

Diagnosis and Monitoring of Neurological Changes in Intensive Care

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Abstract

Since patients are usually incubated or sedated at intensive care units and they are given neuromuscular agents, neurological examination and early diagnosis of neurological complications is difficult and complex for both nurses and doctors. This review includes patient history, evaluation of physical, mental and motor functions and new methods on neurological diagnosis.

Introduction

At intensive care units, simultaneously evaluating and monitoring patients' different systems and organs is vitally important in order to plan patient care and treatment. Neurological evaluation and diagnosis helps early detection of the neurological deterioration before irreversible brain damage occurs, planning the care according to the patient, evaluation of response to the treatment and preventing possible side effects. Furthermore, it is beneficial for the amelioration of the patients' neurological prognosis and life quality after severe brain damage. Physical examination, monitoring methods and scoring methods are used for this evaluation process. Nurses are required to be acquainted with many steps like taking medical history, CVP measurement, cerebral oxymetry follow-up, Glasgow Coma scale, evaluation of pupil as, cranial nerves, deep tendon reflexes, sensory and motor function damages, changes in consciousness and delirium, distinguishing seizure types, knowing and monitoring the effects of drugs on neurological systems and apply them appropriately. For example, when nurses monitor the changes in pupillas, they should be able to recognize that if the pupil as are in size of pinpoint (<1mm) and not responsive to light, it usually indicates a lesion due to haemorrhage in Pons. Thus, nurses can have a primary role in the detection of changes in patients' clinical condition and contribute to the early detection of irreversible situations. This review addresses the points that nurses should pay attention to in neurological diagnosis and evaluation methods.

Subjective Data

In includes debriefing process on medical history, medication and surgical treatment.

Medical history

Three points should be paid attention to when getting the history of patients with neurological problems. First one is to avoid offering the symptoms. For example, instead of asking questions like "Is your right side weak?" more open-ended questions like "Is there anything bothering you on your right side?" should be asked. Second point is how the problem started and medical history [1,2]. Nurses should reveal all the relevant data in the medical history of the current disease. Third point is that since some neurological diseases affect the patient's mental health, it may be difficult the make a proper evaluation. In such a case, medical history should be taken from someone who knows patient's problems and complaints directly [1-3]. Medical history can direct the clinician to the part where nervous system should be evaluated. If the patient's complaint is primary dizziness, examination should be more focused on vision, balance and cerebellum functions instead of somatic, motor and sensorial functions [1,2]. Changes in behavior and consciousness, development problems, paroxysmal problems (like seizures) and traumas should warn the clinicians about the necessity of a detailed neurological examination. When taking the medical history from the patients, nurses should ask specific questions about situations that may affect nervous system like diabetes mellitus, pernicious anemia, cancer, infections, thyroid disease, drug abuse and hypertension [1-3].

Medical treatment

Use of sedatives, tranquilizers and mental drugs should be specifically questioned. If the patient is having dizziness as a side effect of a drug and the medication cannot be changed after detecting the side effect, new strategies will be required to prevent the patient from falling and to fight the dizziness [1-3]. Some patients with neurological problems may be using anti-confusion drugs like phenytoin (dilantin), carbamazepine (tegratol) and phenobarbital. Nurses should gather information about

diplopia (double vision), hypokinesia, ataxia (imbalance) and mental retardation [1-3].

Surgical and other treatments

If the patient is going to go under a surgical operation, its date, reason, methods, healing state and present state should be investigated. Taking perinatal history may help reveal exposure to toxic agents affecting the development of nervous system like viruses, alcohol, tobacco, medications and radiation. A difficult childbirth causing brain damage as a result of Rh incompatibility, hypoxia and obstetrical forceps may be also revealed by taking the history. Growth and developmental history may be important in investigating whether there is problem in nervous system at early ages. Nurses should especially gather information on major developmental stages like talking and walking [1-3].

Objective Data

Physical examination

Physical examination functions are evaluated in six steps: Mental status, Cranial Nerve Functions, Motor Functions, Cerebellum Functions, Sensorial Functions and Reflex Functions. If the patient’s complaint is sensory loss in feet, the examination can be only focused on sense and motion of lower extremities. Similarly, if a patient came to emergency service after a head trauma and is unconscious, the examination will be limited since the patient cannot response to oral instructions. The main objection of the neurological examination done by nurses is to identify the neurological impairment and effects of the ability of patient and family to fight with the neurological deficit on daily life [1-3].

Mental status: Evaluation of mental status (brain functions) provides understanding in how the patient functions as a whole and how the patient adapts to the environment. Items of mental status examination are given below (Table 1).

