Electrodiagnostic Criteria of Demyelination

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NCS: axonal or demyelinating?
Features of axonal loss

- Reduced motor (CMAP) and sensory (SNAP) amplitudes

- Conduction velocity (CV) may be reduced due to the loss of the fastest conducting fibers

- CV will not fall below 70-75% the lower limit of normal – does not reach the “demyelinating range”
Features of axonal loss

• Other measures of motor CV are minimally affected, even with severe axonal loss
  
  Distal motor latency (remains < 150% ULN)
  
  F wave latency (remains < 130% ULN)

• No conduction block or abnormal temporal dispersion

ULN = upper limit of normal
Features of axonal loss

These features of axonal loss may be seen in:

• axonal neuropathies, nerve trauma, etc
• motor neuron disorders and radiculopathies (motor amplitudes only)
• as well as a secondary, or “bystander,” effect in primary demyelinating neuropathies
  o although demyelinating neuropathies often have features of axonal loss, axonal neuropathies do not have features of primary demyelination
Axonal or demyelinating?
Important considerations

• The diagnostic approach to most neuropathies depends on reliably identifying demyelination on NCS
• Demyelinating neuropathies also have axonal loss
• All slowing of conduction velocity is not evidence of demyelination
• Absence of demyelination on NCS does not exclude the possibility of demyelination as the primary process (e.g., the sensitivity of NCS in confirming demyelination in CIDP is about 80-85%)
Demyelination on NCS

• Demyelination – two independent markers

  (1) **Substantial** changes in measures of conduction velocity (CV)
    • Conduction velocity slowing (motor)
    • Prolonged distal motor latencies
    • Prolonged F wave latencies

  (2) Conduction block and/or **abnormal** temporal dispersion
Features of demyelination: conduction velocity (CV)

• In vivo and in vitro studies clearly show that substantial slowing of CV is always due to segmental demyelination*

• Suggested criteria for demyelination in chronic neuropathy
  (2010 PNS/EFNS consensus criteria)

  o Motor CV < 70% LLN
  o DML > 150% ULN
  o F wave latencies > 130% ULN
    (or > 150% if CMAP amplitude < 80% LLN)

DML = distal motor latency
LLN = lower limit of normal
ULN = upper limit of normal
Features of demyelination: conduction block (CB)

- Partial conduction block (CB) - amplitude or area of the proximal response is significantly smaller than the distal response, without an increase in the response duration

- CB reflects the block of conduction through a subset of motor axons in the nerve due to segmental demyelination
Normal motor study

Example: conduction block

Distal Stimulation (wrist)

Proximal Stimulation (elbow)
Suggested criteria for CB

- Definite in any nerve
  - >50% drop in CMAP amplitude
  - >50% drop in CMAP area
Normal nerve
Segmental Demyelination
Temporal dispersion (TD)

- TD is reflected in the duration of the motor response (defined from the onset of the first negative peak to the end of the last negative component of the CMAP).

- Reflects the desynchronization of components of the response due to different conduction velocities along the length of the nerve between the point of stimulation and the recording electrode.
Temporal dispersion

- TD may be physiologic, as occurs along the length of a nerve in normal individuals.

- TD is more substantial when there is an increased range of conduction velocities due to demyelination.

- Abnormal temporal dispersion is due to demyelination – results in a greater than 30% increase in duration (comparing the proximal CMAP to the distal CMAP).
START
CMAP dispersion in CIDP/AIDP
Conduction block and abnormal temporal dispersion

- **Definite conduction block** = > 50% drop in CMAP amplitude

- **Abnormal temporal dispersion** = greater than a 30% increase in proximal CMAP duration compared to the distal CMAP

- **Both** abnormal TD and the presence of CB reflect the presence of primary demyelination!
First of a series of pleas from CIDP experts to:

1. Improve the diagnostic accuracy – immunotherapy will fail if the diagnosis is wrong

2. Use objective measures to assess treatment effect
• 36 of 86 (42%) of patients previously diagnosed with CIDP did not have CIDP – per 2010 EFNS/PNS criteria for NCS/EMG

• Most studies were interpreted as demyelinating, often as a “mixed demyelinating-axonal neuropathy”
  o Often due to moderate slowing of conduction due to axonal loss
    • Conduction velocity (CV) may be reduced due to the loss of the fastest conducting motor axons in an axonal neuropathy
    • For example, ulnar motor CV of 40 m/s or peroneal motor CV of 30 m/s
  o Focal demyelination at compression sites

These 36 misdiagnosed patients had clinical features atypical for CIDP, no or mild elevation of CSF protein (< 100 mg/dl), or a subjective response to treatment.
Suggested criteria for the diagnosis of CIDP

- **2010 EFNS/PNS criteria** - consensus among CIDP experts: the best sensitivity (85%) and specificity (>95%)

  **At least one:**

  **Measures of conduction velocity**

  **Conduction velocity**
  
  CV < 70% LLN  (e.g., < 35 m/s UE and < 28 m/s LE nerves) in 2 nerves

  **Distal motor latency**
  
  DML > 150% ULN  (e.g., ulnar > 4.9 msec) in 2 nerves

  **F wave latencies**
  
  F wave latencies > 120% ULN in 2 nerves, or > 150% ULN if the amplitude of the distal CMAP is < 80% LLN

  **Absence of F-waves in 2 nerves, if nerves have distal CMAP amplitudes of > 20% LLN, plus at least 1 other demyelinating parameter in at least 1 other nerve**
Suggested criteria for the diagnosis of CIDP

At least one:

Measures of conduction block or abnormal temporal dispersion

Partial motor conduction block
>50% drop in amplitude of the proximal CMAP compared to the distal CMAP (if distal CMAP is > 20% LLN) in 2 nerves; or in 1 nerve and at least one other demyelinating parameter in another nerve

Abnormal temporal dispersion
>30% increase in the CMAP duration between proximal and distal sites, in at least 2 nerves

Distal CMAP negative peak durations
Distal CMAP duration > ULN in at least 1 nerve (e.g., ulnar > 6.7 msec; peroneal > 7.6 msec) plus at least 1 other demyelinating feature in at least 1 other nerve

Does using electrodiagnostic criteria fall short?

• No – not when used properly

• Recognize that 1 in 7 patients with CIDP will not meet the electrodiagnostic criteria on the initial study (repeat the study!)

• With no evidence of CIDP on the NCS, when to suspect it:
  o Patterns on the clinical examination of typical CIDP
    • Proximal = or > distal weakness
    • Motor >> sensory
  o Other patterns on exam
    • Prominent ataxia (consider sensory neuronopathies)
    • Patchy involvement like multiple mononeuropathies (consider vasculitis)
  o CSF protein > 100 mg/dl
  o Rapid progression (consider vasculitis and amyloid)
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