TESTS OF FUNCTION (CLINICAL NEUROPHYSIOLOGY)

Recording of electrical activity over the brain and assessment of nerve and muscle function are essential in certain conditions. The major tests are electroencephalography (EEG), evoked potentials (EPs) and nerve conduction studies/electromyography (NCS/EMG)

**Electroencephalography**

Electrical activity arising in the cerebral cortex can be detected using electrodes placed on the scalp, although this is estimated to detect only 0.1-1% of the brain's electrical activity at any one time. When the eyes are shut, the most obvious frequency over the occipital cortex is 8-13/s; this is known as alpha rhythm, and disappears when the eyes are opened. Other frequency bands seen over different parts of the brain in different circumstances are beta (faster than 13/s), theta (4-8/s) and delta (slower than 4/s). Lower frequencies predominate in the very young and during sleep.

**EEG** (Electroencephalography) may support the clinical diagnosis of epilepsy (by demonstrating paroxysmal abnormalities containing spikes or sharp waves), may provide a guide to prognosis, and may help classify the seizure disorder.

**Advantages of EEG:**

1- epilepsy is used to aid in diagnosis and classification and prognosis and localized epilepsy area when the surgery indicated.
   Demonstration of sharp and spike wave which may be generalized or focal
2- in herpes simplex encephalitis
3- hepatic encephalopathy
4- Creutzfeldt-Jakop disease
5- focal brain lesion such abscessor tumour
Other diffuse brain disorders:

Recognizable slow-wave EEG abnormalities appear in encephalitis, prion (Creutzfeldt-Jakob) disease and metabolic states (e.g. hypoglycaemia and hepatic coma).

In Brainstem death: The EEG is isoelectric (flat), but is no longer necessary to confirm brain death

Electromyography [E.M.G]

Is the recording and study of the insertional, spontaneous and voluntary electrical activity of muscle; this allow evaluation of anterior horn cell, peripheral nerve and muscle...

Indications:

- Evaluate patient with weakness
- To differentiate acute denervation from chronic denervation
- To differentiate myopathy from neuropathy
- To differentiate acute[active] inflammatory myopathy from chronic myopathy
- Myotonia disorder like myotonia dystrophica.
- Singe fiber EMG for neuromuscular junction transmission

Nerve Conduction Study

Is recording and measurement of the compound nerve and muscle action potential elicited in response to an electrical stimulus, motor nerve conduction study and sensory nerve conduction study

Study of electrical activity of nerve after electrical stimulation of examined nerve [record the action potential and conduction velocity]

Abnoamality of N.C.s

- Reduce amplitude[axonal neuropathy]
- Slow conduction velocity[demyelinating neuropathy]
- Conduction block[compressive neuropathy]
- Prolog terminal latency[demylinating neuropathy]

Clinical values of NCs

1- Diagnosis of neuropathy, asses the severity and distribution, distal, proximal or diffuse
2- Whether Sensory or motor
3- Pathologic process: axonal or demyelinating
4- Compressive neuropathy like carpal tunnel syndrom
Evoked potentials

The spinal and cerebral potentials evoked by noninvasive stimulation of specific afferent pathways are an important mean of monitoring the functional integrity of these pathways

The cortical response to visual, auditory or electrical stimulation can be measured on an EEG as an evoked potential [EP]

Assessing the latency [time delay] and amplitude can information about integrity of the relevant pathway.

Indications:

1- Visual evoked potential – (multiple sclerosis):
   Visual evoked potential studies are commonly used in the evaluation of suspected multiple sclerosis demyelination in the optic nerve or central optic pathways.

2- Auditory evoked potential – (cerebello-pontine angle tumor and deafness in children):
   Brain stem auditory evoked potential studies in the diagnosis of diseases cranial nerve VIII or its central projections. Lesions at the cerebellopontine angle and the brain stem. Brain stem auditory evoked potentials the diagnosis of deafness in infants.

3- Somatosensory visual evoked – (spinal cord disease):
   Somatosensory evoked potentials are used to identify slowing of central sensory conduction that results. They are also used to evaluate spinal cord-mediated sensory abnormalities.

Routine blood tests

Many systemic conditions can affect the nervous system can identified by simple blood tests. [full blood count, ESR, C-reactive protein, biochemical screening] may provide clue.

Lumbar puncture

It is a procedure that often performed in emergency department to obtain information about the CSF

Procedure:

1- Local anesthetic injection.
2- Needle inserted between lumber spine processes [usually between L3 and L4] through the Dura and into the spinal canal.
3- Intracranial pressure recorded and CSF send for analysis.
Normal CSF:

- The color is clear and colorless
- CSF pressure is 50-250 mm water
- White cell count is 0-4 and lymphocyte
- Red cell count is 0-4
- Glucose is > 50-60 % of blood level
- Protein is < 0.45 gm\L
- Microbiology is sterile
- Oligoclonal band negative

Tests usually performed on CSF include centrifuging to determine the colour of the supernatant (yellow, or xanthochromic, some hours after subarachnoid haemorrhage), biochemistry (glucose, total protein, and protein electrophoresis to detect oligoclonal bands), microbiology (e.g. polymerase chain reaction (PCR) for herpes simplex or tuberculosis), immunology (e.g. paraneoplastic antibodies) and cytology (to detect malignant cells).

Indications:

1. In the CNS infection [meningitis and encephalitis]
2. Subarachnioid hemorrhage
3. Inflammatory condition [multiple sclerosis, sarciodosis and cerebral lupus]
4. Some neurological malignancies (e.g. carcinomatous meningitis, lymphoma and leukaemia)
5. Measure CSF pressure for diagnosis, therapeutic and monitoring of idiopathic intracranial hypertension
6. And can be used in therapeutic procedures, either to lower CSF pressure or to administer drugs.

Contraindication:

1. Mass in the brain or spinal cord
2. Raised intracranial pressure
3. Altered level of consciousness
4. Bleeding tendency
5. Infection at site of LP
6. Meningiocele and spina bifida

Biopsy:

1. Nerve biopsy—Peripheral neuropathy
   - Target nerve is sural or radial nerve
2. Muscle biopsy to differentiate myositis from myopathy
   - Quidricepes
3. Brain biopsy—Dementia and some brain tumor

It should only be consider when the diagnosis is elusive
**Immunological test and genetic test**

1-screen for antibodies in neuromuscular disorder  
2-Screen for antibodies in channel disorder and paraneoplastic disorder

*Thank you,,,*