KNOWLEDGE OBJECTIVES:

Upon completion, the participant will

1. state the purpose of performing a prehospital neuro exams.
2. identify five common chief complaints in patients experiencing neurological dysfunction.
3. explain the parameters to assess when obtaining a SAMPLE history on a neuro patient.
4. obtain a history of present illness using the OPQRST mnemonic.
5. sequence a mental status exam evaluating level of consciousness, affect, behavior, cognition, memory, and speech.
6. categorize causes of altered mental status using the mnemonic AEIOU TIPS.
7. differentiate delirium from dementia.
8. define coma.
9. measure a patient's responsiveness using the Glasgow Coma Scale.
10. identify the 12 pairs of cranial nerves and state one function of each.
11. explain the process of assessing the cranial nerves.
12. describe abnormal or pathological findings of a cranial nerve assessment.
13. test motor strength by observing motor drift.
14. assess cerebellar function by observing rapid alternative movements.
15. explain the process of testing superficial touch/sensation and pain using a broken cotton swab.
16. describe appropriate methods to apply deep pain.
17. state five components to evaluate in an unconscious patient.
18. compare and contrast early from late signs of increased intracranial pressure.
I. **Purpose of a neuro exam**
   A. Confirm or rule out nervous system dysfunction.
   B. Establish a baseline for mental status, thought processes, motor and sensory integrity. Look for localization, lateralization or specificity of findings. If unilateral, is the site of origin in the brain and spinal cord (CNS) or peripheral nervous system?
   C. Everything is based on comparison. Isolated neuro exam findings mean very little out of the context of changes over time.

II. **Overview of the steps**
   A. History
   B. Mental/cognitive status; speech exam
   C. Cranial nerve exam
   D. Motor exam
   E. Sensory exam

III. **STEP 1 History**
   A. Who is the informant? Document if patient is a reliable or unreliable historian. Ask relevant questions.
   B. **Chief complaint; history of present illness**
      1. **What is the patient feeling/experiencing?**
         a. Two of the most common chief complaints in emergency medicine are neurologic until proven otherwise: headache and backache (Henry, 2004)
         b. Dizziness/vertigo: person or environment is spinning (vestibular nerve)
         c. Lightheadedness/faintness: Is it affected by change in position?
         d. Loss of consciousness (frequently denied)
         e. Visual disturbances: One or both eyes; constant or intermittent; blurred vision? Double vision? Wavy appearance of visual images (migraine); curtain being drawn over the visual field (detached retina)? Rainbows or halos (glaucoma)? Yellowish hue (digitalis toxicity)?
         f. Motor/sensory/speech losses
      2. **Associated complaints**: Altered mental status (AMS), weakness, sensory loss, incoordination, tremors
   C. **Allergies**
   D. **Medications**: is altered mental status resulting from a combination of meds?
      1. Drug/alcohol ingestion; many have acute neuro toxicidromes
      2. Cimetadine (Tagamet) in neuro patient can be a real problem, especially in elderly. Causes confusion and presents like a subdural.
      3. Chemical reaction: IV drug abuse most common cause of stroke in young person as drugs are cut with cornstarch, Sweet and low, bleach crystals.
      4. Compliance; time and amount of last dose of prescribed medications
   E. **Past medical history (PMH)**: seizures, head trauma, headaches, hypertension, diabetes mellitus, infections, tumors, previous surgery; cardiac, renal, hepatic, neuro, or psychiatric diseases
   F. **Last oral intake**
   G. **Events/history of the present illness/injury**
      1. **Onset**: Abrupt or gradual; aura?
2. **Provokes/progression/palliation**
   a. What precipitated the event?
   b. Does anything make it better or worse? (chewing or touching the face)
   c. What effect does pressing on the site of pain produce?
   d. Worse during the day or at night?

3. **Quality**: Constant; throbbing (vascular); intermittent

4. **Region/radiation**: Where is the pain/deficit?

5. **Severity**: Worse headache of their life - think subarachnoid hemorrhage

6. **Time** or duration of complaint

H. **Family/social history**

IV. **STEP 2: Mental/cognitive status and speech exam**: Indicates an awareness of, and an ability to respond to, changes in the internal and external environment. To provide consistency, describe the patient's response in specific behavioral terms.

A. **Level of consciousness**: Sensitive indicator of cerebral perfusion and neuronal function.

   General level of consciousness/arousal: Awake or asleep, alert or **lethargic** (drowsy, but answers questions appropriately before falling asleep again), or **obtunded** (opens his eyes and looks at you but gives slow, confused responses).

