

NEUROLOGICAL ASSESSMENT

Components of a Neurological Assessment:

1. Interview
2. Level of Consciousness
3. Pupillary Assessment
4. Cranial Nerve Testing
5. Vital signs
6. Motor Function
7. Sensory Function
8. Tone
9. Cerebral Function

1. INTERVIEW

The patient/family interview will allow the nurse to:

- gather data: both subjective and objective about the patient's previous/present health state
- provide information to patient/family
- clarify information
- make appropriate referrals
- develop a good working relationship with both the patient and the family
- initiate the development of a written plan of care which is patient specific

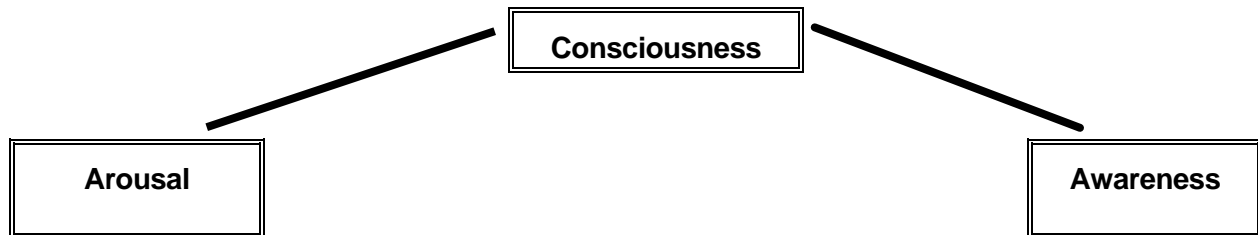
Interview to identify presence of:

- headache
- difficulty with speech
- inability to read or write
- alteration in memory
- altered consciousness
- confusion or change in thinking
- disorientation
- decrease in sensation, tingling or pain
- motor weakness or decreased strength
- decreased sense of smell or taste
- change in vision or diplopia
- difficulty with swallowing
- decreased hearing
- difficulty with swallowing
- altered gait or balance
- dizziness
- tremors, twitches or increased tone

2. LEVEL OF CONSCIOUSNESS

*****Consciousness is the most sensitive indicator of neurological change****

Consciousness can be defined as a state of general awareness of oneself and the environment. Consciousness is difficult to measure directly but it is estimated by observing how patients respond to certain stimuli.



Physiologic Basis for Consciousness

1. Reticular Activating System (RAS)

Loose network of neurons and fibres in the brainstem which receive input from spinothalamic (sensory) pathways and project to the entire cerebral cortex. **Arousal** is dependent on the adequate functioning of the RAS. Arousal is purely a function of the brain stem. It does not have anything to do with the thinking parts of the brain. The fact that your patient opens his/her eyes when you call their name is an indication that their RAS (brainstem) functioning is intact but it does not tell you if they are awake or aware.

2. Cortex

Modulates incoming information via connections to the RAS. Therefore, the cortex requires functioning of the RAS to function itself. **Awareness**, means that the cerebral cortex is working and that the patient can interact with and interpret his environment.

We evaluate awareness in many ways but tend to focus on four areas of cortical functioning: orientation, attention span, language, and memory.

Consciousness will be disturbed if a lesion of the RAS is present or if there is diffuse damage to the cortex (both hemispheres).

Some mechanisms by which consciousness is disturbed:

Diffuse cortical dysfunction:

decreased cerebral metabolism:

hypoxia, hypoglycemia, acidosis/alkalosis, hyponatremia

drugs:

alcohol, barbiturates, phenytoin, phenothiazines, benzodiazepines, methanol, ethylene glycol, paraldehyde

hypotension:

decreased cerebral blood flow

structural lesions:

infarctions, hemorrhages, tumours

Lesions of the RAS

Occasionally a lesion occurs directly in the upper brainstem (e.g. bleed, infarction, tumour) and causes coma by destruction of RAS. More often, a large destruction cortical lesion causes secondary damage to the RAS via: herniation or direct extension of the lesion into the midbrain or diencephalon.

