Neurological Examination

# General History Taking

* Biodata: Age, Gender, Residence, Occupation, Handedness.
* Presenting complaint: In patient’s own words in chronological order with the oldest complaint first.
* History of presenting illness, Past medical history, Family and social history, Systemic enquiry, Summary.
* Physical examination: General exam + Vital signs, Systemic Exam (Resp, CVS, Abdomen, Neuro)
* Diagnostic formulation

# Neurologic History

Biodata: Age, Gender, Occupation, Handedness (Left hemisphere contains language in almost all right handed individuals and in 70% of patients who are left handed or ambidextrous)

PCO, HPI (including neurologic screening questions), PMHx, Drug Hx, Family and Social Hx

### PCO

Nature of complaint: Headaches, seizures, loss of consciousness, behavioural abnormalities, visual disturbances, vertigo, speech disorders, weakness of limbs, sensory disturbances, unsteady gait, abnormal movements, syncope

### HPI

The nature of the complaint:

Ensure to understand what the patient is describing, e.g. when the patient says his vision is blurred he may mean double, dizziness may mean vertigo, a weak limb with no altered sensation may be referred as numb.

The time course of the complaint:

Onset: Sudden (vascular, epileptic), over a few minutes (vascular, epileptic, migranous), over a few hours, few months (inflammatory, infective, neoplastic), a few years (degenerative, genetic, congenital)

Progression: Continuous/intermittent, any improvement, stabilization or progression

The pattern: If intermittent, duration and frequency

Precipitating or relieving factors, Previous treatments and investigations, The current neurological state: i.e. functional abilities

Screen for other neurological symptoms: Headaches, fits, episodes of numbness, weakness, sphincter disturbances (fecal incontinence, urinary retention, fecal retention), visual symptoms (double vision, blurred vision, loss of sight)

# Sequence and Technique of Neurologic Examination

### Assessment of Higher Functions

Level of consciousness using GCS

Concentration/attention: Serial 7, digit span, months in reverse

Orientation in Time, Place and Person

Memory: Registration, recall, immediate/short-term/intermediate-term/long-term/remote

Intelligence (IQ tests), Speech (dysarthria/aphasia)

Dominant hemisphere: Language, Non-dominant hemisphere

### Head, Neck and Spine Examination

Inspection

Facial symmetry, frontal bulging, hair distribution, scars/sinuses, discharge from ears/nose, hydrocephalus, sutural diastasis, battle sign, raccoon eyes

Spinal deformities, curvatures, scoliosis, kyphosis, kyphoscoliosis, globus deformity, hair tufts, swellings, dimplings

Palpation

Head circumference, patency of shunts, transillumination, cracked pot sign

Neck

Rigidity, soft/stiff, Kerning’s sign, Brudzinki’s sign

# Cranial Nerve Examination

## CN I: OLFACTORY NERVE

* Inspect the symmetry of the nose and nostrils for any nasal polyps, septal deviation or foreign bodies. Test each nostril separately by asking the patient to occlude the non-testing nostril
* Inform the patient about the test, and ask them to identify the object by the use of scratch and sniff cards or common fruit items known to the patient

## CN II: OPTIC NERVE

### Visual acuity

Ask for Snellen’s chart to assess for visual acuity (done at 6m/3m if mirror). If patient can’t read at 6m, bring the chart closer at 3m, then 1m, at 1m count fingers, hand movements, light reflex

### Color vision

Ask for Ishihara charts if available

If not, use surrounding items to try and discern red-green, blue-yellow, violet-red, blue-green color blindness

### Visual inattention and visual fields

Visual inattention

At a 1m distance between the examiner and the patient, hold up two fingers horizontally and ask the patient to look forward at you, wriggle the fingers and ask the patient to identify the side that moves

Visual fields

Each eye is tested separately (cover non-test eye with palm of hand), at 0.5m distance between the examiner and patient, with the patient looking ahead and identifying when the finger comes into view

### Blind spots

Stare at a dot from arm’s length and measure the distance when “+” sign disappears

### Reflexes

Inspect the pupils for size, shape and symmetry

Direct response and consensual response are tested for each eye in dim light

Accommodation: Ask the patient to look at a distant object, then at your finger held at a distance and to keep looking as you advance your finger to a distance of about 20cm from the patient’s face. Do it twice.

