Abnormal EMG Patterns in Disease

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I have no financial relationships to disclose that are relative to the content of my presentation.
Basic Tenets of EMG

- EMG (even more than nerve conduction studies) is an extension of the physical exam.
- When in doubt, reexamine the patient (or check the equipment).
- When in doubt, do not overcall.
- EDX findings should be reported in the context of the symptoms and referral doctor’s question.
- EDX are uncomfortable. Always stop when the patient asks.
Abnormal Spontaneous Activity

- Fibrillation potentials: spontaneous depolarizations
- Positive sharp waves: same significance as fibrillation potentials
- Complex repetitive discharges: depolarization of a single fiber followed by ephaptic spread (muscle membrane to muscle membrane)
- Myotonic Discharge: spontaneous discharge of muscle fiber with waxing and waning of amplitude and frequency (rate between 20 and 150)
- Fasciculation: Single, spontaneous, involuntary discharge (slow rate 1-2 hz)
Grading of PSW/fibs

- Very short runs of unsustained P-waves/fibs (<500 ms) should be interpreted as increased insertional activity.
- 1+ fibs/PSW: at least 2 areas of a muscle with sustained fibs/PSWs, clearly defined visually and by audio
- 2+ fibs/PSW: fibs/PSWs present in most areas sampled in a muscle
- 3+ fibs/PSW: fibs/PSWs present in nearly all areas of the muscles sampled, with many PSWs/fibs at each location
- 4+ fibs/PSW: complete interference pattern of PSW/fibs

This grading is helpful to the person hearing your report, but this does not usually make or break a diagnosis. Severity of lesion is usually higher with higher amounts of active denervation.
Examples of Abnormal Spontaneous Activity
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Pattern of EMG changes in Neuropathic Disorders

- Immediate: Morphology normal, recruitment decreased or absent (depending on severity of injury)
- Same pattern seen in demyelinating disorders with conduction block
- 10 days: Spontaneous activity present (wallerian degeneration has taken place)
- After 6 weeks morphology becomes more neuropathic (remodeling has occurred):
  - Decreased recruitment, larger amplitude, polyphasic
  - Satellite potentials: small, short duration, unstable units time locked to another larger unit
  - Nascent units: Small amplitude short duration units with decreased recruitment (recruitment distinguished from myopathic units)
Radiculopathy

- Typically, sensory nerve studies remain normal, in the relevant dermatome.
  - Pathology is proximal to the dorsal root ganglion.
- Motor CMAP amplitudes can be reduced.
- EMG findings:
  - Active denervation, reduced recruitment in at least 2 anterior myotome muscles innervated by that root, likely with paraspinal active denervation also.
Plexopathy

Sensory studies: Most sensitive.

- In contrast to radiculopathy, plexopathies should feature reduced amplitude/absent SNAPs.
- In the dermatome affected:
  - Upper trunk: median SNAP + musculocutaneous SNAP
    - Same for Lateral Cord lesions
  - Middle trunk: radial SNAP
    - Same for Posterior Cord lesions
  - Lower trunk: ulnar SNAP + medial cutaneous forearm SNAP
    - Same for Medial Cord lesions
- EMG: can be severely abnormal, with 3-4+ fibs/no motor units or severely reduced recruitment
  - Paraspinals classically unaffected.
Dorsal scapular nerve arises at the proximal point of the upper trunk. It innervates rhomboids, which if abnormal suggests a C5 root lesion.

Radial muscles + deltoid suggests a posterior cord lesion

Abnormal distal median and ulnar muscles on EMG, with normal median sensory study suggests medial cord.

Always look at paraspinals to evaluate root lesion (avulsion)
Motor Neuron Disease

- ALS, SMA, Kennedy’s disease will all have denervation that cannot be explained by 1 or 2 single lesions.
- One must continue to test additional muscles to rule out more systemic illness.
- E.g. CTS with active denervation in the APB prompts evaluation of pronator, FDI, and other proximal muscles.
- El Escorial criteria: 3 regions, each with 2 muscles showing active denervation PLUS UMN findings in 3 regions (usually no EMG correlate for UMN)
- Awaji criteria are similar but allow for fasciculations to count as active denervation
Chronic Neurogenic Process
Acute Nerve Injury
EMG reports of myopathy should also include the ideal muscle biopsy target (if desired).

- Most abnormal muscle, with small motor units, especially if fibs/PSWs present. Ideally, this would be a vastus, biceps, deltoid, brachioradialis, gastrocnemius, in declining order of preference.

- Some myopathies can involve paraspinal muscles only. Difficult, but possible to bx this site.

- Generally perform EMG on one side only, leaving the contralateral side for biopsy, to avoid EMG needle site affecting the biopsy.

- Exception: generally vastus medialis findings are assumed present in vastus lateralis also.

- The specific diagnosis of type of myopathy is rarely obvious from EMG only (e.g. FSHD vs polymyositis).
  - Exception: myotonic dystrophy
Pattern of EMG changes in Myopathic Disorders

- Myopathy: number of functioning muscle fibers decreased—units smaller, shorter duration.
- Abnormal firing causes polyphasia
- Acute: short duration, small amplitude units with normal or early recruitment
- Chronic: (some denervation often occurs) long-duration, high amplitude MUAPS can be seen (often with short-duration, small units)
- Recruitment is still normal or early until end stage
Recruitment: Myopathic Process
Questions?
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