Issue 4 at a Glance >>>

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The Egyptian Neuromuscular Ultrasound Society
'Affiliated with the Egyptian Society of Electrodiagnosis Medicine & Clinical Neurophysiology'
الجمعية المصرية للموجات فوق الصوتية الأعصاب و العضلات
'منتسبة الى الجمعية المصرية لطب التشخيص الكهربائى و فسيولوجيا الأعصاب الاكلينيكية'

A Periodical insight into the Neuromuscular Ultrasound field & the Egyptian Neuromuscular Ultrasound **Society**

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Practical tip >>>

When you perform muscle ultrasound, avoid errors in measurement by following these tips:

1-Use generous amount of gel to ensure optimum coupling and to minimize pressure by the transducer.
2-The patient must be fully relaxed when you look for involuntary pathologic muscle movements.
3-For follow up over time and for side-to-side comparison: the same machine settings should be used in every visit & the measurements should be taken at the same anatomical landmarks every time.
4-Keep the probe orthogonal to the muscle (oblique orientation overestimates muscle thickness and decreases muscle echogenicity).
5-Put in consideration whether the patient is: old/young, athletic/sedentary, obese/not.

Quote of the issue >>>

"Ambition is the path to success. Persistence is the vehicle you arrive in" – Bill Bradley

Topic of the issue

Nerve echotexture and fascicular pattern, a parameter you should not skip!

(By Dr. Eman Tawfik, Professor of Physical Medicine & Rehabilitation, Faculty of Medicine, Ain Shams University & the President of the Egyptian Neuromuscular Ultrasound Society)

The sonographic workup of nerve disorders involves assessment of several nerve parameters. Although nerve cross-sectional area is considered the most sensitive parameter to diagnose various nerve disorders, other parameters are equally important and can give valuable information. Among these is the nerve echotexture.

Normal nerve echotexture

On the short axis, the nerve typically appears as a honeycomb structure in which multiple hypoechoic dots are embedded in a hyperechoic background and the outer epineurium appears as a hyperechoic border surrounding the nerve. The hypoechoic dots correspond to the nerve fascicles and the hyperechoic background represents the interfascicular epineurium. On the long axis, the nerve acquires a Cable-like appearance consisting of hypoechoic bundles alternating with hyperechoic bands and the outer epineurium is represented by two parallel bold echogenic lines.

Echotexture aspects that can be assessed:

1. Qualitative assessment of the internal nerve echotexture.: involves determining whether the internal nerve echotexture is hypoechoic, hyperechoic, or isoechoic and determining if the altered echogenicity is homogenous or heterogenous.
2. Pattern of fascicle enlargement: whether it is non-selective or selective involving one or more fascicles or certain bundles.
2. Quantitative assessment of nerve fascicles including nerve density and fascicles count.
3. Assessment of the echotexture of the outer nerve sheath.

These aspects are highlighted in the following section

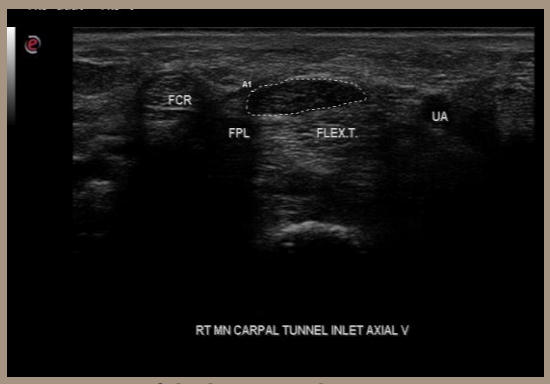

Fig.1. Loss of the honeycomb pattern in a patient with CTS

Fig.2. Non-selective fascicular enlargements in patient with inflammatory neuropathy

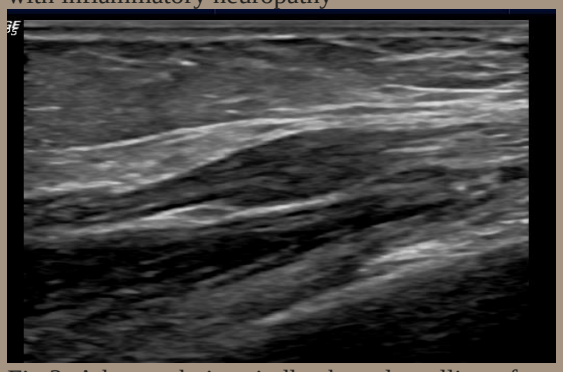

Fig.3. A hypoechoic spindle-shaped swelling of a a continuous nerve = neuroma in-continuity.