   If the patient does not rouse to verbal commands, apply painful stimuli to assess arousal. A **stuporous** patient is arousable for short periods but is not aware of his surroundings. A **comatose** patient is in a state of profound unconsciousness and does not respond appropriately to environmental stimuli (Bledsoe et al, 2006).

B. **Affect/mood**: General appearance/emotional status - Observe facial expressions. Does it change through the interview or remain immobile (labile)? Does patient express happiness, sadness, anger, or depression? Does he appear restless, agitated, irritable, detached or indifferent? Assess intensity of mood. How long has this lasted? Is affect appropriate for the stimulus/situation?

C. **Behavior** (verbal/non-verbal) and posture: Watch the pace, range and character of movements.

   1. Anxiety: Tense posture, restlessness, fidgeting
   2. Agitated, depression: Crying, hand wringing, pacing
   3. Depression: Hopelessness, slumped posture, slowed movements
   4. Manic: Singing, dancing, expansive movements
   5. Obsessive/compulsive behaviors?

D. **Cognition**: Difficult to measure completely in the field or ED

   1. Knowledge and vocabulary
   2. Thought processes: Abstract reasoning, similarities/differences
   3. Thought content: Appropriate and intact or delusions, hallucinations, compulsions, paranoid, or obsessed with one idea.

E. **Grooming and personal hygiene**: How is patient dressed? It takes mechanical ability to dress oneself. Is appearance appropriate for the season, climate and occasion? Observe the patient's hair, teeth, nails, skin, facial hair, use of cosmetics, and body odor. Deterioration in grooming and personal hygiene in a previously well-groomed person suggests an emotional, psychiatric, or organic brain disorder (Alzheimer's disease). One-sided neglect may suggest a brain lesion in the parietal lobe.

F. **Speech and language**: “Hear them talk, watch them talk, and look at their eyes; that’s 90% of the brain” (Henry, 2004)

   1. **Motor speech**
      a. Normal speech is inflected, clear and strong, fluent, and articulate, and varies in volume (Bledsoe, 2006).
b. Assess for coordination of muscle groups, problems with articulation, phonation, pacing, and the proper matching of respirations to speech.

c. Note whether patient speaks spontaneously or only when asked a direct question.

d. Note slowness or explosiveness of speech or a staccato-like speech with pauses between syllables (scanning or Wernicke's speech).

e. An organically depressed person's speech usually loses animation and rhythm. People with very rapid, well-articulated speech, do not have an organic lesion. Altered mental status with slow, well-articulated speech is probably due to a psychiatric problem.

f. Have they lost speech and only make sounds (Alzheimer's patients)?

2. Articulation problems

a. **Dysphonia**: Inability to make laryngeal sounds resulting in voice changes due to damage to CNs IX & X affecting the vocal cords.

b. **Dysprosody**: Inflection, pronunciation, pitch or rhythm; cerebellar coordination

c. **Dysarthria**: Difficulty making individual sounds or letters caused by motor integration deficits in their ability to use the tongue, lips, teeth or throat to form sounds. Have patient repeat a series learned in the past, such as the days of the week to assess all lingual sounds.

   (1) Groups: F, G, R - most common
   (2) Labials: Need lips to make B, P, M, W
   (3) Linguals: Need tongue: L, T, N (CN XII)
   (4) Guttural: G, K

3. Speech content (language)

a. **Aphasia**: Absence of speech

b. **Dysphasia** (word finding difficulty) related to specific areas of cortex

c. **Expressive aphasia** (defective language caused by neurological damage to the brain), words are garbled or all mixed up, called word salad. With one particular type of expressive aphasia, there is damage deep in the speech center of the frontal lobe (Brocca's area), and the patient can show you, but cannot say it. With **receptive aphasia**, the patient's words are clear, but unrelated to your questions. If patient is talking strangely, ask, "Do helicopters eat their young?" Stop questioning patient once an abnormality is detected (do not make them more agitated) (Henry, 2004).

