

**Role of Nurse In Diagnostic and  
Therapeutic Procedures In Critical  
Care Settings-Nervous System**

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“शिक्षा मानव को बन्धनों से मुक्त करती है और आज के युग में तो यह लोकतंत्र की भावना का आधार भी है। जन्म तथा अन्य कारणों से उत्पन्न जाति एवं वर्गगत विषमताओं को दूर करते हुए मनुष्य को इन सबसे ऊपर उठाती है।”

— इन्दिरा गांधी

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*“Education is a liberating force, and in our age it is also a democratising force, cutting across the barriers of caste and class, smoothing out inequalities imposed by birth and other circumstances.”*

— Indira Gandhi

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Block

# 4

## **ROLE OF NURSE IN DIAGNOSTIC AND THERAPEUTIC PROCEDURES IN CRITICAL CARE SETTINGS – NERVOUS SYSTEM**

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October, 2011

© Indira Gandhi National Open University, 2011

ISBN: 978-81-266-5693-6

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Further information on the Indira Gandhi National Open University courses may be obtained from University's office at Maidan Garhi, New Delhi -110 068 or the official website of IGNOU at [www.ignou.ac.in](http://www.ignou.ac.in)

Printed and published on behalf of Indira Gandhi National Open University, New Delhi by Prof T. K. Jena, Director, School of Health Sciences

Laser Composer: Tessa Media & Computers, C-206, A.F.E-II, Jamia Nagar, Okhla, New Delhi

Printed at : Public Printing (Delhi) Service, C-80, Okhla Industrial Area, Phase-I, New Delhi-20

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## BLOCK INTRODUCTION

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In Block 3 of the practical course 1 you have read about cardiac assessment, diagnostic procedures and therapeutic procedures. You have also identified the role of nurse in diagnostic and therapeutic procedures and the skill required in the care of patients suffering from cardiovascular problems. In this block we are dealing with nursing management of critically ill patients with diseases affecting the Nervous system. A critical care nurse has an important role in neurological assessment as well as preparing patients to undergo invasive and noninvasive diagnostic and therapeutic procedures. You being a trainee in critical care nursing definitely need to review, discuss and develop skill in assessment, preparing patients to undergo some of these procedures as well as caring for them after the procedures. In order to equip you with the above skills the following three units are included in this block:

Practical 1 deals with neurological Assessment and Monitoring

Practical 2 focuses on noninvasive Neurological Procedures

Practical 3 explains invasive Neurological Procedures



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# PRACTICAL 1 NEUROLOGICAL ASSESSMENT AND MONITORING

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## Structure

- 1.0 Introduction
- 1.1 Objectives
- 1.2 Neurological History
- 1.3 Specific Neurological Examination
  - 1.3.1 Mental Status
  - 1.3.2 Assessment of level of Consciousness - Glasgow Coma Scale
  - 1.3.3 Assessment of Cranial Nerve functioning
  - 1.3.4 Assessment of Reflexes
  - 1.3.5 Motor and Sensory Assessment
- 1.4 Format of Hourly Neurological Assessment
- 1.5 Nurses role in Neurological Examination
- 1.6 Let Us Sum Up
- 1.7 Activity
- 1.8 Answers to Check your progress
- 1.9 Glossary
- 1.10 References

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## 1.0 INTRODUCTION

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If you wish to be a critical care nurse, it is essential that you gain the skills in neurological assessment. This is necessary for assessing a critically ill neurological patient as well as any other critically ill patient with altered sensorium. This assessment helps to detect nursing problems and assess functional abilities of the patient. It also determines improvement or deterioration of his/her condition enabling nursing management of patient problems and assesses his rehabilitative potential to set realistic goals for a rehabilitative program.

How much neurological assessment should you do? In other words, to what extent should neurological assessment be incorporated into a critical care nurse's role? Nursing assessment doesn't mean that we are substituting the physician's role in medical diagnosis, but rationale use of physical assessment is made within the context of nursing.

A careful and observant nurse has many opportunities to collect data during day-to-day nurse-patient interactions. Watching a patient attend to ordinary activities (getting dressed, eating, walking etc.) can provide a nurse with information concerning the neurological functions the person may require help with, as well as functions which require more detailed testing.

This practical will provide you with the essential skills to be developed while caring for a critically ill patient with neurological disease and the clinical supervisor will guide and direct you to achieve these skills.

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## 1.1 OBJECTIVES

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After completing the practical experiences given in this practical, you will be able to:

- collect and document the Neurological History of a critically ill neurological patient;
- perform Neurological Examination in a critically ill neurological patient;
- assess level of consciousness using Glasgow Coma Scale;
- assess pupillary reaction in a critically ill neurological patient;
- list down the cranial nerves and its function;
- assess the motor and sensory power in a critically ill neurological patient;
- identify and assess the protective reflexes in a critically ill neurological patient;
- assess the functional abilities of a critically ill neurological patient;
- perform hourly neurochecks in a critically ill neurological patient; and
- identify the nurses' role in Neurological Examination.

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## 1.2 NEUROLOGICAL HISTORY

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You have already learned about basics of assessment of patients including history taking and physical examination. Let us now learn about specific neurological history taking as well as neurological examination from a nurses' point of view. Your patient may be unconscious, semiconscious, stupor, drowsy, obtunded, confused, or disoriented. If the patient is unconscious, history may be collected from immediate relatives. History and assessment both initial and ongoing, tell us about the patient's condition.

First of all, you should establish a rapport by showing expressions of concern and addressing him appropriately. You may begin with an interview of the patient to collect health history. If the patient is conscious, ask him/her the reason for present admission or else his major problems. As you listen, you may get some indication of his memory, orientation, thought process and language skills. Document your findings in the assessment sheet. Information related to symptoms, onset, progression and chronology of the event are collected and documented. You can ask open-ended questions like 'Do you smoke'? or go deep into his problems by asking him 'describe your pain'. The history taking is usually combined with a head to foot examination. Asking the patient time (time, day, month, year), place (present location, native place, city, state) and person (name, name of family members) tests patients' orientation. Past medical history, personal history, family history, drug history, allergies if any are also included. For patients with seizures, exact description from a witness is very essential. If headache is a presenting symptom, collect information about location, onset, and type of pain, duration, presence of associated symptoms, aggravating as well as alleviating factors.

If a new admission comes, in addition to observing his general behaviour, you can carry out some of the following assessment procedures to test the functional abilities. Ask him to read a newspaper (if literate) and make a rough estimate of his visual acuity, his language ability etc. You can also test his short term memory

by asking him to repeat what you have already told him a few minutes earlier, If the patient is ambulatory, ask him to stand and walk and observe his gait and coordination. In the case of bed ridden patients you can test their muscular resistance. Watch for fine motor coordination while the patient puts on his shirt buttons. If you find tremor, and if the patient complains of sensory loss and can't make fine hand movements, s/he may be helped with such activities as writing, eating and dressing. If the patient has bulbar weakness (lower cranial nerves arising from bulb shaped medulla), there is a high risk of aspiration. You can ask the patient to make swallowing movement to test bulbar weakness. Sometimes these patients may tolerate substances of thick consistency.

### 1.3 SPECIFIC NEUROLOGICAL EXAMINATION

There are different types of neurological examination. A **quick assessment** can be performed within a minute, which includes pupillary reaction to light (see section 1.3.4(a), overall responsiveness, presence and equality of extremity movement. A **limited assessment** known as screening examination is limited to an overview of all neurological components but not detailed. This usually includes level of consciousness, hand grasps, dorsi/plantar flexion, gross sensation, pupillary size and reaction to light and eye movements. A **comprehensive assessment** includes a detailed examination of all neurological components. Generally detailed neurological examination is done by the physician for which certain equipment is required. Privacy is provided and the nurse gives support. Some of the articles required for a neurological examination and their uses are given in *Table 1.1*.

**Table 1.1: Articles required for Neurological Examination**

| Articles required                   | Uses  |
|-------------------------------------|---|
| Ophthalmoscope                      | To examine the optic fundus (check for papilledema)   |
| Otoscope                            | To examine the external ear and tympanum  |
| Tongue depressor                    | To open and examine mouth and check gag reflex  |
| Pen light/Torch                     | To test pupillary reflex  |
| Wisp of cotton, pins                | To test light touch and pain sensation  |
| Tape measure                        | To measure head circumference for testing hydrocephalus, limb circumference for checking wasting of muscles |
| Tuning Fork                         | To test for hearing   |
| Knee hammer (Reflex hammer)         | To test deep tendon reflex  |
| Coffee powder, cinnamon oil         | To test for smell (when patient complains of anosmia)   |
| Test tubes with warm and cold water | To test for temperature sensation   |
| Salt, sugar                         | To test for taste   |
| Snellen's eye chart                 | To test for Visual acuity   |

When performing a neurological assessment the critical care nurse focuses on mental status, level of consciousness, cranial nerve functioning, protective reflexes, motor status and sensory function.

### 1.3.1 Mental Status

When assessing a patient’s mental status the critical care nurse tests arousal (consciousness), language and memory. Consciousness is a state of general awareness of self and the environment and ability to produce a response. The level of consciousness is evaluated by observing the patient’s response to the environment. Any change in the level of consciousness is an early sign of neurological deterioration and is one of the most important aspects of mental status assessment.

Once consciousness is established you should assess and document the patient’s orientation to place, person and time. As you listen to the patient’s talk, assess his ability to talk, fluency of speech, word finding difficulty and spontaneity of speech. Asking the patient to recall the names of three objects after a 3-minute interval assesses short-term memory. Ask questions about year of birth, childhood days, and school life tests long-term memory.

### 1.3.2 Assessment of level of Consciousness - Glasgow Coma Scale

The Glasgow Coma Scale (GCS), developed in Glasgow, Scotland, in 1974 is a standardized tool in assessing the conscious level of a patient (See *Table 1.2*). It is a simple and reliable method of monitoring level of consciousness. The GCS is especially useful for monitoring changes during the first few days after acute injury or in unstable comatose patients. The components of this assessment tool are best eye opening, best motor response and best verbal response. A consistent stimulus is used, either verbal command or painful stimuli (pressure on nail bed) to arouse a response. If the eyes are closed due to swelling, record ‘C’. Best upper limb response is tested for motor response. If the patient is having endotracheal tube or tracheostomy tube *in situ* record ‘E’ or ‘T’. An alert, oriented person gets a score of 15. Lower score indicates decreased consciousness. A score of 3, the lowest possible score indicates deep coma. Patients with a score of 8 are often unconscious and require a high standard of nursing care.

**Table 1.2: Glasgow Coma Scale**

| Best Response  | Rating Scale  | Score |
|----------------|---|-------|
| Eye opening    | • Spontaneously   | 4     |
|                | • To verbal command   | 3     |
|                | • To pain   | 2     |
|                | • No response   | 1     |
| Motor response | • Obeys verbal command  | 6     |
|                | • Localises pain  | 5     |
|                | • Flexion withdrawal to pain  | 4     |
|                | • Flexion Abnormal (decorticate-flexes elbows & wrists while extending legs ) | 3     |
|                | • Extension Abnormal (decerebrate-extends upper & lower extremities)          | 2     |
|                | • No response to pain   | 1     |

|                 |   |           |
|-----------------|---|-----------|
| Verbal response | • Oriented to time, place & person      | 5         |
|                 | • Converse but Confused/disoriented     | 4         |
|                 | • Inappropriate words                   | 3         |
|                 | • Responds with incomprehensible sounds | 2         |
|                 | • No verbal response                    | 1         |
| <b>Total</b>    |   | <b>15</b> |

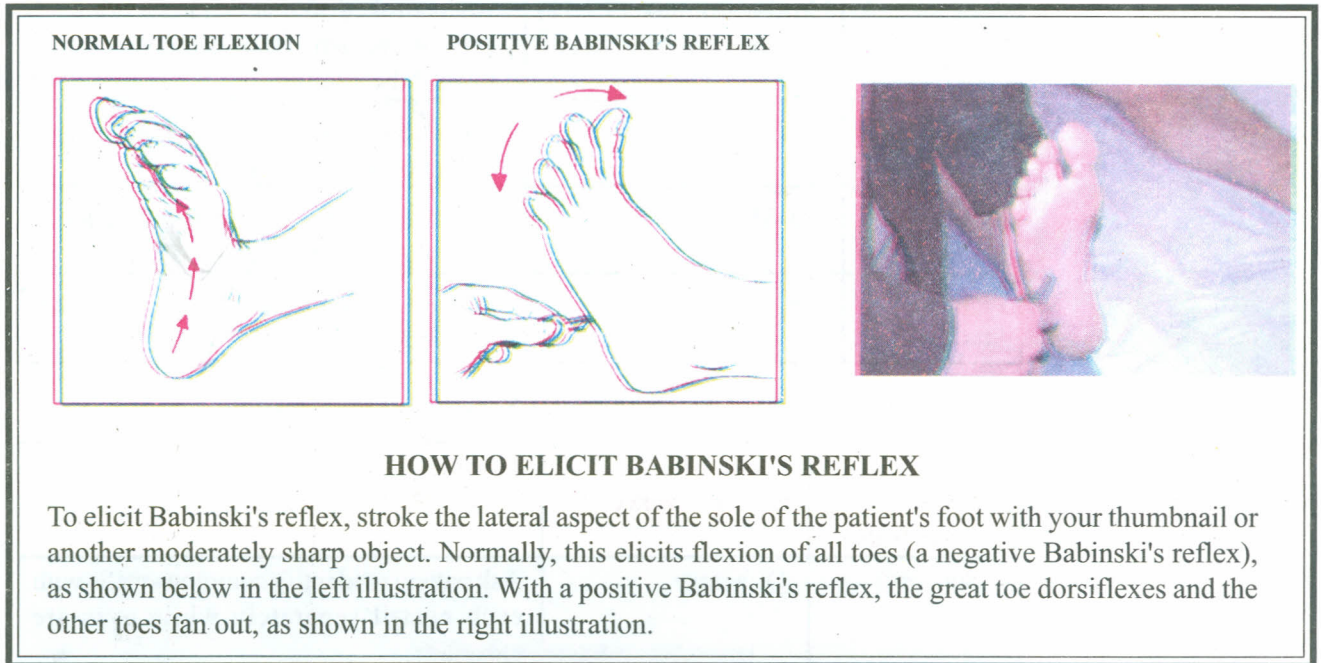


Fig 1.1: Elicitation of Planter Reflex A, Hard object is applied to lateral surface of sole B, Normal response to plantar stimulation, C Babinski reflex

### 1.3.3 Assessment of Cranial Nerve Functioning

Knowledge of the function of each of the 12 pairs of cranial nerves (See *Table 1.3*) helps the nurse in identifying the patient problems related to the cranial nerve deficit. The cranial nerves may be sensory, motor or both sensory and motor in function. You can easily remember this by learning the riddle 'Some say marry money, but my brother say bad business marry money'. Each of the 12 words in the riddle starts with an alphabet 's' or 'm' or 'b'. Here the alphabet 's' stands for sensory, 'm' stands for motor and 'b' stands for both sensory and motor. Check the type of function that is given in the brackets in *Table 1.3*.

Table 1.3: Muscle Stretch Reflexes

| Muscle                         | Nerve roots Involved | Peripheral Nerve  |
|--------------------------------|----------------------|-------------------|
| Upper Extremity                |                      |                   |
| Brachioradialis                | C-5, C-6             | Musculo Cutaneous |
| Biceps                         | C-5, C-6,            | Radial            |
| Triceps                        | C-7, C-8             | Radial            |
| Lower Extremity                | L-3, L-4             | Femoral           |
| Medial Hamstrings              | L-5                  | Sciatic           |
| Lateral Hamstring              | S-1                  | Sciatic           |
| Achilles (gastrocnemiusmuscle) | S-1, S-2             | Tibial            |

Table 1.4: Superficial Reflexes

| Muscle      | Nerve roots Involved  | Peripheral Nerve   |
|-------------|---|--|
| Corneal     | CN V and VII  | Prompt closure of both eyelids when cornea touched with wisp of cotton   |
| Pharyngeal  | CN IX and X   | Gagging response to pharyngeal stimulation   |
| Abdominal   | Epigastric (T6-)<br>Mid-abdominal (T9-11)<br>Hypogastric (T11-L1) | Contraction of the abdominal muscle when stroked so that there is a brief, brisk movement of the umbilicus toward the stimulus |
| Cremasteric | L-1, L-2  | Elevation of Testicle when inner aspect of thigh stroked   |
| Anal        | S3-S5   | Contraction of anal ring as perineum is stroked or scratched   |
| Plantar     | L5, S1  | Flexion of toes from stimulation of the sole of foot   |

Table 1.5: The Cranial Nerves and their testing

| Number (Sensory/Motor/Both) | Name of Cranial Nerves                | Testing  |
|-----------------------------|---------------------------------------|--|
| I (Sensory)                 | Olfactory                             | Ask patient to identify common smells with each nostril separately while eyes are closed.                              |
| II (Sensory)                | Optic                                 | Tests visual acuity using Snellen's eye chart.   |
| III (Motor)                 | Oculomotor                            | Tests for extraocular movements, pupillary reaction to light and accommodation, observe the patient's eyes for ptosis. |
| IV (Motor)                  | Trochlear                             | Tests for extraocular movements.   |
| V (Both)                    | Trigeminal                            | Tests Sensation over face and corneal reflex.  |
| VI (Motor)                  | Abducent                              | Tests muscles of mastication and extraocular movements – abduction of eye.   |
| VII (Both)                  | Facial                                | Test facial expression, eye closure, and taste sensation anterior 2/3 of tongue.                                       |
| VIII (Sensory)              | Vestibulocochlear (Acoustic/auditory) | Tests hearing (Rinne test, Weber's test).  |
| IX (Both)                   | Glossopharyngeal                      | Tests swallowing, and taste sensation posterior 1/3 of tongue.   |
| X (Both)                    | Vagus                                 | Tested together with IX Cranial nerve for swallowing, gag reflex.  |
| XI (Motor)                  | Spinal Accessory                      | Tests elevation of shoulder, tests resistance to head turning.   |
| XII (Motor)                 | Hypoglossal                           | Tests tongue movement sideways, Sticking out, pushing against cheek.   |

### 1.3.4 Assessment of Reflexes

(a) **Pupillary reflex** is part of III cranial nerve testing. Series of assessments are made as part of neurochecks. Examinations of the pupils include checking for size, shape, equality and light reflex. Normal pupil size ranges from 1.5 to 6 mm in diameter. The pupils are normally round with a smooth border, equal in size and are in midline position when the patient looks straight ahead. Nowadays pupillometers are available to measure exact size. Unequal pupils (anisocoria) normally occur in approximately 10% of population. Newly appearing inequality of  $>1$ mm is pathological.

