advance healthcare advanceweb.com | ADVANCE FOR NURSES

Neurological Examination

By Tracy A. Murray, NP, Norma R. Kelly, RN, & Sheryl Jenkins, NP

The neurological examination is challenging due to its complexity and time-consuming nature. Patients with acute neurological symptoms often have altered cognitive or language functions, and therefore have difficulty describing their symptoms or recounting their histories. As a result, patients with neurological symptoms are often referred to a variety of specialists and undergo an array of tests before receiving a definitive diagnosis. This prolonged process may be unnecessary because a reliable neurological diagnosis can frequently be made on the basis of the history and physical examination alone.

The goal of the neurological examination is to identify a dysfunction that gives insight into the anatomical abnormality.[1] An exhaustive examination of every patient is not necessary to accomplish this goal. Instead, focusing the examination toward the specific complaint is more appropriate. The key to an efficient and reliable neurological examination is a systematic, organized approach. The complete neurological exam consists of history-taking and the assessment of mental status, cranial nerve function, motor function, sensory function, cerebellum and gait, and reflexes.

Taking the History

The first step in a focused assessment is gathering a detailed and accurate history, in chronological order, of the events that occurred preceding and during the episode. If the patient is unable to communicate or has difficulty with recall, family members may assist in obtaining accurate descriptions of the incident. Although family members can be helpful in providing observations, their interpretation is not always accurate. For example, when an observer reports that the patient "had a seizure," this may be true. However, a variety of disorders can be mistaken for seizures, including narcolepsy, syncope or psychogenic episodes.

While taking the history, appraise the patient's conversational style. Is it coherent? Is it fluent? Is the language appropriate for the patient's level of education? (If you don't know his educational level, find out.) Can the patient easily recall the events?

During the history, determine whether the patient is thinking, talking and acting coherently. This provides a sense of the patient's reliability, mental status and communication ability. If you have any concerns about the patient's performance, proceed with a full mental status examination that includes level of consciousness, orientation, memory, intellectual and speech evaluation.

Mental Status

The patient's mental status and level of consciousness provide critical information about neurological function. The most useful method of evaluating consciousness is the Glasgow Coma Scale (Table 1). Although not a substitute for formal mental status testing, the scale provides a clinically relevant, objective assessment of level of consciousness and a crude assessment of mental status.[2] The Glasgow Coma Scale grades the patient's level of cerebral dysfunction according to the sum of the best eye-opening response, verbal response and motor response.[3] The maximum score of 15 reflects an optimum level of consciousness, but does not necessarily indicate a high degree of cognitive function. It is possible to have a maximum score of 15 and still have significant alterations in mental status.

The mini-mental status exam (Table 2) is a screening tool to quickly evaluate mental status and is a more reliable method of assessing cognitive functioning than the Glasgow Coma Scale.[4] The total score is a sum of each of the 11 evaluations. Each evaluation is scored with regard to the number of tasks performed correctly. For example, if a patient is able to correctly recall only two of three objects, a score of 2 is given. A mental status score of less than 20 points out of a maximum of 30 points indicates the likely presence of dementia, delirium, schizophrenia or an affective disorder.

Cranial Nerves

Cranial nerve I (CN I), the olfactory nerve, is not routinely tested during a neurological examination because many things can affect the sense of smell (Table 3). However, CN I should be tested if a patient reports an impaired or absent sense of smell, which can occur after a head injury. Pungent or irritating substances, such as vinegar or ammonia, should not be used because they stimulate the pain fibers carried by the trigeminal nerve (CN V).[5] When testing CN I, one nostril should be occluded and the eyes closed. Anosmia, the absence of smell, can be related to head injury, tumor of the olfactory groove, vitamin B_{12} deficiency or advanced syphilis. Obstructive anosmia, the loss of sensation due to obstructive disorders, may be caused by a deviated septum or nasal polyps.[6,7]

Optic nerve (CN II) testing involves assessment of the visual acuity and gross visual fields, as well as an ophthalmoscopic examination. Test visual acuity with a Snellen chart (at a distance of 20 feet) or with a Rosenbaum pocket card held at least 12 inches away from the face. Test all patients with corrective lenses in place and test each eye separately.

In checking visual fields, the confrontational technique is ideal.[8] For this technique, the patient should sit facing you and at arm's length from you. Instruct the patient to cover one eye while you cover your opposite eye. Direct the patient to look straight at your covered eye while you move a hand from outside the visual field, thus comparing the patient's vision to your field of vision. Note decreased or absent vision. A bitemporal hemianopsia (depressed vision or bilateral blindness in the temporal half of the visual field) may indicate a pituitary tumor compressing the optic chiasm or a right homonymous hemianopsia resulting from a lesion of the left optic tract. Care must be taken to distinguish the type of defect observed. Then perform the ophthalmoscopic examination to potentially identify retinal and optic nerve disease.

