Neurological Examination

Moderator: Prof. S.A. Azmi
Presenter: Faisal Shaan

18 April 2020
The Neurological Assessment

Introduction
Mr. Johnson was eating breakfast at the table and his wife was in the living room. She heard what sounded like a dish breaking, and asked Mr. J if he was okay. Mr. J answered slowly, his speech was hard to understand, and did not seem to make sense. Mrs. J was concerned and went into the kitchen to check on him. Mr. J’s Right arm was hanging down and his face looked “droopy” on one side.
Respond FAST !!!

Use the FAST tool to perform a quick assessment on Mr. Johnson!
## FAST Screening

<table>
<thead>
<tr>
<th>FAST</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>F</strong></td>
<td>Face drooping</td>
</tr>
<tr>
<td><strong>A</strong></td>
<td>Arm weakness</td>
</tr>
<tr>
<td><strong>S</strong></td>
<td>Speech</td>
</tr>
<tr>
<td><strong>T</strong></td>
<td>Time to call 9-1-1</td>
</tr>
</tbody>
</table>
Mr. Johnson - At the ER

You are the ER doctor who receives report from the paramedics for an incoming patient.

Mr. Johnson’s wife called 911 this morning because her husband suddenly became confused, his speech was very difficult to understand and his mouth was uneven. He also had extreme difficulty moving his right arm and right leg.

Mr. Johnson who is a 67-year-old male was finally brought to the trauma emergency center by ambulance at 9:30 AM.
Mr. Johnson - At the ER

Mrs. Johnson indicated that the symptoms started at 8:15 AM this morning and she called 911 at 8:30 AM.

His last vitals at 9:20 AM were:

- HR @122/min (Tachycardia)
- Blood pressure 194/98 mm Hg (Hypertension)
- Respiratory rate 24/min (Tachypnoea)
- Oxygen Saturation was 92% on Room Air
- Temperature 37.8°C (100.1°F)

- **ABC** assessment of Airway, Breathing and Circulation

- Vital Monitoring and Send Relevant investigations (NCCT)

- Initial assessment head to toe f/b Detailed Neurological Examination
Nervous System - A Quick Review

Central Nervous System

Peripheral Nervous System

Efferent (Motor) Nervous System

Afferent (Sensory) Nervous System

Central Nervous System

Peripheral Nervous System

Efferent (Motor) Nervous System

Afferent (Sensory) Nervous System

Autonomic Nervous System

Sympathetic Nervous System

Parasympathetic Nervous System

Brain and Spinal Column

The rest of the body

Autonomic = Automatic

“SAME”
Sensory = Afferent
Motor = Efferent

Somatic (body) Nervous System
The Neurological Assessment
Mental Status
<table>
<thead>
<tr>
<th>Mental Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of consciousness (LOC)</td>
</tr>
<tr>
<td>Attention, Concentration and Orientation</td>
</tr>
<tr>
<td>Speech and Language</td>
</tr>
<tr>
<td>Memory, Intelligence and Judgement</td>
</tr>
</tbody>
</table>
### LOC Terminology

| Alertness         | • Patient is alert, attentive, and follows commands  
<table>
<thead>
<tr>
<th></th>
<th>• If asleep, responds promptly to external stimulation</th>
</tr>
</thead>
</table>
| Lethargy          | • Not Fully Alert, Tends to **DRIFT TO SLEEP**      
|                  | • **DROWSY**; When aroused – Impaired Attention      |
| Obtundation       | • **TRANSITION STATE** between Lethargy & Stupor    
|                  | • Difficult to arouse; When aroused - **CONFUSIONAL** |
| Stupor/Semicoma   | • Only aroused by **VIGOROUS STIMULATION**           
|                  | • Restless; **Groans/ Mumbles**                      |
| Coma              | • **UNAROUSABLE** even to continuous or painful stimulation |
LOC Assessment

1. Note if patient is awake and alert !!!

2. If **NOT**, describe the level of stimulation needed to arouse and keep patient awake.

Scales

- Glasgow Coma Scale (GCS)**
- NIH Stroke Scale (NIHSS)
Glasgow Coma Scale

Based on 3 patient responses:

- Eye opening
- Verbal response
- Motor response
Glasgow Coma Scale

Patient receives score for best response in each of these areas (score is added together).