(b) **The light reflexes**

(Light and accommodation reflexes, the pupil is constricted as and when exposed to light or when looking at an object that is nearby. The pupil is dilated as when light is withdrawn or when looking at an object from a distance. (From Chaffee, E.E., and I.M. Lytle 1980. Basic physiology and anatomy, Philadelphia) are tested with a bright pen light. The patient is asked to look straight at a distant point and the light is shown to each eye separately from the periphery/side to observe for direct light reflex. The ipsilateral (same side) pupil constricts briskly (direct light reflex). The contralateral (opposite side) pupil also constricts. This is known as consensual light reflex. Reaction may be brisk (normal) or sluggish (slow). Sometimes pupils may be dilated and nonreactive (abnormal finding) indicating increased intra cranial pressure and deteriorating neurological status.



Fig 1.2: Direct Light Reflex

A patient who is blind in one eye will have direct and consensual light reflex when light is shown to the normal eye and no response while light is shown to the blind eye. Both Optic (afferent) and Oculomotor (efferent) nerves are responsible for the pupillary reflex.

(c) **Corneal reflex** is tested in unconscious patients and also as part of fifth cranial nerve testing. The cornea is touched with a wisp of cotton. The normal response is immediate blinking. If the reflex is absent or diminished, give eye protection to prevent corneal abrasion and infection.

(d) **Gag and swallowing reflex** is tested before oral feeding. This involves testing of cranial nerves IX and X. The patient is instructed to swallow and observe the swallowing movement in the neck. To test the gag reflex the patient is asked to open his mouth and say “Ah”. Observe the symmetry of soft palate rise, with uvula in midline. Touching the posterior pharyngeal wall will produce a ‘retching’ response. When these reflexes are diminished or absent the patient will have difficulty handling secretions and oral intake and are at risk of aspiration. Oral feeding is contraindicated in such patients.

### 1.3.5 Motor and Sensory Assessment

The critical care nurse assesses spontaneous movement of all extremities, muscle strength, muscle tone, deep tendon reflexes, Babinski’s reflex, coordination and abnormal postures. Muscle groups are assessed for symmetry also. Muscles of major joints are tested for normal range of motion, passive range of motion, movement against gravity, and movement against resistance. For an unconscious patient, noxious stimulus is applied to elicit a motor response. For testing paralysis, lift both arms and release. You can observe that the weaker arm falls more quickly than the normal arm. Motor power is assessed and documented using a 0-5 rating scale (See Table 1.6).

**Table 1.6: Motor Power Grading Scale**

| Rating Scale   | Score |
|--|-------|
| Normal range of motion, maintains position against resistance (normal muscle strength)       | 5     |
| Normal range of motion against gravity with some resistance from the examiner                | 4     |
| Able to lift extremity off the bed, but drops it soon / can overcome gravity but no strength | 3     |
| Moves extremity in bed, but unable to raise it off the bed/ gravity eliminated movement      | 2     |
| Weak/Visible flicker of muscle contraction   | 1     |
| No detectable muscle contraction   | 0     |

Taking each extremity through passive range of motion assesses muscle tone. Normal muscle tone shows slight resistance. Limp, flabby muscles are characterized by decreased or loss of tone, so there is no resistance to movement. Increased muscle tone is characterized by spasticity and rigidity demonstrating increased resistance to passive range of motion.

Sensory assessment is performed with patient’s eyes closed and compares both sides. Light touch is tested using a wisp of cotton, superficial pain using pins, sensitivity to vibration is tested using a tuning fork; sensitivity to heat and cold is tested using test tubes filled with hot/cold water. Position sense is determined by having the nurse hold the patient’s thumb or any other finger and move the digit up or down and asking the patient to identify the position without seeing it. Two-point discrimination also is tested by touching on one or both sides of the body and asking the patient to tell whether he is touched on one side or both sides.

The assessment described in this section provides a brief neurological evaluation of a critically ill patient. Reassessment based on hospital protocol or change in the patient's condition is required. The next section provides a format of hourly neurological assessment.

## 1.4 FORMAT OF HOURLY NEUROLOGICAL ASSESSMENT

Each critical care hospital will have its own neurological assessment chart either a separate one or one incorporated to a general Intensive care chart. Documentation of the assessment findings is accomplished using a neurological flowchart and or narrative charting in the nurses notes. The components of an hourly neurological assessment for critically ill patient with neurological illness are given in *Table 1.7*.

**Table 1.7: Components of an hourly neurological assessment**

| Mental Status      | Focal Motor  | Pupils   |
|--------------------|--|--|
| Glasgow Coma scale | Move all extremities, compares strength of right and left side extremities | Size, shape, reaction to light (direct and consensual), extraocular movement |

## 1.5 NURSES ROLE IN NEUROLOGICAL EXAMINATION

The critical care nurse conducts neurological examination or assists the physician by giving explanation to the patient and supporting him. The nurse may be present during the neurological examination. She provides brief explanations, emotional support, physical support and assistance as needed. Irrespective of the role, she has to review the written findings of the examination so as to plan nursing care. For example, an ataxic patient needs supervised ambulation. The critical care nurse's assessment helps to identify abnormal functions. Her expertise evaluates the impact of these dysfunctions on the patient's activities of daily living (ADL) including the ability to care for self. For example, diplopia is an abnormal finding on assessment; however, it also may be a clue suggesting difficulty in carrying out ADLs.

Consider a patient, Mrs.P, a middle aged woman whose medical history describes her as dysphasic, cranial nerve examination describes her left visual field cut, and motor examination reveals apraxia; the nursing assessment of this patient identifies three functional problems viz., difficulty in seeing the periphery to the left, difficulty talking and expressing her thoughts and feelings, difficulty moving especially coordinating her/him movements to perform activities skillfully. Plan of nursing care include: approach her from right, keep furniture/equipment s/he needs on her right, and provide assistance in meeting ADLs like bathing, dressing, and moving as well as give attention to protect her left side.

### Check Your Progress 1

#### Fill up the blanks

- i) The cranial nerves responsible for pupillary reflex are .....
- ii) The Normal range of Glasgow Coma Scale is .....
- iii) Mental status examination includes ....., .....  
and .....
- iv) Optic fundus is tested using .....
- v) If a patient's left upper limb has normal range of motion but not against high resistance from the examiner, he gets a score of .....in motor testing

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## 1.6 LET US SUM UP

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In this practical we have discussed the neurological assessment and monitoring which is the foundational database for a critical care nurse in identifying nursing diagnosis. We have discussed certain assessment tools like Glasgow Coma Scale. It is essential that you should develop the skills and knowledge to conduct this assessment competently and engage in patient management with proper clinical reasoning. Certain new terms are clarified in glossary. You may use a Medical dictionary for further clarification of terms. However, further reading and supervised practical training is solicited to keep you updated and to develop skills for which certain references are given.

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## 1.7 ACTIVITY

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### Self Activities

- Prepare a graphic chart of Glasgow Coma Scale.
- Draw the normal pupil size.
- Enlist the major areas of neurological examination to assess functional abilities of a patient with CVA.
- Write down the names of 12 pairs of cranial nerves and indicate whether they are sensory/motor/both sensory and motor in function. Here is a clue in the bracket (Learn and remember OOOTAFAGVAH for the first alphabets of names of 12 pairs of cranial nerves).

### Supervised Activities

- Assess and compare two patients with altered sensorium-using GCS and observe the trend during one shift. (Give patient details including diagnosis).
- Discuss the meaning of commonly used words in stating the level of consciousness.
- Assess, and compare pupillary reactions in ten different patients. Identify the abnormality, if any, present and discuss possible reasons.
- Assess functional abilities/disabilities of a critically ill neurologic patient.

## 1.8 ANSWERS TO CHECK YOUR PROGRESS

### Check Your Progress 1

- i) Optic, Occulomotor
- ii) 3 – 15
- iii) Arousal (consciousness), language and memory
- iv) Ophthalmoscope
- v) 4

## 1.9 GLOSSARY

- Consciousness** : Awake, alert and oriented to time, place and person.
- Confused** : Disoriented to time, place and person, shortened attention span, has difficulty following commands, memory problems, becomes bewildered easily, may have hallucinations, and may be agitated, restless, irritable, and increasingly confused at night.
- Stupor** : Lies quietly with minimal spontaneous movement, generally unresponsive except to vigorous and repeated stimuli, incomprehensible sound and /or eye opening may be noted. S/he may responds appropriately to painful stimuli with sounds or eye opening and stops responding when stimulation ceases.
- Obtundation** : Able to arouse with stimulation, responds verbally but with few words, appears very drowsy, follows simple commands when stimulated.
- Drowsy** : Appears to be in a sleepy state, responds to call, can obey simple commands.
- Confused** : Patient may be disoriented to time and place, shortened attention span or memory difficulty, has difficulty following commands, patient's perception of stimulus is altered and may include hallucination, agitation, restlessness and irritability.
- Coma** : Unarousable, doesn't make any verbal sounds, doesn't respond to internal or environmental stimuli, withdraws nonpurposefully to painful stimuli, brainstem reflexes may or may not be intact, decorticate or decerebrate posturing may be present.
- Dorsi/plantar flexion** : Flexion toward back/sole of the foot.
- Babinski's reflex** : Is a pathologic reflex elicited by stroking the lateral aspect of the sole from heel to the ball of the foot, curving medially across the ball. The normal response is plantar flexion. Dorsiflexion of the great toe with fanning of the other toes indicates upper motor neuron disease.

|                 |   |  |
|-----------------|---|--|
| <b>ATAXIA</b>   | : | Failure of muscle coordination                                     |
| <b>ACUITY</b>   | : | Sharpness, clear vision  |
| <b>APARAXIA</b> | : | The inability to perform correct movement because of brain lesion. |

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## 1.10 REFERENCES

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# PRACTICAL 2 NONINVASIVE NEUROLOGICAL PROCEDURES

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## Structure

- 2.0 Introduction
- 2.1 Objectives
- 2.2 Noninvasive Procedures
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  - 2.2.4 Positron Emission Tomography (PET); Single Photon Emission Computed Tomography (SPECT) Scan
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## 2.0 INTRODUCTION

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In the previous unit you have learned the assessment of a critically ill neurological patient. You may know that these patients are likely to undergo certain diagnostic investigations as well as therapeutic procedures. Many diagnostic tests are available to help diagnose neurological problems. These may be noninvasive or invasive. These diagnostic procedures continue to develop further and become more sophisticated. You as a critical care nurse need to be knowledgeable as well as update your knowledge and skill to meet the demands of your patients. Patients need a general explanation of the procedure with special emphasis on what to expect and their role as participants. This practical unit will provide you with the essential skills to be developed while your critically ill patient is undergoing noninvasive neurodiagnostic procedures like Electroencephalogram, Computerized Tomography (CT scan), Magnetic Resonance Imaging (MRI) scan, Positron Emission Tomography (PET) scan, Single Photon Emission CT (SPECT) scan, Evoked Potential Studies (EPS) and Transcranial Doppler. Invasive procedures will be dealt in Unit 3 of this block. The clinical supervisor will guide and direct you to prepare patients for these procedures and to provide care to these patients. You are supposed to update yourself when newer diagnostic/therapeutic procedures come up in the clinical field by achieving and maintaining skills.

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## 2.1 OBJECTIVES

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After completing the practical experiences given in this practical, you will be able to:

- identify the major radiological studies used in the diagnosis of a critically ill neurological patient;

- explain purposes implications of the various noninvasive diagnostic procedures in neurological conditions;
- prepare the patients for non-invasive diagnostic problems; and
- provide post procedure care to patients.

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## **2.2 NONINVASIVE PROCEDURES**

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For noninvasive procedures, most of the time a contrast dye may be given with procedures like Computerized Tomography scan thus making it an invasive procedure. In such situations an informed written consent is required, depending upon the institutional policy, consent should be taken from the patient or family member (if the patient has an altered level of consciousness, cognitive deficits). It is usually the responsibility of the nurse to obtain written consent after explaining the procedure, the risks, and answer the questions. The critical care nurse has to see that the patient/family member duly signs the consent form before sending the patient for those procedures that require consent, depending upon hospital policy.

### **2.2.1 Electroencephalogram (EEG)**

An Electroencephalogram is a noninvasive, painless diagnostic procedure that records the spontaneous electrical activity of the brain using multiple scalp electrodes. The EEG provides complimentary data to anatomic imaging studies such as CT and MRI. It records the frequency, amplitude, and characteristics of brain waves. Analysis of the result tracings helps to detect and localize abnormal electrical activity occurring in the cerebral cortex.

#### **Purpose**

It aids in diagnosing particular type of epilepsy, seizure focus detection, dementia related disorders, sleep disorders and evaluation in coma states. It is an important criterion to confirm brain dead.

For patients who have medically refractory epilepsy, continuous EEG monitoring and videotaping is done for 24-48 hrs. This provides continuous data about cerebral electrical activity and behavioural changes that can be correlated to determine the type and characteristics of the seizure activity. It often is done as a pre-surgical evaluation in selected patients who undergo surgery for epilepsy.

To identify areas in the brain and provide treatment for control of seizure activity Continuous EEG monitoring is also helpful for detection of seizure activity in patients with sub clinical seizures so that prompt treatment can be given to control seizure activity.

#### **Procedure**

The patient is made comfortable in an easy chair/bed/stretchers in an EEG laboratory where absolute silence is maintained (can be done in the bed side also). A series of small electrodes (16-21) are symmetrically affixed to the scalp in standard locations with a paste like substance. A Neuro technician usually does this. EEG tracings can be recorded on special graphic paper and can be recorded on CDs that can be read and interpreted by Neurologists /Epileptologists. An EEG may be normal or abnormal (See Fig.2.1). Routinely brain waves are recorded at rest, after hyperventilation (for 2-3 minutes), with photic stimulation

and during drowsiness or sleep. Hyperventilation and photic stimulation are stressors and may precipitate abnormal focal or generalized brain waves. Sleep deprivation stresses the brain and may evoke abnormal waves not seen in normal states. The procedure generally takes 45 – 60 minutes and produces about 100 pages of recording paper. An all night EEG is useful in studying sleep disorders.

### Patient preparation

- Explain the procedure and to the client and his/her family (Printed instruction sheets are provided for elective procedure).
- Reassure the patient that he will not feel an electric shock or pain during this procedure.
- The patient's scalp and hair should be free of oil, dirt, cream and spray for accurate recordings.
- Instruct the patient to lie still during the procedure.
- Withhold anticonvulsant medications as per doctor's prescription.
- Avoid use of stimulants like coffee, tea, colas and chocolate on the previous day.
- Advise to go to sleep late on the previous night and arise early (sleep deprivation technique, if procedure is planned earlier) so that he can sleep during the procedure.
- Discourage napping before the test specially if there is long waiting time.

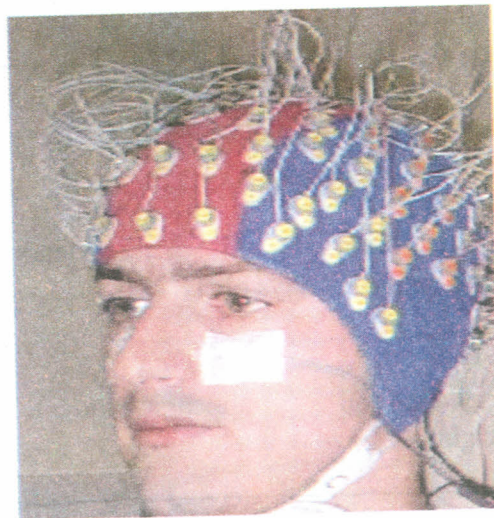


Fig.2.1a: Normal EEG tracing in an awake, interactive patient

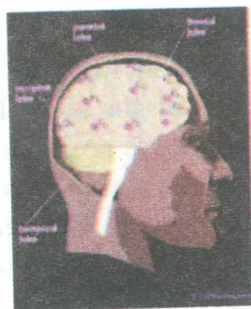
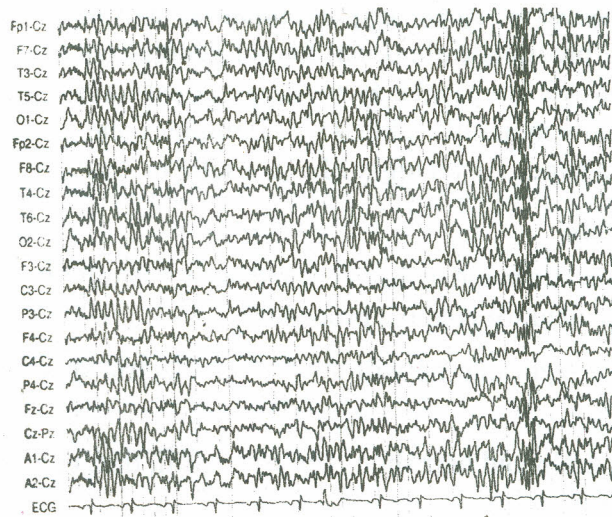


Fig.2.1 b, c: Normal EEG tracing in an awake, interactive patient



**Fig.2.1s: EEG**

**Post procedural care**

After the procedure, wipe and clean the scalp by removing the electrode affixing paste. Hair can be washed also. Resume drugs if these were withheld for EEG.

**2.2.2 Computerised Tomography (CT Scan)**

Computed tomography, give slice image of brain by sending assail x-ray beams through the headache radiation and harmless in multiple direction. Computers integrate this information and then create a composite picture of various tissue densities visualized. Brain tissue appears in various shades of gray depending on density as given in the table 2.1.

|  |                 |
|--|-----------------|
| Air (darkest) appears black            | } appears black |
| Fat                                    |                 |
| CSF and water                          |                 |
| Edematous or infractioned brain        | } appears gray  |
| Subacute hemorrhage (5 to 14 days old) |                 |
| Hemorrhage                             | } appears white |
| Intravenous contrast material          |                 |
| Bone or metal (brightest)              |                 |

Purpose: To diagnose brain lesions. It also demonstrates cerebral edema, shift of structures due to tumors, hematomas, or hydrocephalus.