G. Memory and attention

1. **Awareness**: Assess orientation to person, place, time, and situation. Ask basic orientation questions such as,

   a. "What is your name?" Person disorientation suggests trauma, seizures, psychosis, or amnesia.

   b. "Where are you right now?" "What is your address?" Place disorientation suggests trauma, chemical impairment, psychiatric disorder or organic brain syndrome.

   c. "What day (month, season) is it today?" Time disorientation suggests trauma, anxiety, depression or organic brain syndrome.

   d. Always lost organically in the same order

      (1) Time lost first
      (2) Specific location lost second (take clues from environment)
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(3) General place lost 3rd (cannot tell where they are, even with environmental clues; not safe to function by themselves)
(4) Name is last thing lost (Henry, 2004)

e. Document the "Patient is oriented to self, events, time, and place, denies loss of consciousness, and is able to articulate without difficulty" OR "Patient is unable to articulate applicable events, current location, visually track objects." etc

2. Assess degree of amnesia. Memory is divided into three grades: immediate, recent, and remote.
   a. Test immediate memory by having them remember 3-5 random numbers or words with no relationship to each other. Ask them to repeat the numbers several minutes later.
   b. Recent (short-term) memory is anything that occurred within the last few days to few weeks and may be lost in trauma and many neuro disorders. Ask what they remember about the recent past (breakfast yesterday etc).
   c. Remote: Farther past: spouse's name, child's birthday, SS#.

H. Causes of altered mental status
1. A: Alcohol and ingested drugs and toxins
2. E: Endocrine/exocrine, particularly liver; electrolytes
3. I: Insulin; hyper or hypoglycemia
4. O: Oxygen, opiates
5. U: Uremia, renal causes including hypertensive problems
6. T: Trauma, temperature changes
7. I: Infections, both neurologic and systemic
8. P: Psychiatric
9. S: Space occupying lesions, stroke, subarachnoid hemorrhage, shock

I. Pathologic alterations in consciousness
1. Delirium (rapid onset), dementia (slow onset)
2. Persistent vegetative state: No cortical activity; no higher responses
3. Akinetic mutism: Will open eyes and appear to focus; some cortical activity
4. Locked in Syndrome: Infarct in brain stem; EEG normal; awake and aware, cannot respond

J. Glasgow Coma Score
1. Coma is defined as failure to respond to the environment. GCS allows rapid, reproducible assessment of higher and more primitive brain responses.
2. Limitations on GCS: drugs, alcohol, hypotension (if BP ≤ 80, can't do GCS)
3. Best Eye Opening: Assesses both arousal and content of behavioral response. Eye opening to command or stimuli is a higher level of stimulus recognition.
   a. 4: Spontaneous
   b. 3: To voice
   c. 2: To pain
   d. 1: No response
4. Best Verbal Response: Assesses quality of speech. Evaluates a high level of cognitive function but its absence does not imply total loss of brain function.
   a. 5: Oriented and converses
   b. 4: Confused and converses
   c. 3: Inappropriate words
   d. 2: Incomprehensible sounds
   e. 1: No sounds
5. **Best Motor Response:** Assesses both arousal and content of behavioral response. Allows evaluation of interface between sensing a stimulus, interpreting the information and the reaction to it.

   a. 6: Obey commands  
   b. 5: Protective response: localizes pain  
   c. 4: Withdrawal response: cannot localize pain  
   d. 3: Abnormal flexion  
   e. 2: Abnormal extension  
   f. 1: No motor response

6. **Interpreting the results**

   a. GCS 13 - 15: Minor depression of consciousness  
   b. GCS 9 - 12: Moderate depression of consciousness  
   c. GCS 3 - 8: Coma

K. **Findings indicating dysfunction:** Altered or impaired consciousness, orientation; irritability, restlessness, agitation, visual, auditory or olfactory hallucinations, decreased or impaired verbalization, change in sleep patterns, antegrade or retrograde amnesia.

V. **STEP #3: Cranial nerve exam:** Cranial nerves originate from the base of the brain (often adjacent to brainstem structures) and provide sensory and motor innervation, mostly to the head and face (Bledsoe, 2006). They almost always work in groups of three; i.e., III, IV, VI: eye movements; V, VII, VIII: facial muscles; IX, X, XII: mouth and back of throat. Isolated actions: I, II, XI.

A. **I: Olfactory:** (CNS) sense of smell. Probably the least tested and least helpful in neurological testing because of changes that occur from a wide range of influences, i.e., rhinitis, craniofacial trauma, smoking.

   1. **Exam:** With the patient's eyes closed, present a common substance with a recognizable odor (such as an alcohol wipe) below one nostril while closing off the other. Test each nostril separately. Evaluate in patients with suspected anterior basilar skull fractures, those who complain of taste disturbances, seizures, or headaches. Do not use ammonia capsules as they trigger pain receptors of the trigeminal nerve.

