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NC-STAT TECHNOLOGY VS. TRADITIONAL ELECTRODIAGNOSIS (EDX BY EMG/NCV) CLARIFICATION/CORRECTION

by Mohammad A. Saeed, M.D., M.S. and Edgar S. Steinitz, M.D., editor

The following is a clarification/correction to our Electrodiagnosis & Rehabilitation Update, Vol. 8 Issue 2, published July, 2005, page 2, first paragraph reviewing 'Neurometrics vs. Traditional Electrodiagnosis by EMG/NCS'. After communication with CEO and President of Neurometrix, Inc., Shai N. Gozani, M.D., Ph.D., he wishes to make the following statement and correction to our Electrodiagnosis & Rehabilitation Update:

"I firmly believe that the NC-stat technology is "gold-standard traditional EDX" in the clinical applications for which it is used, and is not a screening tool at all. I further believe that when making clinical decisions whether surgical or not, NC-stat results should be used as an extension of the clinical examination of the patient, as for any EDX study."

Shai N. Gozani, MD, PhD, President & CEO, NeuroMetrix, Inc.

Despite this statement, we at Electrodiagnosis continue to express significant concern regarding limitations of the Neurometrix system. This is not only true when the necessary biosensors are unavailable particularly when proximal conduction is important, but also when concern for axonal/nerve fiber injury or loss as NC-stat technology does not have a needle EMG component, well recognized of vital importance particularly when assessing patients with weakness or muscular atrophy for the severity, distribution and acuity of axonal/nerve fiber injury or loss. We believe physicians will falsely believe "NC-stat technology is gold -standard traditional EDX" not recognizing Dr. Gozani's full statement "in the clinical application for which it is used" as there are definite limitations. The unknowing health care provider using NC-stat technology is at risk to miss easily definable if not significant pathology compared to when NCS is performed combined with needle EMG. Therefore, we reassert that full traditional EDX performed by a physician specialist as the only time tested electrophysiological 'gold standard' for peripheral nerve and muscle disorders. This opinion is fully supported by the recent position statement of the American Association of Neuromuscular & Electrodiagnostic Medicine (AANEM) published Online by Muscle & Nerve January 4th, 2006, regarding **'digital object identifiers'**, which we suspect to have included NC-stat technology:

"The AANEM believes that electrodiagnostic studies should be performed by physicians properly trained in electrodiagnostic medicine, that interpretation of NCS data alone absent face-to-face patient interaction and control over the process provides substandard care, and that the performance of NCSs without needle EMG has the potential of compromising patient care. It is the AANEM's opinion that it is in the best interest of patients, in the majority of situations, for the needle EMG and the NCS exam to be conducted and interpreted at the same time. The AANEM's *Recommended Policy for Electrodiagnostic Medicine* outlines the necessary steps for an appropriate electrodiagnostic consultation as follows:"

1. Development of a differential diagnosis by the EDX physician based upon an appropriate history & physical examination.
2. Completion of indicated NCSs.
3. Completion of indicated needle EMG studies to evaluate the differential diagnosis and to complement the NCSs.
4. Synthesis by the EDX physician of the patient's history & physical with NCS & needle EMG data to reach a diagnosis.

It is the AANEM position that, in order to perform the steps outlined above and to ensure quality patient care, the individual performing these steps must be a physician with special training in the diagnosis and treatment of neurological and neuromuscular diseases and in the application of particular neurophysiological techniques to study these disorders.. When NCSs are performed without needle EMG, the additional and complementary information provided by the needle EMG results (except in limited circumstances) is not available. Without the information provided by the needle EMG examination, valuable data that may be essential in establishing an accurate diagnosis is missing. For example, performing both studies together is critically important when evaluating patients with suspected radiculopathy, plexopathy, and motor nerve or motor neuron disease. Quite often, patients with radiculopathy may have normal NCSs. Some reports have indicated that a radiculopathy can be determined by F waves. However, if even a few of the large myelinated motor fibers are intact, the F-wave results will appear normal. Therefore, a patient may have a normal study when, in fact, a radiculopathy is present. Although a few articles may be cited in an attempt to justify the use of F waves in the diagnosis of radiculopathy, the current body of evidence (substantiated by multiple studies published in well-respected peer-reviewed medical journals) does not support the use of F waves in isolation to diagnose radiculopathy. **AANEM *Recommended Policy*** states that a minimal evaluation for radiculopathy should include one motor and one sensory NCS ***and needle EMG*** (emphasis added) of the involved limb. Radiculopathy is just one example in which NCSs alone should **not** be used to reach a diagnosis. Patients with myopathy, plexopathy, or motor neuron disorders may have more widespread abnormalities that are only detectable by needle EMG.

AANEM Recommended Policy for Electrodiagnostic Medicine Available at: http://www.aanem.org/practiceissues/recPolicy/recommended_policy_2.cfm

Superior EDX: NCS + EMG -> Best Practice Diagnosis & Prescription of Therapeutic Intervention

MYOFASCIAL PAIN SYNDROME by Hui Wang, M.D.

Background:
In 1952, Dr. Janet Travell was the first to strongly implicate "trigger points" as a key component to treating Myofascial Pain Syndrome (MPS). She later combined clinical experience with Dr. David Simons, detailing the phenomenon of "trigger points", "taut bands" and the "localized twitch response" in several publications and texts. One of the observations was that during an infraspinnatus muscle biopsy under local anesthesia, stroking or pinching of either the superficial fascia or muscle tissue in the region associated with the muscle spindle a strong pain response could be elicited with a sclerotomic referral pattern beyond the distribution of the muscle being evaluated.

