Ultrasound of Nerve Entrapments in Osteofibrous Tunnels of the Upper and Lower Limbs

Essay

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Dedication

To my husband, my parents, my sisters and my friends, with love for their never ending-support

Shimaa

Abstract

The development of high resolution ultrasound has allowed evaluation of normal and abnormal ultrasound appearance of peripheral nerves. Ultrasound provides a unique method for evaluation of these nerves because it allows direct imaging of nerves, as well as changes in nerve shape and echo texture. Ultrasound has an ability to follow nerves over a long distance in a limb. The colour and power Doppler improve the ability to evaluate the peripheral nerves by evaluation of near vessels. Entrapment neuropathies are group of disorders result from injury to a nerve as it travels through osteofibrous tunnels.

Key words:-

Ultrasound - Peripheral nerves - Entrapment neuropathies - Osteofibrous tunnels - Upper limb - Lower limb.

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First and foremost, thanks to Allah

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Thanks to my wonderful family for their love and belief in me.

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INTRODUCTION AND AIM OF WORK

The brain and spinal cord receive and send information through muscles and nerves. The nerves travel to upper and lower limbs and traverse the various joints along their paths. Unfortunately, these nerves can become compressed or entrapped at various regions of the extremities (Ly-Pen et al, 2005).

Osteofibrous tunnels are narrow anatomic passageways that redirect the course of nerves along with tendons and vessels across synovial joints (Sailer, 1996).

Many nerves pass in osteofibrous tunnels in upper and lower limbs. In upper limbs median nerve passes through carpal tunnel, ulnar nerve passes through cubital tunnel at elbow and guyon tunnel at wrist. In lower limbs common peroneal nerve passes around the fibular neck, tarsal nerve passes in retromalleolar region, interdigital nerves pass in intermetatarsals region (Spratt et al, 2002).

Entrapment neuropathies are a group of disorders result from chronic injury to a nerve as it travels through osteofibrous tunnels and characterized by pain and/or loss of function (Szabo, 1999).

The diagnosis of nerve entrapment at osteofibrous tunnels relies primarily on clinical and electrodiagnostic findings (Sailer, 1996).

Recently, the refinement of high frecuancy broadband transducers with arrange of 5-15 MHz, and sensitive color and power Doppler technology have improved the ability to evaluate peripheral nerve entrapment in osteofibrous tunnels with Ultrasonography (Stuart et al, 2004).

High-resolution Ultrasound provides a unique method for evaluating peripheral nerves because it allows direct imaging of the involved nerves, as well as documentation of changes in nerve shape and echotexture that occur in compressive syndromes, as well as its ability to follow structures over long distances in a limb, and its dynamic nature that allows movement of patient and transducer (Martinoli et al, 2000).

The ultrasound appearance closely correlates to the histologic findings both in transverse and longitudinal images (Silvistri et al, 1995).

Normal nerves appear as markedly echogenic tubular structures (corresponding to the supportive connective tissue) containing hypo-anechoic discontinuous segments that correspond to the fascicles or group of fascicles. On transverse scans peripheral nerves appear as hyperechoic structures including oval-to-round hypoechoic areas. The size of a single nerve decreases when examined from proximal to distal due to the presence of branches leaving the main nerve trunk. Usually no normal internal blood flow can be detected with color Doppler and as a general rule detectable internal flow signals must be considered as pathologic hypervascular changes (Lowey, 2001).

At most centers, Magnetic Resonance Imaging continues to be the standard for evaluation of the peripheral nervous system because image acquisition is not operator dependent, as it is in Ultrasonography, and interpretation is intuitively easier (Walker et al, 2004).

However Ultrasonography has many advantages over Magnetic Resonance Imaging, including being relatively fast and inexpensive and allowing additional dynamic and blood flow imaging with relatively little additional time and can explore long segments of nerve trunks in a single study (Walker et al, 2004).

AIM OF WORK

The purpose of this study is to describe the features on high-frequency ultrasound of nerve entrapments in osteofibrous tunnels of the upper and lower limbs.

