Neurological examination
Objectives

- Understand neurological examination
- Perform a neurological examination
  - Higher function
  - Cranial nerves
  - Motor system
  - Sensory system
- Interpret neurological examination
Neuroanatomy – parts of nervous system

- Cerebrum
- Corpus callosum
- Cerebellum
- Midbrain
- Pons
- Medulla oblongata
- IVth Ventricle
Neuroanatomy – parts of nervous system

- Lateral ventricles
- IIIrd ventricle
- Pyramidal tract
- Caudate
- Putamen
- Globus pallidus
- Thalamus
- Substantia nigra
Neuroanatomy - lobes

- Pre-central gyrus (motor strip)
- Central sulcus (Fissure of Rolando)
- Post-central gyrus (sensory strip)
- Frontal lobe
- Parietal lobe
- Temporal lobe
- Occipital lobe
- Broca's speech area (Fissure of Sylvius)
- Lateral cerebral fissure (Fissure of Sylvius)
- Wernicke's speech area
Neuroanatomy – blood supply
Neuroanatomy – blood supply

Area of anterior cerebral artery

Area of middle cerebral artery

Area of posterior cerebral artery

Lateral surface

Anterior cerebral artery

Middle cerebral artery

Medial surface

Posterior cerebral artery
Neuroanatomy – parts of nervous system

.writeObject("
Don’t forget

Spinal cord
Peripheral nerves
Autonomic nerves

Aim of neurological examination is to locate the lesion

Aim of neurological history is to determine lesion type

Don’t rely on CT or MRI – you need to know what part to scan!
"
General inspection

Neurological examination is part of a full patient assessment.
Things to look for

❖ Observations
❖ Neck stiffness, Kernig sign
❖ Skin e.g. café-au-lait spots
❖ Anal sensation and tone
❖ With spinal problems especially e.g. cauda equina
❖ General examination e.g.
  ❖ Cyanosis (impaired consciousness)
  ❖ Lymphadenopathy (malignancy, infection)
  ❖ Murmurs, carotid bruit or AF (source of emboli)
  ❖ Teeth, ears (source of infection)
  ❖ Breasts, abdomen (malignancy)
Higher mental function - cognition
Higher mental function - cognition

- **Language:** dysphasia, dyslexia, dysgraphia
  - Verbal, reading and writing
- **Gnosis** “knowing things”: agnosia
  - Geography, objects, people
- **Praxis** “doing things”: dyspraxia
  - Dress, draw, write
- **Number skills:** dyscalculia
- **Memory:** amnesia
  - Immediate, recent, remote
  - visual, verbal
  - retrograde, anterograde
- **Reasoning**
- **Emotion**
- **Personality**
Testing higher mental function

Mini-mental state examination (MMSE)

- 30 point score
- Assesses multiple aspects of cognition
- Visit [website to see MMSE](#)

Abbreviated mental test score

- 10 point easy bedside test
<table>
<thead>
<tr>
<th>Question</th>
<th>Maximum Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orientation</td>
<td>One point for each correct answer, maximum of five.</td>
</tr>
<tr>
<td>What is the (year) (season) (date) (day) (month)?</td>
<td>One point for each correct answer, maximum of five.</td>
</tr>
<tr>
<td>Where are we? (State) (County) (Town) (Hospital) (Floor)</td>
<td>One point each correct answer, maximum of three.</td>
</tr>
<tr>
<td>Registration:</td>
<td></td>
</tr>
<tr>
<td>Name three objects: One second to say each. Then ask the patient all three after you have said them</td>
<td>One point each correct answer, maximum of three.</td>
</tr>
<tr>
<td>Attention and Calculation:</td>
<td></td>
</tr>
<tr>
<td>Serial 7’s: Subtracts 7 from 100 and keep doing it backward until five answers. Alternatively, spell “world” backward or name all the twelve months backward</td>
<td>One point for each correct answer, maximum of five.</td>
</tr>
<tr>
<td>Recalls:</td>
<td></td>
</tr>
<tr>
<td>Ask for the three objects repeated above</td>
<td>One point for each correct answer, maximum three.</td>
</tr>
<tr>
<td>Language:</td>
<td></td>
</tr>
<tr>
<td>Name a pencil, and watch</td>
<td>One point for each correct answer, maximum two</td>
</tr>
<tr>
<td>Repeat the followings: No if, s, and’s or but’s.</td>
<td>One point</td>
</tr>
<tr>
<td>Follow a 3-stage command: Take a paper in your right hand, fold it in half, and put it on the floor.</td>
<td>One point each, maximum of three.</td>
</tr>
<tr>
<td>Read and Obey the following:</td>
<td></td>
</tr>
<tr>
<td>Close your eyes</td>
<td></td>
</tr>
<tr>
<td>Write a sentence</td>
<td></td>
</tr>
<tr>
<td>Copy the following design</td>
<td></td>
</tr>
<tr>
<td>![Design Image]</td>
<td></td>
</tr>
</tbody>
</table>
Abbreviated mental test score

