Disclosures

Nothing to disclose
Objectives

1. Review the standard elements of the neuro exam;
2. Review key neuroanatomy principles;
3. Make sense of exam findings to help with lesion localization and differential diagnosis;
4. Discuss the screening neurological examination.
Neurological complaints are very common

Does the patient who just collapsed on the street have an MI or an ICH?

Is the patient with leg weakness and numbness suffering from lumbar DJD or from impending spinal cord compression?

Does the patient with nausea and vomiting need a GI consult, a head CT, or emergency interventions to lower high ICP?
Why do we need to examine patients?

To **make a specific** diagnosis
To **confirm** a diagnostic impression
NE helps determine the **prognosis**
Helps reassure the patient
Helps **ESTABLISH CONTACT** and **BUILD a RELATIONSHIP**
Exam allows us to screen for **NON-ORGANICITY**
Exam gives us something else!

TIME TO THINK!

Gives us time to feel what type of person we have in front of us and her/his family and friends

What else can it be? What have I missed?

Examine patients to avoid unnecessary tests

Over-testing can lead REAL HARM to our patients (not just in direct costs)
  • DJD of the spine – may lead to unnecessary surgeries
  • NSWMC (leukoarayosis) – epidemic of pseudo-MS
Evidence based value of the neuro exam

Does it really improve our care for the patient?

If you think of the Neuro Exam as a dx test it should:
  Be reliable, be accurate
  Have a measurable dx value (PPV, NPV, Specificity, Sensitivity)

Positive findings should be used in combination
  If only one sign is abnormal, treat it with caution, and correlate with Hx

Patients do not have a constant exam overtime
What is being tested by each part of the NE?

Performing NE well is linked to understanding:

- NEUROANATOMY
- Cerebral and spinal cord BLOOD SUPPLY
- Musculoskeletal system
- Psychiatric and psychological problems
- Other medical systems (respiratory, cardiovascular, etc)
Making Sense of Neurological Findings

Is there evidence of motor dysfunction?
  Weakness, Spasticity, Tremor

Does the pattern follow an **UMN** or **LMN** pattern?
  UMN process (weakness + spasticity). What is the level?

  LMN process (weakness + flaccidity). What is the distribution?
    spinal nerve root
    peripheral nerve
    Bilateral? Distal?

Do **reflexes** support a UMN or LMN process?
  hyper-reflexic in UMN disorders VS hypo-reflexic in LMN disorders

Does the **plantar reflex** testing suggest an UMN lesion?
Making Sense of Neurological Findings

Is there impaired sensation?
- some disorders affect only the motor pathways, sparing sensation

Which aspects of sensation are impaired?
- spinothalamic tract
- dorsal columns

Does the sensation loss suggest dysfunction at a specific level?
- spinal nerve root?
- peripheral nerve problem?

Does the sensory deficit correlate with the "correct" motor deficit?
- radial nerve lesion leads to characteristic motor and sensory findings
General rules for the neuro exam

Learn standard **exam techniques**

http://www.clinicalneurologyvideos.com
http://www.neuroexam.com

Follow **some kind of ORDER**

- Anatomic
- Instrument
- Functional

**QUANTIFY** findings

- Measure - Pupils, Limb circumference, Duration of vibration sensation
- Grade - Reflexes 0/4 to +4/4; Strength 0/5 to 5/5

**COMPARE** with contralateral side

Assume that everything is ABNORMAL until proven otherwise
General rules for the neuro exam

**Analyze** the NE
- Record all findings OBJECTIVELY
- Consider the underlying neurophysiological process
- Convert findings to technical terminology
  - unilateral arm and leg weakness + increased tone = hemiplegia
- Place the lesion in the CNS or PNS
  - pyramidal tract in CNS

Think CIRCUITS and **NEUROANATOMY**

**Localize** the LEVEL of the lesion within the
- Motor, sensory, autonomic, mental circuits
Clinical diagnosis in Neurology

Anatomic localization + Pathophysiologic considerations + Probability of a Dx = ETIOLOGICAL Dx

Is there a lesion?
Where is the lesion?
What is the lesion or disease?

