Echographic imaging of the muscular fascia in lower limb vascular diagnosis

Biomechanical implications

Miranda R.
Institutions: ASL NA 3 Sud – Distretto di Nola (NA) - Italy

Introduction

The containment and compression of the legs are the cornerstone of the treatment and prevention of chronic venous insufficiency, lymphedema and thromboembolic disease, but are also widely applied in many musculoskeletal disorders. Bandages or stockings have an anatomic equivalent in the muscular fascia (MF). MF is a fibrous structure, surface-coating muscles of the limbs in continuity with abdomen and buttocks. The MF of the limbs is a sheath with a mean thickness of 1mm, composed by two to three layers of parallel collagen fiber bundles. The adjacent collagen layers show different fiber orientations and are separated each other by loose connective tissue, that permits the sliding of the collagen layers (1). The MF is not only a separation plane between the subcutaneous tissue and muscles, but plays not yet fully understood mechanical functions. The interest on the MF has grown with the ultrasonography, so that the relationship with the MF determines the distinction between deep and superficial vessels. In this short paper will be summarized some aspects of diagnostic and mechanical role of MF.

Diagnostic importance of the fascia

Veins or lymphatic vessels located below the MF are defined profound, above superficial. An intermediate level is given by the intrafascial veins, placed in a doubling of the MF, the saphenous fascia (SF), that delimits the saphenous lodge. The MF and the SF have small breaks where they are traversed by vessels and nerves. In some subjects, however, the SF can be broken most widely in some segments, mostly in perigenicular area and in distal thigh.

It's essential to use an universally recognized terminology, to avoid misinterpretations in correct structure denomination, confusion in diagnostic reporting and inappropriate treatment of venous disease. According to the criteria established in the International Interdisciplinary Consensus Statement of the 14th World Congress of the International Union of Phlebology in 2002 (2), later supplemented and amended in 2005(3), the definition of saphena in the lower limb is determined by its fascial relationships. The identification of the MF and SF has thus become mandatory in any type of venous imaging technique: ultrasound (4), MR or CT.

Biomechanical properties: fascial ectoskeleton

Because of thick and resistant fibrous nature and collagen fibers orientation, MF plays an inelastic mechanical contention on the underlying structures. This action is closer to that exerted by short stretch bandage than by compression stockings or high elongation bandages. The function of
mechanical support and the anatomical relationship with muscles led Wood Jones (5) to the concept of fascial 'ectoskeleton'. Unlike the exoskeleton, an external skeleton typical of arthropods, the MF is not a rigid structure and is not external, but on it a few muscles are anchored "from the inside-out", unlike the ‘outside-in’ attachment of the muscles on the bones. The upright position of man determines the presence of strong fascial connections of muscles and tendons in the legs. Wood Jones stressed these aspects in his work (5), but is rarely mentioned today and should be reconsidered. This arrangement stabilizes the lower limb which not only provides for the locomotion, but it also withstands the weight of the body in an upright position and acts as a rigid column capable of providing passive support. A prove of this elevated subfascial pression are the muscular hernias: muscle protrusions through a defect of the fascia into the subcutaneous fat.

The exposure of veins to MF mechanical action is determined by the placement above or below the MF: when the underlying muscles contract against the fascia, the thin-walled veins and lymphatics below MF are squeezed and their unidirectional valves ensure that blood and lymph are directed towards the heart.

It is not known the contribution of the SF and of the suspensory ligaments to saphenous vein hemodynamic. Intrafascial veins may be compressed during muscular contraction, with a pump mechanism, probably less effective than the better known of the calf or of the foot. The suspensory ligaments prevent that saphenous vein migrate into his lodge, where usually occupies the central part, and that become tortuous in case of incontinence and ectasia.

**Perspectives**

There are some questions: What is the role of MF in the pathogenesis of varicose veins? Are the epifascial vessels, that continue to full channel with the saphenous vein, at greater risk of varicose evolution? Does the distance of epifascial vessels from the MF could condition the evolution of varicose veins?

Dynamic tests, like postural tests, could provide additional information on mechanical properties of the fascial ectoskeleton and could help us to clarify its role in the pathogenesis of chronic venous insufficiency.

**BIBLIOGRAPHY**