1. Age
2. Time to nearest hour
3. An address to be repeated at the end of the test
4. Where are you now? (name of hospital etc)
5. Year
6. Recognition of 2 people e.g. doctor, nurse
7. Date of birth
8. Year second world war began
9. Name of present monarch
10. Count backwards from 20 to 1
   ☞ Remember to test recall of address
Components of speech disorder

Dysphasia
- Receptive Wernicke
  - Unable to follow instruction
- Conductive Arcuate fasciculus
  - Speech Fluent but disorganised
- Expressive Broca
  - Unable to repeat
- Nominal Angular gyrus
  - Non-fluent speech
  - Unable to name items

Dysarthria
  - Articulation
    - Cerebellar
      - Slow slurred explosive
    - Bulbar
      - Flaccid Nasal
    - Pseudobulbar
      - Spastic "Donald Duck"
    - Extrapyramidal
      - Soft monotone

Dysphonia
  - Phonation
    - Hoarse voice
    - Bovine cough

Speech and language
Test speech and language

- Listen to history
  - Expression, reception and phonation
- Ask “take this paper with your right hand, fold in half and place on the floor
  - Reception
- Repeat “No ifs, ands or buts”
  - Nonsense phrase to assess repetition
- Repeat “British constitution,” “Baby hippopotamus”
  - Articulation
- Name the *strap* of a watch, or *nib* of a pen
  - Nominal dysphasia
- Language disorders usually co-exist “Global”
Cognition summary

- 10 point MTS
  - Age
  - Time
  - Address
  - Place
  - Year
  - 2 people
  - DoB
  - WWII
  - Monarch
  - 20 to 1
  - Recall

- Speech and language
  - Expression
  - Reception
  - Repetition
  - Articulation
Cranial nerves

Numbered for convenience…

…and named for what they do (mostly)
1st (olfactory) nerve

<table>
<thead>
<tr>
<th>Nuclei</th>
<th>None – terminates in cortex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comes from</td>
<td>Inferior frontal and temporal lobes</td>
</tr>
<tr>
<td>Goes through</td>
<td>Cribriform plate</td>
</tr>
<tr>
<td>Supplies</td>
<td>Sense of <strong>smell</strong></td>
</tr>
<tr>
<td>Tested by</td>
<td>Test smell in each nostril separately e.g. coffee</td>
</tr>
</tbody>
</table>
1st (olfactory) nerve

Test smell in each nostril with eyes closed.

Coffee
Vanilla
Perfumed soap
Avoid ammonia – activates sensory nerves

Anosmia — Head injury, tumour, nasal congestion.
Examination of Vision

- Optic (II) nerve – sensory inputs from retina
- Oculomotor – III}
- Trochlear – IV } Motor
- Abducens – VI }
### 2\textsuperscript{nd} (optic) nerve

<table>
<thead>
<tr>
<th><strong>Nuclei</strong></th>
<th>Lateral geniculate nucleus in thalamus (vision), superior colliculus (reflexes)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Comes from</strong></td>
<td>Thalamus</td>
</tr>
<tr>
<td><strong>Goes through</strong></td>
<td>Optic chiasm to optic foramen</td>
</tr>
<tr>
<td><strong>Supplies</strong></td>
<td>Vision from retina</td>
</tr>
<tr>
<td><strong>Tested by</strong></td>
<td>AFRO – acuity, fields, reflexes, ophthalmoscopy</td>
</tr>
</tbody>
</table>
2nd (optic) nerve

Visual Acuity
- Snellen chart
  Wear specs or correct with pinhole
- Finger counting
- Light-dark

Snellen visual acuity
Need good lighting
Patient is kept 6 metres (20ft) from the chart
Read as 6/5, 6/6, 6/10, 6/60
Test one eye at a time
Fields to confrontation
- Test one eye at a time
- Use red pin from each direction
- Gross defect only

- Central vision/blind spot – with red pin faded colour with lesions with macula
Optic pathways and defects
Optic nerve problems