What do I do to confirm Dx?
What is the management?
NEUROLOGICAL EXAM

Mental status
Cranial nerves
Motor exam
Reflexes
Coordination and gait
Sensory exam
NEUROLOGICAL EXAM

Mental status
Cranial nerves

Motor exam
Reflexes

Coordination and gait
Sensory exam
Primary and association cortex

- Primary motor cortex
- Central sulcus
- Primary somatosensory cortex
- Supplementary motor area (SMA)
- Premotor cortex
- Prefrontal association cortex
- Broca’s area
- Limbic cortex
- Primary auditory cortex (in Sylvian fissure)
- Auditory association cortex
- Primary visual cortex
- Secondary somatosensory cortex (in parietal operculum)
- Wernicke’s area

Legend:
- Primary motor or sensory cortex
- Unimodal association cortex
- Heteromodal association cortex
- Limbic cortex
Mental status

Level of alertness, attention and cooperation

Orientation

Memory
  Recent
  Remote

Language
  Spontaneous speech
  Comprehension
  Naming
  Repetition
  Reading
  Writing
Limbic system
Basal ganglia
Mental status

Level of alertness, attention and cooperation

Orientation

Memory
  Recent
  Remote

Language
  Spontaneous speech
  Comprehension
  Naming
  Repetition
  Reading
  Writing
Mental status

“Calculations, right-left confusion, finger agnosia, agraphia”

Apraxia

Neglect and constructions

Sequencing tasks and frontal release signs

Logic and abstraction

Delusions and hallucinations

Mood
Overlap of the brain lesions for (A) all 80 patients, (B) a subgroup of 16 patients showing consistent neglect, and (C) 25 patients showing no neglect

Vincent Verdon et al. Brain 2010;133:880-894
Mental status

“Calculations, right-left confusion, finger agnosia, agraphia”

Apraxia

Neglect and constructions

Sequencing tasks and frontal release signs

Logic and abstraction

Delusions and hallucinations

Mood
NEUROLOGICAL EXAM

Mental status

Cranial nerves

Motor exam

Reflexes

Coordination and gait

Sensory exam
Cranial nerves

Olfaction
(CN I)

Ophthalmoscopic exam
(CN II)

Vision
(CN II)

Pupillary responses
(CN II, III)

Extraocular movements
(CN HI, IV, VI)

Facial sensation and mastication
(CN V)
Cranial nerves

Olfaction (CN I)

Ophthalmoscopic exam (CN II)

Vision (CN II)

Pupillary responses (CN II, III)

Extraocular movements (CN HI, IV, VI)

Facial sensation and mastication (CN V)
Cranial nerves

Facial expression and taste
  (CN VII)

Hearing and vestibular sense
  (CN VIII)

Palate elevation and gag reflex
  (CN IX, X)

Muscles of articulation
  (CN V, VII, IX, X, XII)

Sternocleidomastoid and trapezius
  (CN XI)

Tongue
  (CN XII)
Cranial nerves

Facial expression and taste
  (CN VII)

Hearing and vestibular sense
  (CN VIII)

Palate elevation and gag reflex
  (CN IX, X)

Muscles of articulation
  (CN V, VII, IX, X, XII)

Sternocleidomastoid and trapezius
  (CN XI)

Tongue
  (CN XII)
NEUROLOGICAL EXAM

Mental status
Cranial nerves

Motor exam
Reflexes

Coordination and gait
Sensory exam
Corticospinal Tract
Motor exam

**Observation**
- Involuntary movements – BG, cerebellum
- Tremor - BG, cerebellum, with peripheral nerve lesions
- Hypokinesia