Swinging light reflex: Assess afferent pupillary defect by moving light in arc from pupil to pupil, and if L eye makes R eye dilate, not constrict (Marcus Gunn). Optionally: Do arc test, have the patient place a flat hand extending vertically from his face, between his eyes, to act as a blinder so light can only go into one eye at a time.

### Fundoscopic examination

## CN III, IV, VI: OCCULOMOTOR, TROCHLEAR, ABDUCENS NERVE

* Inspect for any palsy of the eyes, ptosis of the eyelids and look at pupils: shape and relative size
* To test the eye movement muscles: From a 1m distance between you and the patient, stabilize the patient’s head and ask them to follow your finger with their eyes without moving their head at 0.5m
* Test the 6 cardinal points using the “H” pattern of examination
* Assess nystagmus, convergence

## CN V: TRIGEMINAL NERVE

### Sensory component

Explain to the patient the procedure, ask them to close their eyes and assess light touch using a wisp of cotton wool for the ophthalmic, maxillary and mandibular branches of the trigeminal

### Motor component

Inspect the masseters and temporalis muscles for wasting (prominent zygomatic bones). Ask the patient to clench teeth to assess for bulk of masseters. Ask patient to open their jaw and push sideways against resistance for pterygoid muscle power

### Reflexes

Jaw jerk

Ask the patient to let the jaw hang loosely with the mouth slightly open, place your index finger on chin and strike lightly with the patella hammer (reflex contraction of masseters)

Corneal reflex

Brisk blink when cornea is touched with cotton wool (absent in Bell’s Palsy)

## CN VII: FACIAL NERVE

### Sensory component

Taste of anterior 1/3rd of tongue

### Motor component

Inspect for facial symmetry, nasolabial folds, forehead crease lines, mouth deviation, eyebrow levels, no involuntary movements

|  |  |  |
| --- | --- | --- |
| INSTRUCTION | MUSCLE TESTED | RESPONSE IN PALSY |
| Ask the patient to raise their eyebrows (look astonished) | Frontal belly of occipito-frontalis | Asymmetry as patient cannot wrinkle forehead on the side of the palsy in LMN palsy |
| Ask the patient to smile | Levetor anguli oris, zygomatic major and minor, depressor anguli oris, buccinators, risorius | Angle of mouth deviates towards the normal side |
| Ask the patient to clench their teeth and grimace | Platysma | Folds of platysma is seen in the neck as platysma contracts |
| Ask patient to scrunch up their eyes and prevent you from opening them | Orbicularis oculi | In LMN palsy, eyelids don’t close completely. Instead the eyeball rolls up. This is known as Bell’s Phenomenon.  In healthy individuals, eyelids cannot be opened with mild force against the patient’s resistance |
| Puff out cheeks and provide resistance | Orbicularis oris, buccinator | Patient can’t blow out his cheek as air escapes from affected side |
| Pouting/pursing lips and attempt to open them with your fingers |  |  |

## CN VIII: VESTIBULOCOCHLEAR NERVE

Whispering/friction testing, Rinne’s and Weber’s test

Further examinations: Otoscopy, audiometry and Dix-Hallpike test (nystagmus, positioning vertigo)

## CN IX: GLOSSOPHARYNGEAL NERVE, CN X: VAGUS NERVE

Assess speech quality and volume (hoarseness/soft), dysphonia, open mouth and say “Aahh” (check for symmetrical palatal rise and uvular deviation). Offer to do the gag reflex and pharyngeal reflex.

## CN XI: SPINAL ACCESSORY NERVE

Expose the patient until the pubic symphysis and inspect for symmetry of the scapula, shoulder levels, winged scapula and posturing of the patient. Test trapezius muscle by asking the patient to shrug shoulders with resistance. Test sternocleidomastoid muscles by providing resistance to turning the head.

## CN XII: HYPOGLOSSAL NERVE

Inspect tongue at rest for wasting, fasciculations and deviations. Ask the patient to protrude tongue and observe deviation *(deviates to the ipsilateral side)*, ask them to move the tongue side to side, test power of the tongue muscles against each cheek.