Bitemporal hemianopia

Homonymous quadrantanopia
Cranial nerve nuclei

- Different nuclei for different functions
- One nerve can have more than one nucleus
- One nucleus can have more than one nerve
- Efferent means going out of the CNS (like sewage effluent goes out to sea)
- Afferent means going into the CNS
3\textsuperscript{rd} (oculomotor) nerve

<table>
<thead>
<tr>
<th>Nuclei</th>
<th>Oculomotor nucleus (motor), Edinger-Westphal nucleus (PS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comes from</td>
<td>Midbrain</td>
</tr>
<tr>
<td>Goes through</td>
<td>Superior orbital fissure</td>
</tr>
<tr>
<td>Supplies</td>
<td><strong>Motor</strong> to extraocular muscles except superior oblique and lateral rectus, levator palpebrae superioris. <strong>PS</strong> to eye</td>
</tr>
<tr>
<td>Tested by</td>
<td>Extraocular movements and pupillary reflexes (motor)</td>
</tr>
</tbody>
</table>
### 4th (trochlear) nerve

<table>
<thead>
<tr>
<th>Nuclei</th>
<th>Trochlear nucleus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comes from</td>
<td>Midbrain - dorsum</td>
</tr>
<tr>
<td>Goes through</td>
<td>Superior orbital fissure</td>
</tr>
<tr>
<td>Supplies</td>
<td>Motor to superior oblique muscle</td>
</tr>
<tr>
<td>Tested by</td>
<td>Extraocular movements</td>
</tr>
</tbody>
</table>
6th (abducens) nerve

<table>
<thead>
<tr>
<th>Nuclei</th>
<th>Abducens nucleus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comes from</td>
<td>Junction of pons and medulla</td>
</tr>
<tr>
<td>Goes through</td>
<td>Superior orbital fissure</td>
</tr>
<tr>
<td>Supplies</td>
<td><strong>Motor</strong> to lateral rectus muscle</td>
</tr>
<tr>
<td>Tested by</td>
<td>Extraocular movements</td>
</tr>
</tbody>
</table>
III (oculomotor), IV (trochlear), VI (abducens) nerves

- Cn III supplies
  - All extraocular muscles except lateral rectus, superior oblique
  - Levator palpebrae superioris
  - Parasympathetic supply to eye
- Cn IV supplies superior oblique
- Cn VI supplies lateral rectus
- These nerves are tested together
Extraocular muscles and actions

Right eye

- Superior rectus
- Inferior oblique
- Lateral rectus
- Medial rectus
- Inferior rectus
- Superior oblique
Testing extra ocular muscles

♫ Look for ptosis
♫ Eye movements (ask about diplopia, watch light reflection on cornea)
♫ 6 directions of muscle pull
♫ Watch for nystagmus
Cn III, IV, VI defects

Left abducens palsy
Cn III, IV, VI defects

Right oculomotor palsy
A painful, acute Cn III palsy is an emergency!
- could be an enlarging aneurysm
Cn III, IV, VI defects

Left trochlear palsy
Pupillary reflexes

Light reflex
- Fix the eyes on a distant point
- Bring torch / light onto pupil from side
- Look for direct light reflex and consensual light reflex
- Is the defect afferent or efferent

Accommodation reflex
- Check convergence and pupillary constriction
Relative afferent pupillary defect (RAPD)

Swinging light test – shine light first in one eye, then swing to the other
Relative afferent pupillary defect (RAPD)

Left RAPD = left optic nerve pathology
Summary of eyes

1. Visual equity with Snellen chart
2. Visual fields with confrontation
3. Eye movements
4. Pupillary reflexes
5. Fundoscopy
Nystagmus

Type
- Jerk
- Pendular

Direction of nystagmus
- Vertical
- Horizontal
- Rotatory

Direction of fast phase
- Degree
  - 1st degree
    - Only on looking to: one side
  - 2nd degree
    - On looking to: one side straight ahead
  - 3rd degree
    - On looking all directions

Causes
- Ocular
  - Pendular
- Vestibular
  - Never vertical
- Central
  - Any direction
  - Can be just one eye
  - Can change direction