**Inspection**
- Muscle wasting - MND
- Fasciculations - MND

**Palpation**
- Tenderness – myositis, fibromyalgia
- Fasciculations

**Muscle tone** – corticospinal tract, BG

**Functional testing**
- Drift
- Fine finger movements
- Rapid toe tapping

**Strength of individual muscle groups**
Muscle strength scale

0/5 NO contraction
1/5 Flicker, but NO movement
2/5 Movement possible, but not against gravity
3/5 Movement possible against gravity
4/5 Movement possible against resistance
   Optional grades: -4/5 and +4/5
5/5: Normal strength
# Upper vs Lower Motor Neuron Lesions

<table>
<thead>
<tr>
<th>Clinical SIGN</th>
<th>UMN LESIONS</th>
<th>LMN LESIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weakness</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Atrophy</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Fasciculations</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Reflexes</td>
<td>Increased</td>
<td>Decreased</td>
</tr>
<tr>
<td>Tone</td>
<td>Increased</td>
<td>Decreased</td>
</tr>
</tbody>
</table>

Mild atrophy may develop as a result of **disuse**
With **acute UMN lesions**, reflexes and tone may be **decreased**
### Upper Extremity Strength Testing

<table>
<thead>
<tr>
<th>ACTION</th>
<th>MUSCLES</th>
<th>NERVES</th>
<th>ROOTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finger extension at MCP joints</td>
<td>Ext digitorum, ext indicis, ext digiti min</td>
<td>Radial nerve (post interosseous nerve)</td>
<td>C7,C8</td>
</tr>
<tr>
<td>Thumb abduction in plane of palm</td>
<td>Abductor pollicis longus</td>
<td></td>
<td>C7,C8</td>
</tr>
<tr>
<td>Finger abduction</td>
<td>Dorsal interossei, abd digiti minimi</td>
<td>Ulnar nerve</td>
<td>C8,T1</td>
</tr>
<tr>
<td>Thumb opposition</td>
<td>Opponens pollicis</td>
<td>Median nerve</td>
<td>C8,T1</td>
</tr>
<tr>
<td>Thumb abduction perpend plane of palm</td>
<td>Abductor pollicis brevis</td>
<td>Median nerve</td>
<td>C8,T1</td>
</tr>
<tr>
<td>Flexion at DIP joints, dig 2,3</td>
<td>Flexor digitorum prof to digits 2,3</td>
<td>Median nerve</td>
<td>C7,C8</td>
</tr>
<tr>
<td>Flexion at DIP joints, dig 4,5</td>
<td>Flexor digitorum prof to digits 4,5</td>
<td>Ulnar nerve</td>
<td>C7,C8</td>
</tr>
<tr>
<td>Wrist flexion and hand abduction</td>
<td>Flexor carpi radialis</td>
<td>Median nerve</td>
<td>C6,C7</td>
</tr>
<tr>
<td>Wrist flexion and hand adduction</td>
<td>Flexor carpi ulnaris</td>
<td>Ulnar nerve</td>
<td>C7,C8,T1</td>
</tr>
<tr>
<td>Wrist extension and hand abduction</td>
<td>Extensor carpi radialis</td>
<td>Radial nerve</td>
<td>C5,C6</td>
</tr>
<tr>
<td>Elbow flexion (with forearm supinated)</td>
<td>Biceps, brachialis</td>
<td>Musculocutaneous n</td>
<td>C5,C6</td>
</tr>
<tr>
<td>Elbow extension</td>
<td>Triceps</td>
<td>Radial nerve</td>
<td>C6,C7,C8</td>
</tr>
<tr>
<td>Arm abduction at shoulder</td>
<td>Deltoid</td>
<td>Axillary nerve</td>
<td>C5</td>
</tr>
</tbody>
</table>
## Lower Extremity Strength Testing