Evaluation of Mental Status

It is done by assessing the level of consciousness. Consciousness level has two components: wakefulness and awareness.

Wakefulness

Reticular Activation System (RAS) is functional, RAS is correlated with thalamus and cortex and it is the lowest level of consciousness. Patient’s response to oral and tactile impulses is evaluated.

Awareness

It constitutes cognitive mental functions. Cerebral cortex is functional. It is the high level of consciousness. Patient’s adaptation to people, places and time is evaluated.

Table 1: Mental status examination.

General Look and Behavior	Includes posture, clothes and hygiene, facial expressions and speech.
Consciousness	Nurses should assess time, person, place and situation orientation.
Mood and Affectivity	Nurses should identify emotions like aggression, anger, depression, euphoria and the suitability with these situations.
Contents of Thought	Nurses should identify illusions, hallucinations, dreams and paranoia
Intellectual Capacity	Nurses should identify mental deficiencies, dementia and intelligence.

Levels of Consciousness

Awake/full consciousness (Alert)

Patient is oriented to time, place and people. Patient can understand written and oral words and can communicate [4,5].

Lethargy/somnolence

Patient is oriented to time, place and people. Half-awakeness, obtuseness, deceleration in speaking, mental functions and motor activities and indolence is present. Patient responses properly to painful stimulants. Nurses should know that lethargic patients have a tendency to fall and get hurt. To protect the patient, bedsides should be removed; patient should be evaluated frequently and monitored closely.

Confused

Orientation to time, place and people is deteriorated. First the time, then place and lastly person orientation is deteriorated, they got distracted easily. They usually have memory difficulties [4,5]. They get angry easily and have difficulties following the instructions. Their response to stimulants change. They may have hallucinations. Increase in agitation and uneasiness can be seen especially during early confusion [4,5].

Delirium

Attention disorder, disorganization in thoughts, disorientation, memory disorder, perception disorder (illusion, hallucination, and weird fantasies), deteriorations in sleep-wake cycle, convulsions, agitation and excessive excitement disorders are present. It emerges due to high fever caused by infection, toxic situations or alcohol. Patient is hyperactive and gives irrelevant answers to questions [4,5]. It emerges as delirium tremens due to the deterioration of the metabolism of nerves in brain.

Obtuseness (Obtunded)

Patients’ response to external stimulus and questions is at minimum level [4,5].

Stupor

They move very little spontaneously and do not response if the stimulants are not given repeatedly. Incomprehensible voices and/or blinking may be seen. They respond to painful stimulants [4,5]. They cannot fulfill their responsibilities and there is a high risk of injury. Full attention and care is necessary. Physical and mental activities are at minimum level. Response to oral stimulants is inadequate. They respond to light, loud voices and painful stimulants [4,5].

Table 2: Abbreviated mental test score.

What is your age?
What is the time to the nearest hour?
What year is this?
What is the name of this hospital?
Do you know who am I? Do you know who is this person is? The patient is expected to recognize two people who are in the room by name or title.
When was Pearl Harbor attacked? Any important historical event can be asked.
Who is the president of the United States?
Count backwards from 20 to 1.
Mention an address to the patient then ask the patient to repeat the address.

Keogh J, Neurologic Critical Care, in: Critical Care Nursing, McGraw Hill Education, US, 2013:287-298.

Table 3: GCS assessment skor.

13-15= Minor 9-12= Moderate
<9 = Severe ≥9= Coma should be eliminated
≤8: Coma 3-4= Mortality %97

Coma

Patient cannot respond to oral stimulants. Patient in minor or moderate coma wants to distract painful stimulant or give response by wincing. Patients do not respond to painful stimulant in severe coma. Extremities are relaxed and motionless. There is no response to painful stimulants. Incontinence is present. Pupillas might be dilated of constricted [4,5].

Asses for mental impairment using the Abbreviated Mental Test Score (AMTS). Each guest ion is valued at 1 point. A score of 6 or less suggests mental impairment that requires further testing (Table 2) [6].

Nurses have a lot of responsibility requiring complex knowledge and skills for the evaluation of the neurological functions at intensive care units. Gathering subjective and objective data, patient preparation and monitorization are among these responsibilities. However,

interpretation of the changes in classic sensor motor examination may vary from person to person [7]. For this reason, there are several scales to evaluate both the consciousness level and neurological state of the patients more objectively. Glasgow Coma Scale (GCS), FOUR (full outline of unresponsiveness score), Mains Emergency Evaluation Scale, Reaction Level Scale and Reviewed Trauma Scale are examples of these scales. GCS is the most precedence one among them [7].