Fig.4. Selective hypoechogenicity of the anterior fascicles of the fibular nerve at the fibular head level

Abnormal nerve echotexture may take the form of partial or complete loss of the honeycomb pattern:

- In entrapment neuropathies, the nerve mostly turns hypoechoic at the site of maximal enlargement. Hypoechogenicity reflect fascicular swelling and edema.

- In traumatic nerve injuries abrupt change in size and echotexture of a continuous nerve and a hypoechoic spindle-shaped swelling in the long axis is indicative of neuroma in-continuity while a hypoechoic swelling at the proximal &/ or the distal end of a transected nerve indicates stump (terminal neuroma).

Pattern of fascicle enlargements:

- Selective enlargement of a group of fascicles may help in localization of lesion in certain nerve branches. For example, hypoechogenicity and enlargement of the lateral fascicles of the sciatic nerve denotes a lesion of the fibular component of the nerve. Similarly, selective enlargement and hypoechogenicity of the anterior fascicles of the common fibular nerve reflect preferential affection of the deep fibular nerve. This pattern has been reported in 17 % of patients with common fibular neuroapthies.[1]

- The pattern of enlargement may help in the differentiation between different types of polyneuropathy: diffuse fascicular enlargement was found in CMT1a while regional and differential fascicular enlargements were found in multifocal motor neuropathy.[2]

***Fascicle's count**: nerve fascicles can be counted using semiautomated method [3] or manually preferably using ultra-high frequency US machine (70 MHz)[4] but a probe with frequency as low as 14 can also be used.[2] Fascicle density can also be calculated by dividing the number of fascicles by the median nerve area to obtain the fascicle number per square millimeter[3]*

***Nerve density**: is defined as the ratio between hypoechoic and hyperechoic areas of the nerve. It is calculated using software and is =hypoechoic pixels/total pixels. A good ability of nerve density to differentiate between healthy individuals and patients with CTS and neurofibromatosis and between patients with mild and severe CTS has been reported.[5]*

References:

1. *Bignotti et al. Fascicular involvement in common fibular neuropathy: evaluation with ultrasound. Muscle Nerve 2016;53:532–37.*

2. Grimm et al. A look inside the nerve – Morphology of nerve fascicles in healthy controls and patients with polyneuropathy. Clinical Neurophysiology 2017;28:2521–26.

3. Gamber et al. High-Resolution Nerve Ultrasound to Assess Nerve Echogenicity, Fascicular Count, and Cross-Sectional Area Using Semiautomated Analysis. J Neuroimaging 2020;30:493-502

4. Cartwright et al. Ultrahigh-frequency ultrasound of fascicles in the median nerve at the wrist. Muscle Nerve 2017;56: 819–22.

5.Tagliafico et al. Nerve density: a new parameter to evaluate peripheral nerve pathology on ultrasound. Preliminary study. Ultrasound Med Biol 2010;36:1588-93.

Case of the Issue

(By Prof. Eman Tawfik)

A 50-year-old female was referred for neuromuscular ultrasound of the right median nerve 6 months after carpal tunnel release surgery. Post-surgery, the patient experienced temporary improvement for about 2 months but then started to feel the same preoperative symptoms associated with additional new sensory symptoms at the palmar surface of the thenar emeninence. Nerve conduction studies showed delayed distal motor latency and sensory latencies denoting distal entrapment.

The scanning protocol involved tracing of the median nerve from the elbow to the palm as well as tracing the important branches of the median nerve that can be injured during carpal tunnel release surgery including palmar cutaneous branch, recurrent thenar branch and common palmar digital nerves. Ultrasound revealed focal swelling of the median nerve at the tunnel inlet, outlet, and palm with the maximal enlargement observed at the palm reaching a CSA of 18 mm^2 (Figure 1). Nerve mobility was moderately limited with evidence of scar tissue overlying the nerve.