The oculomotor nerve (CN III) is responsible for pupillary constriction. The pupillary response is elicited by shining a light into each eye. Each pupil should constrict directly and consensually (constriction of the opposite pupil). Observe and document pupillary size. A physiologic anisocoria (difference in pupillary size by up to 20 percent) may be preexisting and normal.[2]

The oculomotor nerve also innervates the extraocular muscles affecting lateral (adduction) and vertical (elevation and depression) gaze. Test CN III in conjunction with the trochlear nerve (CN IV), which innervates the superior oblique muscle and aids in depression of the eye and the abducens nerve (CN VI), which innervates the lateral rectus muscle of the eye, causing abduction. Testing of the extraocular eye movements involves having the patient track your finger as it moves up, down, laterally, medially and diagonally. When assessing the eye movements, check for nystagmus and isolated paralysis (inability to move the eye in a particular direction).

The trigeminal nerve has both sensory and motor functions.[9] The nerve consists of the ophthalmic, maxillary and mandibular branches, each of which controls a different portion of the face. Test the sensory portion of CN V by lightly brushing the patient's forehead, cheeks and chin with a piece of cotton or soft tissue while his eyes are closed. When evaluating an unconscious patient, the sensory portion of CN V can be detected by eliciting the corneal reflex.

The motor portion of the trigeminal nerve innervates the temporal and masseter muscles. To assess the strength of the masseter muscle, have the patient clench the teeth while you palpate the angle of the jaw.

The facial nerve (CN VII) also has motor and sensory components. The motor portion innervates the muscles of the face and scalp. Testing the CN VII involves asking the patient to smile, frown, open the eyes wide, raise the eyebrows, wrinkle the forehead, show the teeth, puff out the cheeks and purse the lips (Table 3).

The sensory portion of CN VII supplies the sense of taste on the anterior two-thirds of the tongue and sensation to the ear canal and behind the ear. Like the sense of smell, taste is not routinely tested. If an abnormality in CN VII is present, further testing would be appropriate. Evaluation of CN VII involves placing salt or sugar on the lateral aspects of the tongue and asking the patient to identify the substance.

The acoustic nerve (CN VIII) includes the cochlear branch, which contributes to hearing. The vestibular branch influences equilibrium. Hearing loss can be screened in the office setting. Have the patient cover one ear, then rub your fingers together a few inches from the opposite ear. Although hearing is most accurately measured with audiometric devices, you can grossly screen for hearing loss this way. Repeat this for the opposite ear. If you suspect a hearing loss in one ear, use the Weber test to determine whether it is a conductive hearing loss (e.g., excessive cerumen in the canal) or a sensorineuronal hearing loss due to inner ear or acoustic nerve damage. To perform the Weber test, strike a tuning fork and place it on top of the patient's head, centering it. A conductive hearing loss will produce louder sound in the affected ear. A sensorineuronal hearing loss will be heard better in the unaffected ear.[5] The vestibular nerve portion of CN VIII is not generally tested unless the patient complains of vertigo or dizziness.

The glossopharyngeal nerve (CN IX) supplies sensory sensation to the pharynx, tonsils and the posterior two-thirds of the tongue. Motor fibers travel through both the glossopharyngeal and the vagus nerve (CN X) to innervate the muscles of the pharynx. Test glossopharyngeal nerve function simultaneously with the vagus nerve by eliciting the gag reflex. To perform the gag reflex, depress the tongue slightly with a tongue depressor and touch the throat lightly with a cotton-tipped applicator. As the pharyngeal muscles contract, the patient should gag (CN X). The patient should be able to identify the touch of the blade (CN IX).

To further assess nerve function, ask the patient to swallow. If both CN IX and X are intact, the patient should be able to do this without difficulty.

The accessory nerve (CN XI) controls the movement of the sternocleidomastoid and trapezius muscles of the neck and shoulders. Ask the patient to raise the shoulders (trapezius contraction) against resistance and turn the head (sternocleidomastoid contraction) against resistance.

The hypoglossal nerve (CN XII) is the motor nerve of the tongue. To check the function of the hypoglossal nerve, ask the patient to stick out his or her tongue, which should be midline. A CN XII lesion will cause the tongue to deviate toward the affected side. If CN XII is damaged, dysarthria (difficulty forming words) will result.

Motor Assessment

Motor assessment techniques test muscle innervation by the spinal nerves and are outlined in Table 4.

Strength: Evaluation of arm drift is a sensitive test for weakness in the upper extremities. Instruct the patient to extend his or her arms straight out, with palms up and eyes closed. Significant proximal weakness will cause the affected arm to drift into pronation. Other sensitive tests for extremity weakness include hand grasp, plantar flexion of the foot and dorsiflexion of the foot.

