Neurological Exam
Keith McAvoy, MD
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SESSION OBJECTIVES

• Demonstrate the neurological examination.
• Discuss implications and need for further follow up for abnormal exams.
The Neurologic Examination

Keith J. McAvoy, MD
Attending Adult Neurologist
Dartmouth-Hitchcock Clinic
Manchester, New Hampshire
Overview

- Goals and Objectives
- Introduction
- Basic Components to a Neurological Examination
  - History
  - Cerebral function
  - Cranial nerve function
  - Motor function
- Sensory function
- Cerebellar function
- Reflex function
- Gait and stance
- Interpretation
- Summary
- Web Resources
Goals and Objectives

1. Know and understand the terminology commonly used to describe neurologic signs and symptoms

2. Recognize symptoms which suggest neurologic dysfunction

3. Be able to perform all components to a neurological examination, understanding the significance of each test
Introduction

What is a neurological examination?

- The assessment of sensory neuron and motor responses, to determine whether the nervous system is impaired
- Used both as a screening tool and as an investigative tool
- Intended to test various parts of the nervous system separately -- however, some aspects may assess several parts of the nervous system
- Abnormal findings can suggest which part of the nervous system is injured or impaired

http://www.scarlettlawgroup.com/common-testing.html
Components to a Neurological Examination

- History
- Cerebral function (mental status)
- Cranial nerve function
- Motor function
- Cerebellar function
- Gait and Stance
- Sensory function
- Reflex function
History

- A neurologic history is concerned with the patient’s symptoms, their course over time, and other pertinent factors.
- Obtaining a complete history from the family, as well as the patient, is very important in the evaluation of neurologic diseases.
- In many cases, the neurologic diagnosis depends entirely on the history, especially if the patient has had symptoms only transiently.

http://www.neurosurgical.com/neuro_medical_info/neuro_exam.htm
History – Sample Questions

- When did the difficulties first begin and how rapidly have they progressed?
- Pain? (Location, description of pain, continuous vs. intermittent)
- Changes in vision, hearing, dizziness/vertigo, sensation and weakness?
- Toxin exposure or drug and/or alcohol abuse?
- Changes in level of consciousness and mental functioning or mood?
- Underlying medical illnesses? Medication changes?
- Family history of medical conditions?
Cerebral Function: Defining the Mental Status

The cerebrum is divided into four lobes, and is responsible for many of the body’s important functions:

- **Frontal Lobe** - associated with reasoning, planning, parts of speech, movement, emotions, and problem solving
- **Parietal Lobe** - associated with movement, orientation, recognition, perception of stimuli
- **Occipital Lobe** - associated with visual processing
- **Temporal Lobe** - associated with perception and recognition of auditory stimuli, memory, and speech

Cerebral Function – Cont.

- Check state of consciousness
- Full name
- Check for orientation to place, person, and time
- Check for attention by digit span or by having patient recite months or the year backwards
- Is the patient aphasic?
  - Test for aphasia:
    - Name objects (eg. pen, watch, tie)
    - Repeat (“No if’s, And’s, or But’s”)
    - Read (magazine or newspaper)
    - Check for comprehension
Cerebral Function – Cont.

- **Short term memory**
  - Recall 3 or 4 unrelated objects after 5 minutes
  - Knowledge of recent current events

- **Long term memory**
  - Give correct information about events that occurred some years ago (e.g., naming of Presidents)

- **Calculation**
  - Simple problem – e.g. “If you give the baker $1.00 for a $0.67 item, how much change would you receive?”

- **Abstraction**
  - How are a ball and an orange alike?
  - What do a bath tub and an ocean have in common?
Judgment

What would you do if you spotted a fire in a theater?

Pictures

Interpreting pictures in magazines (Visual agnosia)

Drawing or copying designs (Constructional apraxia)

Mood and mental content

Inappropriately cheerful, fearful or paranoid, active or apathetic?

Constructional apraxia

Cranial Nerve Testing

(I) Olfactory Nerve - smell
- Identify the odor of a common object placed under each nostril (coffee, cloves, lemon or soap)

(II) Optic Nerve - visual acuity and visual fields
- **Visual Acuity**: Snellen eye chart; counting fingers covering one eye at a time
- **Visual Fields**: patient identifies fingers presented simultaneously in the peripheral fields

http://rosariohome.net/blog/category/davids-posts/medicine/neurology/a-guide-for-complete-neurological-examination/
Cranial Nerve Testing – Cont.