- GCS score range 3 – 15.
- The higher the number, the better.
- A score less than 8 usually indicates coma and will likely need intubation to protect the airway.
The NIHSS is a multiple item neurologic examination stroke scale used to evaluate the effect of acute cerebral infarction on:

- Levels of consciousness
- Language
- Neglect
- Visual-field loss
- Extraocular movement
- Motor strength
- Ataxia
- Dysarthria
- Sensory loss
The NIHSS takes **less than 10 minutes** to complete by a certified nurse or physician.

**Utilized at intervals:**
- Baseline
- 2 hours post treatment
- After 24 hours
- After 7-10 days
- At 3 months, etc.

https://www.stroke.nih.gov
Do’s and Don’ts

Always use a nail-bed-press on an extended arm to administer pain.

Good!

What **NOT** to do??

Bad!

That’s why!
If the person is alert or awake enough to answer questions, mentation is assessed by asking questions in a conversational and non-threatening tone to determine Attention, Concentration and Orientation.
Attention (Digit Repetition Test)

I am going to say some simple numbers

Listen carefully

When I am finished, repeat the numbers

Read out in normal tone @ 1 digit/ second

E.g. 7-2-8-5-4-6-7-3-9

Inability to repeat > 5 digits s/o **DEFECTIVE ATTENTION**
Concentration ("A" Random Letter Test)

I am going to read a series of letters

Listen carefully

Whenever you hear “A”, TAP the desk

Read out in normal tone @ 1 letter/ second


**DEFECTIVE CONCENTRATION**

- Omission Errors
- Commission Errors
- Perseveration Errors
Orientation Assessment

What is your name?
Where are you right now?
Who brought you here?
What day, month or year is it?
Can you guess the current time?

1. Patient is “oriented x 3” if all 3 are entirely correct.
2. If not oriented x 3, write out patient’s responses.
   Do not say “oriented x 2 (or 1)”
Speech & Language

- Listen to Patient’s Verbal Output
- Motor Ability to produce words
- Quantity of Spontaneous Speech
- Rate of Speech Production
- Appropriateness of Words used
# Speech & Language

<table>
<thead>
<tr>
<th>Fluency</th>
<th>Repetition</th>
<th>Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal – If Patient speaks in sentences without hesitancy/ breaks</td>
<td>“Repeat after me: I went to the store and forgot my wallet”</td>
<td>Have patient read and follow a written command: “Close your Eyes”</td>
</tr>
<tr>
<td>Comprehension</td>
<td>Naming</td>
<td>Writing</td>
</tr>
</tbody>
</table>
| Normal – If Patient is able to answer your questions appropriately and follow exam instructions | 1. Point to objects around room, asking what they are: Watch, Pen, Telephone  
2. If done well, ask more difficult ones: (watch) band, (pen) cap, (telephone) receiver | “Have patient write a complete sentence of their choice” |
The patient is alert and oriented to person, place and time, with Intact memory of distant, recent and incident, and no amnesic gaps.
### Mental Status – Intelligence & Judgement

<table>
<thead>
<tr>
<th>General Knowledge</th>
<th>Abstraction</th>
<th>Judgement</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Who is the current President of India?</td>
<td>What does “People in glass houses shouldn’t throw stones” mean?</td>
<td>What would you do if you found a sealed, stamped, addressed envelope lying on the ground?</td>
</tr>
<tr>
<td>• What is the capital of Maharashtra?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• What is the name of your _</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reasoning</th>
<th>Insight</th>
</tr>
</thead>
<tbody>
<tr>
<td>How do a lie and mistake differ?</td>
<td>Why did your daughter bring you to the hospital?</td>
</tr>
</tbody>
</table>
The Neurological Assessment
Station & Gait
Station & Gait

A. Observe the patient do the following:
   1. Rise from a seated position.
   2. Walk across room, turn, and come back.
   3. Walk on toes.
   4. Walk on heels.
   5. Walk heel to toe (tandem gait) in a straight line.

B. Be prepared to catch the patient if necessary. If there is any doubt in your mind as to whether the patient may fall, get assistance (nurse, patient care technician, resident) before testing gait.