<table>
<thead>
<tr>
<th>ACTION</th>
<th>MUSCLES</th>
<th>NERVES</th>
<th>ROOTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip flexion</td>
<td>Iliopsoas</td>
<td>Femoral n and L1-L3 n roots</td>
<td>L1, L2, L3, L4</td>
</tr>
<tr>
<td>Knee extension</td>
<td>Quadriceps</td>
<td>Femoral nerve</td>
<td>L2, L3, L4</td>
</tr>
<tr>
<td>Knee flexion</td>
<td>Hamstrings</td>
<td>Sciatic nerve</td>
<td>L5, S1, S2</td>
</tr>
<tr>
<td>Leg abduction</td>
<td>Glut med, glut min, tensor fasciae latae</td>
<td>Superior gluteal nerve</td>
<td>L4, L5, S1</td>
</tr>
<tr>
<td>Leg adduction</td>
<td>Obturator externus, adductor longus, magnus, and brevis; gracilis</td>
<td>Obturator nerve</td>
<td>L2, L3, L4</td>
</tr>
<tr>
<td>Toe dorsiflexion</td>
<td>Extensor hallucis longus, extensor digitorum longus</td>
<td>Deep fibular nerve</td>
<td>L5, S1</td>
</tr>
<tr>
<td>Foot dorsiflexion</td>
<td>Tibialis anterior</td>
<td>Deep fibular nerve</td>
<td>L4, L5</td>
</tr>
<tr>
<td>Foot plantar flexion</td>
<td>Triceps surae (gastrocnemius, soleus)</td>
<td>Tibial nerve</td>
<td>S1, S2</td>
</tr>
<tr>
<td>Foot eversion</td>
<td>Peroneus longus, peroneus brevis</td>
<td>Superficial fibular nerve</td>
<td>L5, S1</td>
</tr>
<tr>
<td>Foot inversion</td>
<td>Tibialis posterior</td>
<td>Tibial nerve</td>
<td>L4, L5</td>
</tr>
</tbody>
</table>
DETECTING SUBTLE HEMIPARESIS

PRONATOR DRIFT - Slight inward drifting rotation (pronation) of one forearm, or even a slight curling of the fingertips on one side, is abnormal.

FINGER EXTENSORS

FINE MOVEMENTS - Patient rapidly taps index finger and thumb together; taps each finger to the thumb in sequence;

ISOLATED FINGER MOVEMENTS - Patient holds fingers abducted and extended and then moves one finger at a time.

SPASTIC CATCH - Feel for a subtle "catch" on one side compared to the other when holding the patient's hand and then rapidly supinating the patient's forearm.

SUBTLE DECREASED NASOLABIAL FOLD

FORCED GAIT - Patient walks on the outsides of the feet. Observe the hands for subtle dystonic posturing on one side.

CAREFUL GAIT TESTING - Look for slight circumduction of one leg (the leg swings out in a circular arc with each step) or decreased arm swing. Also have the patient hop on each foot and walk on the toes.

SILENT PLANTAR - If a normal flexor plantar response is present on one side, then a silent plantar response on the other side may represent a subtle Babinski.
NEUROLOGICAL EXAM

Mental status
Cranial nerves
Motor exam
Reflexes
Coordination and gait
Sensory exam
Reflexes

**Normal** DTR:
- +1 Trace
- +2 NL
- +3 Brisk

**ABNormal** DTR:
- if they are 1+, 2+, or 3+ and:
  - asymmetrical or
  - dramatic difference between the arms and the legs

Reflexes rated as 0, +4, or +5 are usually considered abnormal
  - +4 Non-sustained clonus
  - +5 Sustained clonus

DTRs can be influenced by
- AGE
- metabolic factors such as thyroid or electrolyte abnormalities
- anxiety level of the patient
Decreased Reflexes

In abnormalities of:
1. muscles
2. sensory neurons
3. LMN
4. NMJ
5. **acute** UMN lesions
6. mechanical factors such as joint disease
Increased Reflexes

UMN lesions

Other signs of hyperreflexia
- spreading of reflexes to other muscles
- crossed adduction of the opposite leg
- Hoffmann's sign