Definition:
- **Trigger point (TP):** a circumscribed site of soft tissue tenderness referring pain distantly associated with a 'taut band' and 'twitch response' usually located within the mid belly of the affected muscle.
- **Taut band (TB):** A shortened group of muscle fibers often palpated perpendicularly to a trigger point.
- **Local twitch response (LTR):** when a transient contraction or ***"snap"*** occurs in the affected muscle in response to palpation. By electromyography (EMG), trigger points are located in the region where end-plate noise (EPN) activity is found, but in MPS, there is a pathophysiological increase in release of acetylcholine (ACh) under resting conditions at the TP within the TB.

Clinical Criteria for Myofascial Pain Syndrome (MPS) ***Five major criteria include***:
1. Widespread regional pain complaints.
2. Exaggerated pain or altered sensation in the expected distribution of referred pain from a myofascial TP.
3. TB is palpable in any accessible muscle.
4. Exquisite spot tenderness at one or more points along the length of the TB.
5. Some degree of restricted soft tissue range of motion.

Three minor criteria include:
1. Reproduction of pain complaint by pressure on the tender spot.
2. Elicitation of LTR by transverse snapping palpation or needle insertion at the TP within the TB.
3. Pain alleviated by elongating (stretching) the muscle or by injecting the TP.

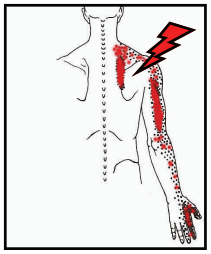

Figure 1. TP and referral pattern

Epidemiology:
Incidence women > men ~3:1, most common age 30-50**.** Asymptomatic shouldergirdle trigger points are found in up to 54% female and 45% of this male population, particularly in the following muscles: trapezius, levator scapulae, infraspinatus, and scalenus (~85%)**.** 5 - 45% of TPs are lumbosacral and gluteal musculature. Up to 30% patients in a general medical clinic, 21% in an orthopedic practice and >90% presenting to pain management centers have MPS & TPs. Fibromyalgia is chronic and diffuse, and is often associated with many non-musculoskeletal symptoms, e.g. headaches, chronic fatigue, insomnia, irritable bowel syndrome among others complaints. .

Pathogenesis
Etiology uncertain, but several hypotheses exist: Injury to the sarcoplasmic reticulum causes Ca++ release with sarcomere contraction resulting in TBs. Sustained sarcomere shortening compromises blood flow despite intensified metabolic demand. Alternatively,↑ production and release of ACh from the motor nerve terminal under resting conditions triggers continuous release of Ca++, resulting in sustained sacromere shorting. Intramuscular deficiency of energy (O2, Ca++ and other nutrients) prevents muscle fiber relaxation.

Electromyography
EMG activity in Trigger Points (not present in nearby muscle even 1 mm away) escalates with stress and diminishes with relaxation. Following a snapping of taut bands, increased motor unit action potentials are associated with visible signs of a local twitch response. Motor unit electrical activity of taut bands are significantly higher than that of normal muscles. Following lidocaine injection, both pain intensity and EMG activity is decreased.

Treatment Options:
1. Trigger Point Injection (TPI), needling & Botulinum Toxin blocks. Often effective treatment for chronic MPS associated with fibrotic scar formation. Indicated in patients with symptoms and findings of active TPs. Contraindicated in bleeding disorders or anticoagulant therapy, pregnancy or acute illness. Efficacy is improved when combined with multimodal intervention to include electrical stimulation, massage, stretching, 'spray and stretch', relaxation training, therapeutic exercise, aerobic conditioning, among other options. Botox blocks ablating TB and pain of TP by attenuating excessive release of ACh at the neuromuscular junction can also be effective with a particular interest given my background, Acupuncture.
2. Rest. ↓ activity only during the acute inflammatory phase (1-3 days after injury), but then progressive submaximal activity is recommended with prolonged inactivity harmful, and yet early return to full activity may predispose to recurrence.
3. Cryotherapy. Application of ice or a topical refrigerant (ethyl chloride) is excellent particularly following TPs injection allowing ↑ muscular stretching with less pain. A comprehensive program of muscle stretching (ROM exercise) is strongly advocated.
4. Physical Therapy. Recommended after resolution of acute pain and swelling for restoring normal muscular endurance, strength and flexibility which is important to prevent recurrent muscular injury. Passive stretching of muscle to reduce stiffness and contracture is important especially when combined with strengthening emphasizing muscular elongation and conditioning.
5. Medications. NSAIDs are beneficial to reduce histologic inflammatory changes in the early stages (vasodilation and extravasation of blood and/or biochemicals into surrounding tissues) triggering the inflammatory cascade. Use is usually limited to the first few weeks. Inflammatory responses do remove necrotic tissue and enable fibroblastic bridging with scar tissue. Muscle relaxants can ↓ pain and tightness, although the mechanism of action is central with sedative side effects and potential for habituation.

Conclusion
Physician-patient preference usually determines the best combination of therapy for each individual patient, although the best treatment is prevention, a program of maintenance to prevent relapse, and early intervention. Addressing ergonomic factors minimizing biomechanical stressors is also important.