Examine: Max 30 degrees from midline
### 5th (trigeminal) nerve

<table>
<thead>
<tr>
<th>Nuclei</th>
<th>Trigeminal motor nucleus, trigeminal sensory nucleus (length of brainstem into cervical cord)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comes from</td>
<td>Pons</td>
</tr>
<tr>
<td>Goes through</td>
<td>V1 ophthalmic: superior orbital fissure</td>
</tr>
<tr>
<td></td>
<td>V2 maxillary: foramen rotundum</td>
</tr>
<tr>
<td></td>
<td>V3 mandibular: foramen ovale</td>
</tr>
<tr>
<td>Supplies</td>
<td><strong>Sensation</strong> to face, <strong>motor</strong> to muscles of mastication</td>
</tr>
<tr>
<td>Tested by</td>
<td>Corneal reflex (sensory), touch, pin, clench teeth, open mouth, jaw jerk</td>
</tr>
</tbody>
</table>
5th (trigeminal) nerve

- **Sensation** to face
- **Motor** to muscles of mastication
- Corneal reflex (sensory)
- Jaw jerk (both components)
CN V - motor

1. Inspect for wasting

2. Ask the patient to clench the teeth and feel for the bulk

3. Ask the patient to open the mouth against resistance
Trigeminal nerve divisions

- Ophthalmic
- Maxillary
- Mandibular
Corneal reflex

Touch the cornea with a wisp of cotton
Look for direct and consensual reflexes

- Touch sensation via ophthalmic branch of Trigeminal Nerve
- Then Motor nucleus of VII —Obicularis oculi

Jaw jerk

Loosely open the mouth
Place the fore finger above the chin
Tap with tendon hammer
# 7th (facial) nerve

<table>
<thead>
<tr>
<th>Nuclei</th>
<th>Facial nucleus (nervus intermedius – salivary nucleus, nucleus solitarius)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comes from</td>
<td>Junction of pons and medulla</td>
</tr>
<tr>
<td>Goes through</td>
<td>Stylomastoid foramen, branches in parotid (T,Z,B,M,C)</td>
</tr>
<tr>
<td>Supplies</td>
<td><strong>Motor</strong> to muscles of facial expression, <strong>taste</strong> to anterior 2/3 of tongue, <strong>sensation</strong> to ear canal and palate, <strong>PS</strong> to salivary and lacrimal glands (nervus intermedius)</td>
</tr>
<tr>
<td>Tested by</td>
<td>Corneal reflex (motor), inspect face at rest, wrinkle forehead, close eyes, blow out cheeks, show teeth (taste: sweet, sour, salt, bitter)</td>
</tr>
</tbody>
</table>
7th (facial) nerve

Supplies:

- **Motor** to muscles of facial expression
- **Also carries:**
  - **taste** to anterior 2/3 of tongue
  - **sensation** to ear canal and palate
  - **PS** to salivary and lacrimal glands (nervus intermedius)

Tested by:

- Inspect face at rest
- Corneal reflex (motor)
- Wrinkle forehead
- Close eyes
- Blow out cheeks
- Show teeth
- (Taste: sweet, sour, salt, bitter)
Upper face has bi-cortical representation
UMN damage does not affect upper face

Orbicularis oculi is sometimes represented bilaterally, so may be spared or involved in UMN lesions
LMN lesion affects whole side of face
7th (facial) nerve - testing

**UMN lesion**
- Spares forehead as:
  - Bilateral cortical representation
  - LMN intact

**LMN lesion**
- Can involve forehead as:
  - LMN only innervates one side
  - Beware: can be partial CnVII palsy!
**8th (vestibulocochlear) nerve**

<table>
<thead>
<tr>
<th>Nuclei</th>
<th>Vestibular and cochlear nuclei on floor of IVth ventricle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comes from</td>
<td>Junction of pons and medulla</td>
</tr>
<tr>
<td>Goes through</td>
<td>Internal acoustic meatus</td>
</tr>
<tr>
<td>Supplies</td>
<td><strong>Hearing</strong> (cochlea), <strong>balance</strong> organs</td>
</tr>
<tr>
<td>Tested by</td>
<td>Otoscopy, whispered speech, Rinné, Weber (vestibular tests)</td>
</tr>
</tbody>
</table>
8th (vestibulocochlear) nerve

Supplies:

- **Hearing** (cochlea)
- **Balance** organs

Tested by:

- Otoscopy
- Whispered speech
- Rinné, Weber tests
- Vestibular tests e.g. Hallpike manoeuvre
Rinné test

- Use 512Hz tuning fork
- Place base firmly on mastoid process
- Ask patient to tell you when sound disappears
- Hold fork tips 2cm from EAM
- Can the patient hear it now?
Interpreting Rinné test

