


**FERNE / MEMC IV Brain Illness and Injury Course:
Localization of CNS Pathology Based on the Physical Exam
Andrew Asimos, MD, FACEP**

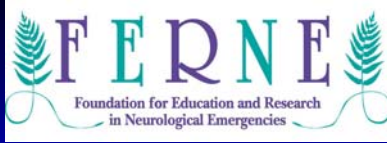
Localization of CNS Pathology Based on the Physical Exam

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Foundation for Education and Research
in Neurological Emergencies

FERNE Brain Illness and Injury Course

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The Fourth International Emergency Medicine Congress (MEMC IV)
Sorrento, Italy
September 17-18, 2007

4th Mediterranean Emergency Medicine Congress
Sorrento, Italy
September 17, 2007

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Disclosures

- NovoNordisk, Boehringer Ingelheim Advisory Boards
- Research support from Boehringer Ingelheim

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Session Objectives

- Emphasize the essential elements of the H&P for localizing CNS pathology
- Describe an algorithmic, systematic approach to localizing neurologic pathology
 - The patient presenting with weakness

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Key Clinical Questions


- Is the clinical presentation consistent with neurological pathology
- Where does the pathology localize to?
- What diagnoses exist at that localization?
- What acute interventions exist for those diagnoses?

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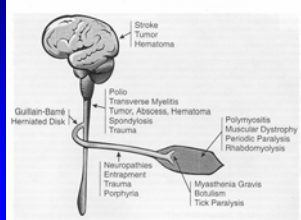
Key Learning Points


- Consider the neuroanatomy systematically
- Use key features of the history and neuro exam to narrow down the localization

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An Algorithm for Diagnostic Localization


- Unilateral versus bilateral
- Start from the cortex and work your way down and out



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Unilateral: Key Questions

- Cortical signs?
- Face involved?
- Dermatomal / Myotomal?
- Peripheral nerve specific?

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Bilateral: Key Facts

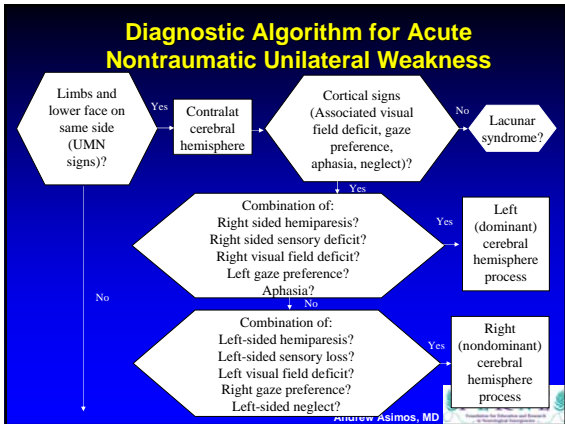
- Mental status impaired?
- Which limbs?
- Sensory level or involvement?
- Bladder involvement?
- Proximal vs distal?
- Fluctuating or fatiguing pattern?
- Ocular or bulbar signs?

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Weakness Cause of : Grouped by Anatomic Subunit

<p>Central (upper motor neuron)</p> <p>Cerebrum</p> <ul style="list-style-type: none"> Stroke Spine-occupying/structural lesion * Left (dominant) cerebral hemisphere process * Right (nondominant) cerebral hemisphere process <p>Subcortical/Brainstem</p> <ul style="list-style-type: none"> Stroke Spine-occupying/structural lesion * Lacunar syndromes * Midbrain/brainstem syndromes <p>Spinal cord</p> <ul style="list-style-type: none"> Acute (transverse myelitis) (infectious or inflammatory) Spinal cord infarct Spinal epidural or subdural hemorrhage Central intervertebral disc herniation Tumors (metastatic or primary) Multiple sclerosis <p>Peripheral (lower motor neuron)</p> <ul style="list-style-type: none"> Anterior horn Anterior horn lateral sclerosis* Polio/myelitis Spinal nerve root Intervertebral disc herniation <p>Polyneuropathies</p> <ul style="list-style-type: none"> Guillain-Barre syndrome** Cipriani (Guinea poisoning)* Sandwich poisoning (aerobic fish poisoning) Sandwich (aquatic shellfish poisoning) 	<p>Periphrinx*</p> <ul style="list-style-type: none"> Lead or other heavy metal poisoning* Alcohol or drug induced Diabetic <p>Phosopathies</p> <ul style="list-style-type: none"> Botulism Limbic <p>Peripheral neuropathies</p> <ul style="list-style-type: none"> Nerve compression syndromes Neuromuscular junction disorders Myasthenia gravis* Botulism* Tick paralysis* *Organophosphate poisoning* <p>Myopathies</p> <ul style="list-style-type: none"> Inflammatory (polymyositis) Endocrine-induced* Alcohol or drug-induced Muscular dystrophy* Endocrine-related* <p>Neurophysiologic/Noncategorical</p> <ul style="list-style-type: none"> Conversion disorder Malingering Chronic fatigue syndrome Anxiety disorder Fibromyalgia <p>*Neurovascular cause of acute respiratory failure **frequently associated with autoimmune dysfunction</p>
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Motor Neuron Neuroanatomy