Do not use this doubt as a reason not to test gait, however.
Station & Gait

C. Pay attention to the following:

1. Posture of body and extremities (e.g., leaning or pulling towards one side or backwards, twisting or holding back one arm).

2. Length, speed, and rhythm of steps.

3. Base of gait (how far apart are the legs).

4. Arm swing (Reduced unilaterally or bilaterally).

5. Steadiness.

6. Turning (steadiness of turns and number of steps required to complete the turn).
The Neurological Assessment
Eyes, Neck & Movements
Pupillary Examination

1. Ideally should be done in a darkened environment.
2. Have the patient take off their glasses (contact lenses are ok) and gaze into the distance, behind you.
3. Shine the light on one pupil and watch that pupil’s reaction, it should constrict – Don’t use a super powerful flashlight!
4. Miosis means constriction, Mydriasis means Dilation
5. When the pupil receiving the light constricts it’s called the ‘Direct response’, but the other pupil (not receiving the light) will also constrict; this is called the ‘Consensual response’.
Pupils

- Constricted pupils
- Normal sized pupils
- Dilated pupils
- Mild-dilated pupils
- Unequal-sized pupils

**NORMAL**
- Both pupils should be the same shape, size, and react equally to light.
- The pupils should both be round, symmetrical, midline and dark.

**ABNORMAL**
- The pupils may be different sizes due to head injury, drugs, trauma to the eye
- Any difference of more than 1 mm is called Anisocoria.

Normal diameter: 2.0 - 5.0 mm

Glaucoma

Head trauma
Pupils

- **Constricted pupils**
- **Normal sized**
- **Dilated pupils**

<table>
<thead>
<tr>
<th>Diameter (mm)</th>
<th>1 mm</th>
<th>2 mm</th>
<th>3 mm</th>
<th>4 mm</th>
<th>5 mm</th>
<th>6 mm</th>
<th>7 mm</th>
<th>8 mm</th>
<th>9 mm</th>
</tr>
</thead>
</table>
The General Assessment – The Pupils

<table>
<thead>
<tr>
<th>Pupils</th>
<th>Causes</th>
</tr>
</thead>
</table>
| Unilateral dilated pupil | • Anisocoria (20%)  
• Head Trauma (CN III compression)  
• Direct trauma or medication to eye |
| Bilateral dilated pupils | • Midbrain injury/lesion (epilepsy, stroke, trauma, tumour)  
• Sympathetic stimulation (adrenergics, pain, love, fear)  
• Oxytocin |
| Irregular pupils | • Direct ocular/orbital trauma |
| Dysconjugate Gaze | • Congenital  
• Frontal Lobe Lesion |
| Pinpoint pupils | • Age  
• Pontine injury  
• Most narcotics, nicotine, antipsychotics (haloperidol), ondansetron, MAO inhibitors, organophosphates |
Retinal Examination

- Have the patient stare at the corner of the room where the ceiling meets the wall.

- Approach the right eye from the right side of the patient. Place one hand on their forehead so you have depth perception and don’t run into their face.

- Place the ophthalmoscope on your forehead and look into the pupil. Examine the fundus (interior of the eye) for abnormalities.
**The Eyes : Conjugate gaze & Tracking**

1. The pupils should both be midline when staring straight ahead and should move together in the same way (conjugate gaze).
2. If they are not, or do not, that is a **Dysconjugate gaze**.
3. People who are conscious will normally ‘track’ (follow) a moving object in front of them.
4. When you enter a scene, note if the patient is ‘**Tracking**’.

**The Eyes : Accommodation**

- Ask the patient to alternate between looking at a distant object, then at your finger, spending about 2-3 seconds on each.
- As the eyes focus on your finger the eyes should cross equally and the pupils should constrict.
- The ability to do so is called ‘**Accommodation**’.
- Lack of accommodation suggests that the brain is not ok.
The General Assessment – The eyes: movement

- Hold your finger about an arms length away from the patient
- Move your finger in a capital ‘H’ pattern
- Make sure both pupils are able to follow the finger through the entire range of motion
The General Assessment – The eyes: Nystagmus