**Procedure**

The patient lies on an adjustable radiographic table with his head/ body part to be scanned, carefully positioned and immobilized on the table. Fig. 2.2 The table is moved and the head/ body part to be scanned is positioned inside the scanner. A movable circular frame encircles the head and revolves around it, making a clicking sound while taking radiographic readings. The head is scanned many times at different angles to collect data. The image is displayed on a monitor and is photographed and stored digitally. The procedure is done in the imaging department and takes about 10 - 20 minutes. The patient must remain motionless during the procedure. Agitated patients may require sedation/anesthesia. CT scan is superior to Magnetic Resonance Imaging (MRI) for diagnosing skull fracture and subarachnoid hemorrhage.

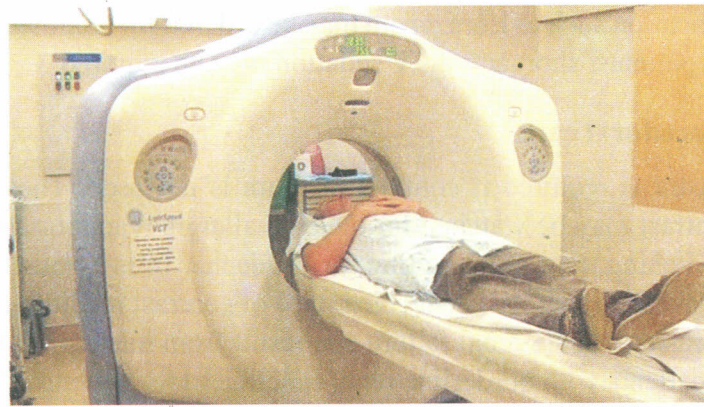


Fig. 2.2: CT Scan

- i) **CT angiography (CTA)** can be done using iodinated contrast bolus injection. High speed CT is obtained during contrast injection to visualize vessels. 3D reconstruction of data allows visualization of arterial anatomy or vascular abnormality. It can be used to assess carotid artery stenosis and to evaluate cerebral aneurysms (Fig.2.3).

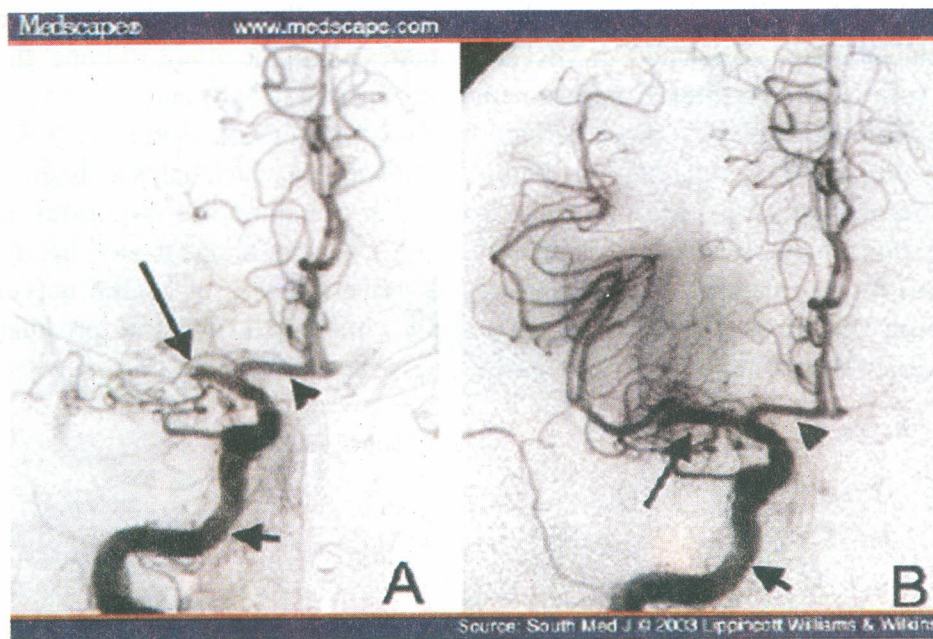


Fig 2.3: CT Angiography

**Patient preparation**

- Explain the procedure and equipment to the patient to reduce his anxiety and gain cooperation. Reassure that the procedure is painless and also that a clicking sound from the machine is normal.
- Instruct the patient to lie flat and perfectly still.
- Remove all jewellery, eyeglasses, metallic clips /pins and ornaments.
- The technician will be outside the scan room but he can see and talk to the patient.
- Fasting is generally not required except in case of contrast medium injection. Before contrast medium injection administration, perform a skin test for allergy.

- Pre medication such as Lorazepam may be ordered for anxious patients. For agitated patients, short acting IV sedation may be required.

#### b) Post procedural care

No special care is required if contrast medium is not used. Those who have received contrast may be watched for delayed allergic reactions such as hives, skin rashes, itching, nausea, vomiting, or headache. Intravenous hydration or oral fluid intake to facilitate renal clearance of contrast medium is important. Tubular necrosis or acute renal failure can result from inadequate hydration in susceptible patients with borderline renal function/older patients.

### 2.2.3 Magnetic Resonance Imaging (MRI)

MRI is a major, painless diagnostic tool for anatomic imaging of the brain and spinal cord. It uses radio frequency waves and a very strong magnetic field in combination. A selected area of the patient's body is placed inside a powerful magnetic field Fig.2.4. The hydrogen atoms inside the patient are temporarily excited and cause oscillation by a sequence of radio frequency (RF) pulsations. The sensitive scanner measures these minute oscillations and a computer-enhanced image is created. An MRI scan creates a graphic image of bone, fluid and soft tissue structures. Contrast media may be used in MRI studies also (e.g., Gadolinium). It gives a more defined image of anatomical details as well as physiological impaired function of muscles and organs which helps in diagnosis of tumor, and early infarction syndromes. It can diagnose structural and biochemical abnormalities of brain and nervous system. It also detects necrotic tissue, oxygen deprived tissue, and degenerative diseases of central nervous system. This test is contraindicated in patients with metallic implants, prosthetic valves, orthopedic appliances and pace makers (See Table 2.2).

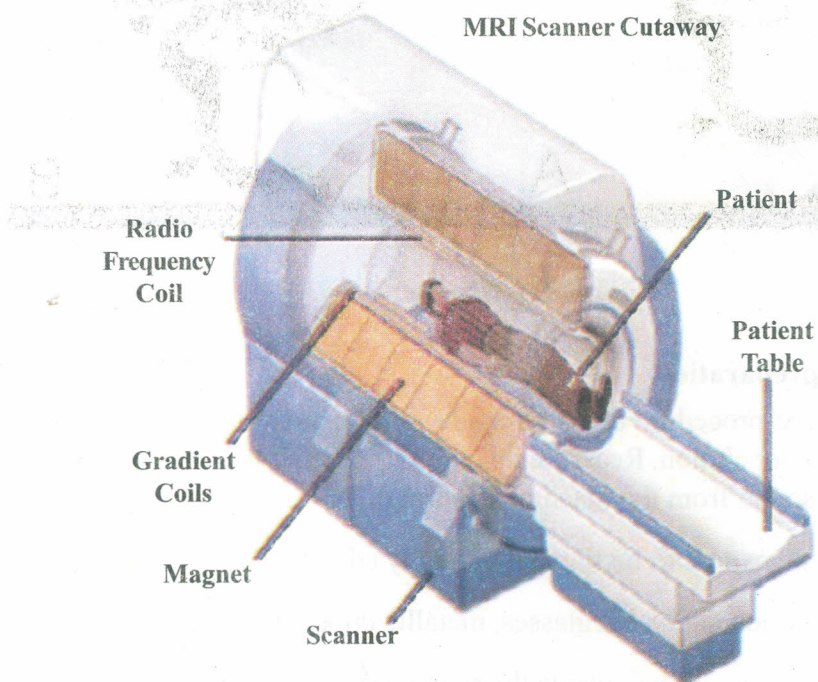


Fig 2.4: MRI

Table 2.2: Contraindications of MRI

| Purpose  | Contraindications  |
|--|--|
| <ul style="list-style-type: none"> <li>Provides detailed sagittal (right to left), axial (top to bottom of the head) and coronal (front to back of the head) images for precise lesion assessment and location.</li> </ul> | <ul style="list-style-type: none"> <li>Patients with metallic devices - pacemakers, cochlear implants, Hip replacement, orthopedic pins, artificial limbs, respirators etc.</li> </ul> |
| <ul style="list-style-type: none"> <li>Doesn't use ionizing radiation.</li> </ul>  | <ul style="list-style-type: none"> <li>Patients with older metal intracranial aneurysm clips or metal bullet fragments in the brain.</li> </ul>  |
| <ul style="list-style-type: none"> <li>Provides better tissue differentiation than CT.</li> </ul>  | <ul style="list-style-type: none"> <li>Agitated, uncooperative patient, patient with uncontrolled movement disorders.</li> </ul>   |
| <ul style="list-style-type: none"> <li>Higher level of gray-white matter contrast obtainable compared to CT.</li> </ul>  | <ul style="list-style-type: none"> <li>Grossly obese patients who can't fit into the MRI tube.</li> </ul>  |
| <ul style="list-style-type: none"> <li>Can detect very small tumors as small as 0.3mm.</li> </ul>  | <ul style="list-style-type: none"> <li>Claustrophobic patient who can't tolerate the closeness of the tube to their face.</li> </ul>   |
| <ul style="list-style-type: none"> <li>Provides high resolution details in the posterior fossa, skull base and orbits compared to CT.</li> </ul>   | <ul style="list-style-type: none"> <li>Patients who have back pain and can't lie flat and immobilized (can be done under General anaesthesia).</li> </ul>                              |

#### a) Procedure

After removing all removable metal objects from the body, the patient lies on the movable MRI stretcher that slides into a tunnel like chamber. The head and arms are positioned and strapped to avoid movement. During the scan noise caused by the pulsating RF waves is heard. Although the patient is alone in the MRI room, the technician can talk to the patient through an intercom. The MRI takes approximately 30 – 50 minutes.

- i) **Magnetic Resonance Spectroscopy (MRS)** is a noninvasive method of studying the biochemistry of brain tissue. It evaluates proton-containing compounds within the brain tissue and provides neurochemical data about normal or pathologic tissue.
- ii) **Functional MRI (fMRI)** is a tool for pre surgical brain mapping. It can map functional cortical activity while performing certain tasks by detecting regional tissue changes in venous blood oxygenation.
- iii) **MR angiography (MRA):** It is same as MRI but with use of gadolinium as I/v contrast to evaluate arterial diseases. It uses differential signal characteristics of flowing blood to evaluate cerebral vessels.

#### b) Patient preparation

- Carefully question and screen the patient for the presence of any metallic implants.

- Explain the procedure and the need to lie still in a large tunnel like structure for about half an hour to forty five minutes.
- Anti anxiety medication may be necessary or sometimes the procedure is done under general anesthesia.
- Inform the patient that the procedure is very noisy.
- Remove all jewellery, eyeglasses, hair clips and pins and all removable metal objects with magnetic characteristics from the patient and bystander in the scan room (Bystanders are allowed sometimes with patients who are claustrophobic).
- Fasting is generally not required except in case of contrast medium injection. Before contrast administration, do a skin test for allergy. Verify renal function through checking Blood urea nitrogen and creatinine level.

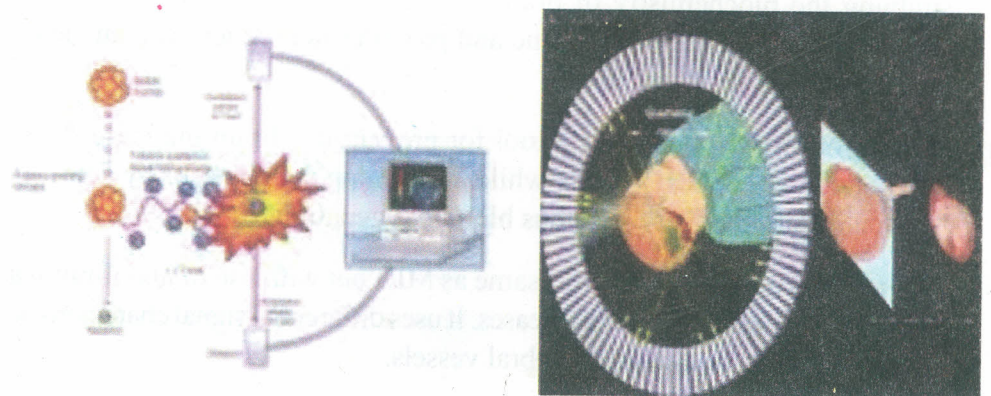
**c) Post procedural care**

No special care is required if contrast medium is not used. Intravenous hydration or oral fluid intake to facilitate renal clearance of contrast medium is important. All other care is similar as in CT scan.

**2.2.4 Positron Emission Tomography (PET); Single Photon Emission Computed Tomography (SPECT) Scan**

The major physiologic neuroimaging studies are Positron Emission Tomography (PET) and Single Photon Emission Computed Tomography (SPECT) Scan. PET uses positron-emitting radionuclide and SPECT uses single photon radioisotopes.

The patient either inhales or receives an IV injection of a compound that has been labeled with the emission of Positron 'tag' (F-fluorodeoxyglucose (FDG)). Once inside the body, the tag concentrates in the area of clinical interest and emits positrons (Fig. 2.5a). A gamma scanner measures the radioactive uptake of these substances, and a computer produces a composite image, indicating where the radioactive material is located, corresponding to areas of cellular metabolism.



**Fig 2.5a: Positron Emission Tomography (PET)**

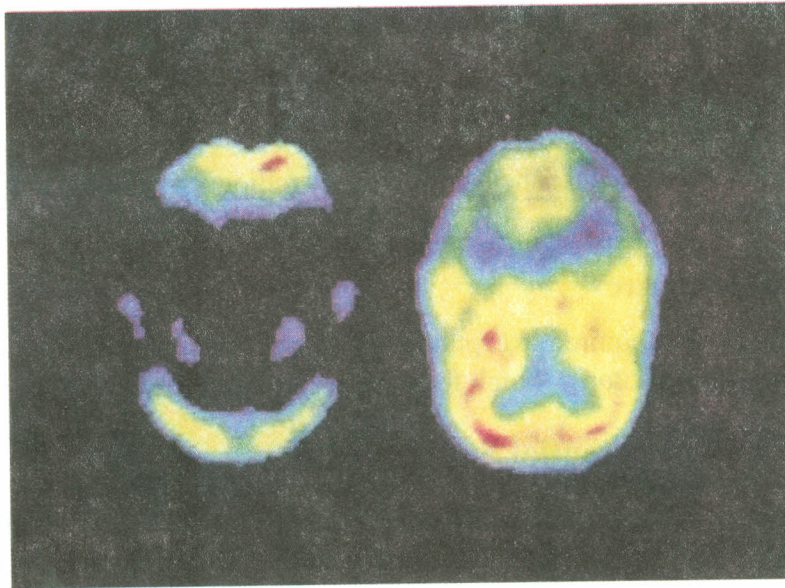


Fig. 2.5 (b): Positron Emission Tomography (PET)

### **Purpose**

To evaluate cerebral metabolism and cerebral blood flow identify morbid Pathophysiology in the brain.

To measure regional physiologic functions such as glucose uptake and metabolism, oxygen uptake and cerebral blood flow patterns.

To diagnose abnormalities (tumors, vascular disease/stroke), seizure foci and metabolic changes in Alzheimer's disease, other behavioural disturbances such as dementia and mental illness like schizophrenia.

### **Steps of Procedure of Positron Emission Tomography (PET)**

The patient is placed on a stretcher in the imaging center.

An arterial line is inserted to draw blood samples for measurement of cerebral metabolic rates.

The FDG/Isotope is given. The patient rests for about 45 minutes in a quiet dimly lit room while uptake of the agent occurs.

The head is placed in the scanner and the scanning takes another 45 minutes.

The patient may be asked to perform cognitive acts such as speaking, calculations etc.

The entire procedure takes about 2 – 3 hours.

In the case of SPECT the scanning is done within 1 hour of administration of isotope and the entire study takes about 1-2 hours.

### **Preparation of the Patient**

Explain the procedure and win the cooperation of the patient.

Tell the patient not to consume caffeine, alcohol or nicotine for 24 hours before the procedure.

Maintain NPO status for 6 –12 hours.

Do not give any glucose solutions in PET scan.

The patient must remain still and immobile.

Explain that he may experience dizziness, light headedness and headache during the Testing procedure may take a few hours.

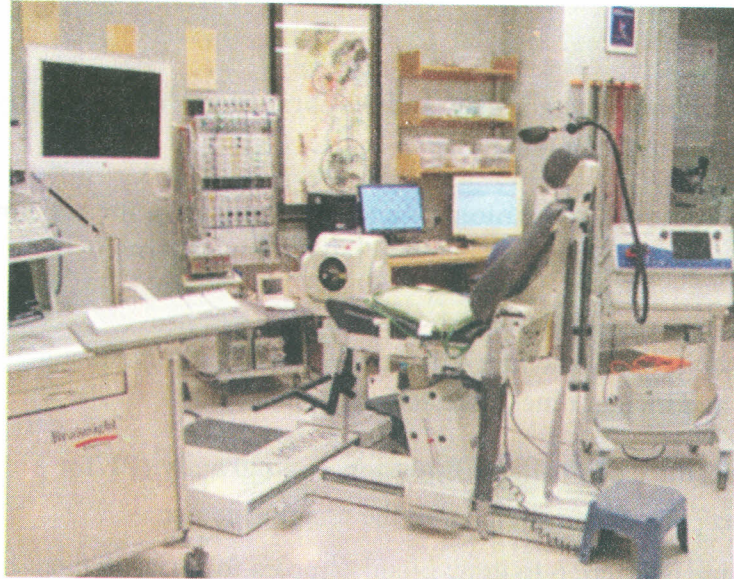
Minimal radiation because the half-life of the radionuclides used is from a few minutes to 2 hours.

### **Post procedural care**

No special care is required except encouraging the patient to consume copious fluids to clear the isotope. Watch for allergic reactions after SPECT.