## Facial Nerve Palsy

UMNL: Meningitis, encephalitis, SOLS, cerebrovascular accidents, brainstem vascular accidents, trauma, multiple sclerosis

Unilateral (LMNL): Ramsey Hunt syndrome (Herpes zoster), cerebellar pontine tumors, acoustic neuroma, trauma, parotid tumors

Bilateral: GBS, sarcoidosis

## IIIrd Nerve Palsy

Head injury, brain tumors, aneurysm, diabetes, HTN

## IVth and VIth Nerve Palsy

* Microvascular disease (diabetes, HTN)
* Raised ICP
* Acoustic neuroma
* Nasopharyngeal tumors
* Trauma (base of skull)

# Motor Examination

*(Sequence of Motor System Exam: Bulk, Tone, Power, Reflexes)*

Introduce yourself and the examiner, sanitize hands.

Explain the examination and gain an informed consent (Today I have been asked to perform a motor exam which will entail me inspecting your limbs, palpating them i.e. touching them, and finally using my patella hammer to assess your reflexes, is that okay with you?)

(Movement: Compare normal to abnormal, ask patient to raise both limbs at once for somparison and obtain an idea of which limb has a problem)

### Inspection

Posture of the limbs, scars: size, shape and symmetry of the limbs, atrophy/hypertrophy/wasting of muscles, pressure sores, fasciculations, involuntary movements, tremors

### Palpation

Muscle bulk and tenderness

Use both hands to palpate each muscle group and compare

(Percussion: Tap over muscles to elicit fasciculations)

### Muscle Tone

Provide resistance of muscles to passive movement at a joint.

Tone can be normal, increased or decreased.

Should be carried out on the whole limb and at each joint.

### Muscle Power

Measured by the ability to contract the muscle group against force or gravity

|  |  |
| --- | --- |
| MRC GRADE | MUSCLE POWER |
| 0 | No contraction/complete paralysis |
| 1 | Flicker of movement |
| 2 | Movement if gravity eliminated |
| 3 | Movement against gravity |
| 4 | Movement against gravity and resistance |
| 5 | Normal strength |

### Reflexes

Includes both deep tendon reflexes (DTR) and superficial reflexes

**DTR:** A deep tendon reflex is the reaction of a muscle to being passively stretched by percussion on the tendon. Graded from 0-4

|  |  |
| --- | --- |
| nerve root | reflex |
| mid pons | Jaw jerk |
| c5,6 | Biceps reflex |
| c6,7 | Triceps reflex |
| c5,6 | Supinator jerk (brachiradialis reflex) |
| l2,3,4 | Quadriceps reflex (knee jerk) |
| s1,2 | Ankle jerk (Achilles reflex) |

|  |  |
| --- | --- |
| grade | reflex strength |
| 0 | Absent |
| 1 | Present (as an ankle jerk) |
| 2 | Brisk (as a knee jerk) |
| 3 | Very brisk |
| 4 | Clonus |

#### Jendrassik’s Maneuver

(Used to reinforce the reflexes)

For upper limb exam: Patient is asked to clench teeth

For lower limb exam: Patient asked to hook the fingers of both hands together and pull them apart as strongly as possible

**Superficial reflexes**

Plantar response/reflex: Extensor plantar response seen in corticospinal tract lesions (UMNL)

Hoffman’s reflex: The test involves tapping the nail or flicking the terminal phalanx of the middle or ring finger. A positive response is seen with the flexion of the terminal phalanx of the thumb

Superficial abdominal reflex: Absence of this results from corticospinal lesion. The reflex is absent ipsilateral to hemiparesis/plegia

**Others:** Cremasteric reflex, anal wink

**Primitive reflexes:** Grasp sign, suck sign, snout sign, glabellar sign

## Lower Limb Motor Examination

### Inspection

Posture of the limbs, scars: size, shape and symmetry of the limbs, atrophy/hypertrophy/wasting of proximal/distal muscles, pressure sores, fasciculations, involuntary movements, tremors

### Palpation

(Muscle bulk and tenderness)

Assess muscle bulk of the quadriceps, gastrocnemius/anterior compartment muscles and compare both sides