_tests whether bone (BC) or air conduction (AC) is better

- If can be heard in front of ear, AC>BC
  - Normal
  - Rinné positive

- If cannot be heard in front of ear, AC<BC
  - Indicates conductive deafness
  - Rinné negative
Weber test

 neurop 

Use the same tuning fork again

 neurop 

Hold somewhere on the head in the midline

 neurop 

Usually vertex or forehead

 neurop 

Which side is louder?
Interpreting Weber test

- Conductive deafness
  - localises to abnormal ear
- Sensorineural deafness
  - localises to normal ear
- Try it on yourself with a finger in an ear
- Where does the sound localise?
- Have you caused conductive or sensorineural deafness?
**9th (glossopharyngeal) nerve**

<table>
<thead>
<tr>
<th>Nuclei</th>
<th>Nucleus solitarius and nucleus ambiguus of medulla</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comes from</td>
<td>Medulla</td>
</tr>
<tr>
<td>Goes through</td>
<td>Jugular foramen</td>
</tr>
<tr>
<td>Supplies</td>
<td><strong>Sensation</strong> to pharynx, middle &amp; inner ear, post 1/3 tongue, <strong>taste</strong> post 1/3 tongue, <strong>PS</strong> to parotid, <strong>visceral sense</strong> from carotid body and sinus</td>
</tr>
<tr>
<td>Tested by</td>
<td>Gag reflex (sensory), (taste) – with CnX</td>
</tr>
</tbody>
</table>
## 10th (vagus) nerve

<table>
<thead>
<tr>
<th>Nuclei</th>
<th>Nucleus solitarius and nucleus ambiguus of medulla, dorsal vagal (motor) nucleus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comes from</td>
<td>Medulla</td>
</tr>
<tr>
<td>Goes through</td>
<td>Jugular foramen</td>
</tr>
<tr>
<td>Supplies</td>
<td>Sensation to pharynx and larynx. <strong>Motor</strong> to pharynx, larynx, palate (from CnXI). <strong>PS</strong> to thoracic &amp; abdominal organs</td>
</tr>
<tr>
<td>Tested by</td>
<td>Say “Ah” – uvula moves towards normal side, gag reflex (motor), phonation/cough, swallow</td>
</tr>
</tbody>
</table>
IX (glossopharyngeal) and X (vagus) nerves

Tested together

Glossopharyngeal supplies:
- **Sensation** to pharynx, middle & inner ear, post 1/3 tongue
- **Taste** post 1/3 tongue
- **PS** to parotid
- **Visceral sense** from carotid body and sinus

Vagus supplies:
- **Sensation** to pharynx and larynx
- **Motor** to pharynx, larynx, palate (from Cn XI)
- **PS** to thoracic & abdominal organs
IX (glossopharyngeal) and X (vagus) nerves

- Tested together
- Say “Ah” – uvula moves towards normal side
- Phonation/cough
- Gag reflex (IX sensory, X motor)
- Swallow – only if rest of IX and X normal
- (taste – not routine)
11th (accessory) nerve

<table>
<thead>
<tr>
<th>Nuclei</th>
<th>Spinal – C1-5 anterior horns (Cranial – nucleus ambiguus, with CnX)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comes from</td>
<td>Medulla</td>
</tr>
<tr>
<td>Goes through</td>
<td>Jugular foramen</td>
</tr>
<tr>
<td>Supplies</td>
<td><strong>Motor</strong> to sternocleidomastoid and trapezius muscles (and motor to vagus)</td>
</tr>
<tr>
<td>Tested by</td>
<td>Turn head against resistance, shrug shoulders</td>
</tr>
</tbody>
</table>
11th (accessory) nerve

_motor_ to sternocleidomastoid and trapezius muscles

- Examine bulk of SCM and trapezius
- Turn head against resistance
- Shrug shoulders
12\textsuperscript{th} (hypoglossal) nerve

<table>
<thead>
<tr>
<th>Nuclei</th>
<th>Hypoglossal nucleus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comes from</td>
<td>Medulla</td>
</tr>
<tr>
<td>Goes through</td>
<td>Hypoglossal foramen</td>
</tr>
<tr>
<td>Supplies</td>
<td>Motor to muscles of tongue except palatoglossus</td>
</tr>
<tr>
<td>Tested by</td>
<td>Look at tongue at rest, poke out tongue and move side-to-side</td>
</tr>
</tbody>
</table>
12\textsuperscript{th} (hypoglossal) nerve