In Which Situations Glasgow Coma Scale Is Used?

1. Spontaneous Subarachnoid Hemorrhage
2. Spontaneous Intracerebral Hemorrhage
3. Ischemic Stroke
4. Intracerebral infection and brain abscess
5. General Trauma
6. Non-traumatic coma
7. Intoxication

Evaluation of Glasgow Coma Scale

When using GCS, it should be reminded that a clear assessment of sedation, drug use, alcohol intoxication, shock and low blood oxygen cannot be done (Table 3) [8-10].

Table 4: Sensory examination.

Sensation	Stimuli	Dysfunction
Spinothalamic Tracts Carry Impulses For		
Pain	Alternate sharp and dull ends of a pin, asking patient to discriminate between the two (superficial pain). Squeeze nail beds; apply pressure on the orbital rim;rub sternum (deep pain).	Ipsilateral sensory loss implies a peripheral nerve lesion. Contralateral sensory loss is seen with lesions of the spinothalamic tract or in the thalamus.
Light Touch	Use a wisp of cotton on skin and ask patient to identify when it touches.	Bilateral sensory loss may indicate a spinal cord lesion. Paresthesia is an abnormal sensation, such as itching or tingling.
Tempature	Use test tubes filled with hot and cold water or use small metal plates of varying temperatures. (Test only if pain and light touch sensations are abnormal).	Causalgia is a burning sensation that can be caused by peripheral nerve irritation.
Posterior Columns Carry Impulses for		
Vibration	Apply a vibrating tuning fork on bony prominences, and note patient’s ability to sense and locate vibrations bilaterally	Ipsilateral sensory loss may be due to spinal cord injury or to peripheral neuropathy.
Proprioception	Move the patient’s finger or toe up and down and ask patient to identify final resting position	Contralateral loss may ocur from lesion of the thalamus or of the parietal lobes.

Morton PG and Fontaine DK Patient Assessment: Nervous System, in Critical Care Nursing A Holistic Approach, Tenth Edition, 2013, Lippincott Williams & Wilkins, China,pp 735.

When and How often is GCS used when Evaluating GCS?

Until GCS is equal to 15= Observe and record in every half hour. For patients whose GCS is 15; start after the first assessment at emergency unit and the minimum observation frequency should be; For 2 hours= Once in every half hour, for 4 hours= Once in an hour, at final = once in every 2 hours [11].

How Much Change in GCS is Significant?

A constant (minimum 30 mins) one point decrease (One point decrease in GCS motor score is more significant). If the Oral Response scores decreases; Oral score should be checked before the change. The situation changed in the scale and the amount of the change should be checked: Motor Response usually requires a faster intervention than eye opening and oral response [11].

Sensory Examination

Various features are tested during somatic nerve examination. Every feature is carried through spinal cord before reaching sensorial cortex. Patients must keep their eyes closed all the time during sensory examination in order to avoid visual clues. Sensory tests of four extremities are adequate for the routine neurological examination. First, patient’s subjective complaints are recorded and patient’s cooperation should be fine. After that objective sensory examination is conducted. It should be identified if the sensory deficits are suitable to the anatomic localizations [12]. Light touch, pain and heat, sense of vibration and position and cortical sensorial functions are controlled when evaluating sensorial system.

Superficial sense examination

Touch, pain and heat

Deep sensory examination

Position, passive movement, vibration and Romberg occur. This test performed by having the patient stand with his or her feet together, first with the eyes open, and then with the eyes closed. The nurse looks for sway or direction of falling and is prepared to catch the patient if necessary [12].

Cortical sensory examination

Sterognatic, two point discrimination, grafesthesia and tactile localization is used (Table 4) [12].

Evaluation of Motor Functions

Muscular strength, muscular tonus, muscular atrophy and involuntary movements are taken into consideration when evaluating motor functions. Initially, muscles should be inspected for size and shape. The presence of atrophy is noted. The patients are instructed to

Table 5: Muscle strength grading scale.

0/5= No movement or muscle constraciton
1/2=Trace contraction
2/5= Active movement gravity eliminated
3/5= Active movement againts gravity
4/5= Active movement with some resistance
5/5= Active movement with full resistance

relax the extremity while the nurse performs passive range-of-motion movement and evaluates the degree of resistance. Muscle tone is appraised for sings of flaccidity (no resistance), hypotonia (little resistance), hypertonia (increased resistance), spasticity, or rigidity [4]. Second, muscle strength in the upper and lower extremities is assessed by having the patient perform a number of movements and movement’s against resistance. Muscle Strength Grading Scale graded on the six point scale (Table 5) [4].