- UMN** - Cortex to the lateral column of the spinal cord
- LMN** - Anterior column to the motor end-plate

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Upper vs Lower Motor Neuron Weakness

Clinical	UMN	LMN
Reflexes	↑	↓
Muscle tone	↑	↓
Fasciculation	None	Present
Atrophy	None	Severe
Babinski sign	Present	Absent

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Somatotopic Organization in the Brain

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Diagnostic Algorithm for Acute Nontraumatic Unilateral Weakness

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    graph TD
      A{Cranial nerve signs +/- hemiparesis (Ipsilateral face/contralateral body, UMN signs)?} -- Yes --> B[Brainstem process]
      A -- No --> C[ ]
  
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Notable Midbrain and Brainstem Syndromes Causing Unilateral Weakness

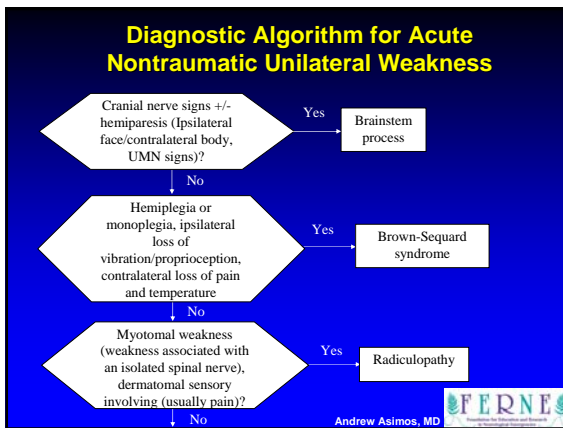
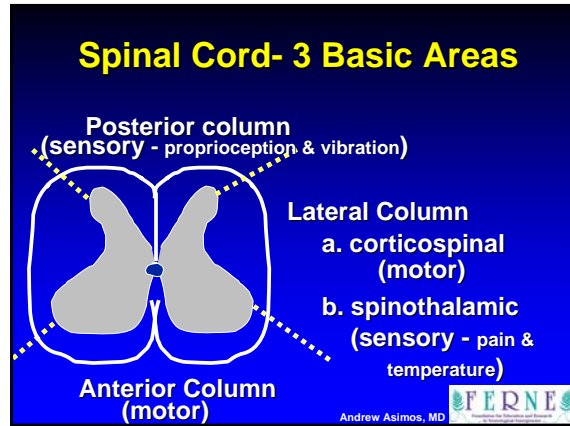
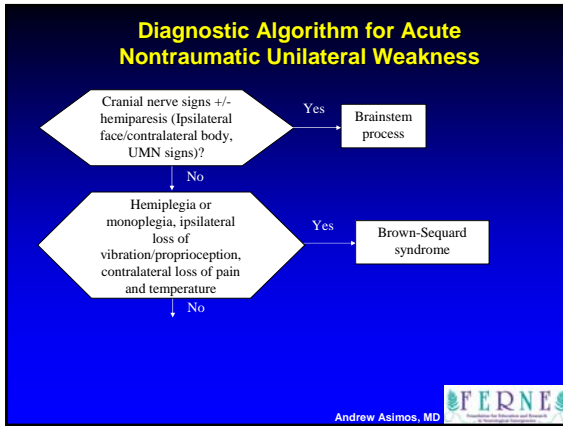
Location	Eponym	Ipsilateral	Contralateral
Midbrain	Weber	3 rd nerve palsy	Hemiparesis
Pons	Millard-Gubler	Facial Palsy	Hemiparesis
Pons	Foville's	Facial Paresis, Abducen's palsy	Hemiparesis

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Anatomy of the Midbrain at the Level of the Third Nerve

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Cervical Myotomes

Level	Muscle(s)
C5	Elbow flexors (biceps, brachialis, & brachioradialis)
C6	Wrist extensors (extensor carpi radialis longus & brevis)
C7	Elbow extensors (triceps)
C8	Finger flexors (distal phalanx – flexor digitorum profundus)
T1	Small finger abductor (abductor digiti minimi)

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Lumbosacral Myotomes

Level	Muscle(s)
L2	Hip flexors (iliopsoas)
L3	Knee extensors (quadriceps)
L4	Ankle dorsiflexors (tibialis anterior)
L5	Long toe extensors (extensor hallucis longus)
S1	Ankle plantar flexors (gastrocnemius, soleus)