- (III) Oculomotor - pupillary reactions (light reflex & accommodation), eyelid elevation, eye movements up, down, and medially
  - *Pupillary reaction*: instruct patient to fix both eyes on an object, shine light directly into each pupil; note size, shape, and reaction (may see "PERRLA" in chart notations)

- (IV) Trochlear - eye movement down & toward nose

- (VI) Abducens - eye movement laterally toward temporal field
  - *Ocular movement (CN III, IV, and VI)*: instruct patient to follow your finger without moving head; note presence of nystagmus and limited eye movement

http://www.dailymail.co.uk/sciencetech/article-461805/Fleeting-glances-help-eyes-focus.html
Cranial Nerve Testing – Cont.

- **(V) Trigeminal Nerve** - sensation of face, corneal reflex, muscles of mastication (jaw movement)
  - Ask the patient to open mouth as wide as possible; examiner attempts to close mouth by placing one hand under chin and the other on top of head

- **(VII) Facial Nerve** - controls facial muscles, supplies taste fibers to the anterior 2/3 of tongue, controls eyelid closure
  - Have patient wrinkle forehead, smile showing teeth, and wink eyes; note any asymmetrical movement or facial drooping

### Cranial Nerve Testing – Cont.

- **(VIII) Auditory (Acoustic) Nerve** - controls hearing and contributes to balance function
  - *Rinne & Weber* tests with tuning fork; test gross hearing by holding watch or rubbing fingers close to ears

- **(IX) Glossopharyngeal Nerve** & **(X) Vagus Nerve** - control cough, gag, swallow, articulation, and phonation
  - CN IX also controls taste of the posterior 1/3 of tongue
  - CN X also controls autonomic function
  - Instruct patient to open mouth and say "ahhh"
    - Look for elevation of soft palate and uvula in midline
    - Assess gag reflex by stimulating back of pharynx with tongue depressor
    - Note any difficulties in articulation and/or speech

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[Rinne Test Image](image-url)
Cranial Nerve Testing – Cont.

- (XI) Spinal Accessory Nerve - controls trapezius and sternocleidomastoid muscles (movement of shoulder and head)
  - **Trapezius testing**: patient raises both shoulders while examiner applies resistance
  - **Sternocleidomastoid testing**: patient turns head L and R while examiner applies resistance

- (XII) Hypoglossal Nerve - controls tongue movement and strength
  - Patient protrudes tongue; normally should be midline; note deviation to R or L
Motor Function

- Abnormalities of the motor system are assessed by evaluating the patient’s:
  - Muscle size
  - Muscle tone -- decreased (flaccid) or increased (spastic)
  - Tenderness
  - Strength (pronator drift and circling hands or fingers)
  - Involuntary or abnormal muscle movements
- Both primary muscle diseases and diseases of nerves innervating muscles can cause weakness and atrophy
Motor Function – Cont.

- Look for symmetry between the sides of the body
- Test both the proximal and distal muscles of the upper and lower extremities
- **Muscle strength is graded on a scale of 0 to 5:**
  - 5/5 ...full ROM against gravity with extreme resistance
  - 4/5 ...full ROM against gravity with some resistance
  - 3/5 ...full ROM against gravity, but not against added resistance
  - 2/5 ...full ROM with gravity eliminated
  - 1/5 ...slight contraction visible
  - 0/5 ...no movement

http://forum.lowyat.net/topic/1329851

R quad atrophy
Cerebellar Function

- The cerebellum is responsible predominantly for balance and coordination.
- Coordination of movement is a complex process involving both sensory afferent information regarding proprioception and muscle efferent stimuli.

The Romberg test evaluates proprioception as well as cerebellar function.

Ataxia is assessed using finger-to-nose (FTN) test, while coordination in the lower extremities is assessed using heel-to-shin (HTS) test.

Other tests:
- Rapid alternating movements in the limbs
- Walking heel-to-toe (tandem gait)

Do not misinterpret weakness for ataxia!

Gait and Stance

- The act of walking requires the integration of the peripheral and central nervous systems.
- Look at the rate, rhythm, and character of the movements; arm swing is important.
  - Ex. A shuffling gait is seen in Parkinson’s disease, and ataxia is frequently seen in cerebellar disorders.
- Stance is tested by asking patient to stand with his or her feet together, head erect, eyes open, and arms outstretched.
- When stable, the patient is asked to close his or her eyes and any tendency to sway or fall is noted.