Reflexes

Nervous system, which serves as a regulator of all the incidents in an organism, performs these functions is reflexes. A reflex is a response given by the organism to a stimulant. It is performed with the help of central nervous system and without conscious [1-3]. A simple reflex is usually executed by swiftly hitting the tendon of the muscle with a reflex hammer. When the tendon is stretched, a reflex stretch in the skeletal muscle occurs. Normal reflexes are the reflexes found in neurologically healthy individuals and classified in 3 groups [1-3].

Superficial reflexes: Corneal reflex, pharyngeal reflex, palatine reflex, abdominal reflex, plantar reflex and anal reflex.

Deep tendon reflexes: When the relevant muscle is hit by the reflex hammer, muscle stretches. Biceps reflex, ciliospinal reflex, oculocardiac reflex (deceleration in cardiac rhythm when eyeballs are pressed), carotids reflex (decrease in cardiac rhythm and blood pressure when carotid sinus in neck is pressed) are among these reflexes. Pathological reflexes are reflexes which normal people do not have [1-3].

Visceral reflexes: Light reflex, ciliospinal reflex (dilatation of the pupillas when neck is scratched), oculo-cardiac reflex (deceleration in cardiac rhythm when eyeballs are pressed), karotis sinus reflex (decrease in cardiac rhythm and blood pressure when carotic sinus in neck is pressed) [1-3].

Pathological reflexes: Pathological reflexes are reflexes which normal people do not have. These reflexes are Babinski reflex, clonuses and Hoffman sign [1-3].

How to Assess the Cranial Nerves

Visual fields are tested by having the patient look straight ahead with one eye covered. The examiner moves a finger from the periphery of each quadrant of vision toward the patient’s center of vision (Table 6). The patient should indicate when the examiner’s finger is seen. This is done for both eyes, and the results are compared with the examiner’s visual fields, which are assumed to be normal (Table 7) [12].

Pupillary Function and Assessment

Assessment of pupillary function focuses on three areas: 1. Estimation of pupil size and shape, 2. Evaluation of pupillary reaction to light and 3. Assessment of eye movement.

Estimation of pupil size and shape

Pupil diameter should be documented millimeters (mm) with the use of a pupil gauge to reduce the subjectivity of description. Most people have pupils have equal size between 2 and 5 mm. [4]. The other pupil description and condition have table 8.

Table 6: Cranial nerves function and examine.

Cranial Nerve	Function	Examine
I. Olfactory	Smell	Test each nostril with scents such as peppermint, coffee, and vanilla.
II Optic	Vision	Eyes with Snellen eye chart.
III Oculomotor	Eye movement	Pupil size
	Constricting Pupils	Pupil shape
	Raising eyelid	Pupil response to light.
IV Trochlear	Moving eyes down and in	Ask the patient to move eyes down and in.
V Trigeminal	Sensation for face and scalp	Ask the patient to look up and out. Touch a piece of cotton to the other side of the eye. Both eyes should blink.
	Chewing	Ask patient to close both eyes. Randomly press a sharp and blunt object on the patient's forehead, jaw, and cheek. Ask the patient whether he or she feels anything and if so, to describe the feeling as sharp or dull.
	Corneal Reflekt	Ask the patient to open his or her mouth and clench the teeth.
VI Abducens	Moving eyes laterally	Ask the patient to move eyes laterally.
VII Facial	Taste	Raise and lower eyebrows.
	Moving mouth, eyes, and forehead to show expression. Tears (lacrimation), salivation	Smile showing teeth.
		Puff cheeks.
		Wrinkle forehead.
VIII Acoustic	Balance	Stand by arm's length away from the patient's ear and rub two fingers. Ask whether the patient hears anything. Repeat the test on the other ear.
	Hearing	Conduct the Weber's test by placing the vibrant fork on top of the patient's head, asking, "Where do you hear the sound coming from? The response should be midline.
		Conduct the Rinne's test. Place a vibrating fork on the mastoid bone behind ear. Ask the patient when he or she stops hearing it. Then move the fork to the patient's ear so the patient can hear the tone. The patient should hear better with the fork by the ear rather than on the mastoid bone.
IX Glossopharyngeal	Taste	Ask the patient swallow.
	Swallowing	
	Gag reflex	
	Salivating	
X Vagus	Gag reflex	Ask the patient talk
	Swallowing	Check the gag reflex by touching the back of the tongue with the tongue blade.
	Heart rate	Ask the patient to open his or her mouth and say "Ah". Uvula should be midline and soft palate should be upward symmetrically.
	Peristalsis	
	Talking	
	Abdominal Function	
	Thoracic Functions	
XI Accessory	Rotation of head	Ask patient to shrug the shoulders while you press down on the shoulders. The shrug should be bilaterally equal.
	Moving Shoulder	Apply resistance to the side of the patient's head while the patient rotates his head against the resistance. Repeat on the other side of the head.
		Ask the patient to stick out his tongue. The tongue should be midline.
XII Hypoglossal	Moving tongue	Ask the patient to say, "Round the rugged rock that ragged rascal ran." The patient should show little problem articulating. Results are dependent on the patient's cognitive ability.
		Ask the patient to push his tongue against his cheek. Apply resistance to the cheek. The tongue should be symmetrical.