A rhythmic regular oscillation of the eyes

<table>
<thead>
<tr>
<th>Types</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Vertical (up and down)</td>
<td>• Congenital</td>
</tr>
<tr>
<td>2. Horizontal (side to side)</td>
<td>• Eye problems (including cataracts, strabismus and focusing problems)</td>
</tr>
<tr>
<td>3. Rotary (in a circle)</td>
<td>• Inner ear problems (including Meniere’s disease)</td>
</tr>
<tr>
<td>4. Physiological (normal) – fine nystagmus is common at the extreme ranges of gaze</td>
<td>• CNS problems (including head injury, stroke, and multiple sclerosis)</td>
</tr>
<tr>
<td></td>
<td>• Medications or alcohol</td>
</tr>
</tbody>
</table>

“New onset nystagmus suggests that the brain is **NOT** ok"
Kernig's Sign

Kernig's Sign, is often used to produce a sign of meningitis. The examination can also be used to reproduce radiculopathy in root compression, or nerve tension (sciatic nerve). The action of the test is identical to Lasègue's Differential/Sign

Procedure
1. Patient supine, examiner flexes patient’s hip to 90° with knee flexed.
2. Examiner then extends patient’s knee.

Interpretation

Positive Kernig's Sign
1. Leg pain: Radiculopathy
2. Increased resistance: Hamstring tightness
3. Involuntary flexion of the opposite knee and hip: Meningitis
Brudzinski’s sign

**Indications**

Brudzinski’s sign or Brudzinski’s neck sign is one of three medical signs, that may occur in meningitis/meningeal disease.

**Procedure**

Patient supine, examiner passively flexes patient’s head & neck.
The General Assessment – Movement Disorders

- **Tremor** – a rhythmical, alternating movement of any part of the body (often the head or limbs)
- **Myoclonic jerks** – A brief muscle contraction that causes a sudden jerking of a limb
- **Tic** – a repetitive, irresistible movement that is purposeful or semi-purposeful
- **Akathesia** – (literally “inability to sit still”) motor restlessness, constant semi-purposeful movements of the arms and legs
- **Athetosis** – writhing, slow, sinuous movements, especially of the hands and wrists
- **Dystonia** – sustained contractions of large groups of muscles often resulting in bizarre posture
The Neurological Assessment

The Cranial Nerves
The Head – The Cranial Nerves

The first nerves to exit the brain are the cranial nerves

<table>
<thead>
<tr>
<th>NAME</th>
<th>TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Olfactory</td>
<td>1. Sensory</td>
</tr>
<tr>
<td>2. Optic</td>
<td>2. Sensory</td>
</tr>
<tr>
<td>3. Occulomotor</td>
<td>3. Motor</td>
</tr>
<tr>
<td>4. Trochlear</td>
<td>4. Motor</td>
</tr>
<tr>
<td>5. Trigeminal</td>
<td>5. Mixed</td>
</tr>
<tr>
<td>7. Facial</td>
<td>7. Mixed</td>
</tr>
<tr>
<td>8. Auditory (Vestibulocochlear)</td>
<td>8. Sensory</td>
</tr>
<tr>
<td>10. Vagus</td>
<td>10. Mixed</td>
</tr>
</tbody>
</table>
Assessing the C.N.
“A 7, a W, a snap! .... then down the hole”
Cranial Nerves - Smell

Have you noticed anything odd with your sense of smell lately?

I'm going to open this alcohol swab, can you smell it normally?
Cranial Nerves - Eyes

1. Tracking well
2. Midline Conjugate gaze
3. PEARL
4. Accommodation (cross and close)
5. Normal Oculomotor Movement (H)

Have you had any troubles with your vision lately?
Are you seeing clearly now?
Cranial Nerves - Eyes

Interesting, but not essential. No need to memorise.
5: Can you feel me touching your face at these points
7: Make a big smile for me
7: Shut your eyelids and don’t let me open them
7: Wrinkle up your forehead

Have you noticed any weakness in your face or eyes recently?
8: Can you hear me rubbing my fingers beside your ears?

Have you noticed any difficulties with your hearing recently?

