

## **The Electro-diagnostic Evaluation**

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The electro-diagnostic evaluation commonly known as Emg/Ncv is a specialized neuromuscular evaluation used to evaluate conditions affecting the nerves, muscles, motor neurons and neuromuscular junction.

The evaluation should be conducted by a Specialist in the field of Neurology or Physical Medicine and Rehabilitation with training and experience in Electro-diagnostic. Some physicians even go the additional step to obtain Board Certification in Electrodiagnostic Medicine (American Board of Electrodiagnostic Medicine) and go through additional training and education in the field to obtain a Fellow status in the American Association of Neuromuscular and Electrodiagnostic Medicine.

The components of a quality Electrodiagnostic Evaluation include:

- History and Physical Examination including temperature of the extremity or extremities to be evaluated. The electrodiagnostic evaluation is a dynamic evaluation, extension of clinical history and physical examination and must be planned and modify based on findings.
- Differential diagnosis
- Nerve Conduction Study needs to include the nerves being study, stimulation, recording points and distance from stimulation to recording. The data obtained needs to include distal latency (specify if it is onset or peak latency for sensory nerves), amplitude, duration of the response and conduction velocity.
- Electromyography (Emg) tabular data presented including muscles being study, insertional activity, presence or absence of abnormal potentials at rest (i.e. Positive Sharp Waves, Fibrillation potentials), voluntary motor unit potentials and recruitment based on recruitment frequency and ratio which is not to be confused with interference pattern.
- Electrodiagnostic impression needs to include the clinical correlation.
- Conclusion needs to indicate Acute, Sub-acute or Old denervation findings as it will allow for temporal relationship to be established.

Pitfalls of the Electrodiagnostic Evaluation:

- Acting like a technician and in many cases having a technician conduct the same nerves on every individual with no history, no physical examination and no differential diagnosis.
- Not recording the temperature and conducting the study on cold extremities which provides a false prolonged distal latency and slow conduction velocity.

- Not in the correct point or location and recording from a far field potential.
- Performing the test with incorrect extremity positioning or angle (i.e. Ulnar nerve across the elbow conduction with elbow straight which will provide with false slow conduction across the elbow)
- Confusing Conduction Block with Temporal Dispersion which will cause Phase Cancellation making the amplitude smaller.
- Failure to identify anomalous innervation or variants (i.e. Martin Gruber Anastomosis, Accessory Peroneal Nerve Innervation).
- Recording Positive Sharp Waves and Fibrillation Potentials when needle is actually on endplate zone.
- Interference Pattern confused and presented as recruitment when recruitment is better established by recruitment frequency and ratio.
- Performing studies when there is too much edema.
- Wrong filters and machine set-up used can create abnormal potentials affecting the latency and amplitude of the response.
- Age related changes confused with pathology (normative values for elderly need to be use).
- Incomplete studies.
- Reports with no clinical correlation or wrong clinical correlation.

#### Additional points:

- Conduction slowing alone should not cause weakness. To have weakness needs to have conduction block or axonal involvement on nerve conduction study.
- If small amplitude for a nerve is found but no clinical findings and no needle EMG abnormalities then it is most likely a normal variant for that patient.
- If the clinical presentation (symptoms, physical examination findings) don't match the electrodiagnostic findings they don't have it (i.e. numbness in dorsum of the hand and little finger with emg/ncs suggestive of CTS)
- To diagnosed a myopathy need have index of suspicion by obtaining a detailed history (including family history), performed a detailed neurologic and musculoskeletal physical examination including gait evaluation, differential diagnosis, emg/ncs study and confirmatory muscle biopsy.
- If emg/ncs shows abnormalities but do not correlate with symptoms and clinical findings the correct conclusion is electrodiagnostic abnormalities do not correlate with symptoms and clinical findings.
- Surgery success rate on patients with no CTS or very mild CTS only 50% get better and 13% got worse (Bland JD, Muscle & Nerve, 2000).
- Technique is crucial, bad technique can create pathology and unnecessary surgery.

In Summary: The Emg/ Ncs is not just a test but Electrodiagnostic Evaluation which in my opinion needs to be performed by a physician trained in Electrodiagnostic Medicine through specialty training in Physical Medicine and Rehabilitation or Neurology, Board Certified in the respective specialty with Electrodiagnostic Medicine Board a plus. The Emg/ Ncs needs to include a history, physical examination, temperature of the extremity. The conclusions need to established clinical correlation of the clinical findings with the electrodiagnostic findings in order to avoid the wrong diagnosis, creating pathology and unnecessary surgeries and treatments.

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