\textbullet{} **Motor** to muscles of tongue except palatoglossus

\textbullet{} Look at tongue at rest

\textbullet{} Fasciculation

\textbullet{} Poke out tongue

\textbullet{} Move side-to-side

\textbullet{} Press into cheek against resistance
Practical – cranial nerves

- 2nd (optic) nerve
  - AFRO – acuity, fields, reflexes, ophthalmoscopy
- 3rd (oculomotor), 4th (trochlear), 6th (abducens) nerve
  - Test light reflex and extraocular muscles
- 5th (trigeminal) nerve
  - Motor and sensory
- 7th (facial) nerve
- 8th (vestibulocochlear) nerve
  - Rinné, Weber test
- 9th (glossopharyngeal) nerve
- 10th (vagus) nerve
- 11th (accessory) nerve
- 12th (hypoglossal) nerve
Trunk and limbs

Not just peripheral nervous system
Inspection

- Posture – clawing hands, pes cavas
- Wasting/Hypertrophy – feel for muscle bulk
  - Proximal or distal?
  - Symmetrical?
  - Specific muscle group?
- Fasciculation
- Abnormal movements
  - Tremor
  - Chorea
  - Other uncontrolled movement
- Scars – tracheotomy scars,
- Surrounding – wheel chair, walking stick or urinary catheter, NG, PEG
Tone - testing

- Patient relaxed, movements by examiner
- Rapid alternating movements
  - Upper limb: rotate wrist, flex and extend elbow
  - Lower limb: roll leg and watch foot
  - Lift leg briskly at knee
    - Does heel lift or drag along bed?
- Test for clonus at:
  - Ankle by rapid dorsiflexion
# Tone - abnormalities

<table>
<thead>
<tr>
<th>Tone Type</th>
<th>Description</th>
<th>Lesion Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>Barely perceptible resistance to movement</td>
<td></td>
</tr>
<tr>
<td>Decreased</td>
<td>Reduced resistance to movement</td>
<td>LMN or cerebellar lesion</td>
</tr>
<tr>
<td>“Lead pipe” ↑</td>
<td>Increased resistance throughout movement</td>
<td>UMN lesion</td>
</tr>
<tr>
<td>“Clasp knife” ↑</td>
<td>High resistance that suddenly releases</td>
<td>Extrapyramidal lesion</td>
</tr>
<tr>
<td>“Cogwheel rigidity”</td>
<td>Jerky resistance</td>
<td>Extrapyramidal lesion (esp. PD)</td>
</tr>
</tbody>
</table>
Arm drift

Pyramidal lesion, Parietal/ cerebellar lesion

Compare with
other side
yourself

Test each muscle group

Is the deficit:
Proximal or distal?
Flexor or extensor?
Cortical, nerve root, peripheral nerve distribution?
<table>
<thead>
<tr>
<th>MRC power rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
</tbody>
</table>
**Myotomes**

<table>
<thead>
<tr>
<th>Vertebra</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>C5</td>
<td>Shoulder abduction</td>
</tr>
<tr>
<td>C6</td>
<td>Elbow flexion</td>
</tr>
<tr>
<td>C7</td>
<td>Elbow extension</td>
</tr>
<tr>
<td>C8</td>
<td>Finger flexion</td>
</tr>
<tr>
<td>T1</td>
<td>Finger abduction</td>
</tr>
<tr>
<td>L2</td>
<td>Hip flexion</td>
</tr>
<tr>
<td>L3</td>
<td>Knee extension</td>
</tr>
<tr>
<td>L4</td>
<td>Dorsiflexion at ankle</td>
</tr>
<tr>
<td>L5</td>
<td>Extensor hallucis longus</td>
</tr>
<tr>
<td>S1</td>
<td>Plantar flexion</td>
</tr>
</tbody>
</table>
Reflexes – what do they test?

Spinal arc modulated by higher centres

<table>
<thead>
<tr>
<th>Reflex</th>
<th>Spinal Cord Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biceps</td>
<td>C5,6</td>
</tr>
<tr>
<td>Radial (supinator, brachioradialis)</td>
<td>C5,6</td>
</tr>
<tr>
<td>Triceps</td>
<td>C6,7,8</td>
</tr>
<tr>
<td>Finger jerk/ Hoffman</td>
<td>C8</td>
</tr>
<tr>
<td>Abdominal (4 quadrants)</td>
<td>T7-12</td>
</tr>
<tr>
<td>Knee</td>
<td>L3,4</td>
</tr>
<tr>
<td>Ankle</td>
<td>S1,2</td>
</tr>
<tr>
<td>Plantar</td>
<td>L5, S1,2</td>
</tr>
</tbody>
</table>
Tendon reflexes – how do I test them?