Have you been dizzy, or had trouble with feeling like the room has been spinning?
Cranial Nerves - Holes

12. Hypoglossal
10. Vagus
9. Glossopharyngeal
11. Accessory

12: Stick out your tongue
10: Open your mouth and say “ahh”
9: Try to swallow, then cough gently
11: Shrug your shoulders

Have you noticed your voice has changed at all?
Is it more hoarse?
Have you had any difficulty speaking or swallowing?
The Neurological Assessment

Sensory Examination
Sensory System Examination

A. General points.
   1. Explain each test before you do it.

   2. Unless otherwise specified, the patient's eyes should be closed during testing.

   3. Test all 4 extremities.

   4. Compare side to side and ask if the two sides are about the same. Avoid leading questions like “Is this sharp?”

   5. Compare distal and proximal areas of the extremities.

   6. When you detect an area of sensory loss, map out its boundaries in detail.
# Sensory System Examination

<table>
<thead>
<tr>
<th>Vibration</th>
<th>Pain</th>
<th>Light Touch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tap a 128 Hz Tuning Fork and place on the joint.</td>
<td>Use a Safety Pin Apply Stimulus (Pin-Prick) Sensation – Same/Diff.</td>
<td>Ask Patient to respond when he feels light touch sensation</td>
</tr>
<tr>
<td>Distal - to- Proximal</td>
<td>Temperature</td>
<td>Crude Touch</td>
</tr>
<tr>
<td>Joint Position</td>
<td></td>
<td>Similarly Touch (Crude) to be tested in different areas and difference to be noted</td>
</tr>
<tr>
<td>Patient - Closes Eyes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grasp the great toe and Move “Up”/“Down”</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Sensory System Examination

<table>
<thead>
<tr>
<th>Graphesthesia</th>
<th>Stereognosis</th>
<th>Double Stimulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Can be performed only when light touch is intact.</td>
<td>1. Can be performed only when light touch and position sense are intact.</td>
<td></td>
</tr>
<tr>
<td>2. Using a pen cap, paper clip, or your finger, draw a number in patient’s palm or, for more sensitivity, on index finger.</td>
<td>2. Place a familiar object (e.g., coin, paper clip, key) in patient’s hand.</td>
<td>1. Can be performed only when light touch is intact.</td>
</tr>
<tr>
<td>3. Ask patient to identify the number.</td>
<td>3. Ask patient to move it around using fingers and to identify it.</td>
<td>2. Touch both sides of patient’s face or body simultaneously.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Ask patient to indicate whether touch is felt on the left, right, or both.</td>
</tr>
</tbody>
</table>

Integrative Sensation
The Neurological Assessment

Motor Examination
Motor System Examination

A. **Visual inspection.**
   1. Note muscle bulk. Look for generalized or focal muscle wasting or hypertrophy.
   2. Look for extraneous movements, e.g., tremor (At rest? With action?), fasciculation (muscle twitching).
   3. Note speed of movement, e.g., slow to initiate (bradykinesia).

B. **Tone** (muscle tension at rest).
   1. Ask patient to relax.
   2. Flex and extend patient’s wrists, elbows, ankles, and knees.
   3. Look for resistance that is decreased (hypotonia) or increased (throughout range of motion=rigidity; spring-like=spasticity).
Motor System Examination

C. Strength and Endurance:

1. Isolate muscle you are testing so patient can’t use strong muscles that have similar function to compensate for weak one being tested.

2. Fix proximal joint when testing distally. E.g., if testing pronation, fix the humerus, so patient can’t use shoulder to compensate for weak pronation.

3. Have patient walk on heels and toes and do deep knee bend or get out of chair without using arms.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0/5</td>
<td>No Muscular Contraction</td>
</tr>
<tr>
<td>1/5</td>
<td>Visible M/s Contraction; No Movement at Joint</td>
</tr>
<tr>
<td>2/5</td>
<td>Movement at the Joint; Not Against Gravity</td>
</tr>
<tr>
<td>3/5</td>
<td>Movement Against Gravity; Not Against Resistance</td>
</tr>
<tr>
<td>4/5</td>
<td>Movement Against Resistance but less than full</td>
</tr>
<tr>
<td>5/5</td>
<td>Movement Against Full Resistance; Normal Strength</td>
</tr>
</tbody>
</table>

Assign score of 0-5 for each muscle (based on Medical Research Council scale)
The Neurological Assessment
The Reflexes
Muscle Stretch Reflexes

Instructions:

1. Position limb and place muscle in slight tension.

2. Quickly tap the tendon/periosteum to which muscle is attached.


4. If reflexes are diminished or absent, try reinforcing the reflex by distraction or via isometric contraction of other muscles (clenched teeth).

