

How to Get the Most of Nerve Conduction Studies and EMG

Objectives

- Understand what NCS/EMG is
- Know what conditions or problems EMG/NCS is most likely to be useful for
- Increase your confidence in when to order studies
- Aid in your ability to integrate studies with clinical presentation

NCS/EMG in One Slide

- NCS
 - Stimulate nerves and measure motor and sensory response (amplitudes and conduction velocities)
 - Decreased amplitudes, slowing of conduction, conduction block
- EMG
 - Needle electrode placed in muscle and record electrical properties of muscle at rest and with activation
 - Myopathic vs Neuropathic changes

EDX Studies are an Extension of the Clinical Exam

- Tests do not replace a careful history or physical – in fact may lead to confusion
- As in the clinical exam significant weakness and hard sensory findings are easier to localize
- Cooperation is important – a patient that is difficult to assess clinically will be a challenge to assess electrophysiologically

EDX Studies are an Extension of the Clinical Exam

- Clinically findings related to prior pathology will affect results so let EMGer know about them
- EDX studies are operator dependent
- EDX studies are helpful in localizing deficits found on the clinical exam
 - Therefore if you can't frame your question in anatomical terms EDX is less likely to be helpful

EDX Studies are an Extension of the Clinical Exam

- If you can confidently localize based on exam are EDX studies going to help you
 - They may – severity, disease activity, prognosis
- EDX studies usually help with localization, but not etiology

Testing the Tests

- Sensitivity and Specificity
- Problem for some disorders EDX are part of the diagnostic criteria (CTS, CIDP)
- In others other studies/findings may be the gold standard
- Paradoxically the best sensitivity and specificity data exists for conditions where there is a gold standard (MRI)

Testing the Tests

- EMG is not a single test but evolutionary one
 - Someone with wasting of the hand muscles sent for an ulnar neuropathy but NCS normal
 - Should prompt EMG search for a T1 radiculopathy or motor neuron disease
- EDX studies are not just normal or abnormal so studies must be interpreted in the light of the clinical situation
 - Think of hemoglobin as a good parallel

Pragmatist or Completist

- Pragmatists order tests that will provide unique or definitive information
 - Risk misdiagnosing conditions particularly those that are rare or mimic more common conditions
- Completist will order tests to describe and document the condition
 - Risk misdiagnosis due to false positive results particularly where there is a low prevalence of the condition
- Understand you biases and the biases of your electromyographer

Focal Mononeuropathies

- Localization by evidence of slowing or conduction block
- Localization by inference
 - Median nerve normal NCS studies but denervation FPL, FDP-Median but not pronator teres, APB, or FDP-Ulnar = AIN
- Evaluates diffuse processes (polyneuropathy, myopathy)

Focal Mononeuropathies-Helpful

- For Diagnosis if localization unclear on clinical grounds
- Management
- Prognosis

- EMG changes largely not seen until three weeks after nerve injury

Table 1 Methods used in localising upper limb focal mononeuropathies

Nerve	Site of lesion	Demonstration of focal slowing	Finding changes in CMAP and SAP	Denervation changes in nerve distribution	Comments
Common					
Median	Carpal tunnel	+++	+++	+	EMG not usually needed
Ulnar	Elbow (cubital tunnel)	+	+++	++	
Uncommon					
Radial	Upper arm	+	++	+++	Depends on other ulnar studies being normal Limited usefulness; small risk of pneumothorax
Axillary	Humeral head	NA	NA	++	
Ulnar	Wrist (Guyon's canal) or hand	+	++	+++	
Long thoracic	Not clear	NA	NA	++	
Rare					
Anterior interosseous branch of median nerve	Just below the elbow	NA	NA	++	Depends on other median studies being normal
Posterior interosseous branch of radial nerve	As nerve enters supinator muscle	NA	NA	++	Depends on other radial nerve studies being normal
Suprascapular	Suprascapular notch	NA	+	+++	
Musculocutaneous		NA	+	++	

+++ high likelihood; ++ probable finding; + possible finding; - unlikely finding.

Findings will be dependant on severity of lesion.

CMAP, compound motor action potential; NA, not applicable; SAP, sensory action potential.

Table 2 Methods used in localising lower limb focal mononeuropathies

Nerve	Site of lesion	Demonstration of focal slowing	Finding changes in CMAP and SAP	Denervation changes in nerve distribution	Comments
Common					
Lateral cutaneous nerve of the thigh	Inguinal ligament	NA	-	NA	Electrodiagnostic studies limited in this common mononeuropathy
Common peroneal Interdigital	Fibular head	++	+++	++	Difficult nerves to study
	Between heads of metatarsals	NA	-	NA	
Uncommon					
Femoral		NA	NA	+++	Distinguish from plexopathy/radiculopathy
Sciatic	Pelvis, buttock or thigh	NA	++	+++	
Tibial, at ankle	Tarsal tunnel	+	++	++	
Perineal	Alcock's canal	NA	NA	NA	
Saphenous	Thigh or knee	NA	+	NA	
Rare					
Tibial, at knee		NA	++	+++	
Posterior cutaneous nerve of the thigh		NA	NA	NA	Limited use
Obturator	Obturator foramen	NA	NA	++	
Gluteal		NA	NA	++	
Sural		NA	+++	NA	

+++ high likelihood; ++ probable finding; + possible finding; - unlikely finding.

Findings will be dependant on severity of lesion.

CMAP, compound motor action potential; NA, not applicable; SAP, sensory action potential.

Radiculopathies

- In the **majority** of patients MRI will be the best test
- In those with equivocal, or confusing imaging EMG can be helpful
- EMG will rarely ever provide an etiology

Plexopathies

- These are complex studies requiring fairly sophisticated knowledge of peripheral nerve anatomy and physiology
- Mild abnormalities may be difficult to detect
- If the electrophysiology is not clear cut imaging may be required to evaluate for multiple radiculopathies, or lesion in plexus

Peripheral Neuropathies

- EDX can categorize peripheral neuropathy
 - motor, sensory, length dependent, axonal, demyelinating, multifocal
- Utility in many chronic mild neuropathies unclear
- Very useful in acute neuropathies – i.e. GBS, asymmetric neuropathies, mononeuritis multiplex, disabling severe neuropathies
- May be normal in patients with mild sensory neuropathy

Motor Neuron Disease

- Needed to document abnormalities
- Needed to exclude other processes

Neuromuscular Junction

- EDX pivotal in establishing diagnosis

Myopathy

- Don't do if a known genetic myopathy
- Helpful if unsure weakness is neurogenic or myopathic
- EMG may show specific features that aid in diagnosis – myotonia, fibrillations and positive sharp waves
- EMG in some myopathies may be normal
- EMG in myopathies may be very hard to interpret

Syndrome Hunting

EDX key points

- The tests are there to help you (and if they won't help don't do them)
- NCS and EMG are an extension of clinical examination.
- Generally NCS and EMG are effective at localising the level of the nervous system involved or the site of the lesion but not the cause
- Sometimes NCS can be misleading—for example, finding abnormalities that occur within the general population or misattributing myopathic and neuropathic weakness
- Tests other than NCS or EMG will usually be needed to determine the cause of a problem