   2. **Results** – Should be able to accurately interpret the odor they are smelling.

   3. **Dysfunction:** ↓ sense of smell from cold, smoking; 30% basilar skull fracture patients will never taste food again because olfactory bulbs are destroyed. Lost some - hyposmia. Lost entirely: anosmia

B. **II: Optic:** (CNS) Transmits visual information to occipital lobe for processing

   1. **Visual acuity:** Ability of the eyes to perceive visual detail (near and/or far). Ranges from light perception only to perception of shape, shadow, & motion; to image/color interpretation.

      a. **Exam:** Have patient close or cover one eye at a time and read something at arm's length, i.e., your badge or a Rosenbaum near card. If unable to read, ask if they can count the number of fingers being held up or can detect your hand moving in front of their face. Lastly, determine if they can see the projection of light in any visual field.

      b. **Results:** Report their best acuity.

      c. **Dysfunction**

         (1) Permanent blindness if nerve is severed. Worst visual acuity: no light perception (NLP) or blind eye.

         (2) Optic neuritis: S&S of MS. Optic nerve inflamed. Decreased central vision.
2. **Visual fields**: peripheral vision
   a. **Exam**: Have the patient cover one eye and sit facing you. Extend your arm out perpendicularly and wiggle a finger in each of the visual quadrants. Ask patient to identify what quadrant the movement is in.
   b. **Results**: Visual fields can be impaired in head injury/stroke. With one hemisphere disease, neither eye sees the contra-lateral environment (*hemi-anopsia*).

3. **Funduscopic exam**: Usually not done by EMS
   a. Evaluate appearance of optic disk using an ophthalmoscope.
   b. **Dysfunction**: Papilledema: Brain sits on optic chiasm. If CSF pressure increases, it will be transmitted to the retinal vein as it travels in the subarachnoid space, resulting in congestion of the vein, edema of the retina, and bulging of the optic disc. Papilledema results due to forward pressure of CSF to head of optic nerve. Decreased peripheral vision from edema. Not an acute event. May take up to 18 hours to occur.
   b. Assess for venous pulsations. If a child with a shunt does not have venous pulsations, the shunt is malfunctioning.
   c. Look for retinal hemorrhages

C. **III: Oculomotor**: Lifts eyelid; moves eye ↑, ↓, and in towards nose; constricts pupils

1. **Exam**: Look at both eyes or bilaterally lift both eyelids and simultaneously assess the equality of pupillary size, shape, and eye position (deviation) and then check reactivity to a light stimulus.

2. **Size**: Pupils normally range between 3-7 mm, depending on the lighting, patient's age, vision, medications, or poisoning. A 20% difference between R & L pupils is within the range of normal. Inspect simultaneously before checking the light reflex.
   a. Midrange bilaterally reactive = midbrain OK
   b. Midrange, bilaterally non-reactive = midbrain lesion
   c. Pin point bilaterally non-reactive = pontine lesion
   d. Dilated, bilaterally non-reactive = medullary lesion

3. **Drugs and toxins that affect pupil size/reactions**
   a. **Constriction**
      (1) Sympathetic blockade: beta blockers, MAO inhibitors
      (2) Parasympathetic stimulant: acetylcholine, narcotics, methadone, neostigmine, nicotine, physostigmine, pilocarpine, tetraethyl ammonium
      (3) Narcotics
   b. **Dilation**
      (1) **Sympathetic stimulants**: Cocaine, ephedrine, phenylephrine, tyramine
      (2) **Parasympathetic blockers**: Alpha-methylidopa, atropine, botulinus toxin, chlorpheniramine maleate, clonidine, curare, dopamine, doxepin hydrochloride, ibopamine, imipramine hydrochloride, jimson weed, methantheline bromide, scopolamine, toadstool toxin, wild sage.
      (3) Early and late barbiturate intoxication
      (4) **High blood alcohol levels** over 300 mg/dl
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4. **Shape:** Round, oval, tear drop, keyhole, irregular, iridodialysis (edge of pupil torn)
   a. Oval shape: ↑ ICP just before herniation
   b. Tear drop: often means ruptured globe
   c. Key hole: old iridectomy during cataract surgery

2. **Equality: Dysfunction:** Shifting brain causes ipsilateral pupil dilation. 1 mm difference is significant in a patient with altered mental status. Four percent of the population normally has unequal pupils (anisocoria); others show unequal pupils due to an earlier injury or neck surgery. If comatose, attempt to find their picture from a driver's license or ask bystanders to determine if pupils were always unequal or whether it is a new development. If condition is physiologic, the pupils should maintain their relative sizes in both bright and dim light. If a disparity is accentuated in dim light, suspect Horner's Syndrome (CN III deficit). If > 3 years of age with a dilated pupil after trauma - oxygenate and assume brain shift.