5. Elicit the Deep Tendon Reflexes (DTRs)
Assessing DTRs - Instructions

Biceps (C5,C6)

i. Patient’s arm should be partially flexed at the elbow with palm down.
ii. Place your thumb or finger firmly on biceps tendon.
iii. Strike your finger with reflex hammer.
iv. You should feel the response even if you can’t see it.

Triceps (C6,C7)

i. If patient is seated: support upper arm and let forearm hang free.
ii. If patient is lying down, flex arm at elbow and hold it close to chest.
iii. Strike the triceps tendon above the elbow.

Knee (L2,L3,L4)

i. Have patient sit or lie down with knee flexed.
ii. Strike patellar tendon just below patella.
iii. Note contraction of the quadriceps and extension of the knee.

Ankle (S1,S2)

i. Dorsiflex foot at ankle.
ii. Strike Achilles tendon.
iii. Watch and feel for plantar flexion at the ankle.
Assessing DTRs - Grading

Tested with "Reflex hammer"

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Absent</td>
</tr>
<tr>
<td>1</td>
<td>Hypoactive</td>
</tr>
<tr>
<td>2</td>
<td>Normal</td>
</tr>
<tr>
<td>3</td>
<td>Brisk/Hyperactive</td>
</tr>
<tr>
<td>4</td>
<td>Markedly Hyperactive with Clonus</td>
</tr>
</tbody>
</table>

**Test for clonus**
(Rhythmic oscillations of flexion/extension)

i. Support knee in a partly flexed position.
ii. With patient relaxed, quickly dorsiflex foot.
iii. Observe for rhythmic oscillations.
Plantar Response

Tests the patency of the Pyramidal tracts

• This should be tested in comatose patients, and those with suspected injury to lumbar or sacral areas of the spinal cord.

• Stimulate the sole of the foot with a tongue blade or the handle of a reflex hammer.

• Begin at the heel and move up the foot, in a continuous motion, along the outer aspect of the sole and then across the ball to the base of the big toe.
Plantar Response

Tests the patency of the Pyramidal tracts

• **Normal response** is plantar flexion (curling under) of the toes.

• Dorsiflexion or Extension of the big toe (**Babinski’s Sign**) is **Abnormal**, except in children younger than 2 years.

• It suggests a upper motor neuron (brain-to-spine) lesion.

• Do not use the terms ‘positive Babinski’ or ‘negative Babinski’ as there are ambiguous.
Assessing Brain Stem Reflexes

Assess brain stem reflexes in comatose patients to determine if the brain stem is intact.

<table>
<thead>
<tr>
<th>Oculocephalic</th>
<th>Oculovestibular reflex</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Doll’s eye reflex)</td>
<td>(ice caloric/cold caloric reflex)</td>
</tr>
</tbody>
</table>
| • Turn patient’s head briskly from side to side – the eyes should move to the left while head is turned to the right, and vice versa.  
• If this reflex is absent, there will be no eye movement. | • A physician will instill at least 20 mL of ice water into patient’s ear.  
• With intact brain stem, eyes will move laterally toward affected ear.  
• With severe brain stem injury, gaze will remain at midline. |
The Neurological Assessment
Cerebellar Function
Say lah-pah-kah can test rapid alternating movements of the tongue, lips & palate.

- Slow, indistinct, and scanning speech
- Loss of normal phrasing and intonation
Tremor

**INTENTION TREMOR**

- Arises mainly from limb girdle muscles and is maximal at the most demanding phase of the active movement.

**POSTURAL TREMOR**

- Postural tremor (fine distal 8-13 Hz)(1st scene)
- Resting tremor (coarse distal 5-6 Hz)(2nd scene).
Rebound

**NORMAL**

- Tap outstretched arms.
- Patient's arms should recoil to original position.

**ABNORMAL**

- Increased range of movement with lack of normal recoil to original position is seen in cerebellar disease.
Check Reflex

**NORMAL**

- Examiner pulls on actively flexed arm then suddenly releases. The patient should be able to check the arm's movement when released.