### Tone

(Tell the patient to relax and let their legs loose)

Roll the leg to assess general tone of the limb, briskly flex the hip by lifting the leg behind the knee (normally the knee will flex with the ankle being dragged on the couch, if spasticity the ankle will be lifted off the bed), or excessively floppy: hyper/hypo tonia

### Power

* Ask the patient to lift their legs up (each separately). If they can, that is Grade 3 MRC
* Provide resistance and ask patient to lift the leg up (hip flexors: L2 myotome) and to push down (hip extensors: L5, S1 myotome), push outwards (hip abductors: L4,5), push inwards (hip adductors: L2,3)
* Test the knee flexors (S1) and extensors (L3) by having the knee slightly flexed and pushing/pulling at the ankle
* Push hand placed on foot dorsum for Dorsiflexors (L4), and push hand placed on sole of foot for Plantarflexion (S1) and Big toe extensor (L5)

### Reflexes

* Quadriceps reflex (knee jerk): L2, 3, 4 nerve roots
* Ankle jerk (Achilles reflex): S1, 2
* Plantar reflex (stroke with hammer): Normal response is flexion of the toes

*(UMNL – Big toe extends with fanning of the toes)*

## Upper Limb Motor Examination

### Inspection

Posture of the limbs, scars: size, shape and symmetry of the limbs, atrophy/hypertrophy/wasting of proximal/distal muscles, pressure sores, fasciculations, involuntary movements, tremors, myoclonic jerks

### Palpation

(Muscle bulk and tenderness)

Assess muscle bulk of the deltoids/biceps/triceps/forearm muscles and compare both sides

### Tone

Please shake my hand, leave your arm loose, check at each joint (wrist, elbow, shoulder) with fast and slow movements, assess for spasticity/rigidity or hyper/hypo tonia

Hoffman’s sign - To test Finger flexors: C8 *(abnormal thumb flexion in UMNL)*

### Power

* Ask the patient to lift their hands up (if they can, then it’s MRC Grade 3)
* Provide resistance, ask the patient to push hands away (shoulder abductors: C5), resist push inwards (shoulder adductors: C6)
* Resist pull at wrist (elbow flexors: C5), resist push at wrist (elbow extensors: C6)
* Resist push on dorsal surface of hand (wrist extensors: C6), palmar surface (wrist flexors)
* Fan fingers, push in and out plus pincer grip and push from inside (finger abductors: T1)
* Finger flexors: C8 (hold a finger in their palm then try to pull it away

### Reflexes

* Biceps reflex: C5, 6
* Triceps reflex: C6, 7
* Supinator jerk for brachioradialis reflex: C5, 6

Note:

Finger reflexes (hit hammer below held fingers)

Play piano (for extrapyramidal lesions)

Pronator drift (hands held in supination, eyes closed)

## Upper Motor Neuron Lesions Vs Lower Motor Neuron Lesions

UMN starts from motorcortex to the cranial nerve nuclei in the brain and anteriorhorn cells in the spinal cord.

LMN is the motor pathway from the anterior horn cell (or CN nucleus) via the peripheral nerve to the motor end plate.

|  |  |  |
| --- | --- | --- |
| features | umnl | lmnl |
| muscle bulk | No wasting | Wasting/atrophy of affected muscles |
| muscle tone | Hypertonia | Hypotonia |
| muscle power | Spastic/clasp knife | Flaccid paralysis |
| reflexes | Hyper reflexia  Present abdominal reflex | Hypo reflexia  Absent abdominal reflex |
| fasciculations | Absent | Present |
| babinski sign | Present | Absent |
| causes | - Hemorrhage, thrombosis in the internal capsule e.g. HTN, stroke, trauma to the middle meningeal artery  - Spinal cord transaction (e.g. Brown-sequard syndrome)  - Cerebral palsy  - Multiple sclerosis | - Spinal root lesions or peripheral nerve lesion e.g. nerve injury by trauma or compressive lesion such as tumors, TB spine  - Anterior horn cell lesions e.g. poliomyelitis, motor neuron dx (ALS)  - Guillaine Barre syndrome  - Transverse myelitis  - Botulism paralysis |

# Sensory Examination

Modalities of sensation assessed include pain, temperature (spinothalamic), light touch (relayed in both spinothalamic and posterior column), joint position sense and vibration sense (posterior column).