5. **Position/ptosis** (drooping eye lid)
   a. Look at both eyes to see if one or both eyelids are drooping (ptosis).
   b. If large pupil, ptosis and eye is pulled to ear: assess carefully for a complete 3rd nerve palsy which could be caused by an aneurysm. (Eye looks to the side of destruction). Changes are first seen when the brain is ready to herniate.
   c. If eye is pulled to nose = VI nerve is dysfunctional and ↑ ICP

6. **Reactivity** (CN II & III); direct and consensual response to light stimulus
   a. Have patient look straight ahead in as dim a light as possible
   b. Bring a light source in from the side (so they cannot see the penlight) and direct the beam of light through the pupil.
   c. Observe that pupil for its response (direct response). Note as brisk, sluggish, or non-reactive. Should briskly constrict at least 1 mm
   d. Bring light in again from the side and shine into the same eye. Observe the opposite pupil for its response (consensual response).
   e. Repeat the procedure on the other eye
   f. If a dilated, non-reactive pupil is due to injury inside or outside of the brainstem, it is likely that this will be accompanied by other prominent neurologic symptoms, like diplopia or an altered state of consciousness (Goldberg, 31).

7. **Accommodation:** Pupil should constrict when focus changes from a distant to a nearby object. Argyll-Robertson’s or “prostitute’s pupil” - accommodates, but does not respond.

8. **Hippus:** Pupil spontaneously dilates and constricts after a light stimulus. Indicates ↑ ICP. Seen in pre/postictal patients. Both eyes = herniation.

D. **III, IV (Trochlear), VI (Abducent):** Controls lateral and vertical gaze. Examine together as they collectively control ocular motility. When stimulated, these muscles shorten.
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1. **Exam: Extra ocular movements (EOM's)** - Have patient follow a finger in all six directions of gaze. Eyes should move together. Assess conjugate or dysconjugate gaze.
   
   a. **IV (Trochlear)** innervates **superior oblique** muscles that depress the adducted eye and help move the eye in other positions.
   
   b. **VI (Abducens)** innervates **lateral rectus** muscle and normally pulls eye towards ear; most sensitive nerve (first to become dysfunctional) in the presence of ↑ ICP. Dysfunction will result in an eye that is pulled to the nose by CN III.
   
   c. **III (Oculomotor)** supplies all the other ocular muscles (superior rectus, medial rectus, inferior rectus, inferior oblique and levator palpebrae). Eye will pull to nose from unopposed CN III. If CN III is “off”, the eye will be pulled to the ear by CN VI.

2. **Results:** Roving eyes = frontal lobe dysfunction. (Pearl: before 6 or 7 months old, nerves are unmyelinated, that is why infants often look cross-eyed). Eyes look towards a lesion as neither can move to the contralateral side.
   
   a. **Nystagmus** may be horizontal or vertical. Slight nystagmus at the extreme lateral position is normal. Marked nystagmus on extreme lateral gaze or forward gaze is abnormal. Jerk nystagmus with a fast and slow component suggests CNS or PNS lesion. Vertical nystagmus suggests brain stem lesion.
   
   b. **Diplopia** or double vision should disappear when one eye is covered. Exception: dislocated lens, retinal detachment.

E. **V: Trigeminal nerve:** Sensation to facial skin, cornea, and various mucous membranes (ocular, nasal, and oral) by way of three branches: ophthalmic, maxillary, and mandibular. Mandibular branch also supplies motor ability to muscles of mastication.

1. **Sensory component:** Test by lightly stroking patient across forehead, upper lip and chin to assess symmetry of sensation. In an unconscious or nonresponsive patient, assess for a **Blink reflex:** With eyes closed, gently stroke lashes or tap forehead between the eyebrows to check for a blink reflex (blinking is normal).

2. **Motor component:** Have patient bite down and clench teeth on a tongue depressor to test occlusion and strength of temporalis and masseter muscles. Try to pull it out (no resistance to pulling is abnormal).