In the case of peripheral nerve or muscle injury, or if abnormal results are elicited with the motor testing described above, more formal testing of the affected muscle groups is needed. All relevant joints should be tested in full range of motion against appropriate resistance. Although perceived strength is somewhat subjective, it can be documented in a more objective manner by using the Oxford scale (Table 5).[2]

Atrophy: Observe large muscle groups (i.e., calf muscles, biceps) for symmetry and determine if their size is appropriate for the patient's age.

Tone: Observe and test muscles for flaccidity, spasticity or rigidity. Rigidity presents as stiffness regardless of the rate of passive movement. When an extremity is rigid, it "catches" during passive movement. Spasticity, on the other hand, is dependent on rate. When the spastic extremity is moved slowly, the tone appears normal. If the extremity is moved quickly, it "catches" and loses all resistance.

Sensory Examination

The basic sensory examination consists of pain, light touch, proprioception, stereognosis and vibration. Complete sensory testing of the dermatome is often unnecessary. The location of tingling, burning or numbness will identify the affected dermatome. Test the affected and adjacent dermatomes bilaterally, with a pinprick and light touch.

Proprioception provides the most sensitive measure of posterior column defects.[2] To perform this test, ask the patient to close his or her eyes. Grasp the great toe by the sides and bend the toe either up or down, asking the patient to distinguish whether the toe is being moved up or down. Clinical conditions that cause alterations in proprioception include multiple sclerosis and tertiary syphilis.

Stereognosis is dependent on touch and position sense, as well as the cerebral cortex function of recognition. Ask the patient to close his or her eyes and identify a familiar object, such as a key or pencil, which you have placed in the patient's hand.

Vibration sense is often the first sensation to be lost in peripheral neuropathies such as alcoholism and diabetes.[2] Test vibration by placing a vibrating tuning fork over the distal interphalangeal joint of a finger and the great toe. Ask the patient to tell you when the vibration disappears.

Cerebellum and Gait

The cerebellum organizes and coordinates movements but does not control individual muscles. Therefore, smooth, coordinated movements depend on normal functioning of the cerebellum. Ataxia describes disorganized, unsteady or inaccurate movements.

A simple way to test cerebellum function is to observe a patient's fine-motor movements. Ask the patient to close his or her eyes and hold the arms out in front. Instruct the patient to touch the tip of his or her nose with the right index finger, then the left index finger, repeating this process several times.

A variation of this test is to observe the performance of rapid alternating movements. Have the patient place the palms of his or her hands on the lap. Instruct the patient to then turn the hands onto the dorsal surface. Repeat this process rapidly.

The "heel-knee-shin" test can assess coordination of the lower extremities. In this exam, have the patient place the right heel on the left knee. Next, slide the heel down to the left shin. Repeat this for the right side. The Romberg test can also assess cerebellar function. Instruct the patient to stand upright with feet together and eyes closed. The test is positive if swaying occurs. A positive Romberg test may indicate a proprioception deficit or cerebellar lesion. Another sensitive test of cerebellar function is to have the patient walk heels to toes, on heels and then on toes. A smooth, coordinated gait indicates normal function of the cerebellum and normal motor and sensory functions in the lower extremities.

Reflexes

The major deep-tendon reflexes are the Achilles (S1, S2), patellar (L3, L4), biceps (C5, C6) and triceps reflexes (C7, C8). The patient must be completely relaxed, with the ankle joint in a partially flexed position. Briskly strike the tendon with a reflex hammer and observe for muscle contraction. Grade the response on a scale from 0 to 4+. Zero reflects no contraction (absent reflex), 1+ is diminished but present, 2+ is normal, 3+ is hyperactive and 4+ is hyperactive with clonus. Asymmetric reflexes indicate neurologic (or muscular) dysfunction.

Perform the Babinski reflex by holding the patient's foot with one hand and stroking the lateral aspect of the sole from the heel toward the ball with a pointed object. The normal response is plantar flexion of the toes. A positive Babinski sign is characterized by dorsiflexion of the great toe with fanning of the other toes, which indicates an upper motor neuron lesion.

Reaching a Conclusion

Once the history and physical evaluations are completed, it is time to stop and synthesize the data. Based on your exam, does there appear to be a neurologic deficit or impairment? If there is, what area is most likely affected? The next step is to generate a list of differential diagnoses. Reference books can assist you in this.