## **2.2.5 Evoked Potential Studies (EPS)**

This noninvasive study assesses functional integrity of the brain through sensory stimulation and measuring the minute electrical potentials that are created through electrodes applied over the scalp. Evoked changes are detected, displayed on an oscilloscope and can be stored in a magnetic tape or disc. The stimulus is repeated several times and the computer then calculates the average curve (Fig.2.6).



**Fig. 2.6: Evoked Potential Studies (EPS)**

### **Purpose**

EPS is a diagnostic aid for detecting lesions in cerebral cortex, ascending pathways of spinal cord, brain stem and thalamus.

It is an adjunct in diagnosing neuromuscular disorders and aids in evaluating comatose patients.

It provides intraoperative monitoring to minimize functional damage. It also evaluates visual and auditory acuity in patients unable to cooperate because of age or classification of EPS. EPS are classified into three categories based on the type of stimulus provided and the sensory system stimulated. The three sensory systems used in EPS are the **visual, auditory, and somatosensory pathways.**

**Visual evoked potentials (VEP):** In Visual evoked potentials (VEP), monocular view of checkerboard pattern on a TV monitor/flashing light is given as a stimulant. Each eye is tested separately. The retina is stimulated, allowing the

visual pathways to carry those potentials to the visual cortex in the occipital lobe to be evaluated. The response is recorded with electrodes over the occipital region. If the patient uses eyeglasses it should be worn during the procedure. The cooperation of the patient is necessary during the testing. Helps in diagnosing optic neuritis.

**Brainstem Auditory Evoked Response (BAER):** In Brainstem auditory evoked potential (BAEP) repetitive clicks vary in rate, intensity and duration and are heard through earphones and sequential activation of sub cortical auditory pathways is measured. These are primarily used for following purposes:

**Diagnosis** brain stem function (can be conducted on alert or comatose patients).

It is helpful in diagnosing lesions in multiple sclerosis, acoustic neuroma, and hearing loss.

BAER is also used intraoperatively to monitor the eighth cranial nerve for surgical injury.

**Somatosensory Evoked Potential (SSEP):** In Somatosensory Evoked Potential (SSEP), a peripheral nerve is stimulated. Either the median nerve in the upper extremity or the posterior nerve in the lower extremity is used for following purposes:

It is helpful in evaluating spinal cord function, sensory dysfunction associated with multiple sclerosis.

To diagnose nerve root compression.

### 2.2.6 Transcranial Doppler

This is a noninvasive diagnostic technique using ultrasound and Doppler to measure and record the blood flow velocities of intracranial vessels. A hand held Doppler probe emits a pulsed beam; moving red blood cells within the blood vessels reflects the signal. The probe is held over thin areas of skull bones (temporal, orbital area) (Fig. 2.7). The purposes of this test are as follows:

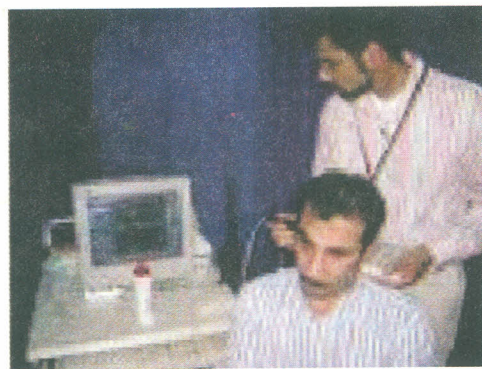


Fig. 2.7: Transcranial Doppler

To assess vasospasm in patients with subarachnoid hemorrhage, and blood flow in ischemic stroke or other vascular diseases. To provide anatomical imaging of blood vessels combined with hemodynamic information like direction of blood flow, pulsatile rhythmicity, and resistance to flow.

## 2.3 NURSES ROLE IN NONINVASIVE NEURODIAGNOSTIC PROCEDURES

Conscious patients need to be explained that it is a noninvasive painless procedure and water soluble contact jelly is used which can be wiped off after the test.

The nurses' role in neurodiagnostic testing involves patient and family preparation and monitoring the critically ill patient for potential complications during and after the procedure. Nurses must be knowledgeable about all these procedures and related care and also be sensitive to the anxiety or fear of the patient and family for whom this may be a new experience.

Appropriate emotional support and patient education is provided so that the patient and family's anxiety is relieved and cooperation is achieved.

Transfer the patient to the neuroimaging department or even out of the institution, for tests, depending on the institutional policy. Ensuring patient safety during transportation is also the responsibility of the nurse.

Monitors the patient during the procedure, and be alert for complications related to patient position of the procedure, for example in a spinal cord injury patient, care should be taken to ensure stabilize patient's neck by a hard cervical collar and log rolling during testing.

Help the patient to lie quietly and follow instructions. Administration of ordered sedation before and during the procedure is necessary and document it.

### Check Your Progress 1

i) List down the noninvasive diagnostic procedures in neurology.

- 1) .....
- 2) .....
- 3) .....
- 4) .....
- 5) .....
- 6) .....
- 7) .....

### Activity

Prepare an instruction sheet to be given to a patient undergoing Electroencephalogram (EEG).

.....  
.....  
.....  
.....  
.....

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## 2.4 LET US SUM UP

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In this unit we have learnt about the noninvasive diagnostic procedures in Neurology. We have identified the major radiological studies used in the diagnosis of neurological diseases and also described the indications, procedures and clinical implications of the various noninvasive diagnostic procedures in neurology. The critical care nurses' role in caring these patients also are discussed. Certain new terms are clarified in glossary. You may use a Medical dictionary for further clarification of terms. However, further reading and supervised practical training is solicited to keep you updated and to develop skills for which certain references are given.

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## 2.5 ACTIVITIY

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- 1) Prepare an instructional material to be used as a guide line for patients undergoing C T Scan.
- 2) Prepare an instructional material for patients undergoing MRI study.
- 3) Write indications, observe patient undergoing MRI, record the findings and provide appropriate nursing care.
- 4) Select four patient each for the following noninvasive procedures and do the following:
  - a) Preparation of patient
  - b) Indication for procedure
  - c) Observation during procedures
  - d) Post Procedural care
  - e) Record the findings
- 5) Visit an imaging unit and visualize CT scan and MRI scan and write your observations.

### SUPERVISED ACTIVITIES

- i) Give pre-procedural explanation to a patient undergoing any one of the noninvasive procedures.
- ii)
  - Instruct patient to clean the hair and to refrain from using any hair spray.
  - Under medical supervision the patient should avoid sedative, anticonvulsant, anxiolytics alcohol, and stimulants such as caffeine and nicotine for 24 to 48 hours before the test.
  - Instruct patient to limit sleep to 5 hours for adult and 7 hours for child the night before the study.

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## 2.6 ANSWERS TO CHECK YOUR PROGRESS

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### Check Your Progress 1

- i) List down the noninvasive diagnostic procedures in neurology.
- 1) EEG
  - 2) CT scan,
  - 3) MRI scan
  - 4) PET scan,
  - 5) SPECT scan
  - 6) EPS
  - 7) Transcranial Doppler
- ii) • Instruct patient to clean the hair and to refrain from using any hair spray.
- Under medical supervision the patient should avoid sedative, anticonvulsant, anxiolytics alcohol, and stimulants such as caffeine and nicotine for 24 to 48 hours before the test
  - Instruct patient to limit sleep to 5 hours for adult and 7 hours for child the night before the study.

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## 2.7 GLOSSARY

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- Refractory epilepsy** : Patients with uncontrolled seizures or those who develop intolerable side effects that interfere with their quality of life, despite maximally tolerated trials of one or more antiepileptic drugs are considered to have refractory epilepsy. Such patients are considered for presurgical evaluation for epilepsy surgery.
- Dementia** : It is a generic term that indicates a deterioration of memory and other acquired higher cognitive abilities from a normal premorbid level of intellectual and social functioning. One of the major causes of dementia is Alzheimer's disease.
- Photic stimulation** : A technique used during EEG recording to trigger seizure activity. It is applied by focusing a flickering light (strobe light) on the closed-eyed patient while recording the EEG.
- Claustrophobia** : Intense fear towards narrow/closed space.
- Log rolling Method** : This is a technique of position change used in patients with a spinal cord injury. To avoid additional injury without flexing spinal column the nurses roll the patient as if he is a single piece of log (wood). A draw sheet may be used to facilitate the procedure.

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## 2.8 REFERENCES

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- 2) Explain about the duration of time which is 30-60 minutes.
- 3) Hickey JV. *The Clinical Practice of Neurological and Neurosurgical Nursing*. Philadelphia: Lippincott Williams Wilkins. 2003, p.93-115.
- 4) Inform and reassure the patient
- 5) Instruct patient that he or she may be asked to alter breathing, follow simple commands like opening, closing, blinking or swallowing, stimulated with bright light or given drug to induce sleep.
- 6) Morton PG, Fontaine DK, Hudak CM and Gallo BM. *Critical Care Nursing*. Philadelphia: Lippincott Williams Wilkins. 2005, p.765-774.
- 7) Obtain medication history
- 8) Smeltzer SC, Bare BG, Hinkle JC and Cheever KH. Brunner&
- 9) Suddarth's *Textbook of Medical-Surgical Nursing*. New Delhi: Wolters Kluwer (India Pvt. Ltd.), 2009. p.2152 – 2156.

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# PRACTICAL 3 INVASIVE NEUROLOGICAL PROCEDURES

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## Structure

- 3.0 Introduction
- 3.1 Objectives
- 3.2 Lumbar Puncture
- 3.3 Cerebral Angiography and Digital Substract Angiography
- 3.4 Contrast Enhanced Computerized Tomography and Magnetic Resonance Immaging
- 3.5 Electromyography and Nerve Conduction
- 3.6 Let Us Sum Up
- 3.7 Activity
- 3.8 Answers to Check Your Progress
- 3.9 Glossary
- 3.10 Reference

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## 3.0 INTRODUCTION

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We know that the brain is so complex and inaccessible that indirect techniques are used to study the nervous system. But today modern techniques that help for more direct visualization of the brain, which makes it possible for the physician accurately diagnose and treat the patient.

Modern imaging technology has revolutionized neurodiagnosis. Most of the diagnostic tests can be performed as outpatient procedures.

For our discussion, neurodiagnostic tests can be broadly classified as noninvasive and invasive. You have already learnt that noninvasive technique doesn't require penetration of the body.

An invasive technique involves puncture or incision of the skin or insertion of an instrument or injection of foreign material into the body.

Here in this unit we are going to learn in detail about lumbar puncture, cerebral angiography and contrast enhanced CT and MRI. We will be mainly focusing on the preparation of the patient for these procedures and how to take care of them after Lumbar puncture and angiography. You have to recall what you have learned about CT and MRI in unit 2. You should refer Annexure 1 for additional inputs.

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## 3.1 OBJECTIVES

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After completing this practical, you will be able to:

- prepare patient physically and psychologically for undergoing invasive neurodiagnostic procedures;
- assemble appropriate articles required for lumbar puncture;
- perform focused assessment of the patient undergoing invasive diagnostic procedures;

- identify post procedure complications; and
- provide appropriate nursing care after the procedure.

### 3.2 LUMBAR PUNCTURE (SPINAL TAP)

#### Definition

It is a procedure in which a hollow needle and stylet is introduced into the subarachnoid space at Lumbar 4 or Lumbar 5 level of the spinal cord. It is done for diagnostic and therapeutic purposes.

- Indications for Measure cerebro spinal fluid pressure
- To assist in the diagnosis of subarachnoid hemorrhage, meningitis or encephalitis in febrile patients ; acute or chronic demyelinating diseases as Guillain-Barre syndrome, multiple sclerosis, malignancies and unexplained neurologic disorders when the CT scan findings are negative.
- To Evaluate of the canal for the presence of cerebro spinal fluid blockage.
- Introduction of local anesthetic to induce spinal anesthesia.
- Placement of a small amount of patient's blood in the epidural space to form an autologous epidural blood patch to prevent CSF leak.

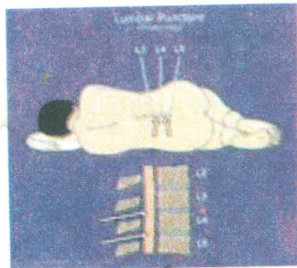
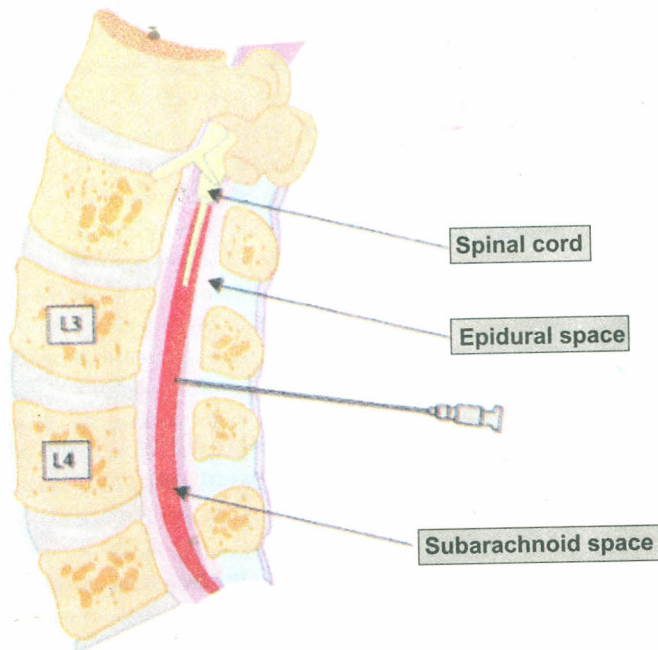


Fig. 3.1a, b,c: Lumbar Puncture (Spinal Tap)

### Contraindications

- Increased intracranial pressure (if performed in patients suspected of having increased ICP, there is chance of herniation of brainstem, coma and death).
- Presence of localized sepsis at the intended puncture site.
- If myelogram or air encephalogram is planned.
- In patients who are on anticoagulation and thrombocytopenic drugs; (due to chance of spinal epidural hematoma).

### Equipments

- 1) Lumbar puncture tray (sterile) containing;
  - 20 gauge  $\times$  3 ½ inch spinal needle with stylet
  - extra spinal needle
  - 3ml syringe with 23 gauge needle for local anesthesia
  - sterile drape and towels
  - specimen bottles
  - manometer with three way stop cock
  - sterile swabs & two artery forceps
  - 4 $\times$ 4 gauze sponge.
- 2) Local anesthetic agent (1% xylocaine)
- 3) Surgical mask
- 4) Sterile gloves
- 5) Providone iodine solution
- 6) Tr. Benzoin
- 7) Emesis bowl

### Preparation of patient

As the decision to perform an L-P is made, explain to the patient the purpose and need of the procedure. An informed consent must be obtained as per the hospital policy.

- Ensure the bladder and bowel is emptied out before the procedure.
- Instruct patient to be still during the procedure.
- Assemble all the needed equipment at the client's bed side. Provide a mask and gown to doctor. Have laboratory request forms and a marking pencil available to label the samples of spinal fluid. If CSF has to be sent for bacterial study, label the CSF specimen and transport immediately.
- A blood glucose level test is to be performed to rule out symptomatic hypoglycemia and as a baseline to compare with CSF glucose level.
- Privacy may be provided either by closing the door or having curtains or screen.

**Procedure fig.**

- Position the client on the side with the back close to the edge of the bed (Fig. 3.1a,b,c) pillow can be placed under the flank, between the knees and under the head to keep the spine in horizontal position.
- Ask the client to draw the knees up to the abdomen and the chin onto the chest. This position is to be maintained throughout the procedure. It helps to separate and increase the space between the vertebrae and make the needle insertion easy.
- The nurse must stand in front of the client, placing one hand behind the clients knees and the other around the neck.
- A sitting position with head and arms resting over a padded bedside table may also be done in obese persons and in those who have bony deformities.



**Fig. 3.2: Carotid Doppler imaging**

- Anesthesia to desensitize the part.
- Pat the sterile drape to the patients back.
- Infiltrate the skin and the subcutaneous tissue and the interspinous spaces with anesthetic solution.
- Insert the spinal needle with the stylet midway between the two vertebrae, aiming towards the umbilicus. Advance the needle 1 ½ to 2 inches, when a resistance is felt. Further advance the needle a few more millimeters until a 'give or pop' is felt as the needle enters the subarachnoid space.
- Remove the stylet, observe the flow of CSF.
- Attach the stopcock and the manometer to the needle. Record initial or opening pressure. There should be fluctuations with respirations and an increase with abdominal pressure. Instruct patient to slowly straighten lower extremities to provide an accurate reading. Normal pressure is 80-150 mm H<sub>2</sub>O. If there is blockage in the spinal canal, CSF pressure may not oscillate.
- Collect specimens in a series of small sterile test tubes, numbered in the sequence of collection (No.1, No.2 etc). 2 to 3ml may be collected in each tube. 8 to 10ml may be removed totally.
- Withdraw the needle and apply a sterile dressing over the puncture site.



|                   |  |   |   |
|-------------------|--|---|---|
| White blood cells | 0-6 mm <sup>3</sup>  | 10 mm <sup>3</sup> (Cell counts range from below 100 to many thousand depending on causative factor, all are abnormal findings) | Occurs in many conditions<br>Bacterial infections of meninges<br>Viral infections of meninges<br>Neurosyphills<br>Tuberculosis meningitis<br>Metastatic neoplastic lesions<br>Parasitic infections<br>Acute demyelinating diseases<br>Following introduction of air or blood into subarachnoid space  |
| Protien           | 15-45 mg/100 ml (1% of serum protien)                      | <10 mg/100 ml<br>>60 mg/100 ml  | Occurs in many conditions<br>complete spinal block<br>quillainbarre syndrome,<br>carcinomatosis of meanings,<br>Tumor close to pail or ependymal surfaces, or in cerebellopositive angle,<br>Acute and chronic meningitis<br>Meningeal hemorrhage<br>Demyelinating disorders<br>Degenerative diseases |
| Glucose           | 50-75 mg/100 ml (approximately 60% of blood glucose level) | <40 mg/100 ml   | Acute bacterial meningitis<br>meningeal carcinomatosis  |
| Chloride          | 700-750 mg/100 ml 125 mm                                   | <625 mg/100 ml<br>>800 mg/100 ml  | Hypochloremia<br>Tuberculous meningitis<br>Not of neurological significance<br>Correlated with blood levels of chloride   |

**Check Your Progress 1**

i) Name the conditions where Lumbar puncture is contraindicated.