Keogh J, Neurologic Critical Care, in: Critical Care Nursing, McGraw Hill Education, US, 2013: 287-298.

Table 7: Visual field defects associated with defects on the visual system.

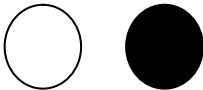



Visual Field Defect	Visual Field	Description
Anopsia		Blindness in one eye; due to complete lesion on the right optic nerve
Bitemporal Hemianopsia (central vision)		Blindness in both lateral visual fields; due to lesions around the optic chiasm such as pituitary tumors or aneurysms of the anterior communicating artery. Affected fibers originate in the nasal half of each retina.
Homonymous hemianopsia		Half blindness involving both eyes with loss of visual field on the same side of each eye; due to lesion of temporal or occipital lobe with damage to the optic tract or optic radiations (blindness occur on the side opposite the lesion; here, the lesion occurred in the right side of the brain, resulting in loss of vision in the left visual field of both eyes)
Quadrant Deficit		Blindness in the upper or lower quadrant of vision in both eyes, resulting from a lesion in the parietal or temporal lobe.

Table 8: Recognizing Pupillary Changes.

Pupillary Change	Possible Causes
Unilateral dilated (4mm), fixed, and nonreactive	<ul style="list-style-type: none"> *Uncal herniation with oculomotor nerve damage *Brain stem compression *Increased intracranial pressure *Tentorial herniation *Head trauma with subdural or epidural hematoma *May be normal in some people
Bilateral, dilated (4mm), fixed, and nonreactive	<ul style="list-style-type: none"> *Severe midbrain damage *Cardiopulmonary arrest (hypoxia) *Anticholinergic poisoning
Bilateral, midsize (2mm), fixed, and nonreactive	*Midbrain involvement caused by edema, hemorrhage, infarctions, lacerations, or contusions
Bilateral, pinpoint (<1mm), and usually nonreactive	*Lesions of pons, usually after hemorrhage
Unilateral, small (1.5mm), and nonreactive	*Disruption of sympathetic nerve supply to the head caused by spinal cord lesion above the first thoracic vertebra

Diehl TS, Neurologic System, Critical Care Nursing, Incredibly Easy, Wolters Kluwer Health, Lippincott Williams&Wilkins, China, pp.66

Evaluation of pupillary reaction to light

The technique for evaluation of the pupillary right response involves use of a narrow-beamed bright light shined into the pupil from the outer canthus of the eye [4]. If the light is shined directly

onto the pupil, glare or reflection of the light may prevent assessor’s proper visualization. Pupillary reaction to light is identified as brisk, sluggish, or nonreactive or fixed. Each pupil should be evaluated for direct light response and for consensual response [4].

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Assessment of eye movement

Extraocular eye movements are controlled by muscles innervated by cranial nerves III, IV, and VI. To test extraocular movements, the patient is asked to follow an object through six positions. A normal response consists of the eyes moving in the same direction, at the same speed, and in constant alignment. Abnormal eye movements include nystagmus or an extraocular palsy. Mild nystagmus with extreme lateral gaze may be normal. Dysconjugate gaze, in which the eyes are not aligned, is an abnormal finding (Table 8) [13].

Bilaterally dilated pupils, bigger than 5 mm, indicates meencephalon damage. Coma, atropine (for fundus oculi examination). Eye assessment; Pupil, Equal, Round, Reactive, Light, (PERRLA) method is used. The popular acronym PERRLA-pupils equal, round, and reactive to light and accommodation-is a convenient but incomplete description of pupillomotor function. It specifically omits important clinical data such as the actual size and shape of each pupil, the speed and extent of pupillary constriction, and the results of determining an afferent pupillary defect [15].

Consequently, since nurses monitor the patients closely for 24 hours, having advanced skills and knowledge in the assessment of neurological functions will be beneficial for the early detection of complications, survival, patient prognosis and increase in the life quality.

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