Plantar response - Babinski's sign is associated with UMN lesions anywhere along the corticospinal tract
Reflexes tested in special situations

Coma

Spinal cord injury
  absence of certain reflexes can help localize the level and severity
  abdominal cutaneous reflexes
  cremasteric reflex in males
  bulbocavernosus reflex
  anal wink

Frontal lobe dysfunction

Neurodegenerative disorders
NEUROLOGICAL EXAM

Mental status
Cranial nerves
Motor exam
Reflexes

Coordination and gait
Sensory exam
Coordination and gait

**Appendicular** coordination
- Rapid alternating movements
- Finger-nose-finger test
- Heel-shin test
- Overshoot

**Axial** coordination
- Romberg test
- Gait
- Ordinary gait
- Tandem gait
- Forced gait
ROMBERG TEST

Sensory systems required:
vision
proprioception
vestibular sense
Gait involves multiple sensory and motor systems

vision
propiroception
vestibular sense
LMN
UMN
basal ganglia
cerebellum
higher-order motor planning systems in the association cortex
Gate exam

**stance** (how far apart the feet are)
**posture**
**stability**
how high the feet are raised off the floor
**trajectory of leg swing**
**leg stiffness and degree of knee bending**
**arm swing**
tendency to fall or swerve
**rate and speed**
difficulty **initiating and stopping** gait
**involuntary movements**
**turning**
patient's ability to **rise from a chair**
# Localization of Common Gait Disorders