3. **Results:** Cerebral lesion results in full loss of sensation on opposite side of the face. Peripheral nerve damage will result in deficit on one branch. Unilateral weakness or the inability to contract the jaw muscles suggests a trigeminal nerve lesion. Bilateral dysfunction suggests motor neuron involvement.
F. **VII: Facial nerve:** Motor to muscles of facial expression; closes eye lids

1. **Exam:** Inspect face during conversation for any asymmetry, tics, or abnormal movements. Have patient smile, frown, tightly close eyelids, puff out cheeks, and pucker lips. Observe for asymmetry or weakness on one side or flattening of the nasolabial fold. When lids are tightly closed, assess if one side shows more lashes than the other. If so, motor deficit on that side.

   Taste from the anterior 2/3rd of the tongue (salt, sour, sweet) and sensory from the soft palate and salivary glands. Not usually tested.

2. **Results/dysfunction:** Lesions generally result in contralateral paralysis of the lower face (below the eye) due to bilateral nerve connections to the forehead and eyelids from each hemisphere. Typical stroke results in weakness in elevating the corner of the mouth (asymmetric smile), but no significant weakness in wrinkling the forehead. *Bell's palsy* or peripheral nerve damage results in total ipsilateral hemi-facial paralysis.

G. **VIII: Vestibulocochlear:** Two separate nerves purely sensory: vestibular (equilibrium & balance) function and cochlear (auditory) function.

1. **Exam**
   a. Check hearing equality through whispered speech. Softly whisper a phrase, word or number in each ear and ask the patient to repeat it. Have patient hum. If a conductive defect, the poorly hearing ear hears the hum louder. Can test on self by occluding one ear and humming.
   b. If not contraindicated, have patient stand straight with eyes closed (substantial swaying is abnormal)

2. **Results:** Auditory information is processed bilaterally, so may not be affected. If CN VII has dysfunction, check CN VIII very carefully as they run together.

H. **IX & X: Glossopharyngeal & Vagus:** Examine together; lifts palate, provides gag reflex

1. **Exam:** Have patient open mouth and say, "Ah" or repeat "Ha, ha, ha". Look for elevation of the palate (normal) an position of uvula (abnormal). Test gag reflex.

2. **Results/dysfunction:** Vagal dysfunction will result in hoarseness or vocal cord paralysis. Deviation of uvula may indicate a stroke. Loss of gag reflex. Not significantly affected by unilateral cerebral lesions.

I. **XI: Spinal accessory:** Supplies sternocleidomastoid muscles and the upper portion of the trapezius muscles. Sternocleidomastoids on each side of the neck turn the face to the opposite side. An isolated XI nerve does not exist (Henry, 2004)

   **Exam:** Have patient turn head against your hand and shrug shoulders with and without resistance. Assess equality of strength, bulk of muscle.

J. **XII: Hypoglossal:** Supplies most of extrinsic lingual muscles. If patient is speaking normally, do not test XII separately.

1. **Exam:** Have patient stick out tongue. Observe any asymmetry, deviation or atrophy. Tongue usually points to side of a lesion. Have patient push tongue into cheek against resistance, assess for strength.

2. **Result:** Weakness on one side of the tone will cause the tongue to deviate to that side. Rare for this nerve to be affected.

VI. **Step #4: Motor exam:** Check motor outflow tracts from frontal lobe and cerebellum for strength/equality, coordination/control. The motor exam is invalid if the patient cannot perform due to pain.

A. **Muscle size, symmetry.** Note loss of muscle mass (atrophy).

B. **Muscle movement/strength** against gravity/resistance
1. **Gross motor assessment:** Check for drift of upper extremities.
   a. **Pronator drift:** With eyes closed, have patient lift both arms palms up to a 45°- 90° angle. While counting backwards from five to one, watch for one hand to pronate and drift downward. Drift indicates paresis (weakness).
      (1) If patient can hold position for 15 seconds with no movement, there is no difference in motor outflow of both sides
      (2) If pronation and downward drift of one limb occurs, abnormality is present and must be defined
   b. **Paralysis:** Loss of voluntary movement
   c. If either frontal lobe has a dysfunction, the opposite (contralateral) side of the body will experience motor loss as 80% of the motor fibers cross in the medullary pyramids. If both arms or legs are affected, consider spinal cord lesion although some TIAs/strokes can cause bilateral losses.
   d. Searching when visual input is removed indicates parietal lobe dysfunction. Ask patient to point to the door when their eyes are closed.

