The Integration of Neurography and EMG

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Neurography and EMG, the integration

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<th>Condition</th>
<th>Neurography</th>
<th>RNS</th>
<th>EMG</th>
<th>SFEMG</th>
<th>Other</th>
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<td>MND/MMN</td>
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First choice | Complementary | Not necessary

Neurography in GBS

- demonstrate acute motor and sensory neuropathy
- demonstrate conduction block
- assess: severity, pathology, distribution

Neurography in GBS

- confirm MOTOR-sensory demyelinating pnp
- confirm conduction block (MCS, F persistence)
- assess site (prox-dist --antiMAG)
- assess amount of axonal involvement (CAMP ampl)
- autonomic involvement

NOTE:
- CB due to high temperature
- nerve hypoexcitability

Myotonia

- Special protocol with studies of CMAP
  - short term exercise
  - long term exercise
- Genetic studies

Place of EMG

1. Ways to express EMG abnormality
2. MUP and IP analysis
3. Neurography and EMG, integration
**What do we want to express**

- Muscle membrane function - spontaneous
- Muscle fibre characteristics; diameter
- MU organisation
  - number of fibres
  - grouping
- N-M transmission
- # motor units
  - total
  - activation; pattern, fullness

**Neurography in muscle disorders**

- Indications
  - concomitant neuropathy? (mitochondr, pm, paramalignancy, secondary entrapment)
  - use CMAP to assess muscle bulk

**Neurography in MND/MMN**

**MND:**
- Exclude axonal neuropathy
- Confirm normal SCS
- Exclude MMN

**MMN:**
- Demonstrate motor cond block in individual motor nerves
- Confirm normal SCS

**EMG in pnp, MUP summary**

**EMG in pnp, jiggle + poly**
Integration EMG_Neurography, Stålberg

Small fiber testing

- Autonomic test (RR, SR)
- Epidermal nerve fiber density
- Thermotests
- Near nerve needle neurography
- Microneurography
- Axon reflex and laser doppler
- Laser evoked potentials (LEP)

Other investigations for muscle

- CK
- Muscle biopsy
  - morphology
  - histochemistry
  - electrophysiology
  - metabolic factors
- Genetic studies
- MRI
- CT
- Ultrasound
Other tests in MND

- **MUNE**
  - Reduced # MU should be assessed in MND, St p polio
    - electrical stimulation (incremental, dual stim sites, statistical)
    - voluntary (MUNIX)
- **TMS**
  - Excitability (threshold and PSTH)
  - CCT
  - TST

EMG in myotonia

- confirm myotonic discharges
- is EMG myopathic or not
- explore distribution (prox-dist)
- effect of temperature
- effect of activity

Neurography in St p polio

- No primary reason
- Atypical symptoms need further EDX
  - neuropathy (pnp, entrapment)

EMG in St p polio

- confirm neurogenic involvement
- find subclinical involvement
- assess degree of MU loss
- find other cause of symptoms:
  - entrapment, radiculopathy

Neurography in MG

- No primary reason for neurography
- Used when picture is atypical and when RNS and SFEMG are negative
- **NOTE:**
  - during any neurography low CMAPs should alert the examiner on nmj problems (remember to test facilitation in routine and in ICU)
**SFEMG in MG**

- assess increased jitter (same as jiggle in conc EMG)
- confirm normal FD
- not expected
  - increased FD (reinnervation)
  - normal jitter in 20/20 recordings

**EMG in CTS**

- EMG NOT necessary for the diagnosis *per se*. Neurographic methods are sensitive and specific.
- If EMG is used,
  - the question is to exclude roots; in Ext Carp Rad (C6) and EDC and Flex carp rad (C7)
  - in APB it may answer the question of amount of axonal lesion (but CMAP is usually better)

**Autonomic tests, RR, SSR**

- To assess involvement
  - in GBS may be vital
  - small fiber involvement
  - specific conditions, e.g. amyloidosis,

**EMG in Musc Dystr**

- Typical findings
  - spont activity
  - small polyphasic MUPs
  - early recruitment
  - dense or reduced IP (severity)
- Not expected
  - normal EMG - think of non dystrophic cond.
  - myotonia