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ii) Write post procedural care of patient undergoing lumber puncture.

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### 3.3 CEREBRAL ANGIOGRAPHY

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It is an invasive radiographic technique used to evaluate cerebral vasculature. (Extra and intracerebral).

#### Purpose

- To visualize about the lumen of the vessels and vessel size of cerebral vasculature
- To diagnose an aneurysm, arterio-venous malformation or occlusion
- To evaluate the effectiveness of surgical vascular interventions
- To treat aneurysms or fistula with balloons or coils.
- To assess effectiveness of vascular surgery

#### Patient preparation

- Assess patient for any bleeding disorders and history of allergy to iodine – based dye.
- Ask for any recent intake of aspirin or anticoagulants.
- Get an informed consent signed
- Explain the purpose of entire procedure to the patient and the risk involved.
- Keep the patient on NPO status from the previous midnight onwards.
- Keep the patient well hydrated before the test to facilitate dye dilution and renal excretion.

#### Post Procedural Care

- Check the site of injection for the presence of haematoma
- Assess all the peripheral pulses and temperature of the extremities and mark the areas where pulse is felt.
- Perform complete neurological assessment before and after the procedures.
- Remove dental prosthesis
- Sedative may be administered before taking the patient to the radiology department.

#### Procedure

- Keep the patient in supine position on the x-ray table.
- Prepare the site of catheter insertion; usually the femoral artery is used.
- Shave the area, cleanse with iodine solution and drape with sterile towels.
- Inject local anesthetic agent at the catheter insertion site.
- The radiologist inserts a needle into the femoral artery. Then a soft tip guiding wire is inserted through the needle into the artery.
- Insert the catheter into the femoral artery over the wire and pass up to the desired artery, usually the common carotid artery. The passage of the catheter will be visualized using fluoroscopy.

- Inject radio opaque contrast (6-8ml) material into the catheter several times. The patient usually experiences an intense hot flushed feeling in the neck, face and head. Tell the patient that this feeling will disappear within minutes.
- A series of radiographs are taken to follow the flow of the contrast material through the vessels.
- Once the injections are completed, remove the catheter, apply direct pressure for more than 15 minutes over the puncture site and apply a dressing.
- The procedure usually takes 60 to 120 minutes. Before 1980s the images were taken by film. Imaging now is done using digital means (without film).

You might possess a digital camera, with which photographs are taken. You don't have to load it with film roll. X-ray machines which are coupled with a digital camera and computer is available now. These systems display the 'subtracted image' i.e., made from two images; one just before the contrast was injected and one with the contrast in the artery.

### **Complications**

- Hematoma formation
- Vasospasm
- Dissection of vessels due to catheter insertion
- Infection at the catheter site
- Embolism secondary to trauma inside the vessel wall
- Atherosclerotic plaque may also become dislodged resulting in transient ischemic attacks.

### **Post procedural care**

- After performing a neurological assessment the patient will be taken back to the nursing unit.
- Keep the patient on complete bed rest for several hours.
- Instruct him to keep the leg straight and immobilize the leg during bed rest.
- Check the extremity for adequate circulation. The skin colour and temperature, pulses distal to the injection site and capillary refill are to be checked.
- Observe the vital signs every 15 minutes for one hour or until the patient is stable, and every hour until a 12 hour period is complete.
- Assess the neurological status every hour.
- Encourage patient to increase fluid intake after the test, to help kidneys clear the dye.
- Apply ice packs to the injection site to reduce local edema.
- Check the site for evidence of bleeding and hematoma.
- Observe the patient for delayed reaction to the dye, including itching, rashes, hives or dyspnoea.

Angiography is the most important diagnostic test to detect cerebral arterial and venous supply of the brain. Pioneered by Dr. Egas Moniz in 1927, it is now the gold standard for detecting vascular problems of brain. Apart from the uses of angiography mentioned earlier in some countries, it is required to confirm brain death.

### Digital Angiography

**Definition** – DSA is a computer assisted radiographic proceed for visualization of the carotid and other cavernous fisluta

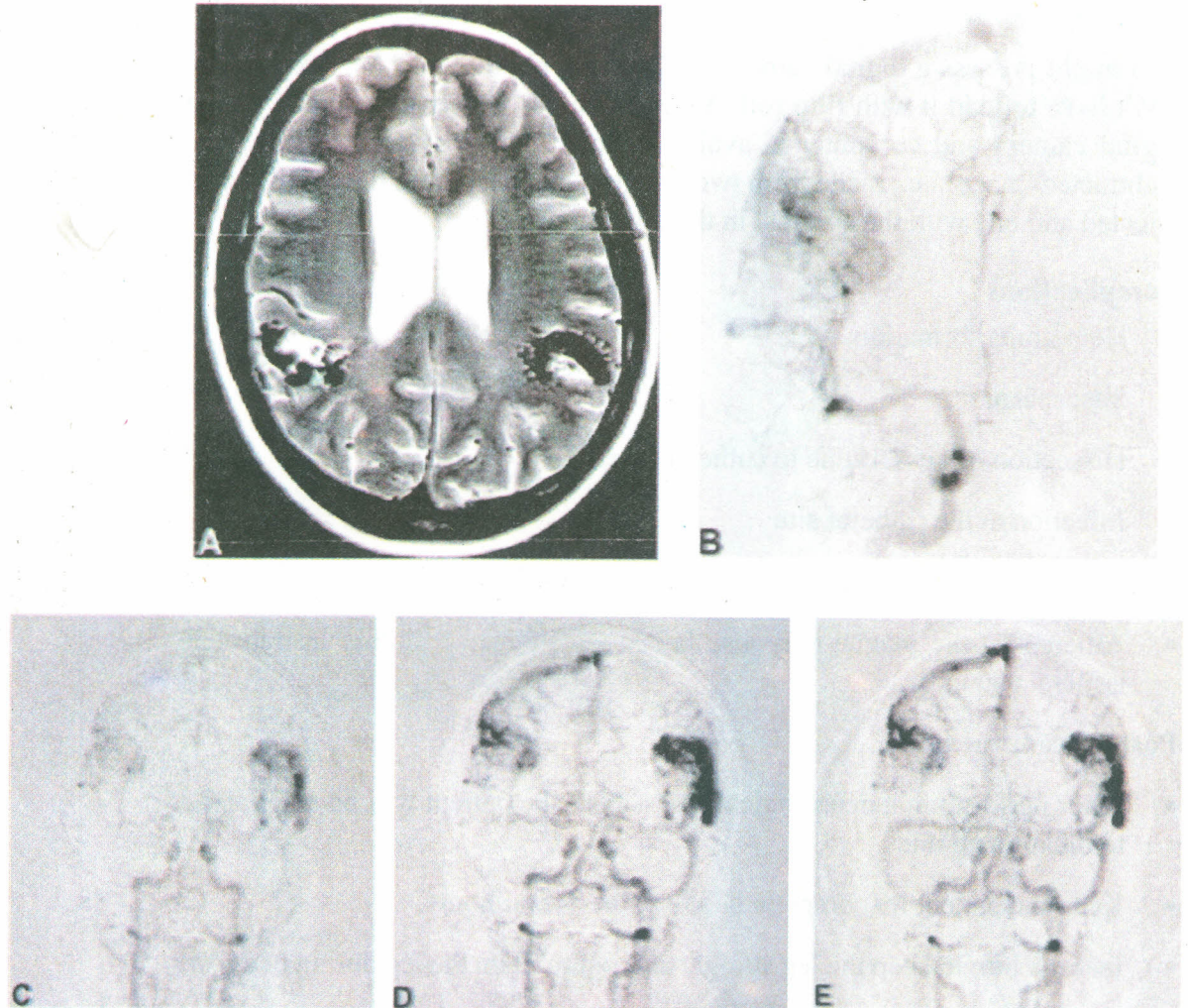


Fig. 3.3: Digital subtraction Angiography

### Overview of Digital Substract Angiography DSA

- The image produced is distinct by elimination of surrounding structure.
- This is accomplished by reloading images before and after injection of control medium and substrng the front image.

### Purpose Digital Substract Angiography (DSA)

- To diagnose atherosclerotic disease of brain (stenosis & occlusion).
- To visualize vascular lesions like (AV malformation annexure and carotid cavernous fistula).
- To make post operative evaluation of anastomosis, aneurysms, clipping and AVM repair.

### Preparation of Patient

- Explain the procedure to the patient
- Oral intake is withheld for 2 hours prior to the procedure
- Check /the enquire /patient for any allergic reaction to iodine or contrast medicine.
- Explain to the patient to hold the breath on command, remain breath on command, remain motionless and lie in supine position at the X-ray table.

### Procedure of Digital Substract Angiography (DSA)

- Clean the antecubital area/assist the Doctor on injection lidocaive locally for incision.
- A catheter is advanced into superior vena cave and content medium is injected and selected vessels are visualized with an image intensifier video system that displays vessels on a T.V. monitor.
- The pictures are taken and stored on magnetic tape.
- The images which are collected before contract injection by the computer are subtracted from those taken after from those taken after injection, so that the desired area is enhanced. Images can be manipulated by the computer to focus on specific problems that might otherwise not be visualized.

### Post Procedural Care of Digital Substract Angiography (DSA)

- Check the vitals of your patient, and look for any allergic reactions, haematoma at the injection site and infection.
- Encourage him to take more fluids (2000 to 3000 ml) in 24 hours for excretion of contrast medium.

### Check You Progress 2

i) Define cerebral angiography.

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ii) List 3 uses of cerebral angiography.

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iii) Explain the preparation of patient for angiography.

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iv) List 3 complications of cerebral angiography.

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v) What is the reason for increasing fluid intake after angiography?

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### 3.4 CONTRAST ENHANCED COMPUTERIZED TOMOGRAPHY AND MAGNETIC RESONANCE IMAGING

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You have already learnt in detail about CT and MRI in unit 2, which are noninvasive diagnostic test. When CT and MRI become invasive that is, if contrast material is injected intravenously while performing CT or MRI, the procedure becomes invasive. Contrast enhanced CT is especially useful in locating and identifying tumor type and masses.

#### **Patient preparation: contrast enhanced CT and MRI**

- Iodinated contrast agents are used to increase tissue density.
- Patients who are required to have a contrast scan should be questioned about any history of allergy to iodine based dye or shell fish.
- Patients may be instructed not to eat or drink 2-3 hours before the scan.
- Explain clearly to the patient that there is chance of developing a warm feeling, nausea or slight headache after the injection of the contrast.
- Administration of the contrast is being done in the scanning room itself.

### Post procedural care

Once the patient returns from scanning he can normally assume usual activities without restriction.

- Encourage to drink more fluids to help the body to remove the contrast.
- Nausea, vomiting and a heat sensation may be the usual complaints of patient.
- Signs of allergic reaction to the contrast must be watched for flushing, rash and itching.
- Some patients may develop an anaphylactic reaction, manifested by respiratory distress a drop in blood pressure and shock. This can be life threatening, so each patient must be watched carefully.

## 3.5 ELECTRO MYOGRAPHY AND NERVE CONDUCTION

**EMG:** Assess the integrity and function of muscles and nerve respectively.

**Purpose:** It helps to distinguish neuropathic from myopathic diseases.

- Helps in diagnosis of specific muscles disorders. Such as myasthenia gravis, myopathics and inflammatory disorders of muscles such as polymyositis
- To evaluate neuropathies, spinal cord lesion and peripheral nerve lesions.

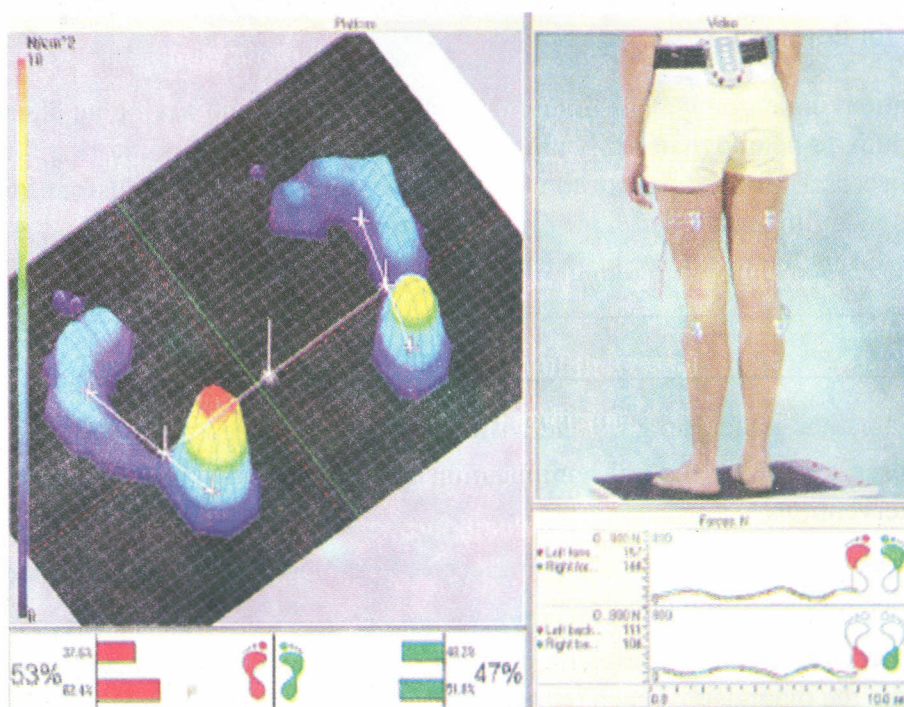


Fig. 3.4: Electro Myography and Nerve Conduction

### Procedures

The procedure is performed by inserting a needle electrode into a muscle and analyzing motor unit potentials both at rest (spontaneous) and with varying degree of muscle contraction (voluntary muscle) the following parameters are analyzed:

**Nerve Conduction Studies:** Indication for NCS can be performed on motor or sensory nerves, by applying electrical appliances stimulating skin sites overlying a peripheral nerve and recording action potential. The results are compared with standardized norms. e.g., a normal motor conduction spreads for the ulnars and median nerves are 50 m-60 m/sec and 45-55 sec for lateral popliteal values.

**Pre procedural care of the Patient:** There is pain with the insertion of the EMG needles and patient should be warned about this. Take 4/0 use of anticoagulation or aspirin – which may lead to bleeding after insertion of the needle. There is no diet or activity restrictions before or after test.

Position the patient in such a way to have access to the muscles involved. after the recording ask the patient to contract the muscles slowly and progressively. EMG usually takes 20 to 45 minutes which also depends upon number of muscles under study and cooperation of the patient.

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### 3.6 LET US SUM UP

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In this unit we have learned in detail about two procedures that are very basic for neurodiagnosis. Lumbar puncture is often performed at the bed side. nurse's role is in patient preparation, getting the articles ready, assisting the physician during procedural, observing patient for development of any complication and the post procedural care of patient and articles. Cerebral angiography is performed in the radiology department, patient education and post procedural care is the major concern of the nurse. Contrast enhanced CT and MRI places the patient at risk for developing allergic reactions.

The patient undergoing any of these diagnostic tests may be having an altered sensorium, or hemodynamically unstable and require frequent monitoring. It is often necessary for the patient to cooperate, lie quietly or follow instructions. So it is most important that a proper explanation of the procedure and what to expect during the test, to be provided before hand to the patient.

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### 3.7 ACTIVITY

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Select a patient undergoing LP and write the preparation steps:

- 1) Observe post procedural complication and write the subsequent nursing interventions.
- 2) Observe four patients undergoing cerebral angiography and provide post procedural care and document.
- 3) Observe three patients undergoing EMG and nerve conduction studies and write the diagnosis of each patient.

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### 3.8 ANSWERS TO CHECK YOUR PROGRESS

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#### Check Your Progress 1

i) **Contraindications**

- Increased intracranial pressure (if performed in patients suspected of having increased ICP, there is chance of herniation of brainstem, coma and death).

- Presence of localized sepsis at the intended puncture site.
- If myelogram or air encephalogram is planned.
- In patients who are on anticoagulation and thrombocytopenic drugs; (due to chance of spinal epidural hematoma).

ii) **Post procedure care**

- Record patient's vital signs
- Keep patient lying flat for 2-3 hours
- Prone position may help to reduce CSF leak
- Patient can resume food and fluids
- Observe for any changes in the level of consciousness, altered motor or sensory status in the lower extremities or complaints of headache.
- Check or enquire from the patient for post puncture headache, allow patient to rest in supin position for 4-6 hours and administer analgesics if required.
- Observe the puncture site for CSF leakage.
- Document : The date and time of the procedure
- Characteristics of CSF – Colour
- Amount withdrawn
- CSF pressure
- Laboratory specimens sent
- Observation for post procedural complication.
- Observe Patients tolerance of the procedure.

**Check Your Progress 2**

- i) Angiography is an x-ray study of the circulation after injecting a contrast medium.
- ii) - To get information about the lumen of the vessel
  - To diagnose AVM, aneurysm and occlusion.
  - To perform neurodiagnostic procedures
- iii) - Assess history of allergy to iodine based substance
  - Explanation about the procedure
  - Informed consent
  - NPO status from previous midnight
- iv) - Hemorrhage
  - Vasospasm
  - Arterial dissection
- v) To facilitate dye removal from body

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### 3.9 GLOSSARY

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- Angio** : Blood vessels
- Anticoagulant** : A drug that lengthens the prothrombin time and helps to prevent thrombosis and embolism
- Capillary refill** : A palpation technique for assessment of the vascular system of the extremities. Pressure is put on the nail bed to cause blanching. The area should return to the normal state within 3 seconds.
- Anaphylaxis** : An immediate reaction that results from sensitivity to a foreign protein.