<table>
<thead>
<tr>
<th>NAME</th>
<th>LOCALIZATION</th>
<th>DESCRIPTION</th>
<th>COMMON CAUSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPASTIC</td>
<td>Unilateral or bilateral Corticospinal tracts</td>
<td>Unilateral or bilateral. Stiff-legged, circumduction, sometimes with scissoring of the legs and toe-walking (from increased calf tone), decreased arm swing, unsteady, falling toward side of greater spasticity</td>
<td>Cortical, subcortical, or brainstem infarcts affecting upper motor neuron pathways; cerebral palsy; degenerative conditions; multiple sclerosis; spinal cord lesions</td>
</tr>
<tr>
<td>ATAXIC</td>
<td>Cerebellar vermis or other midline cerebellar structures</td>
<td>Wide based, unsteady, staggering side to side, and falling toward side of worse pathology. Subtle deficit can be detected with tandem (heel-to-toe, or &quot;drunk walk&quot;) testing</td>
<td>Toxins such as alcohol; meds; tumors of cerebellar vermis; infarcts or ischemia of cerebellar pathways; cerebellar degener</td>
</tr>
<tr>
<td>VERTIGINOUS</td>
<td>Vestibular nuclei, vestibular nerve, or semicircular canals</td>
<td>Looks similar to ataxic gait, wide based and unsteady. Patients sway and fall when attempting to stand with feet together and eyes closed (Romberg sign)</td>
<td>Toxins such as alcohol; infarcts or ischemia of vestibular nuclei; benign positional vertigo; Meniere's disease</td>
</tr>
<tr>
<td>FRONTAL</td>
<td>Frontal lobes or frontal subcortical white matter</td>
<td>Slow, shuffling, narrow or wide based, &quot;magnetic&quot; (barely raising feet off floor), unsteady. Sometimes resembles Parkinsonian gait. Some can perform cycling movements on their back much better than they can walk (&quot;gait apraxia&quot;)</td>
<td>Hydrocephalus; frontal tumors such as glioblastoma or meningioma; bilateral anterior cerebral artery infarcts; diffuse subcortical white matter disease</td>
</tr>
<tr>
<td>PARKINSONIAN</td>
<td>Substantia nigra or other regions of basal ganglia</td>
<td>Slow, shuffling, narrow based. Difficulty initiating walking. Often stooped forward, with decreased arm swing, and &quot;en bloc turning.&quot; Unsteady, with &quot;retropulsion&quot;</td>
<td>Parkinson's disease; other parkinsonian syndromes, such as progressive supranuclear palsy, or use of neuroleptic drugs</td>
</tr>
<tr>
<td>NAME</td>
<td>LOCALIZATION</td>
<td>DESCRIPTION</td>
<td>COMMON CAUSES</td>
</tr>
<tr>
<td>------------</td>
<td>------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>DYSKINETIC</td>
<td>Subthalamic nucleus, or other regions of basal ganglia</td>
<td>Unilateral or bilateral dancelike (choreic), flinging (ballistic), or writhing (athetoid) movements occur during walking and may be accompanied by some unsteadiness.</td>
<td>Huntington's disease; infarct of subthalamic nucleus or striatum; side effect of levodopa; other familial or drug-induced dyskinesias</td>
</tr>
<tr>
<td>TABETIC</td>
<td>Posterior columns or sensory nerve fibers</td>
<td>High-stepping, foot-flapping gait, with particular difficulty walking in the dark or on uneven surfaces. Patients sway and fall in attempts to stand with feet together and eyes closed (Romberg sign)</td>
<td>Posterior cord syndrome; severe sensory neuropathy</td>
</tr>
<tr>
<td>PARETIC</td>
<td>Nerve roots, peripheral nerves, neuromuscular junction, or muscles</td>
<td>Exact appearance depends on location of lesion. With proximal hip weakness there may be a waddling, Trendelenburg gait. Severe thigh weakness may cause sudden knee buckling. Foot drop can cause a high-stepping, slapping gait, with frequent tripping.</td>
<td>Numerous peripheral nerve and muscle disorders</td>
</tr>
<tr>
<td>PAINFUL</td>
<td>Peripheral nerve or orthopedic injury</td>
<td>Pain may be obvious based on patient's report or facial expression. Patients tend to avoid putting pressure on affected limb.</td>
<td>Herniated disc; peripheral neuropathy; muscle strain; contusions; fractures</td>
</tr>
<tr>
<td>(ANTALGIC)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ORTHOPEDIC</td>
<td>Bones, joints, tendons, ligaments, and muscles</td>
<td>Depends on nature and location of the disorder. Peripheral nerve injury or spinal cord-related deficits may be present as well</td>
<td>Arthritis; fractures; dislocations; contractures; soft tissue injuries</td>
</tr>
<tr>
<td>FUNCTIONAL</td>
<td>Psychologically based</td>
<td>Can be hard to diagnose. Sometimes patients say they have poor balance, yet spontaneously perform highly destabilizing swaying movements while walking, without ever falling.</td>
<td>Conversion disorder; factitious disorder</td>
</tr>
</tbody>
</table>
NEUROLOGICAL EXAM

Mental status
Cranial nerves
Motor exam
Reflexes
Coordination and gait
Sensory exam
Sensory exam

**Primary sensation** — asymmetry, sensory level
- Light touch, two-point discrimination
- Pain (sharp vs. dull)
- Temperature (cold vs. warm)
- Vibration and joint position sense

**Cortical sensation**
- Graphesthesia
- Stereognosis
- Extinction
Localization of sensory deficits

- peripheral nerves
- spinal nerve roots
- spinal cord or brainstem
  - posterior columns
  - anterolateral sensory systems
- thalamus
- sensory cortex
Pain and Temperature

Spinothalamic (anterolateral) pathway
Vibration & Joint Position
Posterior Column Pathway
Spinal nerve root pattern (Dermatomes)
Peripheral nerve patterns ARM