Finally, laboratory work and imaging studies may be needed to help confirm or narrow the list of diagnoses. For instance, if the patient reports a decrease in visual fields and presents with a bitemporal hemianopsia, the differential diagnosis list will include a pituitary tumor. The diagnosis may be confirmed when enhanced and unenhanced computerized axial tomography (CT) of the head reveals a pituitary adenoma compressing the optic chiasm. The key to an effective neurological examination is a systematic and focused assessment.

References

1. Pellegrino, T. (1997). A faster, focused neurological exam. *Emergency Medicine*, 6, 68-94.

2. Sturmann, K. (1997). The neurologic examination. *Emergency Medicine Clinics of North America*, 15(3), 491-505.

3. Teasdale, G., & Jennett, B. (1974). Assessment of coma and impaired consciousness: A practical scale. *Lancet*, 2(7872), 81-84.

4. Folstein, M.F., Folstein, S.E., & McHugh, P.R. (1975). Mini-mental state: A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research*, 12, 189-198.

5. Barker, E., & Moore, K. (1992). Cranial nerve assessment. *RN*, 5, 62-68.

6. Bernat, J., & Vincet, F. (1987). Neurology: Problems in primary care. Montvale, NJ: Medical Economics Books.

7. Kilmon, C. (1990). Nursing assessment of the neurological system. In P.G. Beare & J.L. Myers (Eds.), Principles & practice of adult health nursing. St. Louis: Mosby.

8. Neatherlin, J. (1999). Foundation for practice: Neuroassessment for neuroscience nurses. *Nursing Clinics of North America*, 34(3), 573-592.

9. DeLorenzo, R. (1997). Demystifying the neurological examination. *JEMS*, 22(9), 68-78.

Tracy Murray is an acute-care nurse practitioner at Miamisburg (OH) Family Practice. Norma Kelly is a doctorally prepared nurse who is director of the Peoria regional nursing program at the University of Illinois in Chicago. Sheryl Jenkins is an acute-care nurse practitioner at Town and Country Healthcare, Eureka, IL.

2900 Horizon Drive, King of Prussia, PA 19406 • 800-355-5627
Publishers of ADVANCE Newsmagazines
Advance for Nurses: Florida: January 6, 2003
www.advanceweb.com

NEUROLOGIC EXAMINATION ARTICLE TABLES

Table 1

The Glasgow Scale[3]

EYE OPENING		VERBAL RESPONSE		MOTOR RESPONSE	
4	Spontaneous	5	Oriented	6	Obeys commands
3	To loud voice	4	Confused	5	Localizes pain
2	To pain	3	Inappropriate words	4	Withdraws from pain
1	None	2	Incomprehensible words/sounds	3	Flexion from pain
		1	None	2	Extension from pain
				1	None

Table 2

The Mini-Mental Status Examination: Sample Items

Orientation to Time:

"What is the date today?"

Registration:

"Listen carefully. I am going to say three words. You repeat them to me after I stop. Ready? Here they are: house (pause), car (pause), lake (pause). Now repeat the words."

Naming:

"What is this?" (Point to a pencil or pen.)

Reading:

"Please read this and do what it says." (Show the words on the stimulus form.) "Close your eyes."

Table 3

Summary of Cranial Nerve Function[8,9]

	NERVE	LOCATION	FUNCTION
I:	Olfactory	Olfactory bulb & tract	Smell
II:	Optic	Optic nerve, chiasm & tract	Vision
III:	Oculomotor	Midbrain	Eye movement, pupil contraction and accommodation, eyelid elevation
IV:	Trochlear	Midbrain	Up and out movement of eye
V:	Trigeminal	Pons	Facial sensation, chewing
VI:	Abducens	Pons	Lateral gaze
VII:	Facial	Pons	Facial muscles, taste on anterior 2/3 of tongue, corneal reflex
VIII:	Acoustic	Pons	Hearing
IX:	Glasso-medulla	Pharyngeal	Taste, swallowing, gag reflex, cough
X:	Vagus	Medulla	Parasympathetic to organs, laryngeal muscles
XI:	Accessory	Cervical	Movement of head & shoulders
XII:	Hypoglossal	Medulla	Tounge muscles

Table 4

Muscle Innervation by Spinal Nerves

MUSCLE GROUP	FUNCTION	SPINAL LEVEL
Biceps	Elbow flexion	C5,C6
Triceps	Elbow extension	C7, T1
Rectus abdominus	Trunk flexion	T6-L1
Iliopsoas	Hip flexion	L2, L3
Quadriceps	Knee extension	L2, L4
Biceps femoris	Knee flexion	L5, S2

Table 5

Muscle Strength Grading Scale (Oxford Scale)[2]

0/5	N contraction
1/5	Visible/palpable muscle contraction
2/5	Movement with gravity eliminated
3/5	Movement against gravity only
4/5	Movement against gravity with some resistance
5/5	Movement against gravity with full resistance