Assessment of Level of Consciousness

A. Stimulate with progressively stronger stimuli:

- i) normal voice
- ii) shout
- iii) light touch
- iv) pain

Observe patient's response (verbal or motor). If there is no response to voice or light touch, painful stimulus is needed to assess neurological status. Central pain should be used first. Sternal rub, supraorbital pressure, or pinching the fleshy portion of the upper arm near the axilla are methods for introducing central pain. Patience is needed to properly assess response. Watch for symmetry. Hand grasp is a reflex and is a poor test for motor strength.

If the patient does not respond to verbal stimulus but moves spontaneously in a purposeful manner (picks at linen, pulls at tubes), the patient is localizing. Painful stimulus is not required if spontaneous localization has been observed.

Localizing is purposeful and intentional movement intended to eliminate a noxious stimulus, whereas, withdrawal is a "smaller" movement used to "get away from" noxious stimulus. Localizing is sometimes defined as movement that crosses the midline.

Abnormal flexion differs from withdrawal in that the flexion is rigid and abnormal looking. Abnormal extension is a rigid movement with extension of the limbs.

B. If arousable, progress to assessment of awareness

The Glasgow Coma Scale (GCS) helps us to decrease the subjectivity of our responses. The GCS is not intended to identify focal findings; it is a rating score to grade the best possible central (brain) response. Remember to give each score the BEST possible rating. If the patient can only move one eyebrow to command, they are still given a "6" for motor score.

Score	Eye Opening	Speech	Motor Function
6			Obeys
5		oriented	Localizes
4	spontaneous	confused at times	Withdraws
3	to voice	inappropriate words	abnormal flexion
2	to pain	incomprehensible	abnormal extension
1	none	none	None
15 (best)			

Other common terms are used to describe assessment of LOC (e.g. alert, drowsy, confused, stuporous, comatose). It is important that the terms used are defined for the practitioners at the bedside and are used consistently. You want a change in terminology to represent a change in the patient, not the practitioner's interpretation of the terminology. At change of shift, perform a neuro exam with the oncoming nurse to ensure clear communication of the patient's previous status.

Examples of Definitions

Alert:

- awake, looks about
- responds in a meaningful manner to verbal instructions or gestures

Drowsy:

- oriented when awake but if left alone will sleep

Confused:

- disoriented to time, place, or person
- memory difficulty is common
- has difficulty with commands
- exhibits alteration in perception of stimuli, may be agitated

Stuporous:

- generally unresponsive except to vigorous stimulation
- may make attempt at verbalization to vigorous/repeated stimuli
- Opens eyes to deep pain

Comatose:

- unarousable and unresponsive
- some localization or movement may be acceptable within the comatose category depending on the coma definitions e.g. light coma to deep coma
- Does not open eyes to deep pain

The difference between Coma and Sleep:

- sleeping persons respond to unaccustomed stimuli
- sleeping persons are capable of mental activity (dreams)
- sleeping persons can be roused to normal consciousness
- cerebral oxygen uptake does not decrease during sleep as it often does in coma

Special States of Altered Levels of Consciousness*Brain Death:*

An irreversible loss of cortical and brain stem activity.

Persistent Vegetative State:

A condition that follows severe cerebral injury in which the altered state becomes chronic or persistent.

Locked-in Syndrome:

A state of muscle paralysis, involving voluntary muscles, while there is preservation of full consciousness and cognition.

Some Final Points to Consider.