Gross anatomy of nerves and osteofibrous tunnels in upper limbs

Anatomy of osteofibrous tunnels in upper limbs:

1-Anatomy of carpal tunnel: (fig.1)

The floor and walls of the carpal tunnel are formed by the the carpus which is composed of the carpal bones and has a concave bony contour on its flexor surface and is covered by the flexor retinaculum. The rigid flexor retinaculum forms the roof of the tunnel. The flexor retinaculum, or transverse carpal ligament, attaches to the scaphoid tubercle, the ridge of the trapezium, and the ulnar aspect of the hook of the hamate and pisiform (Palmar et al, 2007).

The proximal fibers of the volar carpal ligament contribute to the roof of the carpal tunnel but this contribution is not as significant as that of the thicker flexor retinaculum. The long flexors of the fingers and thumb (flexor pollicis longus, flexor digitorum superficialis, flexor digitorum profundus) all pass through the carpal tunnel. The separate flexor digitorum superficialis tendons are arranged in two rows, with the tendons to the third and fourth digits positioned volar to the tendons of the second and fifth digits. The flexor digitorum profundus tendons are arranged in the same coronal plane and the tendon to the second digit is separated from the 3 adjacent profundus tendons.

All 8 flexor tendons are covered with a common synovial sheath. The flexor pollicis longus tendon, contained in its own synovial sheath, is located on the radial aspect of the flexor tendons within the carpal tunnel.

The median artery and nerve are included inside the tunnel (Colak et al, 2007).

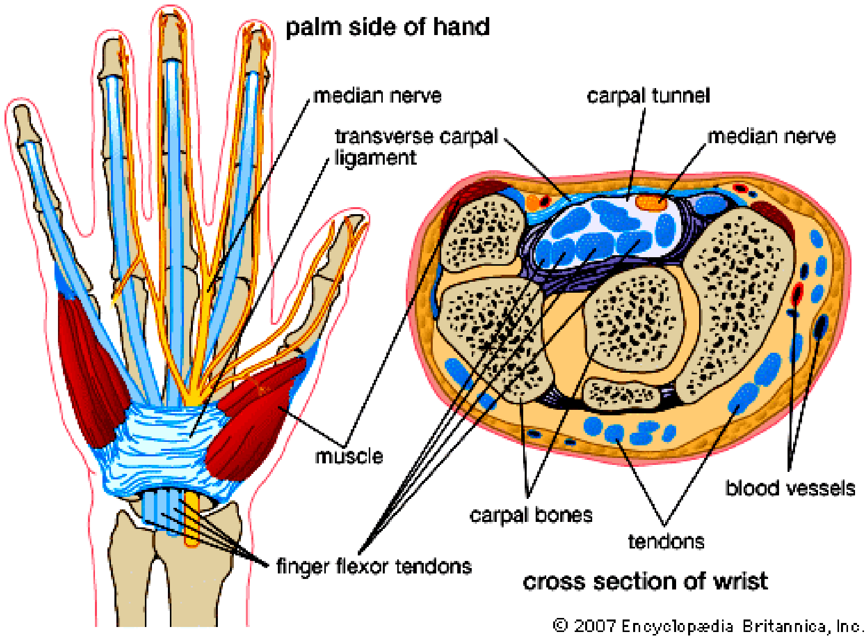

Fig.1: Cross section of wrist showing the anatomy of the carpal tunnel.
(Colak et al, 2007).

2-Anatomy of cubital tunnel: (fig.2)

The cubital tunnel is formed by a groove between the olecranon process of the ulna and the medial epicondyle of the humerus and bridged by a fascial sheet, the cubital tunnel retinaculum (also known as Osborne fascia).

During elbow flexion and extension, the cubital tunnel changes its shape (from slightly ovoid to elliptical) and volume because of the eccentric origin of the retinaculum (Gelberman et al, 1998).

Fig.2: Showing passage of ulnar nerve through the cubital tunnel
(Pascarelli et al, 2001).

3- Anatomy of guyon tunnel: (fig.3)

The walls of this canal consist of the pisiform medially and the hook of the hamate laterally; the floor is formed by the flexor retinaculum, and the roof is formed by the palmar carpal ligament and the palmaris brevis muscle.

The guyon tunnel houses the ulnar nerve, ulnar artery, and the ulnar vein (Stewart, 1993).