2. Test spontaneous movements by moving limbs through ROM: shrug shoulders, flex/extend elbows, wrists; open fingers against resistance; keep them open against resistance; flexion of hips, knees, dorsi/plantar flexion of feet.
   Check lower extremities on a patient with AMS by lifting up quickly behind a supine patient's knee. If the leg comes up as a unit so that the heel doesn't drag an inch or two on the bed, that's abnormal. Assess any stop-and-start movement or hesitation, especially associated with ↑ or ↓ tone and spasms.

3. **Involuntary muscle dysfunctions**
   a. **Athetosis:** Writhing movements as seen in cerebral palsy
   b. **Chorea:** Brief, rapid, involuntary movements of face, head, trunk, or limbs.
   c. **Dystonia:** Abnormal tonicity of the muscles
   d. **Fasciculations:** Involuntary contraction or twitching of a group of muscle fibers (often under the skin surface due to demyelinating diseases, ALS)
   e. **Myoclonus:** A sudden rapid twitch resulting from the sudden contraction of one or more muscle groups. Seen with liver disease.
   f. **Tics:** An involuntary, brief and recurrent twitching of a group of muscles, most commonly involving the face neck and shoulders, i.e., repeated eye blinking, facial grimace. Ex: Tourette's syndrome.
   g. **Tremors:** Trembling rhythmic, involuntary, alternating contraction of opposing muscle groups, fairly uniform in frequency and amplitude. (Entire extremity or nystagmus which is tremors of eyeball). May be intention (cerebellum) or coarse 4-6 cycle/second "pill-rolling" resting tremors (basal ganglia) as seen in Parkinson's disease.
   h. **Spasticity:** Increased muscle tone or rigidity. Seen after SCI.
   i. **Posturing:** Abnormal flexion or extension
   j. **Seizure activity**

4. **Strength is graded at the hospital as follows:**
   a. 0 - No movement
   b. 1 - Flicker of movement
   c. 2 - Able to move with gravity
   d. 3 - Able to move weakly against gravity
   e. 4 - Weak against resistance
   f. 5 - Full strength against resistance
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C. **Muscle tone**: Resistance to change in muscle movement/mass
   1. Normal
   2. Rigidity: continuous ↑ in resistance
   3. Spasticity: alternating ↑ & ↓ in tone
   4. Abnormal flexion
   5. Abnormal extension
   6. Flaccid/atonic: chronic loss of tone

VII. **Cerebellar exam: Integrated with motor exam** (Works subconsciously in concert with the basal ganglia - extrapyramidal system). If cerebellum has dysfunction on the right side, the right side of the body will be affected. (Double cross). Cerebellar lesions are ipsilateral.
   A. If patient can walk and walking is not contraindicated: observe the following:
      1. Balance and gait: shuffling, ataxia (awkward movements), wide stance
      2. Stride: short steps, scissors steps, leg lagging
      3. Arm swing: presence or absence
      4. Control: ability to turn quickly, start and stop quickly
   B. Test upper extremities by having patient touch finger to finger and performing rapid alternating movements by rapidly pronating and supinating hands or bringing fingers to thumb in rapid succession.
   C. Test lower extremities by having patient slide heel of one foot rapidly up and down shin of opposite leg.

VIII. **Step 5: Sensory exam**: Peripheral nerves provide sensation to specific areas called dermatomes. The exam is highly subjective based on patient response - test with eyes closed. Do not spend a lot of time on this unless patient has a sensory complaint.
   A. **Superficial sensation**
      1. Tactile sense or light touch is brought to the brain by both the posterior columns and the spinothalamic tracts of the spinal cord before the fibers synapse in the thalamus and are routed to the parietal lobe for localization and interpretation.
         a. Central nervous system lesions will result in general sensory deficits
         b. Peripheral NS lesions cause pain along one or more dermatomes
      2. Point location. Touch patient with the cotton tip of a broken cotton swab or the dull side of a partially opened paperclip. Patient should be able to localize where a stimulus is being applied and discriminate which side of the body is being stimulated. Test extinction by touching the patient on both sides at once. If they are able to feel only one side, they have parietal lobe disease.
      3. Pain/temperature pathway: Lateral spinothalamic tract
         a. Superficial pain (sharp vs. dull): alternate between touching the patient with the sharp and dull sides of the stimulus. They should be able to perceive the difference.
         b. Temperature discrimination (hot vs. cold) (Optional - not usually done in the field). Will lose on the contralateral side below a lesion.
   B. **Deep sensation**
      1. Proprioception: Position sense mediated by the posterior columns of the spinal cord
Neuro assessment in 5 easy steps
Connie J. Mattera - page 12

2. **Vibration**: (tuning fork) (Optional)

3. **Deep pain**: Squeeze calf, biceps or trapezius muscle or apply pressure over bony prominence. Tested on those who lack ability to distinguish superficial pain.