1. Progression from coma to full consciousness is often a gradual occurrence (especially in the case of head trauma). For example, an individual may experience coma that lasts for 8 weeks in duration, followed by 4-6 weeks of restlessness and agitation, and then one day become fully conscious.
2. Recovery from an altered level of consciousness is influenced by:
 - age (under 20 years of age, prognosis is better)
 - type of injury
 - premorbid health
3. The longer the coma the worse the outcome.
4. Absence of corneals, gag, pupillary reflexes, oculocephalic reflex is equivalent with poor prognosis. Very poor prognosis is associated with abnormal flexion, abnormal extension or flaccidity.

3. PUPILLARY ASSESSMENT

When assessing pupils (eyes) it is important to assess the following:

- size
- shape
- reactivity to light
- comparison of one pupil to the other

Size

Normally, both pupils are the same size, from 2-6 mm. Size of pupils should be assessed after the eyelids have opened and the pupils have accommodated to room light. Seventeen percent of the population have unequal pupils and this is a normal finding for them. Direct eye injury or past surgery can affect size.

Pupils can be described according to their size (in mm) or by description:

- Pinpoint:* Seen with opiate overdose and pontine hemorrhage.
- Small:* Normal if the person is in a bright room.
May be seen with Horner's syndrome, pontine hemorrhage, ophthalmic drops, metabolic coma etc.
- Midposition:* Seen normally.
If pupils are midposition and nonreactive the cause is midbrain damage.
- Large:* Seen normally when the room is dark.
May be seen with some drugs and some orbital injuries.
- Dilated:* Always an abnormal finding.
Bilateral, fixed and dilated pupils are seen in the terminal stage of severe anoxia-ischemia or at death.
Anti-cholinergic drugs can dilate pupils.

Shape

Pupils are normally round in shape. Here are some of the possible abnormally shaped pupils with their potential causes.

- Ovoid:* Almost always indicates intracranial hypertension and can be associated with an early sign of transtentorial herniation. The ovoid pupil represents the intermediate phase between a normal pupil and a fully dilated and fixed pupil.
- Keyhole:* Seen in patients with iridectomy (common part of cataract surgery). These pupils may still react to light but usually the reactivity is sluggish.
- Irregular:* may be seen with traumatic orbital injury.

Reactivity

To assess for reactivity make sure that the light in the room is dim. Bring a light source (should not be larger than a flashlight) in towards the eye from the side of the eye towards the pupil. The smaller the light source the better (pen lights are better than larger flashlights).

Normally, pupils briskly constrict to light and briskly dilate when light sources are removed. Pupils tend to be larger and more reactive in younger people.

Pupils can also react in the following manner:

sluggish: found in conditions that compress the third cranial nerve, such as, cerebral edema and herniation

nonreactive or fixed: seen in conditions that compress the 3rd cranial nerve such as herniation, severe hypoxia and ischemia

hippus phenomenon: with uniform illumination of the pupil, alternating dilation and contraction of the pupil occurs. This is often associated with early signs of transtentorial herniation or may indicate seizure activity.

Extraocular eye movement

What to expect in a normal healthy person:

- the eyes blink periodically
- the eyes move together in the orbital sockets
- no nystagmus or abnormal eye movements
- the eyeball neither protrudes or is sunken into the eye socket
- the eyelids do not droop

You might want to assess extraocular eye movement once per shift in a comatose patient. If the patient does not have a suspected C spine injury you can perform the Dolls eyes manoeuvre.

A point of interest:

If a patient is in true coma and you lift their eyelids and let them go, they will gradually cover the eyes. If a patient is in a hysterical coma and you lift their eyelids, the lids will rapidly close.

Nystagmus

Involuntary movement of an eye which may be horizontal, vertical, rotary or mixed. It can result from many different problems. If it is present you should document what it looks like e.g. fast horizontal movement, circumstances that seemed to have caused it, when it started.

4. CRANIAL NERVE ASSESSMENT

As per A&P outline.