<table>
<thead>
<tr>
<th>NERVE</th>
<th>MOTOR FUNCTIONS</th>
<th>REGION OF SENSORY LOSS WITH NEUROPATHY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radial</td>
<td>Extension at all arm, wrist, and proximal finger joints below the shoulder; forearm supination; thumb abduction in plane of palm</td>
<td>Posterior cutaneous nerve of arm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Posterior cutaneous nerve of forearm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dorsal digital nerves (radial)</td>
</tr>
<tr>
<td>Median</td>
<td>Thumb flexion and opposition, flexion of digits 2 and 3, wrist flexion and abduction, forearm pronation</td>
<td>Median nerve</td>
</tr>
<tr>
<td>Ulnar</td>
<td>Finger adduction and abduction other than thumb; thumb adduction; flexion of digits 4 and 5; wrist flexion and adduction</td>
<td>Ulnar nerve</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NERVE</th>
<th>MOTOR FUNCTIONS</th>
<th>REGION OF SENSORY LOSS WITH NEUROPATHY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axillary</td>
<td>Abduction of arm at shoulder beyond first 15°</td>
<td>Axillary nerve</td>
</tr>
<tr>
<td>Musculo-cutaneous</td>
<td>Flexion of arm at elbow, supination of forearm</td>
<td>Lateral cutaneous nerve of forearm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lateral cutaneous nerve of forearm</td>
</tr>
</tbody>
</table>
Peripheral nerve patterns LEG

<table>
<thead>
<tr>
<th>NERVE</th>
<th>MOTOR FUNCTIONS</th>
<th>REGION OF SENSORY NERVE LOSS WITH NEUROPATHY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femoral</td>
<td>Leg flexion at the hip, leg extension at the knee</td>
<td>Femoral nerve, Saphenous nerve</td>
</tr>
<tr>
<td>Obturator</td>
<td>Adduction of the thigh</td>
<td>Obturator nerve</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NERVE</th>
<th>MOTOR FUNCTIONS</th>
<th>REGION OF SENSORY NERVE LOSS WITH NEUROPATHY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sciatic</td>
<td>Leg flexion at the knee (see also tibial and peroneal nerves, in column at left)</td>
<td>Common peroneal nerve, Sural nerve, Posterior tibial nerve</td>
</tr>
<tr>
<td>Tibial</td>
<td>Foot plantar flexion and inversion, toe flexion</td>
<td>Posterior tibial nerve</td>
</tr>
<tr>
<td>Superficial peroneal</td>
<td>Foot eversion</td>
<td>Superficial peroneal nerve</td>
</tr>
<tr>
<td>Deep peroneal</td>
<td>Foot dorsiflexion, toe extension</td>
<td>Deep peroneal nerve</td>
</tr>
</tbody>
</table>
## 3 Roots to Remember in the ARM

<table>
<thead>
<tr>
<th>NERVE ROOT</th>
<th>MAIN WEAKNESS</th>
<th>REFLEX DECREASED</th>
<th>REGION OF SENSORY ABNORMALITY</th>
<th>USUAL DISC INVOLVED</th>
<th>APPROXIMATE PERCENTAGE OF CERVICAL RADICULOPATHIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>C5</td>
<td>Deltoid, infraspinatus, biceps</td>
<td>Biceps, pectoralis</td>
<td>Shoulder, upper lateral arm</td>
<td>C4-C5</td>
<td>7%</td>
</tr>
<tr>
<td>C6</td>
<td>Wrist extensors, biceps</td>
<td>Biceps, brachioradialis</td>
<td>First and second fingers, lateral forearm</td>
<td>C5-C6</td>
<td>18%</td>
</tr>
<tr>
<td>C7</td>
<td>Triceps</td>
<td>Triceps</td>
<td>Third finger</td>
<td>C6-C7</td>
<td>46%</td>
</tr>
</tbody>
</table>
## 3 Roots to Remember in the **LEG**