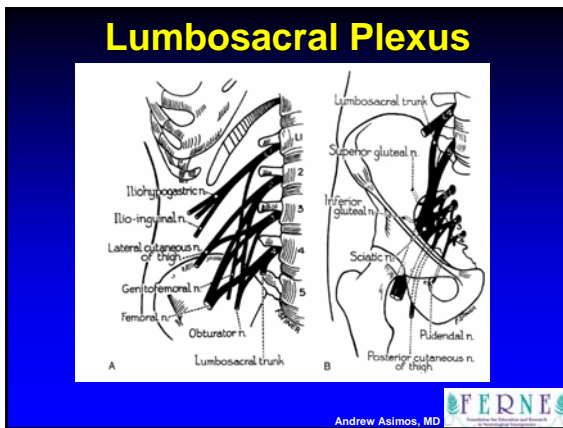
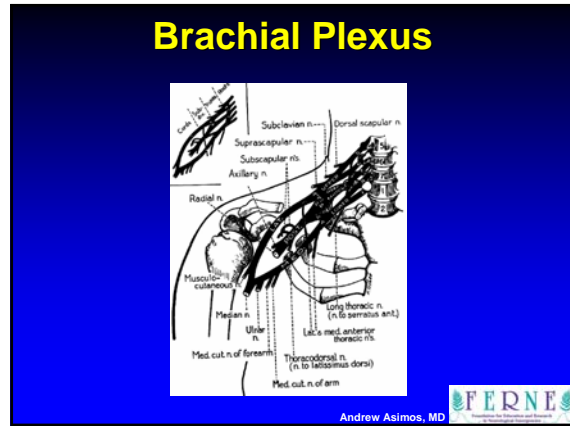
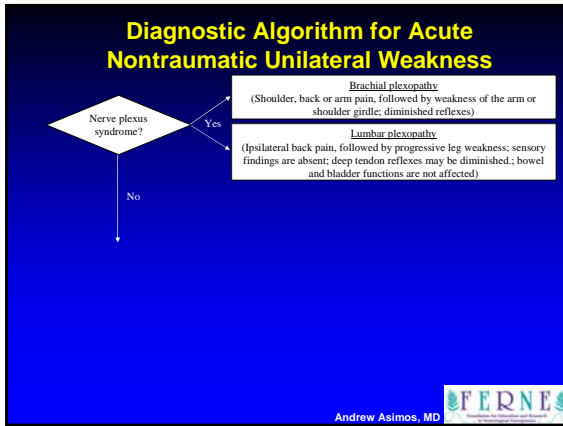
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Sensory Dermatomes

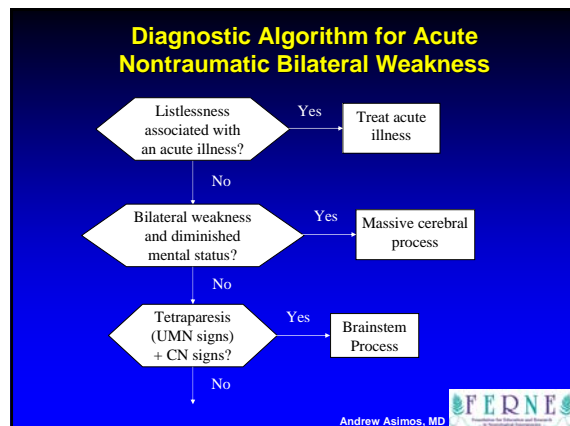
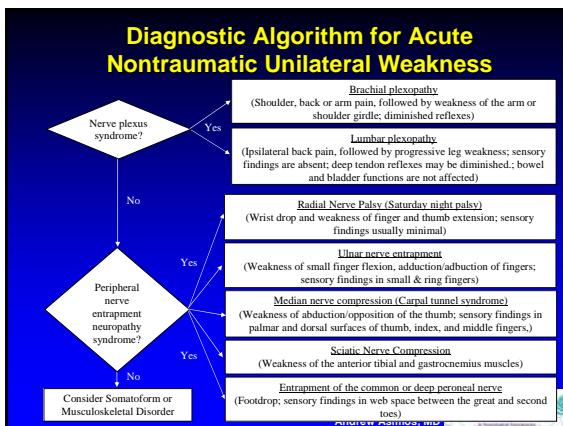
C4 Top of ACJ	T4 Nipple line
C5 Lateral ACF	T10 Umbilicus
C6 Thumb	L4 Medial malleolus
C7 Middle finger	L5 Dorsal 2-3 MTP
C8 Little Finger	S1 Lateral heel
T1 Medial ACF	