- Everything needs to be floppy
  - Patient’s limb
  - Your tendon hammer wrist
- Find tendon with finger (upper limb)
- Hit tendon or finger on tendon
- Try reinforcement if no response
  - Clench teeth
  - Pull hands apart
- Abdominal – stroke each quadrant towards umbilicus
- Plantar – stroke outer sole and ball of foot
Interpreting reflexes

Reduced in
- LMN lesion (including same level spine)
- Muscle weakness
- Early UMN lesion
- Slow in hypothyroidism

Increased in
- UMN lesion
- Anxiety, thyrotoxicosis, youth
Recording reflexes

- 0 = none, even with reinforcement
- + = only present with reinforcement
- ++ = normal
- +++ = hyper-reflexia
- ++++ = with clonus

Clonus is rhythmical beating in response to muscle stretch
UMN lesion

- Normal muscle bulk
- Increased tone
- Reduced power
- Brisk reflexes

LMN lesion

- Wasting and atrophy
- Reduced tone
- Reduced power
- Reduced or absent reflexes
Coordination

**Upper Limb**
- Finger-nose
- Dysmetria or past-pointing
- Clap with alternating palm and dorsum
- Dysdiadochokinesia
- “Play piano”
- Rebound
  - Test at same time as drift

**Lower limb**
- Heel-shin test
  - Run heel down other shin, lift up and repeat
- Tapping toes
Cerebellar signs

- Dysdiadochokinesia
- Ataxia – present with eyes open/close (broad base gait)
- Nystagmus - fast component towards the lesion
- Intention tremor (=dysmetria)
- Speech – slow, slurred, explosive, scanning
- Hypotonia
- Pendular jerks - muscle contraction and relaxation is slow
- Past pointing
- Rebound phenomenon

Ipsilateral signs. If central (vermis, alcohol) only truncal ataxia may be present
# Sensory modalities and testing

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pain</strong></td>
<td>Pin (neurotip)</td>
<td>Spinothalamic Cross–spinal cord</td>
</tr>
<tr>
<td><strong>Temperature</strong></td>
<td>Ice, cold tuning fork (not routine)</td>
<td>Spinothalamic Cross–spinal cord</td>
</tr>
<tr>
<td><strong>Proprioception</strong></td>
<td>Eyes closed, move joint</td>
<td>Dorsal column Cross - brainstem</td>
</tr>
<tr>
<td><strong>Light Touch</strong></td>
<td>Wisp of cotton wool</td>
<td>Dorsal column Cross - brainstem</td>
</tr>
<tr>
<td>**2 point</td>
<td>Two-point discriminator</td>
<td>Dorsal column Cross - brainstem</td>
</tr>
<tr>
<td>discrimination</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Vibration</strong></td>
<td>128 Hz tuning fork on bony prominence</td>
<td>Dorsal column Cross - brainstem</td>
</tr>
</tbody>
</table>
### Dermatomes

<table>
<thead>
<tr>
<th>Spinal Level</th>
<th>Dermatome</th>
</tr>
</thead>
<tbody>
<tr>
<td>C4</td>
<td>Cape</td>
</tr>
<tr>
<td>C7</td>
<td>Middle finger</td>
</tr>
<tr>
<td>T2</td>
<td>Arm pit</td>
</tr>
<tr>
<td>T5</td>
<td>Nipple</td>
</tr>
<tr>
<td>T10</td>
<td>Umbilicus</td>
</tr>
<tr>
<td>T12</td>
<td>Inguinal ligament</td>
</tr>
<tr>
<td>L2</td>
<td>Hands in pockets</td>
</tr>
<tr>
<td>L3</td>
<td>Knee</td>
</tr>
<tr>
<td>L5</td>
<td>Big toe</td>
</tr>
<tr>
<td>S1</td>
<td>Lateral foot</td>
</tr>
</tbody>
</table>

Visit [ASIA scoring sheet](#)
Finally…

☞ Romberg Test
Positive if sways when eyes closed

☞ Gait
Gait assessment

Gait depends on:

- Tone
- Strength
- Balance
- Sensation
- Coordination

- Visual
- Vestibular
- Proprioception

Walk a few metres, turn and return
Watch width, rhythm and step length
If easy, try tandem walking
Gait