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### 3.10 REFERENCES

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- 3) Ignatavicius, Donna D and Workman Linda M; "*Medical – surgical nursing*", W.B. Saunders, Missouri.
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**Cerebral Angiography**

- It is an X-ray study of cerebral circulation with a contrast agent injected into selected artery
- Indication
- Vascular aneurysm
- Arteriovenous malformation
- Before craniotomy
- Vascular blockage or other disruption

**Contra indication**

- Patients with allergic to shell fish or iodinated dye
- Patient with bleeding disorder
- patient who are pregnant
- dehydrated patients
- renal failure

**Pre procedure**

- Inform and consent
- Obtain history of allergic agents
- Record the date of menstrual periods
- Obtain list of medication patient is taking to affect bleeding
- Review the procedure with the patient
- Explain about symptoms experienced during contrast agent

**Intra test**

- Ensure the patient is complied with all necessary restriction
- Have emergency equipment available
- Establish IV line
- The location of appropriate peripheral pulses are done
- Instruct patient to remain still during procedure
- A local anaesthetic is injected to prevent pain at insertion site
- A catheter is introduced through femoral artery and guided by fluoroscopy during injection of contrast agents images are taken

**Post test**

- Neurologic status is assessed including peripheral pulses
- Encourage to increase fluid intake
- ice packs to be applied to reduce edema
- Immobilise extremity for 6-8 hours
- Observe for delayed reaction of dye

## Cerebro Spinal Fluid analysis lumbar puncture

- Lumbar puncture is a procedure that involves the introduction of a hollow needle and stylet between two vertebrae into subarachnoid space of the lumbar part of the spinal canal below the level of spinal cord

### Purpose

- Diagnostic
- Therapeutic

### Indication

- CSF measurement
- Withdrawal of CSF to reduce Increased ICP
- Evaluation of canal for the presence of CSF blockage or tumour
- Evaluation of signs of hemorrhage
- Lab analysis of CSF for infection
- Therapeutic administration of drug
- For spinal anaesthesia

### Pre procedure

- Inform and consent
- Review the procedure with the patient
- No dietary restriction is required
- Base line neurologic examination
- Inform patient about the position
- Inform to void
- Position on one side of edge of bed with back facing towards physician, thighs and legs flexed as much as possible.
- Pillow is placed under patient head to maintain the spine in horizontal position
- The nurse must assist in maintaining position
- The area of L4-L5 is prepared with iodine or alcohol and covered with sterile drapes

## Neuro-Diagnostic Procedure

### Neuro-diagnostic testing:

Uses :

- As an adjunct to a complete clinical examination.
- To evaluate the effectiveness of various treatment modalities.

### Classification of diagnostic studies:

#### 1) History /physical examination

#### 2) Radiographic studies

- Skull radiography
- Spine radiography
- Computed tomography
- Magnetic resonance imaging
- Cerebral angiography
- Myelography

#### 3) Cerebro spinal fluid evaluation

#### 4) Biophysical studies

- Carotid Doppler imaging
- Transcranial Doppler imaging

#### 5) Electrophysiologic studies

- Electro encephalography
- Electromyography
- Evoked potential studies

#### 6) Nuclear medicine testing

- Positron emission tomography

#### 7) Special sense testing

- Caloric testing
- Audiometric studies
- Visual field testing

### History

#### Physical examination

- Cerebral function test
- Cranial nerve test
- Motor function test
- Sensory function test

### Skull radiography

Now a days very rare because of CT .

#### Findings

- Presence of fracture
- Displacement of pineal body
- Sinuses
- Hematomas

### Spine radiography

Radiography of specific region of spine are usually ordered in traumatised patients

Usually AP,oblique,and lateral views are ordered

#### Findings

- Vertebral fracture
- Traumatic dislocation
- Subluxation
- Collapsed vertebra,scoliosis,spondylosis

### Patient preparation

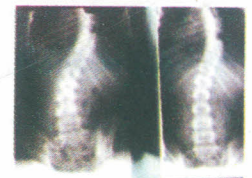
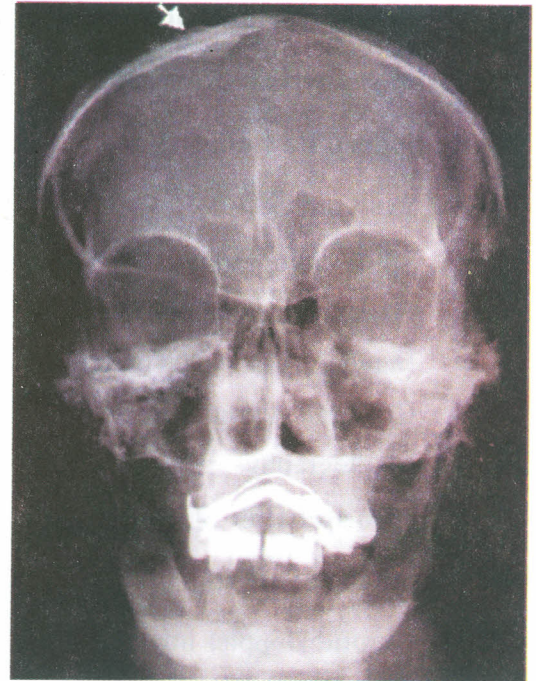
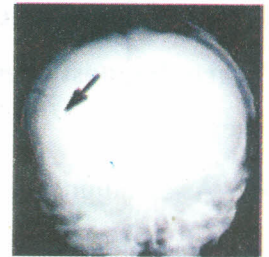
- Help to reduce anxiety
- Neck stabilization with cervical collar in case of suspected injury
- Patient mouth open for C<sub>1</sub> and C<sub>2</sub>
- Downward traction of arms for C<sub>6</sub> and C<sub>7</sub>
- Flexion and extension views

### Post procedure care

- Immobilization
- Patient neurologic status should be reassessed

### Computed tomography

- It uses a narrow X-ray beams to scan the head in successive layer
- The images provide cross sectional views of brain with distinguishing difference in tissue density of skull, cortex, sub cortical structure and ventricles.
- The patient lies on a table and moved in and out of a doughnut like device called gantry
- The image is photographed and stored digitally





- Can be done with contrast or plain CT

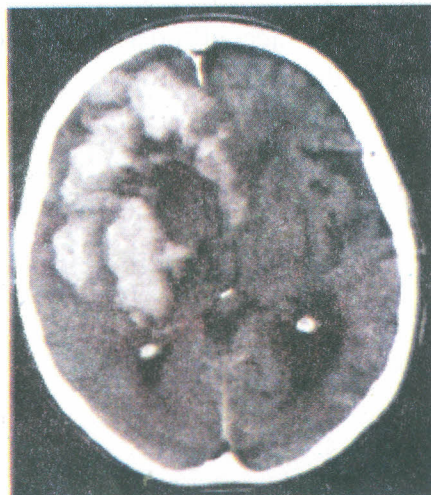
#### Indication

- Detect brain infection like abscess
- Detect ventricular enlargement
- Determine any tumour
- Determine multiple sclerosis
- Determine the size and location of lesion causing a stroke



Medscape® www.medscape.com

## Cerebral Amyloid Angiopathy



Frontal Bleed



Occipital

Source: South Med J © 2003 Lippincott Williams & Wilkins

- Differentiate among hematoma

#### Contra indication

- Patient allergic to shell fish or iodinated dye

Courtesy: Ms. Meena Agarwal, Faculty, College of Nursing AIIMS

- Patients who are claustrophobic
- Patients who are pregnant
- Patient with dehydration

#### **Nursing Implication:**

##### **Pre procedure**

- Inform and consent
- Obtain history of allergies
- Record the date of last menstrual period
- Obtain list of medication in use
- Explain about duration 30-60 minutes explain about insertion of IV line
- Inform about experience of nausea, feeling of warmth, a salty metallic taste or transient headache
- Instruct the patient to remove jewellery, dentures etc

##### **Intra test**

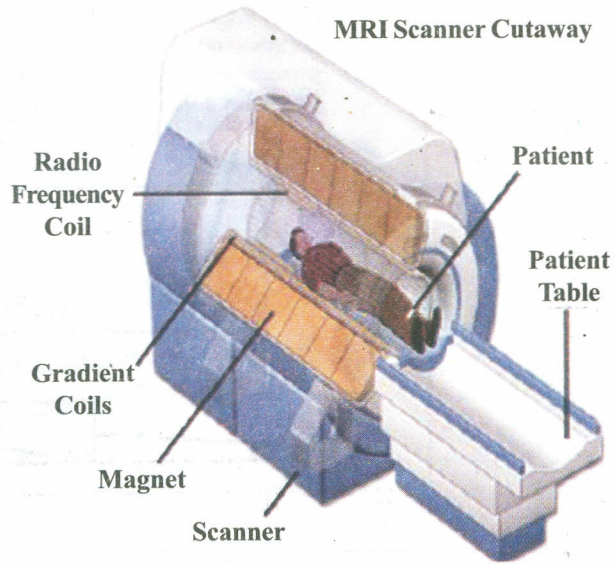
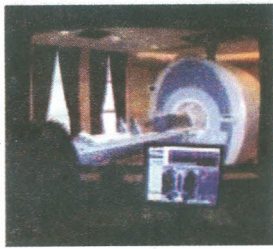
- Ensure that the patient has complied with pretesting preparation
- Have emergency equipment readily available administer ordered prophylactic steroids or anti histamine before procedure
- Instruct the patient to cooperate and remain still throughout the procedure
- Establish an IV line
- Administer anti anxiety drug when necessary
- If contrast medium is used contrast medium is injected and a rapid series of images are taken during and after filling of the vessel.

##### **Post test**

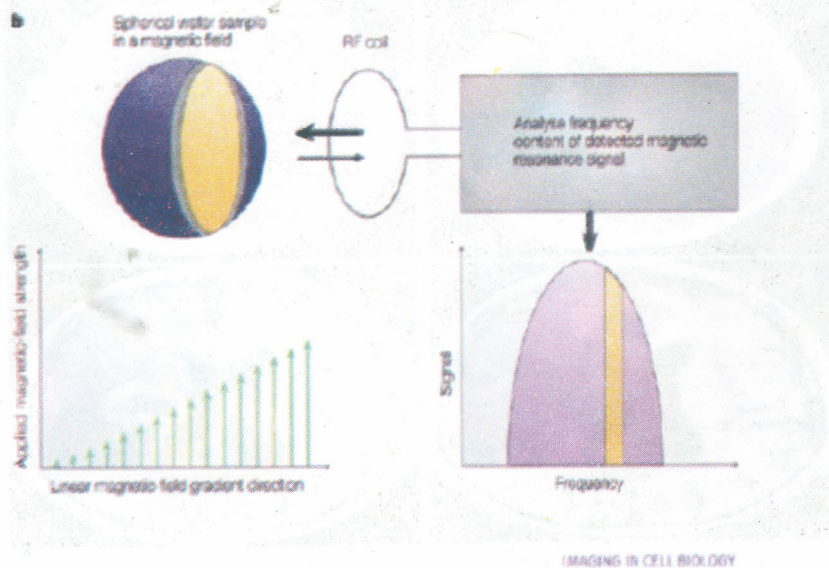
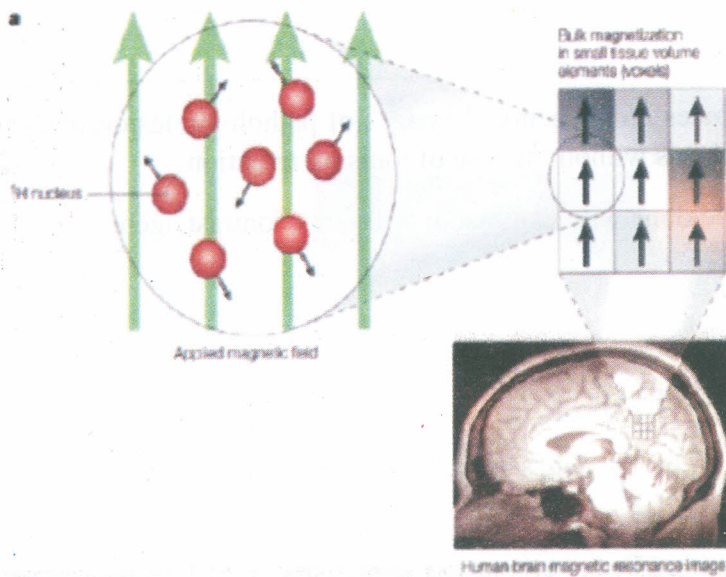
- Monitor for complication
- Remove needle and apply pressure
- Renal function should be evaluated
- Monitor vital signs and neurologic function
- Instruct patient to increase fluid intake

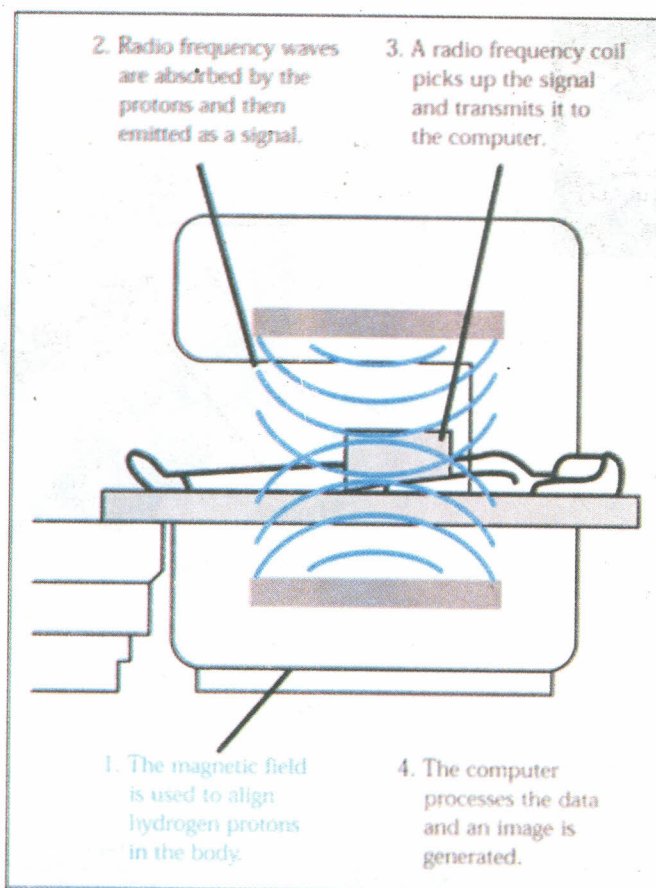
##### **Magnetic resonance imaging**

- Magnetic resonance imaging uses a magnet and radio waves to produce a energy fields that can be displayed on an image
- Use of magnetic fields with the aid of radiofrequency energy produces images primarily based on water content of tissue
- The magnetic field cause the hydrogen atom on tissue to line up and when radi waves are directed towards the magnetic field, the atom absorbs radio waves and change their position



- This change in the energy field is sensed by the equipment and images are generated

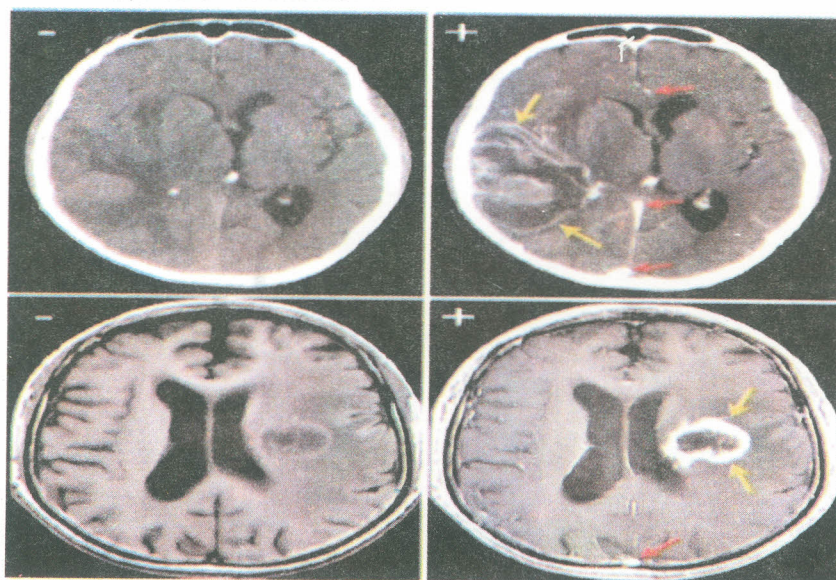




- MRI produces cross sectional images of pathologic lesion of the brain in multiple planes without the use of ionising radiation
- MRI can be done with contrast or without a contrast agent

#### Indication

- Locate brain tumour
- Detect cause of CVA
- Evaluate cerebral changes associated with dementia
- Evaluate demyelinating disorder



- Evaluate intracranial infection
- Evaluate optic and auditory nerve
- evaluate the potential cause of headache ,vomiting, visual loss
- Evaluate the vascularity of the brain

**Contra indication**

- Patient with metal prosthesis
- Patient, valves, aneurysm clips, orthopedic hard ware and other metallic objects
- Patients with pace maker, cochlear implants
- Patients with IUD
- Patients who are claustrophobic

**Nursing implication:**

• **Preprocedure**

- Inform and consent
- Obtain history of allergic agents
- Obtain history of any implants
- Inform about duration of procedure usually 30-60 minutes
- Inform patient that he will be placed in supine position on a flat table in a large cylindrical scanner
- Tell patient to expect to hear loud banging from the scanner and flickering light in the visual field
- Explain that an IV line may be inserted
- Instruct the patient to remove dentures, jewellery including watches, hairpins, credit card and other metallic objects

• **Intra test**

- Ensure that the patient has removed all metallic objects prior to procedure
- Have emergency equipment readily available
- Administer prophylactic steroids or antihistamine before the procedure
- Patient are given a gown and instructed to void before the procedure
- Instruct the patient to remain still during the procedure
- Supply ear plugs to patient to block out the loud, banging sound that occur during the test
- The patient can communicate with the technologist with the microphone attached
- establish IV line

- Administer anti anxiety drugs
- Contrast medium are injected and series of images are taken

#### **Post test**

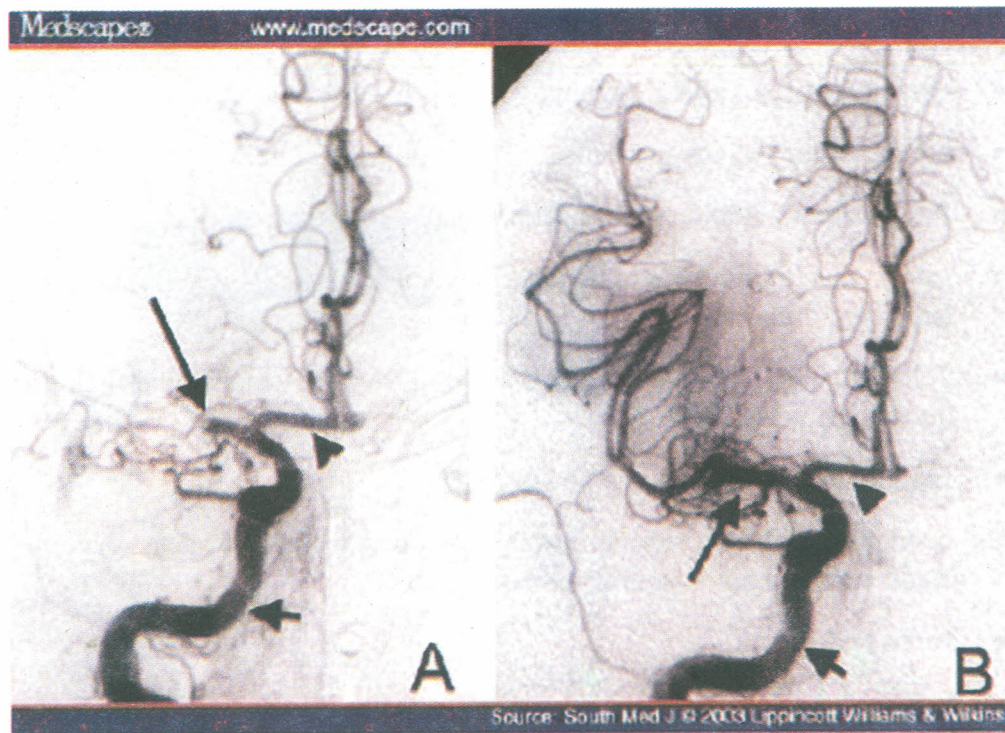
- Observe for delayed allergic reaction
- Instruct the patient to report immediately symptoms like fast heart rate, difficulty breathing, skin rash, decreased urine output.