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- ### Plexopathies
- More difficult to recognize and localize than lesions of the spinal roots or peripheral nerves
 - Trauma, radiation or malignancies
 - Best clue is a motor and sensory deficit involving more than one spinal or peripheral nerve
 - LMN signs more prominent than the sensory changes
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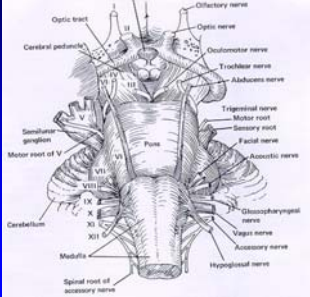
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Locked-in Syndrome

- Quadriparesis, mutism, and preserved consciousness
- Pontine lesion paralyzes
 - Horizontal eye movements
 - Jaw, face, bulbar muscles
- Can be misdiagnosed as coma

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Cranial Nerves & the Brainstem




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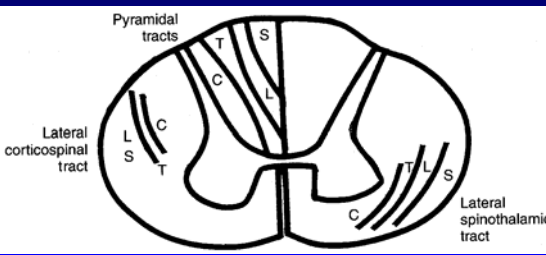
Diagnostic Algorithm for Acute Nontraumatic Bilateral Weakness


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    graph TD
      A{All 4 limbs (UMN signs), sensory level, bladder dysfunction?} -- Yes --> B[Mid or upper cervical myelopathy]
      A -- No --> C{Legs and hands (UMN signs)?}
      C -- Yes --> D[Low cervical myelopathy]
      C -- No --> E{Legs, UMN signs?}
      E -- Yes --> F[Thoracic myelopathy (Also may be caused by a parasagittal lesion in the interhemispheric fissure)]
      E -- No --> G[ ]
    
```

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Somatotopic Arrangement in the Spinal Cord



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Myelopathies

- Intact cranial nerves and speech
- UMN signs to some degree
 - Except in spinal shock
- Distinct level to sensory findings
- Bladder dysfunction

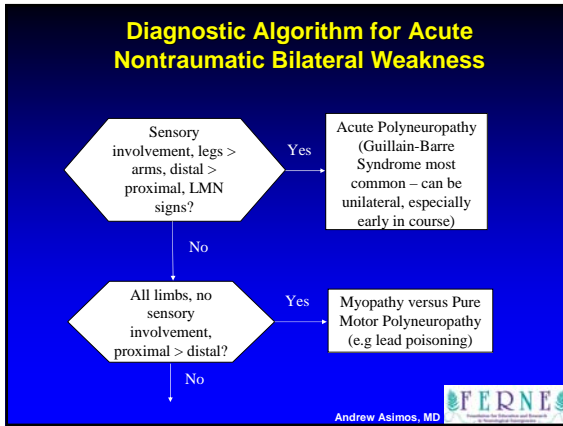
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LMN and Beyond

Clinical	Neuropathy	Myopathy	NMJ
Distribution	Distal > proximal	Proximal > distal	Diffuse (bulbar & respiratory)
Reflexes	↓	↓	Normal
Sensory involvement	+	-	-
Atrophy	+/-	+/-	-
Fatigue	+/-	+/-	+
Serum CPK	Normal	Normal to ↑	Normal

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Polyneuropathy

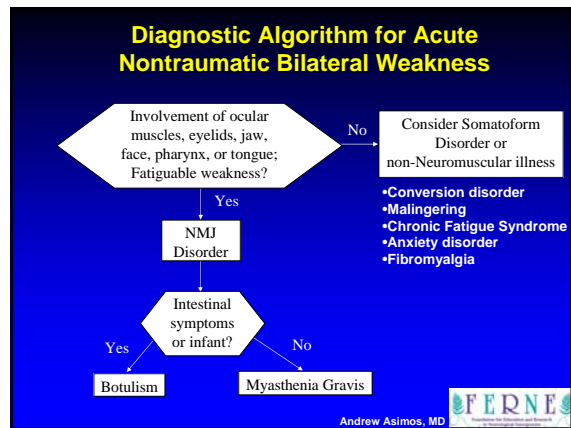
- Affect both motor and sensory symptoms
 - Unlike myopathies and NMJ disorders
- Often heralded by paresthesias
- Invariably, vibratory sense is lost distally
- Weakness due to the involvement of a large number of nerves
- Distal power reduced most dramatically
 - Longer nerves since most severely affected
- DTR's characteristically diminished

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Myopathies

- Primary process in the myocyte
- Systemic disorder
 - Metabolic, inflammatory, drug related, etc.
- Reflexes maintained until weakness is severe
- Inflammatory myopathies "classically" involve proximal muscles

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Conclusions

- Approach CNS Pathology Localization
 - Systematically
 - In the context of important distinguishing features
 - Based on the relevant neuroanatomy

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Questions?

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