- Hemiparetic/spastic
- Festinant
  - PD, short shuffling steps, leaning forward
- Wide-based
  - Cerebellar (staggering)
  - Frontal lobe
- Stamping
  - ↓ proprioception
- Steppage/high stepping
- Foot drop
- Proximal myopathy
- Waddling
Extra tests with spinal problems

- Straight leg raise (root entrapment, Lasegue)
  - Pain at <60°
  - Eased by bending knee
  - Can be “crossed” – pain on other side
- Femoral stretch
- Perianal sensation
- Touch and pin
- Anal tone
- Anal “wink”
Practical - limbs

- Inspection
- Tone
- Power
  - UL: Drift, SAb/Ad, EF, EE, WE, FF, FAb/Ad, opposition
  - LL: HF, HE, KF, KE, AInv/Ev, DF, EHL, PF
- Sensory modalities and testing
  - Pin, touch, proprioception, vibration
- Reflexes
  - UL: Biceps, brachioradialis, triceps
  - LL: Knee, ankle, plantar
- Coordination
  - Finger-nose, heel-shin, alternating movements, Romberg
- Spinal tests, SLR, femoral stretch if needed
Neurological Examination of the unconscious patient

- ABC, any sedative drugs, C-spine protection if trauma
- Pattern of breathing –
  - ↑ RR - pontine lesions, respiratory causes, Metabolic causes
  - Cheyne-stokes – central medullary lesions, Resp/CVS
  - Irregular pattern – medullary lesions
- Glasgow coma scale
- Pulse and blood pressure ? ↑ ICP
- Blood glucose
- Temperature
  - Hypothermia
  - Pyrexia - CNS infection, medullary lesion
- Neck stiffness – meningitis, SAH, ↑ ICP
- Pupils - size
  - Small - pontine lesion, opioids
  - Unresponsive midbrain lesions
- Pupils – asymmetry
  - Large/unreactive III nerve palsy
  - Small slow to dilate - Horner's
- Light reflex
- Fundoscopy – papilloedema
Eye movements
- primary position - squint
- Nystagmus
- Dolls eye movements –
  horizontal –III / VI, pons
  vertical – III , IV, midbrain

Corneal reflex - V, VII, pontine lesion

Gag reflex

Posture
- Decorticate – pyramidal tracts from cortex to
  internal capsule
- Decerebrate – midbrain, thalamus and
  subthalamic nuclei

Check the tone of the limbs
- Limb Reflexes
- Planters

- Monitoring the progress at regular time interval – improving/deteriorating
AVPU score

.Alert
★ Responds to Verbal stimulus
★ Responds to Painful stimulus
★ Unresponsive
# Glasgow coma scale—eyes (4)

- **Record best score for each section**
- **Record in components, not just sum**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open spontaneously</td>
<td>4</td>
</tr>
<tr>
<td>Open to command</td>
<td>3</td>
</tr>
<tr>
<td>Open to pain</td>
<td>2</td>
</tr>
<tr>
<td>No opening</td>
<td>1</td>
</tr>
<tr>
<td>Closed due to swelling</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>---</td>
</tr>
<tr>
<td>Orientated</td>
<td>5</td>
</tr>
<tr>
<td>Disorientated</td>
<td>4</td>
</tr>
<tr>
<td>Inappropriate words</td>
<td>3</td>
</tr>
<tr>
<td>Sounds</td>
<td>2</td>
</tr>
<tr>
<td>None</td>
<td>1</td>
</tr>
<tr>
<td>Intubated</td>
<td>T</td>
</tr>
</tbody>
</table>
**GCS – motor (6)**

- Start with command
- If no response, squeeze side of nails
- Sternal rub and nail bed pressure bruise

<table>
<thead>
<tr>
<th>Action</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>To command</td>
<td>6</td>
</tr>
<tr>
<td>Localises pain</td>
<td>5</td>
</tr>
<tr>
<td>Withdraws from pain</td>
<td>4</td>
</tr>
<tr>
<td>Abnormal flexion to pain</td>
<td>3</td>
</tr>
<tr>
<td>Extension to pain</td>
<td>2</td>
</tr>
<tr>
<td>None</td>
<td>1</td>
</tr>
</tbody>
</table>
System for neurological examination

- General inspection
- Glasgow coma scale
- Higher mental function
- Speech and language
- Cranial nerves

- Trunk and limbs
  - Inspection
  - Tone
  - Power
  - Sensation
  - Reflexes
  - Coordination
- Gait