5. VITAL SIGNS

Changes in vital signs are not consistent early warning signals. Vitals are more useful in detecting progression to late symptoms. Both respiratory and cardiac centres are located in the brainstem. Therefore, compression of the brainstem will cause changes in vital signs. This is usually a late sign and impending herniation/death will occur if the problem is not resolved. The respiratory centres in the brainstem control rate, rhythm, inspiration/expiration. The cardiac centres also play a part in cardiac acceleration/inhibition e.g. controlling heart rate and rhythm as well as hemodynamic stability/instability.

Respiratory

The role of the Nurse is to:

1. Ensure patent airway is maintained
2. Assess rate, rhythm, and characteristics of inspiration/expiration
3. Assess gas exchange, tissue perfusion, airway clearance, and risk for aspiration
4. Assess for causes of respiratory disturbances or secondary conditions that can cause respiratory complications
5. Assess for actual respiratory complication/insufficiency and intervene appropriately

Do not forget to compare findings to previous assessment.

What can cause changes in respirations from a neurological standpoint?

▪ **Increased Intracranial Pressure**

Initially with increased ICP you should expect to see a slowing of respirations but as the ICP increases so will the rate of respirations. The rhythm of respirations will also become more

irregular.

- **Spinal Cord Injury**

Cervical spine trauma can cause alteration in respiratory effort. If the injury is at level C4 (phrenic segment) or above, total respiratory arrest can occur.

Pulse

1. Assess rate, rhythm, and quality of pulse
2. Assess tissue perfusion, cardiac output, activity intolerance
3. Assess for causes of cardiac instability and intervene appropriately

Do not forget to compare findings to previous assessment.

What can cause changes in pulse from a neurological standpoint?

Tachycardia

1. If a patient has tachycardia related to neurological impairment it can mean that they are reaching a terminal phase in their disease process.
2. In a patient with multiple trauma, hemorrhage must be ruled out (intra-abdominal).

Bradycardia

1. Bradycardia is seen in the later stages of increased intracranial pressure. As BP rises to overcome the increased ICP, reflex inhibition causes a slowing of the HR.
2. Bradycardia can also be seen with spinal cord injury and interruption of the descending sympathetic pathways.

Cardiac Arrhythmias

Cardiac arrhythmias may occur in several neurological conditions. Subarachnoid hemorrhage patients with blood in the CSF and patients who have undergone posterior fossa surgery tend to have an increased incidence of arrhythmia.

Blood Pressure

1. Assess for hypertension, hypotension, and pulse pressure
2. Assess tissue perfusion, cardiac output

Do not forget to compare findings to previous assessment.

What can cause changes in blood pressure from a neurological standpoint?

Hypertension

Increases in blood pressure are usually associated with rising ICP. **An increased systolic pressure, widening pulse pressure, bradycardia and apnea are advanced stages of increased ICP and are known as Cushing's response.**

Hypotension

1. Decrease in blood pressure is rarely seen as a result of neurological injury. If it is present it is usually accompanied by tachycardia and is terminal.
2. Hypotension and bradycardia can be seen with cervical spine injuries as a result of neurogenic shock.

Temperature

The hypothalamus is the regulatory centre for temperature. Regulation of heat is monitored by blood temperature and is controlled through impulses to sweat glands, dilation of peripheral vessels and shivering of skeletal muscles.

What can cause changes in temperature from a neurological standpoint?

Hyperthermia

Temperature elevation in the neurological patient can be caused by direct damage to the hypothalamus or traction on the hypothalamus as a result of increased ICP, CNS infection, subarachnoid hemorrhage etc. Temperature elevations may become very high, very rapidly. They need to be treated aggressively as fever will cause an increase in cerebral oxygen requirements, increased metabolic rate, and increased carbon dioxide production. Increased carbon dioxide production can lead to cerebral vasodilation. Cerebral vasodilation can increase the ICP, leading to more cerebral ischemia.

Hypothermia

Can occur with spinal shock, metabolic or toxic coma, or lesions of the hypothalamus.