#### **Cerebral angiography**

- It is an X-ray study of cerebral circulation with a contrast agent injected into selected artery

#### **Indication**

- Vascular aneurysm
- Arteriovenous malformation
- Before craniotomy
- Vascular blockage or other disruption



#### **Contra indication**

- Patients with allergic to shell fish or iodinated dye
- Patient with bleeding disorder
- patient who are pregnant
- dehydrated patients
- renal failure

### Pre procedure

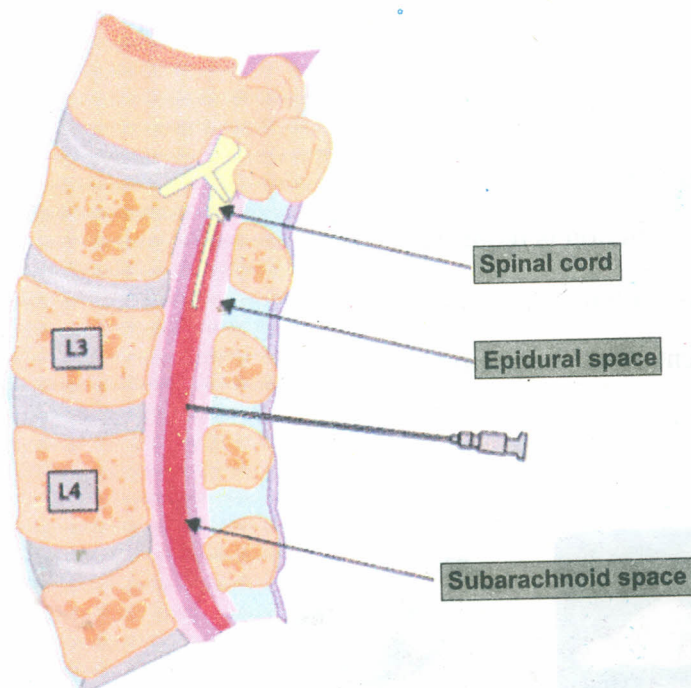
- Inform and consent
- Obtain history of allergic agents
- Record the date of menstrual periods
- Obtain list of medication patient is taking to affect bleeding
- Review the procedure with the patient
- Explain about symptoms experienced during contrast agent.

### Intra test

- Ensure the patient is complied with all necessary restriction
- Have emergency equipment available
- Establish IV line
- The location of appropriate peripheral pulses are done
- Instruct patient to remain still during procedure
- A local anaesthetic is injected to prevent pain at insertion site
- A catheter is introduced through femoral artery and guided by fluoroscopy during injection of contrast agents images are taken

### Post test

- Neurologic status is assessed including peripheral pulses



- Encourage to increase fluid intake
- Ice packs to be applied to reduce edema
- Immobilise extremity for 6-8 hours
- Observe for delayed reaction of dye

### **Cerebro spinal fluid analysis lumbar puncture**

- Lumbar puncture is a procedure that involves the introduction of a hallow needle and stylet between two vertebrae into sub arachnoid space of the lumbar part of of the spinal canal below the level of spinal cord

#### **Purpose**

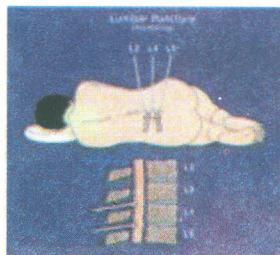
- Diagnostic
- Therapeutic

#### **Indication**

- CSF measurement
- Withdrawal of CSF to reduce Increased ICP
- Evaluation of canal for the presence of of CSF blockage or tumour
- Evaluation of signs of haemorrhage
- Lab analysis of CSF for infection
- Therapeutic administration of drug
- For spinal anaesthesia

#### **Pre procedure**

- Inform and consent
- Review the procedure with the patient
- No dietary restriction is required
- Base line neurologic examination
- Inform patient about the position
- Inform to void



### Intra test

- Position on one side of edge of bed with back facing towards physician, thighs and legs flexed as much as possible
- Pillow is placed under patient head to maintain the spine in horizontal position
- The nurse must assist in maintaining position
- The area of L4-L5 is prepared with iodine or alcohol and covered with sterile drapes
- A imaginary line is drawn from tip of iliac crest to help locate site
- Aesthetic agent is injected, after which a spinal needle with obturator is inserted below fourth lumbar vertebrae
- Once the physician feels that the needle is in subarachnoid space the obturator is removed
- Collect CSF in 3 vials separately
- If pressure is to be measured a sterile manometer is attached to spinal needle

### Queckenstedt's test:

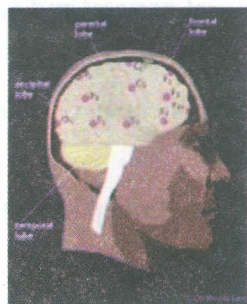
#### Post test

- Apply pressure to the area for several minutes and put a sterile covering
- Some physician prefer patient on prone with a pillow in abdomen
- Encourage intake of fluid and keep their head flat for several hours
- Monitor for vital signs
- Activity restricted for 6-8 hours

### Electro physiologic studies:

#### Electroencephalography

- It is a non invasive study that measures the brain activity and records that activity on a graph
- Electrodes placed at 8-20 sites on the patient scalp transmit different frequency and amplitude of the brain electrical activity to the EEG machine



### **Indication**

- Detect seizure activity and focus
- Confirm brain death
- Detect cerebral ischemia during endarterectomy
- Detect intracranial cerebrovascular lesion
- Determine the presence of tumour
- Evaluate sleep apnoea

### **Pretest**

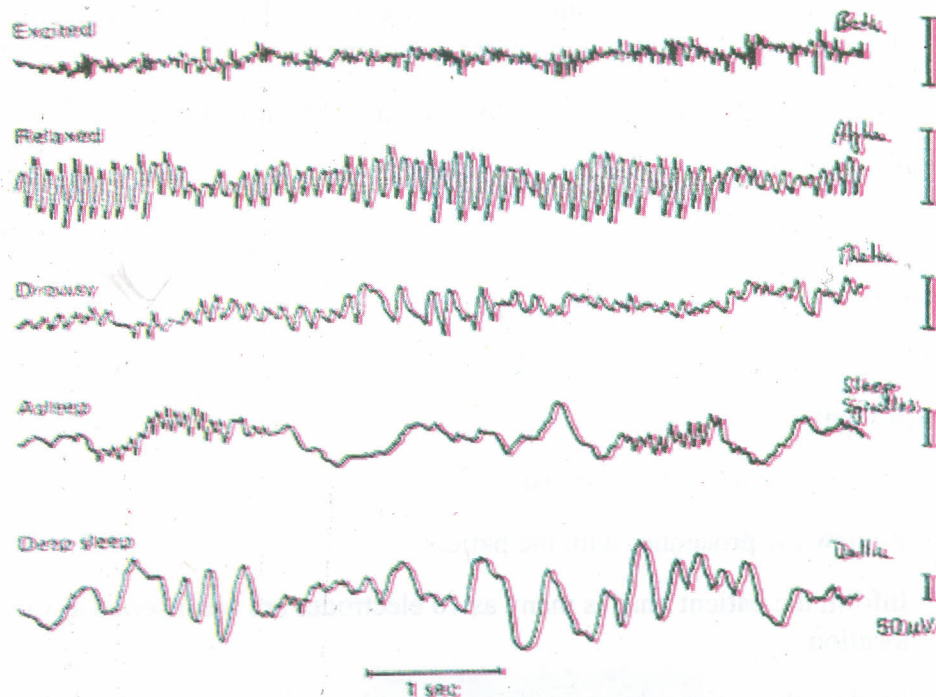
- Inform and reassure
- Obtain medication history
- Explain about the duration 30-60 minutes and even days in VEEG
- Inform patient that he or she may be asked to alter breathing, follow simple commands like opening, closing, blinking or swallowing, stimulated with bright light or given drug to induce sleep
- Instruct patient to clean the hair and to refrain from using any hair spray
- Under medical supervision the patient should avoid sedative, anticonvulsant, anxiolytics alcohol, and stimulants such as caffeine and nicotine for 24 to 48 hours before the test
- Instruct patient to limit sleep to 5 hours for adult and 7 hours for child the night before the study

### **Intra test**

- Ensure pre procedure instruction are followed
- Ensure that the patient is able to relax
- Place patient in supine position or in semi recumbent position on a recliner in a special room protected from any noise or electrical interference that could affect tracing
- Remind patient to relax and not to move any muscle or parts of the face or head.
- The electrode are applied to scalp over frontal, temporal, parietal and occipital lobe
- Recordings are made with the patient rest, drowsy, and sleep period based on patient clinical condition
- Procedures e.g., Light stimulation, hyperventilation and sleep induction are done
- Observation of seizure activity are carried out during the study and description and time of activity is noted by the technician

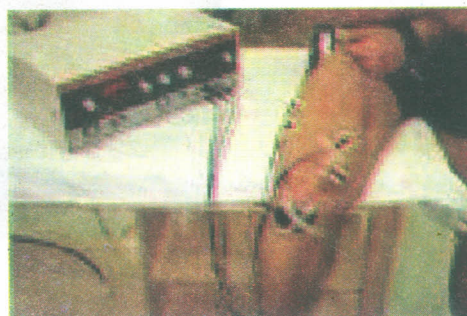
### Post test

- Clean the hairs
- Allow patient to recover from sleep, bed side rails are put in the raised position for safety
- Resume medication as ordered



### Electro myography

- It measures the skeletal muscle activity during rest, voluntary contraction and electrical stimulation
- Per cutaneous extracellular needle electrode containing fine wires are inserted into selected muscle group to detect neuromuscular abnormality and measure nerve and electrical conduction property of skeletal muscle



- Comparison and analysis of the amplitude, duration, number and configuration of the muscle activity provide diagnostic information about extent of nerve or muscle involvement in the detection of primary muscle disease, including lower motor neuron, anterior horn cell, or neuro muscular junction

### **Indication**

- Assess primary muscle disease affecting striated muscle fibres or cell membrane, such as muscular dystrophy or myasthenia gravis
- Detect muscle disorder caused by disease of lower motor neuron involving the motor neuron on the anterior horn of spinal cord, such as poliomyelitis, amyotrophic lateral sclerosis, amyotonia
- Detect muscle disorder caused by disease of lower motor neuron involving the nerve root such as gullian barre syndrome
- Detect neuromuscular disorder like peripheral neuropathy etc

### **Contraindication**

- Extensive skin infection

Patients with anti coagulant therapy

### **Nursing implication:**

#### **Preprocedure**

- Inform obtain medication history
- Review the procedure with the patient
- Inform the patient that as many as 10 electrodes are inserted at various location
- Explain the patient about the duration 1-3 hours



#### **Intra test**

- Ensure that the patient has refrained from smoking and drinking caffeine containing beverages for 3 hours before the procedure
- Have patient remove clothing, patients are given a gown to wear and instructed to void before procedure
- Ask patient to remain still and relaxed and to cooperate with instruction

- Administer mild analgesic as ordered to promote a restful state before the procedure
- Cleanse skin with alcohol, then electrode are applied to the skin
- During the test muscle activity is tested while the patient is at rest and during varying degree of muscle contraction

#### Post test

- Remove electrode
- Monitor electrode site for bleeding hematoma
- Mild analgesic and warm compress are applied

#### Evoked brain potential

- It is a physiological studies performed to measure the brain electrical response to various visual, auditory and somato sensory stimuli. EP studies help diagnose lesion of the nervous system by evaluating the integrity of visual, sensory and auditory nerve path ways
- Three responses are measured visual evoked response, auditory brainstem response, and somato sensory evoked response

#### Indication:

##### VER

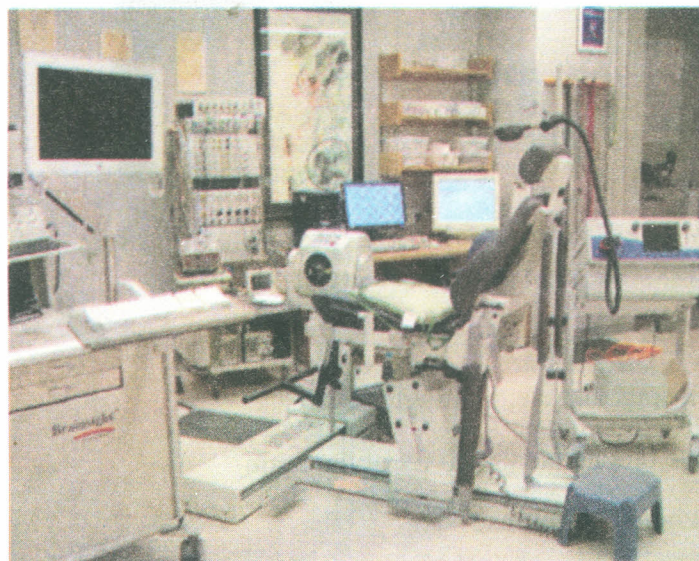
- Detect retro bulbar neuritis
- Detect lesion of optic nerve
- Evaluate optic pathway lesion and visual cortex defects

##### ABR

- Detect abnormality in brain stem or auditory nerve areas
- detect acoustic neuroma

##### SER

- Detect multiple sclerosis and gullianbarre syndrome
- Detect sensorimotor neuropathy and cervical pathologies
- Evaluate spinal cord and brain injury and function



Courtesy: Ms. Meena Agarwal, Faculty, College of Nursing AIIMS

## **Nursing implications**

### **Pre-test**

- Inform
- Review the procedure with the patient
- Explain the duration of procedure 30-2 hours instruct the patient to clean the hairs and refrain from using any spray
- No food restriction

### **Intra test**

- Ensure the patient is able to relax
- In VER patient in comfortable position about 1 meter from the stimulation source attach electrode to the occipital area. A light emitting stimulation is provided
- In AER electrode are placed in scalp at vertex lobe area on each ear lobe. Ear phone are placed in patients ears and a clicking noise stimulus is delivered
- In SER electrodes are placed at nerve sites of wrist, knee, and ankle

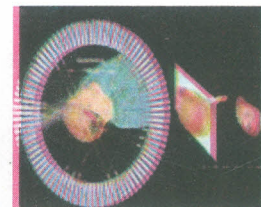
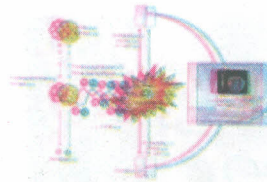
### **Post test**

- Remove electrode and clean skin

## **Nuclear medicine testing:**

### **Positron emission tomography**

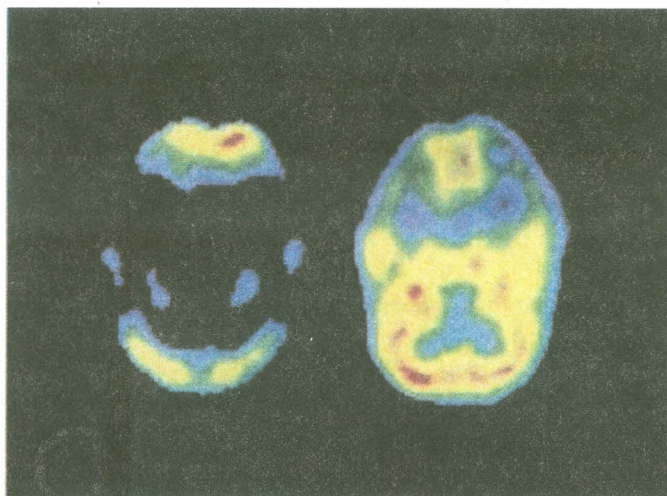
- It combines the biochemical properties of nuclear medicine with the accuracy of computed tomography
- PET uses specific nucleotide to produce functional images of body
- After the radio nucleotide becomes concentrated in brain, PET images of blood flow or metabolic process at cellular level can be obtained



- Commonly used radio nucleotide are flourine-18 in the form of flurodeoxyglucose, it is a glucose analogue

### **Indication**

- Detect parkinsons disease, huntingtons disease
- Determine the biochemical activity of the brain
- Evaluate Alzheimer's disease



- Identify focal seizure

#### **Contraindication**

- Pregnancy

#### **Preprocedure**

- Inform
- Obtain history of allergic agent
- Review the procedure and explain about the duration of the procedure usually 60-120 mt
- The patient should restrict food for 4 hours; restrict alcohol, nicotine and caffeine containing foods

#### **Intratest**

- Ensure the patient is compiled with dietary regimen
- Patient are given gown, foot covering and instructed to void before the procedure
- Instruct he patient to cooperate and remain still during the procedure
- After radio nucleotide is injected images are taken after 30 minutes
- The patient may be asked to perform different cognitive activities like reading to measure changes in brain activity
- The patient may be blindfolded or asked to use earplug to decrease auditory and visual stimuli
- Wear glove during injection and patient excreta
- Monitor for any complication