C. **Alterations in sensory function**

1. **Hypalgesia**: ↓ sensation
2. **Analgesia**: no sensation
3. **Hyperalgesia/hyperesthesia**: every touch is interpreted as painful

D. **Paresthesia**: alteration in sensation (pins and needles)

IX. **Reflex exam**: Inborn stimulus-response mechanism that provides basic defense to the organism. Reflexes may be extremely important in the diagnosis and localization of neurologic lesions. If patient is comatose, assess reflexes. Abnormal: areflexic and > 2 beats of clonus. Important only by comparison, side → side, top → bottom and above and below the foramen magnum.

A. **Scale**

1. 0 - Absent, no response
2. 1 - + Diminished, below normal
3. 2 - ++ Normal, average
4. 3 - +++ Brisker than normal
5. 4 - ++++ Hyperactive (clonus)

B. **Superficial reflexes**

1. **Mucous membrane reflexes**
2. **Abdominal** (T7-T11): Stroke abdominal wall upward; navel should deviate towards stimulus
3. **Cremasteric**: Rising of the scrotum (testicle) when the inside of the thigh is stroked upward. (Up tight and out of sight). (One of last reflexes to go!)
4. **Anal wink**

C. **Deep tendon reflexes (DTRs)**

1. **Achilles**: S1, S2
2. **Patellar (quadriceps)**; L2, L3, L4
3. **Biceps**: C5, C6
4. **Triceps**: C6, C7, C8

D. **Plantar response**: Tests nerve roots L4, L5, S1, & S2. Firmly stroke up the lateral sole of foot and medially across the ball of the foot. The toes should normally flex downward. An abnormal response is evidenced by dorsiflexion of the big toe with or without outward fanning of toes (positive **Babinski response**). This indicates upper motor neuron (UMN) (pyramidal tract) dysfunction. A Babinski response is normal in children up to age of 2 or before they walk.

X. Evaluation of the unconscious patient

A. Hand drop from over face
B. Pupil size, shape, equality, reactivity to light
C. Abnormal eye movements
D. Grimacing, withdrawal from noxious stimulation

XI. Cut to the chase…bottom line

Best single screening test if time is of the essence: Ask the patient to close her eyes, stick out her tongue, and put her right thumb on her left ear. If she can do that, and knows where she is, her screening neuro exam is OK for the moment. If you are still not sure ask, “Do you walk to work or carry your lunch?” Patients who recognize that those questions do not go together have good discrimination (high cortical function) (Henry, 2004)

CJM: Neuro exam S08
**References**


Hanson, M.R. (December 1995). Clinical evaluation of cranial nerves I through VII. *Hospital Medicine*, 37-41.


<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Contralateral</td>
<td>On the opposite side of the body</td>
</tr>
<tr>
<td>Dermatome</td>
<td>The strip-like projection areas of individual sensory nerve roots</td>
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<tr>
<td>Diplopia</td>
<td>Double vision</td>
</tr>
<tr>
<td>Diplopia</td>
<td>Double vision</td>
</tr>
<tr>
<td>Hemianesthesia</td>
<td>Absent sensation on one side of the body</td>
</tr>
<tr>
<td>Hemiparalysis</td>
<td>Total loss of motor ability on one side of the body</td>
</tr>
<tr>
<td>Hemiparesis</td>
<td>Partial loss of motor ability on one side of the body</td>
</tr>
<tr>
<td>Ipsilateral</td>
<td>On the same side of the body</td>
</tr>
<tr>
<td>Lesion</td>
<td>An injured focus</td>
</tr>
<tr>
<td>Paralysis</td>
<td>Total loss of motor ability</td>
</tr>
<tr>
<td>Paresis</td>
<td>Partial loss of motor ability</td>
</tr>
<tr>
<td>Vertigo</td>
<td>A sense of spinning, of either the individual or the environment</td>
</tr>
<tr>
<td>Vestibular apparatus</td>
<td>The balance-sensing apparatus within the inner ear</td>
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