All tests are explained and demonstrated to the patient on the sternum, then performed with the eyes closed.

### Pain

Pin prick (neurotip) on the various dermatomes after explaining, demonstrating the procedure and with the patient’s eyes closed

### Temperature

Test tubes with cold and warm water OR a cold tuning fork

### Touch

Wisp of cotton wool

### Joint position sense

Big toe and thumb movement (upwards and downwards)

### Vibration sense

Tuning fork of 128Hz frequency (on bony prominences e.g. big toe, thumb)

Tested distally from the toes/fingers and in an ascending manner following the dermatomes

Any sensory level is defined by the dermatome involved

### Graphaesthesia

Patient to identify letter or number written on palm

### Stereognosis

Patient to name an object placed on the palm

### Sensory inattention

Double stimulation: Touch on one hand and then the other, and then both.

Repeat with the eyes closed and ask patient to identify as right, left or both

# Cerebellar Examination

### Scanning speech

Causes enunciation of individual syllables, “the British Parliament” becomes “the Brit-tish Par-la-ment”.

### Nystagmus

Fast phase towards side of cerebellar lesion

### Finger to nose & finger to finger test

Ask patient to fully extend arm then touch nose or ask them to touch their nose then fully extend to touch your finger.

You increase the difficulty of this test by adding resistance to the patient’s movements or move your finger to different locations.

Abnormality of this is called dysmetria, past pointing, intention tremors.

### Rapid alternating movements

Ask patient to place one hand over the next and have them flip one hand back and forth as fast as possible (alternatively you can ask the patient to quickly tap their foot on the floor as fast as possible).

If abnormal, this is called dysdiadochokinesia.

### Rebound Phenomenon (of Stewart & Holmes)

Have the patient pull on your hand and when they do, slip your hand out of their grasp.

Normally the antagonist muscles will contract and stop their arm from moving in the desired direction.

A positive sign is seen in a spastic limb where the exaggerated “rebound” occurs with movement in the opposite direction.

However, in cerebellar disease, this response is completely absent causing the limb to continue moving in the desired direction.

(Be careful that you protect the patient from the unarrested movement causing them to strike themselves)

### Heel to shin test

Have the patient run their heel down the contralateral shin (this is equivalent to the finger to nose test)

Abnormal exam occurs when they are unable to keep their foot on the shin.

### Hypotonia

“Pendular” knee jerk, leg keeps swinging after knee jerk more than 4 times *(4 or less is normal)*

### Trunkal ataxia

Ask patient to put hands on their shoulders and then to get up

### Tibutations

Stand with the feet together then assess for any movement of the trunk

### Gait

Commonly wide based and staggering, they may fall to the side of the lesion

**Note:**

Patients with the disease of the vermis and flocculonodular lobe will be unable to stand at all as they will have truncal ataxia – they may not be able to sit

**Note: The Romberg Test is NOT a sign of Cerebellar Disease**

It is a sign of a disturbance of proprioception, either from neuropathy or posterior column disease. The patient does not know where their joint is in space and so uses their eyes. In the dark or with eyes closed they have problems.

## Cerebellar Lesions

|  |  |  |
| --- | --- | --- |
| Lesion | Causes | Symptoms |
| Posterior lobe = Neocerebellar lesions | Vascular e.g. stroke  Tumors  Neurodegenerative | **D**ysmetria, **d**ysdiadochokinesia  **A**taxia  **N**ystagmus  **I**ntention tremor  **S**lurred speech  **H**ypotonia |
| Anterior lobe = Gait/limbic ataxia | Alcohol\*  Malnutrition  *\*(symptoms improve if the drinking stops)* | Drunken gait, can’t walk straight  Head tremor |
| Midline = Truncal ataxia | Medulloblastoma in 4th ventricle – young children  (affects vestibular nerve) | Fall towards most affected side  May involve eye movements |

### Formulation of diagnosis

1. Clinical
2. Anatomical (PNS, NMJ, SC, Brain stem)
3. Aetiological
4. Pathological process