#### **Post test**

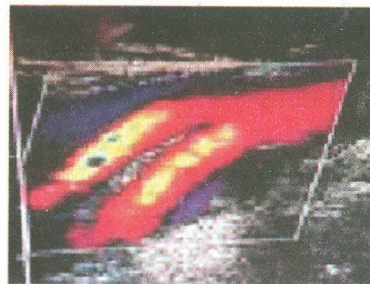
- Advise patient to report symptoms like fast heart rate, difficult breathing, skin rash, decreased urine output
- Instruct the patient to take increased amount of water to increase the elimination of radio nucleotide

- Instruct all care giver to wear glove for 24 hour

### **Bio physical studies**

#### **Carotid Doppler imaging**

- It provides a non-invasive means for monitoring intracranial hemodynamic at bedside
- Doppler imaging uses ultrasonic technology to provide information about patency of the carotid artery
- Used to assess the location and extent of plaque and flow velocity



#### **Pre test**

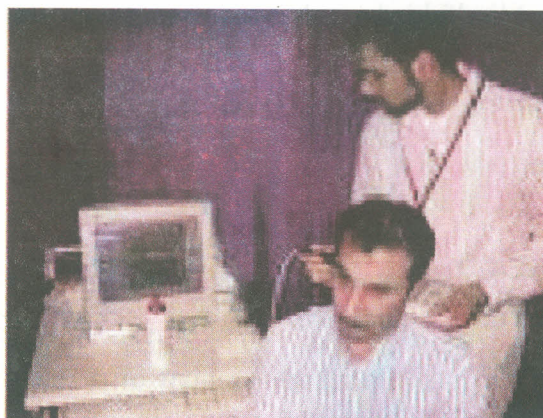
- Inform and educate
- Explain about duration 10-20 minutes and about nature of the studies

#### **Intra test**

- The patient is asked to relax the shoulders and head slightly extended away from the area to be imaged
- Obese patient need special attention

#### **Trans cranial Doppler**

- It uses the same non-invasive technique as carotid flow studies except that it records the blood flow velocities of intracranial vessel
- Flow velocities of basal artery can be measured through thin areas of temporal and occipital bones of the skull



### Indication

- TIAs related to arteriostenosis or with atherosclerosis
- Cerebro vascular disease
- Vasospasm secondary to subarachnoid haemorrhage, following aneurysm clipping

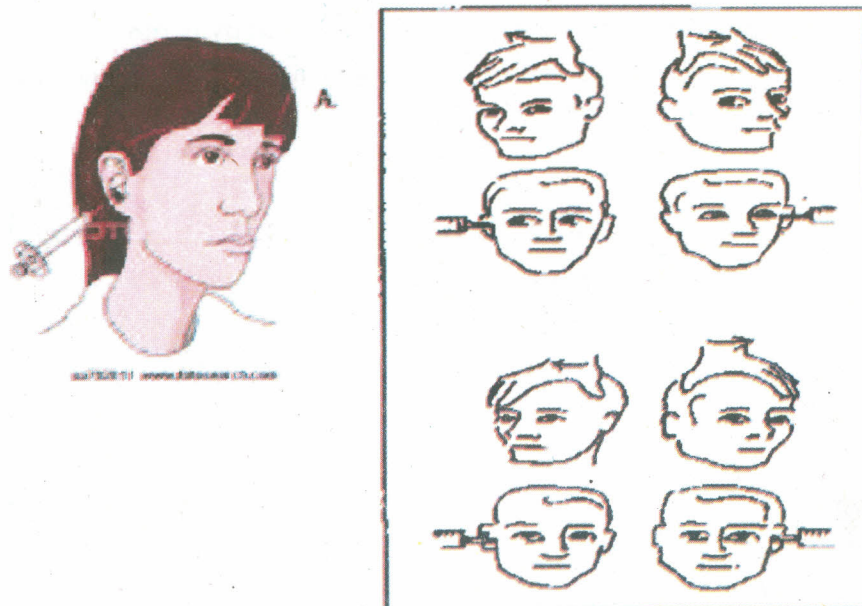
### Nursing implication

- Inform and educate

### Special sense testing:

#### Caloric testing for vestibular function

- It is used to evaluate the vestibular part of eighth cranial nerve by irrigating auditory canal with warm or cold water.
- Normal finding include rotatory nystagmus away from the side being irrigated with cold water. Hot water conversely induces nystagmus toward the side being irrigated



- In abnormal test result no nystagmus is produced .
- Contra indicated in perforated ear drum

### Preprocedure

- Inform and explain
- NPO before 6-8 hours before the procedure

### Post procedure

- The patient should lie down until untoward effects such as nausea, vertigo, resume diet.

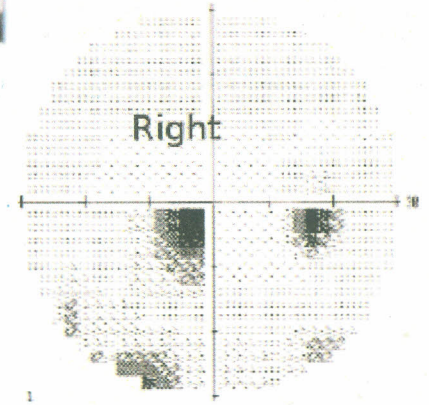
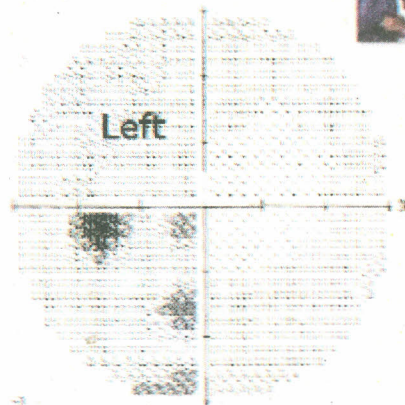
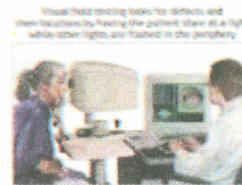
### **Audiometric studies**

- Individual with injury to auditory branch of eighth cranial nerve or hearing loss may be referred for a routine battery of audiologic studies.
- The test include voice, tuning fork, a ticking watch and a electronic audiometer to assess the hearing loss.



### **Visual field testing**

- It is used to evaluate peripheral vision.
- Gross visual field testing may be performed by means of confrontation
- For more precise testing visual field are evaluated by perimeter
- It is used to detect lesion of the retina or optic nerve and hemianopia caused by compression of optic tract



### **Summary**

- Uses
- Various classification
- Radiographic studies
- Cerebrospinal fluid analysis
- Nuclear medicine testing
- Biophysical methods
- Electrophysiological methods
- Special sense testing

List of Self activities

| Sr.No. | Practical              | Title of the Activity   | Hours | Marks |
|--------|------------------------|---|-------|-------|
| 1.     | Block 1<br>Practical 2 | Select a patient who is undergoing computed tomography of the abdomen.<br><ul style="list-style-type: none"> <li>• Prepare the patient for procedure</li> <li>• Provide the nursing care for this patient, during and after the procedure.</li> <li>• Monitor the patient's condition following the procedures.</li> <li>• Record the findings and procedure</li> </ul>   | 5     | 2     |
| 2.     | Block 1<br>Practical 3 | Select two patients undergoing upper Gastrointestinal endoscopy /colonoscopy.<br><ul style="list-style-type: none"> <li>• Prepare the patient for the procedure.</li> <li>• Observe the patient during the procedure.</li> <li>• Provide the nursing care during and after the procedures.</li> <li>• Record the nursing action and the patient's condition following the procedure.</li> </ul>   | 5     | 5     |
| 3.     | Block 1<br>Practical 4 | Select a patient receiving nasogastric feeding .<br><ul style="list-style-type: none"> <li>• Give nasogastric feed to the patient and document the nursing action, type of enteral feed and its indications.</li> </ul>   | 5     | 5     |
| 4.     | Block 1<br>Practical 4 | Select a patient undergoing abdominal paracentesis<br><ul style="list-style-type: none"> <li>• Prepare the patient and collect the required articles</li> <li>• Assist the physician during the procedure.</li> <li>• Provide the nursing care during and after the procedure.</li> <li>• Observe the characteristics of the drainage and condition of the patient</li> <li>• Send the sample for the investigation as prescribed</li> <li>• Record the procedure and findings</li> </ul> | 5     | 3     |
| 5.     | Block 2<br>Practical 3 | Select a patient undergoing Bronchoscopy<br><ul style="list-style-type: none"> <li>• Prepare the patient for the procedure</li> <li>• Assist the physician during the procedure</li> <li>• Observe the condition of patient during the procedure</li> <li>• Give pre and post procedure care to the patient</li> <li>• Record the procedure and condition of the patient</li> </ul>   | 5     | 3     |
| 6.     | Block 2<br>Practical 2 | Select two patients (one with pulmonary tuberculosis and the other with pneumonia)<br><ul style="list-style-type: none"> <li>• Collect sputum from these patients</li> <li>• Observe and compare the two specimen with respect to the difference in consistency, color and characteristics of sputum.</li> <li>• Record the findings and write a report</li> </ul>  | 5     | 2     |

|     |                                |  |    |   |
|-----|--------------------------------|--|----|---|
| 7.  | <b>Block 2<br/>Practical 2</b> | Select two unconscious patients with ineffective airway patency. <ul style="list-style-type: none"> <li>• Apply laryngeal mask airway or place combitube</li> <li>• Observe the patient</li> <li>• Record the procedure and the status of the airway.</li> </ul>   | 10 | 5 |
| 8.  | <b>Block 2<br/>Practical 4</b> | Select one patient with endotracheal intubation /Tracheostomy <ul style="list-style-type: none"> <li>• Perform endotracheal suctioning / Tracheostomy suctioning in a patient with E T tube/ Tracheostomy tube.</li> <li>• Assess the patient during the procedure.</li> <li>• Check the consistency and color of secretions</li> <li>• Record the procedure and condition of the patient.</li> <li>• Practice endotracheal tube insertion in the simulated setting / simulator /dummy</li> </ul>  | 10 | 7 |
| 9.  | <b>Block 2<br/>Practical 7</b> | Select a patient requiring chest physiotherapy <ul style="list-style-type: none"> <li>○ Check for the presence of any contraindications for the procedure</li> <li>○ Perform chest physiotherapy using the methods as given in the practical 7.1</li> <li>○ Record the procedure and findings</li> </ul>   | 5  | 3 |
| 10. | <b>Block 2<br/>Practical 7</b> | Select a patient undergoing chest tube drainage or is planned for chest tube drainage. <ul style="list-style-type: none"> <li>• Collect the articles for chest tube drainage.</li> <li>• Prepare the patient for the procedure and assist in the procedure.</li> <li>• Observe the patient during the procedure</li> <li>• Carry out the nursing action, during procedure.</li> <li>• Observe outcome of the procedure in terms of colour, amount of drainage and condition of the patient.</li> <li>• Record / document the findings</li> </ul> | 10 | 5 |
| 11. | <b>Block 3<br/>Practical 2</b> | Select a patient requiring electrocardiographic monitoring <ul style="list-style-type: none"> <li>• Obtain a 12 lead ECG tracing of the patient</li> <li>• Observe the tracing and the patient's condition</li> <li>• Record the findings</li> <li>• Demonstrate lead placement for continuous cardiac monitoring</li> <li>• Select the best leads for the patient for monitor display</li> <li>• Observe the ECG findings of the patient and interpret in terms of rate, rhythm and specific findings for the patient.</li> </ul>               | 10 | 6 |
| 12. | <b>Block 3<br/>Practical 3</b> | Select two patient undergoing the following procedures <ul style="list-style-type: none"> <li>○ Transesophageal echocardiography</li> <li>○ Holter monitoring</li> <li>○ Treadmill test</li> <li>• Prepare patients and the unit</li> <li>• Provide nursing care to the patient during procedure and monitor the patient after procedure</li> <li>• Record the patient's condition and document the care</li> </ul>  | 10 | 5 |

|     |                                |  |    |   |
|-----|--------------------------------|--|----|---|
| 13. | <b>Block 3<br/>Practical 3</b> | <p>Select five patients with Central venous Pressure line and on hemodynamic monitoring</p> <ul style="list-style-type: none"> <li>• Observe the CVP catheter insertion site</li> <li>• Observe and monitor the central venous pressure of the patient using flush system.</li> <li>• Provide care for CVP line in situ.</li> <li>• Observe the condition of the insertion site</li> <li>• Record the findings and procedure</li> </ul>  | 10 | 5 |
| 14. | <b>Block 3<br/>Practical 3</b> | <p>Select two patients undergoing angiography and cardiac catheterization</p> <ul style="list-style-type: none"> <li>• Prepare the patients before the procedure.</li> <li>• Observe the patient during procedure and give care as required</li> <li>• Observe and care for injection site after the procedure</li> <li>• Prepare an instruction chart for patient undergoing cardiac catheterization/ angiography</li> <li>• Document / record the findings / activity</li> </ul>   | 10 | 5 |
| 15. | <b>Block 3<br/>Practical 4</b> | <p>Select two patients undergoing Pacemaker implantation carry out following activities</p> <ul style="list-style-type: none"> <li>• Prepare articles</li> <li>• Assist in the procedure</li> <li>• Monitor the patient after procedure</li> <li>• Prepare the instruction material for patients with permanent pacing to be given at the time of discharge.</li> <li>• Write a report and record the activity</li> </ul>  | 10 | 5 |
| 16. | <b>Block 3<br/>Practical 7</b> | <p>Select two patients and practice following procedures under supervision:</p> <ul style="list-style-type: none"> <li>• Introducing an oropharyngeal airway in a CPR simulator</li> <li>• Bag mask ventilation using CPR simulator.</li> <li>• Cardiac compression in a CPR simulator</li> <li>• Demonstrate CPR to your supervisor and peer group</li> <li>• Document / record the activity</li> </ul>   | 10 | 5 |
| 17. | <b>Block 3<br/>Practical 4</b> | <p>Select a patient with intra aortic balloon pump (IABP) counter-pulsation device</p> <ul style="list-style-type: none"> <li>• Note for vascular changes (if any) in the distal limb (Observe and Record for the possible complications)</li> <li>• Carry out the nursing interventions related to the IABP counter-pulsation</li> <li>• Observe the inflation and deflation of balloon, its timing and dichotic notch on the arterial waveform. Note the beat ratio.</li> <li>• Assess the patient's status and cardiac performance.</li> <li>• Evaluate the patient for weaning from IABP.</li> <li>• Record the findings / activity</li> </ul> | 10 | 5 |

|     |  |   |            |            |
|-----|--|---|------------|------------|
| 18  | <b>Block 4<br/>Practical 2</b>           | <p>Select the patients posted for following investigations (select each two patients for investigation)</p> <ul style="list-style-type: none"> <li>• EEG,</li> <li>• video EEG,</li> <li>• MRI,</li> <li>• PET,</li> <li>• transcranial doppler</li> <li>• cerebral angiography</li> <li>• EMG and nerve conduction studies</li> <li>• Prepare the patient</li> </ul> <p>Observe them during the procedure and after procedure<br/>Provide care during and after the procedure<br/>Document /Record the observations in each case</p>   | 15         | 6          |
| 19. | <b>Block 5<br/>Practical 2<br/>and 3</b> | <p>Select three patient undergoing following investigations (one patient for each procedure)</p> <ul style="list-style-type: none"> <li>o ultrasonography Kidney utters , bladder (KUB)</li> <li>o intravenous pyelography</li> <li>o 24 hour urine collection</li> </ul> <ul style="list-style-type: none"> <li>• Give necessary instructions to the patient for all the procedures</li> <li>• Observe the patients during the procedure</li> <li>• Give post procedure care</li> <li>• Prepare instruction chart for the patient undergoing the above procedures.</li> <li>• Document / record the findings and activity</li> </ul> | 15         | 8          |
| 20  | <b>Block 5<br/>Practical 4</b>           | <p>Select two patient (one for each procedure) undergoing hemodialysis and peritoneal dialysis</p> <ul style="list-style-type: none"> <li>• Collect the equipments</li> <li>• Prepare the patient, unit and the machine</li> <li>• Note the type of shunt to be used / used for the patient</li> <li>• Provide the nursing care to the patient before , during and after the dialysis procedure</li> <li>• Observe for any complications that may occur/d</li> <li>• Record the observations and nursing care action</li> </ul>   | 15         | 10         |
|     |  | <b>Total</b>  | <b>180</b> | <b>100</b> |

## **BNSL – 033 : Clinical Nursing Practice in Critical Care - 1**

### **Block 1      Role of Nurse in Diagnostic and therapeutic procedures in Critical Care Settings – Gastro intestinal System**

- Practical -1    Assessment related to Gastrointestinal System
- Practical - 2    Non Invasive And Invasive Diagnostic Procedures
- Practical - 3    Invasive Procedures
- Practical - 4    Therapeutic procedures

### **Block 2      Role Of Nurse in Diagnostic and Therapeutic Procedures in Critical Care Settings – Respiratory System**

- Practical-1    Assessment of Respiratory System
- Practical-2    Non Invasive Procedures
- Practical-3    Invasive Procedures
- Practical-4    Airway Management
- Practical-5    Oxygen Therapy
- Practical-6    Mechanical Ventilation
- Practical-7    Chest Physical Therapy and Chest Tube Drainage

### **Block 3      Role of Nurse in Diagnostic and therapeutic procedures in Critical Care Settings – Cardiovascular system**

- Practical-1    Cardiac Assessment
- Practical-2    Non Invasive Diagnostic Procedures
- Practical-3    Invasive Diagnostic Procedures
- Practical-4    Therapeutic Procedures
- Practical-5    Cardio Pulmonary Resuscitation

### **Block 4      Role of Nurse In Diagnostic and Therapeutic Procedures in Critical Care Settings – Nervous System**

- Practical -1    Neurological Assessment and Monitoring
- Practical-2    Noninvasive Neurological Procedures
- Practical-3    Invasive Neurological Procedures

### **Block 5      Role of Nurse in diagnostic of therapeutic procedures in critical care setting - Renal System**

- Practical -1    Assessment of Renal system
- Practical -2    Non invasive Procedures
- Practical -3    Invasive Procedures
- Practical -4    Therapeutic Procedures