6. MOTOR FUNCTION

When assessing motor function, from a neurological perspective, the assessment should focus on arm and leg movement. You should consider the following:

1. muscle size
2. muscle tone
3. muscle strength
4. involuntary movements
5. posture, gait

Symmetry is the most important consideration when identifying focal findings. Compare one side of the body to the other when performing your assessment.

Assessment of a Conscious Patient

Limb assessment of a conscious patient usually involves a grading of strength.

Grade Strength

- | | |
|---|---|
| 5 | Full ROM against gravity and resistance; normal muscle strength |
| 4 | Full ROM against gravity and a moderate amount of resistance; slight weakness |
| 3 | Full ROM against gravity only, moderate muscle weakness |
| 2 | Full range of motion when gravity is eliminated, severe weakness |
| 1 | A weak muscle contraction is palpated, but no movement is noted, very severe weakness |
| 0 | Complete paralysis |

NB: In a conscious patient, the single best test to quickly identify motor weakness is the “drift test”. Have the patient hold their arms outward at 90 degrees from the body. With palms up, have the patient close their eyes and hold the arms for a couple of minutes. “Drifting” will occur if one side is weak.

Lower Extremities

Assess the patient in a supine position. Ask him/her to separate both legs to test for hip abduction. Then ask the patient to bring the legs back together to test for hip adduction. Sit the patient on the side of the bed to assess knee flexion and extension. Ask the patient to flex and extend the knee. If able to do this, apply resistance as these movements are repeated. Test plantar and dorsiflexion by having the patient push down against your hand with their foot and then pull up against your hand with their foot. Remember to compare left side to right side.

Upper Extremities

Assess ability to flex elbow (biceps) and straighten (triceps). Assess ability to raise shoulders and return to a resting position. Assess wrist flexion and extension. Test each function with resistance. For focused upper extremity assessment, assess each digit for flexion, extension and lateral movement.

Assessment of an Unconscious Patient

Upper Extremities

1. Observe the patient for spontaneous/involuntary movement
2. Apply painful stimuli to elicit a motor response (start with central pain; move to peripheral pain if no response occurs).
3. Assess for paralysis of the limb by lifting both arms and releasing them together. If one limb is paralysed it will fall more rapidly than the non paralysed arm.

Lower Extremities

1. Observe for spontaneous/involuntary movement
2. Apply painful stimuli to elicit a motor response. Begin with central pain. Nailbed or peripheral pain can be attempted if the patient doesn't respond to central pain (caution needs to be used when interpreting peripheral pain as it may stimulate spinal reflex responses vs withdrawal or other more deliberate responses).
3. To assess for paralysis of the one limb you can position the patient on their back and flex the knees so that both feet are flat on the bed. Release the knees simultaneously. If the leg falls to an extended position with the hip externally rotated, paralysis is present. The normal leg should stay in the flexed position for a few seconds and then gradually assume its previous position.

7. SENSORY FUNCTION

When assessing sensory function remember that there are three main pathways for sensation and they should be compared bilaterally:

1. pain and temperature sensation
2. position sense (proprioception)
3. light touch

Pain can be assessed using a sterile pin. Light touch can be assessed with a cotton wisp. To test

proprioception, grasp the patient's index finger from the middle joint and move it side to side and up and down. Have the patient identify the direction of movement. Repeat this using the great toe.

Sensory Tests:

A number of tests for lesions of the sensory cortex can be done. Examples include:

Stereognosis: The ability to recognize an object by feel. Place a common object in the person's hand and ask them to identify the object.

Graphesthesia: "Draw" a number in the palm of the person's hand and ask them to identify the number.

Two-Point Discrimination: Simultaneously apply two pin pricks to the skin surface. Continually repeat the test while bringing the two pins closer together, until the individual can no longer identify two separate stimuli. The finger tips are the most sensitive location for recognizing two point differences while the upper arms, thighs and back are the least sensitive.