No abnormalities were found in the recurrent thenar motor branch or the common palmar digital nerves. The palmar cutaneous branch was continuous along its course and its CSA was within average values. However, just after it penetrates the antebrachial fascia, the nerve was surrounded by scar tissue and its border was hyperechoic and markedly thickened (Figure 3).

The above findings denote:

1. Recurrent CTS due to entrapment of the nerve by scar tissue.
2. Encasement of the palmar cutaneous branch of the median nerve by scar tissue. The hyperechoic border mostly reflects chronic fibrosis of the outer nerve sheath.

Concluding Tip

- NMUS is a valuable assessment tool in post CTS release cases. Ultraosund provides information that cannot be obtained via electrodiagnosis given its ability to detect structural changes in the nerve and to evaluate the small, tiny branches. Without US, the structural changes around the palmar cutaneous branch which are the cause of the new sensory symptoms at the palm would not have been recognized.
- When evaluating patients post-carpal tunnel release, scanning the different median nerve branches that are liable for injury is mandatory. Scanning the palmar cutaneous branch is essential whenever the patient complains of palmar pain.

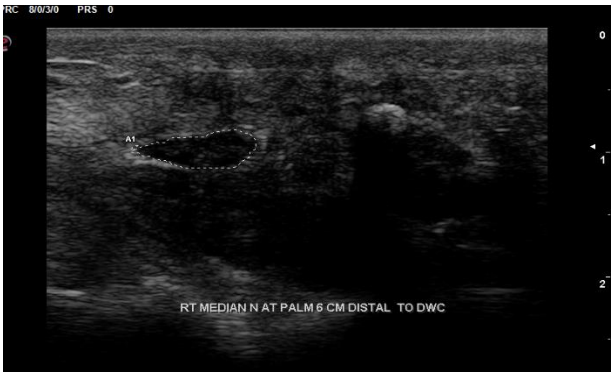

Figure 1: Maximal enlargement of the median nerve at the palm

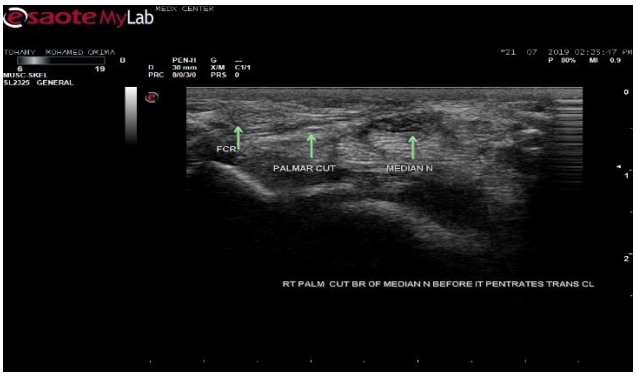

Figure 2 showing the palmar cutaneous branch as it penetrates the antebrachial fascia: looking normal with average CSA and no scar tissue around.

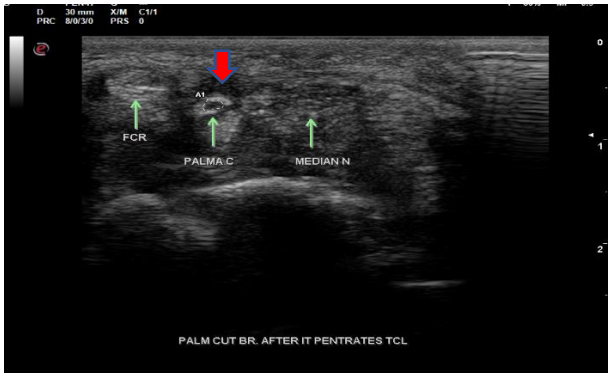

Figure 3: showing the palmar cutaneous branch just after it penetrates the fascia surrounded by scar tissue (red arrow). The CSA is within average values for this branch, but its outer border is hyperechoic and thickened.