WASTING WITH
FASCICULATIONS –
Differentiating Peripheral Nerve
Injuries from ALS

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OVERVIEW

- DEFINITION
- AMYOTROPHIC LATERAL SCLEROSIS
- DIFFERENTIAL DIAGNOSIS
- WORK UP
FASCICULATIONS

- Spontaneous, involuntary, irregular and painless twitching (contractions) of part of a muscle
  - Visually apparent
  - Percussion may bring out
- Creates concern because of its association with ALS
FASCICULATIONS - EMG

- Spontaneous discharge of single motor unit
- Fire irregularly
- Relative slow pattern
  - 2-3 per second to one every several seconds
- “corn popping”
FASCICULATIONS - benign

- OFTEN BENIGN
- Eyelids
- Thumb
- Gastrocnemius
- Tend to fire faster than malignant form
- Tend to continue in same muscle
FASCICULATIONS - benign

- 70% of medical personal have occasionally
- 2% have daily
- Majority who present with fasciculations have NO associated neurological disease
FASCICULATIONS - malignant

- Tend to fire slower
- Varying muscles
- Associated with
  - Atrophy
  - Weakness
  - Reflex abnormalities
- More complex wave form on EMG
FASCICULATIONS
Pathogenesis

- Neural in origin
- Impulses generated in peripheral nerve
  - Terminal portion of the axon
  - Hyperexcitable distal motor axons
- Stretching the muscle = decreased fascics
- Seen in virtually all ALS patients
  - May be generated at multiple points along diseased motor neuron
  - If no fasciculations need to reconsider dx
FASCICULATIONS
benign causes: not usually associated with wasting

- Caffeine
- Stress
- Vigorous exercise
- B-agonists
FASCICULATIONS
benign causes: not usually associated with wasting

- BENIGN FASCICULATION SYNDROME
- Fatigue, cramps, generalized myalgias
- < 30 yo
- Occasional preceded by viral syndrome
- EMG / NCS are normal
- 50% spontaneously improve over few years
FASCICULATIONS
benign causes: not usually associated with wasting

CRAMP – FASCICULATION SYNDROME

- Cramps; fasciculations;
- Normal neuro exam
- EMG / NCS are normal
- Occasional CK elevation
- Cramps respond to carbamazepine
ALS (amyotrophic lateral sclerosis) “Lou Gehrig’s Disease”

- Progressive neurodegenerative disorder
- Upper motor neuron (UMN) and Lower motor neuron (LMN) findings
  - UMN = corticospinal tract
  - LMN = anterior horn cells
- Progressive disease to death
- 1859 first classic ALS description
- 1939 = Lou Gehrig’s disease
(a) Corticospinal pathway

Upper motor neuron

Lower motor neuron

Motor homunculus on primary motor cortex of left cerebral hemisphere

Corticobulbar tract

To skeletal muscles

Motor nuclei of cranial nerves

Cerebral peduncle

Mesencephalon

Medulla oblongata

Pyramids

Decussation of pyramids

Lateral corticospinal tract

Anterior corticospinal tract

To skeletal muscles

Spinal cord
ALS

- SOD 1 gene mutation
- Prevalence rate = 0.2 – 2.4 / 100,000
- Peaks 6th decade
- Men > women
- Mean duration to death = 3 years
- 10% live > 10 years
ALS

- MOTOR NEURON DISEASE
  - ALS
  - Primary lateral sclerosis – 2-3% - slow – UMN only
  - Progressive muscular atrophy – slow – LMN only - most favorable outcome
  - Progressive bulbar palsy – does not spread beyond bulbar area
ALS

UMN-corticospinal & corticobulbar tracts

- Weakness
- Spasticity
- Hyperreflexia
- Poor dexterity
- Pathologic reflexes
  - Babinski
  - Hoffman / Tromners
- Pseudobulbar signs

LMN- anterior horn cells

- Weakness
- Atrophy
- Fasciculations
  - Limbs
  - Tongue / face
- Cramps
- hyporeflexia

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ALS - questioned if

- Sensory loss
- Sphincter dysfunction
- Extraocular dysmotility
- Dementia
  - ALS-parkinsons-dementia complex - Guam
ALS presentation

- Weakness – asymmetric
- Distal hands = most frequent site of onset
- Progresses
  - pattern
- Often c/o cramps
- Pseudobulbar symptoms
  - Inappropriate crying / laughing / yawning
- Bulbar symptoms
  - Facial weakness; dysphagia; dysarthria, etc
ALS presentation

- Hyperreflexia
- Weight loss / cachexia
- Respiratory compromise
- Depression

RARE

- Pure lower motor neuron presentation
- Pure upper motor neuron presentation
ALS – typical progression

- If one arm → other arm → ipsilateral leg → contralateral leg → bulbar
- If one leg → other leg → ipsilateral arm → contralateral leg → bulbar
- If bulbar → one arm → other arm → legs
ALS variation

- Flail-arm syndrome
  - Bibrachial wasting – relatively symmetric
  - One UMN finding (eg Babinski)
- Mill’s hemiplegic variant
  - One sided UMN and LMN findings
ALS – etiology - hypothesis