**Neurography in Musc dystr**

- No primary reason for neurography
  If performed:
- Expected findings
  - low motor ampl,
  - normal MCV
  - F waves low ampl, normal persistence
  - normal sensory ampl
- Not expected
  - abnormal neurography (think of mitochondrial cond, paramalignant condition)

**Neurography**

- pathophysiology
  - demyelinating/axonal/CB
- fiber type
  - sensory/motor/autonomic
- fiber size
  - large/small
- distribution
  - distal/proximal
- severity
Neurography in root/plexus

• Sensory (with sensory symptoms)
  – normal distal amplitudes - root or CB anywhere
  – reduced distal ampl - axonal plexus involvement

• Motor (with weakness)
  – reduced distal amplitudes - axonal lesion
  – normal amplitudes - CB

Neurography in focal lesion

Motor symptoms:
  – pathophysiology and severity
    • demyelinating or CB focal testing (SSS)
    • axonal SSS may not help, go to EMG

Sensory symptoms:
  • low distal amplitudes go to other nerves, + EMG
  • normal distal ampl find focus (if not, make SEP)

Neurography in CTS

• to assess:
  • pathophysiology:
    – demyelination latency
    – axonal distal ampl
    – CB block across ligament
  • fiber type
    – sensory/motor
  • severity

CTS severity

• very slight only relative abnormality
  (other nerves; uln mot, uln sens, rad sens)
• slight only sensory abnormaly
• moderate sens + motor
• severe no sens resp, motor abnormality
• very severe no responses

EMG in GBS

• EMG in Early phase:
  – No indication
  – MUNE (but only MUNIX which includes voluntary act)

• EMG in Late phase:
  – degree of axonal involvement
  – jiggle
  – IPC
  – Macro

EMG in MG

• No indication in diagnostic work up
• If SFEMG is neg, EMG is indicated to find alternative diagnosis to MG
EMG in MND
- To confirm
  - generalized denervation
  - fasciculations
- To exclude myopathy

EMG in MMN
- To demonstrate focal/multifocal denervation

Neurography in myotonia
- NCS is usually not necessary when EMG has confirmed myotonia
- When myotonia is suspected, it is wise to start with EMG

RNS in MG
- Least sensitive method. If this is pos. and typical, MG is highly suspected.
  - proximal muscles
  - no treatment
  - warm muscle
- exclude (think of…)
  - LEMS, myotonia, Mc Ardle, cong MG

EMG in PM/IBM
- Expected positive findings
  - myopathy
  - spont. activity (fib, CRD) (th. paraspinals)
- Not expected
  - normal EMG
  - neurogenic pattern (except in end stage)
  - myotonia

EMG in focal nerve lesions
- Localize site
  - pure axonal focal lesion cannot be defined with neurography
  - root lesions (involvement of post rami= root, ant rami for segment)
- assess degree of axonal damage
- follow reinnervation (spont activity, conventional MUP parameters, jiggle, IP)
- MUNE/MUNIX

Why EMG in pnp
Not always necessary…but possible objectives are to:
- assess amount of axonal damage
  - long nerves
- assess dynamics
  - jiggle
- assess distribution
  - distal/prox
  - asymmetric
- exclude other reasons of symptoms
  - distal myopathy
- find clue to underlying condition
  - neurotonia
**Distribution of conduction slowing**

- GBS: +
- CIDP: +
- CMT1: +
- anti MAG: +

(proximal, even distal, (+))


**Conduction block in MMN**

- Wrist: 9.9 m/s, 4.1 m/s, 13.9 m/s, 6.1 m/s
- Elbow: 12.3 m/s, 8.3 m/s, 8.9 m/s, 7.3 m/s

**MRI in muscle disorders**

- Titinopathy (Udd)

**NCS vs small fiber neuropathy**

- Exclude large fiber pnp
- Large fibers may be involved

**EMG in small fiber neuropathy**

- Usually not indicated, unless focal symptoms

**Small fiber pnp, autonomic tests**

- Part of a larger battery of tests
Myelopathy, NCS

- If sensory symptoms, NCS is useful. Should be normal.
- Often F-responses abnormal (increase/decreased)

Myelopathy, evoked pot

- If sensory symptoms – SEP
- If motor symptoms – MEP
- If pain – LEP

Myelopathy, EMG

- Evaluate amount of LMN involvement
  - distribution (spinal cord lesion, PLS)
  - specifics (MND, syringomyelia)