *interossea cruris membrane*, which largely limits the possibility of increasing the interfascial space when this muscle is loaded.

Manifestations

The first to appear in the developing compartment syndrome is pain in the ventral part of the lower leg, which can spread to the instep area. The pain increases with passive stretching of the segment, as well as with active contraction of the affected muscle. Significant pain during dorsiflexion of the thumb and foot (both passive and active). With the continued development of the compartment syndrome, the oppression of nerve fibers continues, so the patient has sensory disturbances (paresthesia to anesthesia in an advanced stage) – after about 30 minutes of ischemia. Another manifestation is edema of the limbs in an advanced stage of manifestation until the smoothing of the skin relief.

Therapy

Conservative therapy

The goal of the therapy is primarily to restore the motility of the fascia and stretch its retracted parts. When stretching the fascia, we proceed according to the same rules as for other soft tissues, i.e. we use the phenomenon of melting when stretching and moving the achieved barrier towards the physiological state. ^[1] Myofibroblasts

respond to soft techniques faster than the collagen fibers of the fascia, which is why sometimes the effects of therapy are surprisingly quick and positive. We often combine it with **physical therapy**: especially heat therapy – the collagen structures are loosened and thus the tension of the fascia is released

- with athletes, we often approach therapy using kinesio tape as a preventive measure
- as part of the therapy, we try to limit the movement or activity causing the development of compartment syndrome, or end it at the moment of the onset of difficulties
- however, this would be undesirable for top athletes, which is why we often resort to an operative solution in these cases
- to maintain fitness, we recommend cycling, i.e. an activity that does not overload the tibialis anterior muscle ^[3]

Fasciotomy

An operative solution to compartment syndrome, during which the fascial spaces are cut and opened, thereby releasing the pressure exerted on the muscle. It is performed under general anesthesia, by open or subcutaneous route. During this procedure, it is possible to orientate yourself by the color of the muscle belly, when muscle fibers that are affected by ischemia are significantly paler than muscle fibers with sufficient blood supply.

Links

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- Compartment syndrome
- Crush syndrome

Sources

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Fasciotomy performed due to compartment syndrome.



Fasciotomy covered with a skin graft.