- Excitotoxicity
  - Glutamate (excitatory amino acid)
- Immune mediated - inflammatory
- Viral initiated
- Environmental toxins
  - Aluminum / manganese / cycasin (cycad nut)
- Trauma
  - football; soccer; boxers
ALS Pathology

- **Macroscopic**
  - Atrophy / graying (gliosis / sclerosis)
  - Motor cortex / ventral spinal roots / lateral columns spinal cord

- **Microscopic loss**
  - Large motor neurons anterior horn cells of spinal cord
  - Brainstem motor nuclei (V, VII, IX, X, XII)
  - Large pyramidal cells in motor cortex
  - Large myelinated axons in corticospinal tract
ALS – Clinical Diagnosis

- Largely by clinical exam
- Ancillary testing to confirm or refute
ALS – Clinical Diagnosis

- Clinically definite
  - UMN / LMN in 3 separate CNS regions
- Clinically probable
  - UMN / LMN in 2 separate CNS regions
- Probable lab supported
  - UMN one region
  - EMG positive and MRI negative for other
- Less = watch and monitor for progression
ALS - EMG

- Indispensable in diagnosis of ALS
- Order specifically “r/o ALS”
  - More thorough and time consuming than “r/o radic or CTS”, etc
  - Assess “four limbs” (tongue) and thoracic
- Normal sensory nerve conductionss
- Slow motor conductionss
  - No less than 70% of normal for age
  - Prolonged F-waves
ALS – EMG needle exam

- Evidence of active and chronic denervation
  - Fibrillations, sharp waves
  - Decreased # MUAPs; polyphasia; increased amplitudes

- Fibrillations and fasciculations – in at least 2 (prefer 3) areas
  - Cervical, thoracic, lumbar, bulbar
  - Limb muscles; bulbar muscles (face / tongue)
  - Paraspinals
ALS - MRI

- r/o structural lesion
- Brainstem
- Cervical stenosis

- May see hyperintensities in primary motor cortex – pons- corticospinal tract
  - Wallarian degeneration
ALS - Labs

- Mildly positive or normal CK
- CBC, calcium, lytes, ESR, TSH, B12, SPEP/immunofixation
- Anti GM1 Ab
  - Multifocal motor neuropathy
  - Treat with IV IgG
- > 50yo: chest x-ray, fecal occult blood?
  - paraneoplastic
- Muscle biopsy
  - Not specific for ALS (chronic denervation)
  - r/o other such as myopathy
Differential diagnosis: wasting and fasciculations

- **Hyperthyroidism**
  - Corticospinal tract findings
  - Weight loss
  - Weakness
  - ALSO: tachycardia, anxiety, tremor, heat intolerance, goiter
Differential diagnosis: wasting and fasciculations

- **CERVICAL SPONDYLOSIS**
- Asymmetric weakness (4 extremities)
- UMN & LMN findings
  - Spinal cord compression
  - Foraminal stenosis
- ….spinal cord tumor…
Differential diagnosis: wasting and fasciculations

- FORAMEN MAGNUM LEVEL LESIONS
  - Syrinx; Multiple Sclerosis plaque; neoplasm
  - May have typical ALS features
  - …SENSORY often involved
- MRI; CSF analysis
Differential diagnosis: wasting and fasciculations

- SUBACUTE COMBINED DEGENERATION
- B12 Deficiency
- UMN / LMN
- ......Sensory loss.....
Differential diagnosis: wasting and fasciculations

- MULTIFOCAL MOTOR NEUROPATHY WITH CONDUCTION BLOCK
  - Presents with distal weakness
  - Multiple separate peripheral nerves
  - Fasciculations and cramps often seen
  - Very slow progression
  - Lack of atrophy despite weakness
  - Striking absence of sensory involvement
  - Often elevated GM1 ganglioside antibody
  - Treatable with IV IgG
Differential diagnosis: wasting and fasciculations

- **COMPRESSIVE RADICULOPATHY**
  - Interosseous wasting – C8
  - Foot drop – L5
  - Typically sensory complaints
  - Follows specific root dysfunction
  - EMG ..............MRI

- **RADIATION INDUCED RADICULOPATHIES**
  - History is key .............. sensory often involved
Differential diagnosis wasting and fasciculations

- **POEMS**
  - Polyneuropathy; organomegaly; endocrinopathy; monoclonal protein; skin changes
  - Weakness, wasting, tremor,
  - *sensory changes on NCS*
Differential diagnosis wasting and fasciculations

- BRACHIAL NEURITIS
- Parsonage-Turner syndrome
- Profound aching pain proximal arm
- Weakness follows
- Improves with time
- EMG may be abnormal bilaterally – normal other areas
- Sensory on NCS likely
Differential diagnosis wasting and fasciculations

- INCLUSION BODY MYOSITIS
  - Distal asymmetric weakness
  - Dysphagia possible
  - No fasciculations
  - Biopsy proven

- MYASTHENIA GRAVIS
  - Weakness without wasting; EMG and Labs
Differential diagnosis wasting and fasciculations

- ORGANOPHOSPHATES
- Pesticide poisoning
- Nausea; salivation; bladder; seizures
Other Motor Neuron Diseases

- Primary lateral sclerosis
  - UMN only; very slow progression
- Progressive bulbar palsy
  - No spread beyond bulbar region
- Progressive muscular atrophy
  - Most rare form; LMN only; most favorable