Additional information:
- http://www.healthybike.com/parkinsons-disease-information/
Sensory Function

- The primary sensations include pain, touch, vibration, joint position sense (JPS) and thermal.
- Pain is conveyed by small, unmyelinated fibers and is tested with a pinprick (PP).
- Light touch (LT) is mediated by a combination of small and larger nerve fibers and is tested with a wisp of cotton.
- Vibration and proprioception are mediated by large, myelinated fibers (vibration is tested with a tuning fork).
- Other tests:
  - Graphesthesia (write numbers on the palm)
  - Stereognosis (using a coin, comb, or pen)
If any abnormality is found, it is important to identify the area of deficit clearly and find the point where the abnormal sensation becomes normal again.

This point is referred to as a **sensory level**.

Typically, begin distally and move proximally; test side to side if appropriate as well.
Reflex Function

- Evaluation of deep tendon reflexes (DTRs) examines the spinal reflex arc
- DTRs are tested by tapping on a tendon with a reflex hammer (stretching of muscles results in contraction)
- When damage occurs to higher centers (upper motor neurons), the spinal reflex arc is uninhibited and the DTRs are hyperactive
- When damage occurs to the peripheral nerve or dorsal roots (lower motor neurons), the reflex arc is interrupted and the DTRs are decreased
- The rapidity and strength of the reflexes should be symmetrical when comparing one side with the other
Reflex Function – Cont.

Reflexes are graded on a scale of 0 to 4:

0 ...Not present
1+ ...Present but diminished
2+ ...Normal
3+ ...Hyperactive, may have clonus but not sustained
4+ ...Hyperactive with sustained clonus

<table>
<thead>
<tr>
<th>Reflex</th>
<th>Nerve root</th>
<th>Muscle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ankle jerk</td>
<td>S1</td>
<td>Gastrocnemius</td>
</tr>
<tr>
<td>Knee jerk</td>
<td>L2, L3, L4</td>
<td>Quadriceps</td>
</tr>
<tr>
<td>Biceps</td>
<td>C5, C6</td>
<td>Biceps</td>
</tr>
<tr>
<td>Triceps</td>
<td>C7, C8</td>
<td>Triceps</td>
</tr>
</tbody>
</table>

# Review: Upper and Lower Quarter Screens

<table>
<thead>
<tr>
<th>NERVE ROOT</th>
<th>DERMATOME</th>
<th>MYOYOME</th>
<th>DEEP TENDON REFLEX</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LOWER QUARTER</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L1</td>
<td>Low back → hips → groin</td>
<td>Hip flexion</td>
<td>n/a</td>
</tr>
<tr>
<td>L2</td>
<td>Lateral, anterior thigh → medial, proximal thigh</td>
<td>Knee extension</td>
<td>Patellar tendon</td>
</tr>
<tr>
<td>L3</td>
<td>Medial thigh → medial knee</td>
<td>Ankle dorsiflexion</td>
<td></td>
</tr>
<tr>
<td>L4</td>
<td>Medial, anterior lower leg</td>
<td>Great toe extension</td>
<td></td>
</tr>
<tr>
<td>L5</td>
<td>Lateral, anterior lower leg</td>
<td>Ankle plantarflexion</td>
<td>n/a</td>
</tr>
<tr>
<td>S1</td>
<td>Posterior calf → plantar surface → great toe</td>
<td>Achilles tendon</td>
<td></td>
</tr>
<tr>
<td>S2</td>
<td>Posterior medial calf</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>UPPER QUARTER</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C4</td>
<td>- back neck</td>
<td>Shoulder shrug</td>
<td>n/a</td>
</tr>
<tr>
<td>C5</td>
<td>Deltoids → biceps</td>
<td>Shoulder abduction</td>
<td>Biceps tendon</td>
</tr>
<tr>
<td>C6</td>
<td>Lateral forearm → thumb, 2nd finger</td>
<td>-Elbow flexion</td>
<td>Brachioradialis</td>
</tr>
<tr>
<td>C7</td>
<td>Middle forearm → 3rd finger</td>
<td>-Elbow extension</td>
<td>Triceps tendon</td>
</tr>
<tr>
<td>C8</td>
<td>Medial forearm → 4th and 5th fingers</td>
<td>Finger flexion</td>
<td>n/a</td>
</tr>
<tr>
<td>T1</td>
<td>Medial elbow</td>
<td>Finger ab- and adduction</td>
<td>n/a</td>
</tr>
<tr>
<td>T2</td>
<td>Axillary</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>
Pathological Reflexes