<table>
<thead>
<tr>
<th>NERVE ROOT</th>
<th>MAIN WEAKNESS</th>
<th>REFLEX DECREASED</th>
<th>REGION OF SENSORY ABNORMALITY</th>
<th>USUAL DISC INVOLVED</th>
<th>APPROXIMATE PERCENTAGE OF LUMBOSACRAL RADICULOPATHIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>L4</td>
<td>Iliopsoas, quadriceps, foot dorsiflexion, big toe extension, foot eversion, inversion</td>
<td>Patellar tendon (knee jerk)</td>
<td>Knee, medial lower leg</td>
<td>L3–L4</td>
<td>3%–10%</td>
</tr>
<tr>
<td>L5</td>
<td>None</td>
<td>Dorsum of foot, big toe</td>
<td>L4–L5</td>
<td>40%–45%</td>
<td></td>
</tr>
<tr>
<td>S1</td>
<td>Foot plantar flexion</td>
<td>Achilles tendon (ankle jerk)</td>
<td>Lateral foot, small toe, sole</td>
<td>L5–S1</td>
<td>45%–50%</td>
</tr>
</tbody>
</table>
SCREENING NEURO EXAM

First, learn the complete neurological exam
Then learn when and how to do a focused exam
Examine patients to get a feel of NORMAL
Are the findings of the neuro exam anatomically CORRECT?
What should a focused exam involve?
## SCREENING NEURO EXAM

<table>
<thead>
<tr>
<th>Mental status</th>
<th>Level of alertness and orientation. Months forward/backward. Immediate registration and delayed recall of 3 objects for 4 minutes (timed). Naming of watch parts. Note behavior, language, affect.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor</td>
<td>Drift. Rapid hand and foot tapping. Upper and lower extremity tone. Strength in several proximal and distal muscles in the upper and lower extremities bilaterally (e.g., finger extensors, finger abductors, wrist extensors, biceps, triceps, deltoids, iliopsoas, quadriceps, foot and toe dorsiflexors, and knee flexors).</td>
</tr>
<tr>
<td>Reflexes</td>
<td>Biceps, brachioradialis, patellar, Achilles tendon, plantars.</td>
</tr>
<tr>
<td>Coordination and gait</td>
<td>Finger-nose-finger and heel-shin tests. Gait and tandem gait.</td>
</tr>
<tr>
<td>Sensory</td>
<td>Light touch in hands and feet, including extinction testing. Pin prick and temp testing in feet. Vibration and joint position sense in feet.</td>
</tr>
</tbody>
</table>
Patient presentation is determined by

**Time course**

Acute

(i.e. stroke) generally causes obvious symptoms as the loss of function is abrupt

no time to develop compensatory mechanisms

Sub-acute or chronic

Disorders which occur more slowly tend to cause relatively subtle symptoms

**Size and location of the lesion**

more overt problems

Larger lesions

Lesions affecting critical areas of function

**Pre-existing medical or neurological dysfunction**
Exam Limitations and Workaround Strategies

PATIENTCE IS REQUIRED!

In **MILD** to **MODERATE** impairment of alertness or attention,
most aspects of the exam can be done with **repeated stimulation**

In **SEVERE** impairment of alertness or attention,
follow comatose patient exam procedures

**UNCOOPERATIVE** patient, strategy depends on the situation:
- careful observation of spontaneous speech and movements
- some techniques from the coma exam

For **poor language COMPREHENSION**
- simple questions or commands
- gestures or demonstrations of the action desired.

For **impaired EXPRESSION**
- ask yes-no or multiple-choice questions
- for testing memory, several objects can be hidden around the room and the patient can be asked to find them after a delay
Conclusions

The **Neuro Exam can be adapted** to test patients who are awake and cooperative suffering from psychiatric disorders malingering comatose or any combination of other impairments

**Explore the neuroanatomical systems** being tested and the effects of disease on function

Once the **clinical suspicion of a lesion** has been raised, several important decisions need to be made

Depending on the **TYPE and LOCATION of the lesion** consider:
- Emergency surgical or medical therapy
- Less urgent therapy
- Further investigations
References

*Aids to the Examination of the Peripheral Nervous System.*


Lectures by Dr Michael Aminoff
PROVIDENCE
Brain and Spine Institute