Extinction: Touch the same spot on both sides of the body at the same time (e.g. the left and right forearms). Ask the individual to describe how many spots are being touched. Normally, both sides are felt; with sensory lesions the individual will sense only one.

Point Locations: Touch the surface of the skin and remove the stimulus quickly. Ask the individual to touch the spot where the sensation was felt. Sensory lesions can impair accurate identification, even if they retain their sensation of light touch.

8. TONE

Upper motor neuron problems (brain and spinal cord) are associated with increased tone. Lower motor neuron problems are associated with decreased tone.

Look at the muscles on each side of the body in pairs. Assess for symmetry of bulk.

Evaluation of the stretch reflexes assesses the intactness of the spinal reflex arc at various spinal cord levels. The limb should be relaxed while applying a short and snappy blow with a reflex hammer. Hold the hammer loosely in a relaxed manner, making a wrist action. Allow the hammer to bounce.

Reflex responses:

- 0 no response
- 1+ diminished, low normal
- 2+ average, normal
- 3+ brisker than normal
- 4+ very brisk, hyperactive

Lower motor neuron disease is associated with 0 or 1+, upper motor neuron disease is associated with 3+ or 4+.

Biceps Reflex (C5 – C6): Support the forearm on the examiner's forearm. Place your thumb on the biceps tendon (located in the front of the bend of the elbow; midline to the antecubital fossa).

Tap on your thumb to stimulate a response.

Triceps Reflex (C7-C8):

Have the individual bend their elbow while pointing their arm downward at 90 degrees. Support the upper arm so that the arm hangs loosely and “goes dead”. Tap on the triceps tendon located just above the elbow bend (funny bone).

Brachioradialis Reflex (C5-C6):

Hold the person’s thumb so that the forearm relaxes. Strike the forearm about 2-3 cm above the radial styloid process (located along the thumb side of the wrist, about 2-3 cm above the round bone at the bend of the wrist). Normally, the forearm will flex and supinate.

Quadriceps Reflex (Knee jerk) L2 – L4

Allow the lower legs to dangle freely. Place one hand on the quadriceps. Strike just below the knee cap. The lower leg normally will extend and the quadriceps will contract.

If the patient is supine: Stand on one side of the bed. Place the examiner’s forearm under the thigh closest to the examiner, lifting the leg up. Reach under the thigh and place the hand on the thigh of the opposite leg, just above the knee cap. Tap the knee closest to the examiner, (the one that has been lifted up with the examiner’s forearm).

Achilles Reflex (ankle jerks) L5 – S2:

Flex the knee and externally rotate the hip. Dorsiflex the foot and strike the Achilles tendon of the heel. In conscious patients, kneeling on a chair can help to relax the foot.

Heel Lift

While the patient is supine, bend the knee and support the leg under the thigh. Have the leg “go dead”. Briskly jerk the leg to lift the heel of the bed. Normally, the leg will remain relaxed and the heel will slide upward; increased tone will cause the heel and leg to stiffen and lift off the bed.

Babinski Response:

Dorsiflexion of the great toe with fanning of remaining toes is a positive Babinski response. This indicates upper motor neuron disease. It is normal in infants.

9. CEREBELLAR FUNCTION

The cerebellum is responsible for muscle coordination and balance on the same side. To test cerebellar function use the following tests:

1. Finger to finger test: have the patient touch their index finger to your index finger (repeat several times).
2. Finger to nose test: perform with eyes open and then eyes closed.
3. Tandem walking: heel to toe on a straight line
4. Romberg test: stand with feet together and arms at their sides. Have patient close his/her eyes and maintain this position for 10 seconds. If the patient begins to sway, have them open their eyes. If swaying continues, the test is “positive” or suggestive of cerebellum problems.

Dizziness that occurs in response to position changes is usually blood pressure initiated. If the

patient sways during a Romberg test, but stops when the eyes are opened, the problem is probably visual or CN VIII (vestibular).