- Superficial or deep reflexes are normally controlled or inhibited by the motor cortex or pyramidal tracts.
- If a lower motor neuron is released from the control or inhibition, certain primitive responses occur upon appropriate stimuli.
- These primitive responses are pathological if found in adults, but may be normal in infants up to 6-12 months of age.
- A list of pathological reflexes are detailed on the following slides (not exclusive).
Pathological Reflexes – Cont.

- **Ankle clonus**
  - **Action** - forcibly and quickly dorsiflexing foot while holding up legs under popliteal space
  - **Response** - continued and rapid flexion and extension of foot

- **Babinski**
  - **Action** - noxious stimuli is applied to bottom of foot
  - **Response** - upgoing great toe and fanning of other toes is a positive response (a normal response is a downgoing toe)

- **Oppenheim’s sign**
  - **Action** - Caudal stroking of tibia and tibialis anterior muscle
  - **Response** - Extension of great toe
Pathological Reflexes – Cont.

- **Hoffman’s sign**
  - **Action** - flicking distal phalanx of index finger
  - **Response** - clawing movement of fingers and thumb

- **Suck**
  - **Action** - stroke or touch lips
  - **Response** - sucking movements by lips

- **Snout**
  - **Action** - sharp tapping on middle upper lip
  - **Response** - puckering or protrusion of lips

- **Grasp**
  - **Action** – stimulate palm of baby’s hand
  - **Response** - patient grasps examiner's hand with variable strength and continues to grasp as examiner's hand is moved
Other Diagnostic Tests

- **Lumbar puncture (LP) & cerebrospinal fluid (CSF)** - to diagnose meningitis, subarachnoid hemorrhage, multiple sclerosis, and dementia

- **Electroencephalography (EEG)** - records electrical activity of brain, used to assess seizure disorders

- **Computed tomography (CT)** - useful in differentiating cerebral infarction from hemorrhage and to identify tumors and cerebral edema

- **Magnetic resonance imaging (MRI)** - proven advantage over CT scans in certain situations

- **Positron emission tomography (PET) and single photon emission computed tomography (SPECT)** - assess chemical activity and rates of biologic processes within brain; studied in epilepsy, cerebral tumors, cerebrovascular disorders, dementia, and movement disorders
Interpretation

- The results of the examination are taken together to anatomically identify the lesion.

- May be diffuse (e.g. neuromuscular diseases) or highly specific (e.g. abnormal sensation in one dermatome due to compression of a specific spinal nerve by a tumor).

- Differential diagnoses may then be constructed that takes into account the patient's background (e.g. previous cancer) and present findings to include the most likely causes.

http://www.jlcauvin.com/wordpress/?attachment_id=1013
Summary

- A neurological evaluation is a clinical assessment of the nervous system aimed at detecting any abnormalities which may be related to a nervous system disease.

- The goal of a neurological examination is to determine the location of the lesion.

- The major components to a neurological evaluation are: history, cerebral function, cranial nerve function, motor function, sensory function, cerebellar function, reflex function, and gait and stance.

- All of these parts of the neurological evaluation can help the provider to determine the most likely diagnosis as well as the most appropriate course of action.
Relevant Factors

- Identify classic patient presentation for the common neurological disorders/illnesses:
  - Parkinson’s Disease
  - Multiple Sclerosis
  - Alzheimer’s Disease

- Describe how to determine neurological function (with observations, measurements and special tests) within each area of the neurological exam

- Review cranial nerve, dermatome and myotome testing
Web Resources

- **NeuroLogic Exam (University of Utah)**
  - Provides great video examples of normal and abnormal neurological findings

- **Test My Brain**
  - Test yourself and help Harvard University learn more about the mind and the brain! (Very fun!)
  - [https://www.testmybrain.org/index.html](https://www.testmybrain.org/index.html)

- **Neuroexam.com**
  - An interactive online guide to the neurological examination