**ABNORMAL**

- The Patient is unable to stop flexion of the arm on sudden release so the arm may strike the chest and doesn't recoil to the initial position.
Hand Rapid Alternating Movements

NORMAL

• Finger tapping, wrist rotation and hand patting.
• Note the rapidity, rhythmical performance or any right-left disparity.

ABNORMAL

• Slow & irregular movements with imprecise timing.
• Unable to perform repetitive movements in a rapid rhythmic fashion called DYSDIADOCHOKINESIA.
Finger to Nose Test

- The Patient moves the pointer finger from nose to the examiner's finger as the examiner moves his finger to new positions.

**NORMAL**

**ABNORMAL**

**APPENDICULAR ATAXIA**
- Under (hypometria) shooting of a target
- Over (hypermetria) shooting of a target
Heel to Shin Test

NORMAL

Places one heel on the opposite knee, then run the heel down the shin to the ankle and back to the knee in a smooth coordinated fashion.

ABNORMAL

Difficulty placing the heel on the knee with a side-to-side irregular over- and undershooting as the heel is advanced down the shin.
• The patient should be observed walking as she normally would.

• Wide-based, unsteady, irregular steps with lateral veering
• Ataxia more prominent on turning or stopping.
Tandem Gait

- Walk heel-to-toe. Note steadiness.
- Tandem gait requires the patient to narrow the station and maintain balance.

Abnormal

- Difficulty narrowing the station in order to walk heel to toe.

Ataxia
The Neurological Assessment

The Dermatomes
The nerves exit the spine at specific locations (between the vertebrae) and connect with sensory organs, or muscles.

1. Can the patient feel us touching them?
2. Can they move their body?
Assessing Dermatomes - Instructions

- This can easily be done on any patient lying supine (or prone) on your stretcher.

- Stroke with a ‘light touch’ and Stroke on the same way on both sides of the body in order to test the patient bilaterally.

**Instruct the patient by saying:**
“I’m going to very lightly stroke your skin with the tip of my scissors and I want you to tell me if there are any places where either you can’t feel me touching you, or, if it feels strange or different when I do”

**Note:**
This can be done over clothes, but it’s better if it’s done directly on the skin.
Assessing Dermatomes
The Stroke Tests

1. Stroke from behind the ear to the collarbone, then out to the shoulder (C2-C5) on both sides of the body. (Red line)
2. Touch both thumbs (C6), the first two fingers (C7) and the inner two fingers on each hand (C8). (Red dots)
3. Stroke from the collar bone, lateral to the breast, then down to the inguinal line bilaterally, (T1-T12). (Yellow lines)
4. Stroke from the belt line, down the middle of the thigh to the patella, then laterally to the side of the calf (L1-L5). (Blue lines)
5. Stroke across either the back of the hamstrings or the back calves (whichever is accessible) (S1- S2). (Purple lines)

- S3-S5 are peri-anal and are not assessed
The Neurological Assessment
The Myotomes
Assessing Myotomes

The nerves exit the spine at specific locations (between the vertebrae) and connect with sensory organs, or muscles.

1. Can the patient feel us touching them?
2. Can they move their body?
Assessing Myotomes – Flexion & Extension

Neck Flexion/Extension (chin-chest/chin-sky): C1, C2
Neck lateral flexion (ear-shoulder): C3
Shoulder elevation (shrug): C4, CNXI
Shoulder abduction (hands together above head): C5
Pronator Drift -
Elbow flexion (curl arm): C6
Elbow extension (straighten arm): C7
Finger flexion (make a fist): C8
Finger abduction (spreading): T1
Hip flexion (lifting knees): L2
Knee extension (straighten leg): L3
Knee flexion (bend leg) S2
Ankle dorsiflexion (all toes-head) L4
Hallux dorsiflexion (big toe up against resistance) L5
Ankle plantarflexion (gas pedal) S1
Plantar Babinski Reflex -
The Neurological Assessment

The CNS Tracts
## Important CNS Tracts — What we will be learning...

### The Brain

<table>
<thead>
<tr>
<th>Sensory Tracts (↑)</th>
<th>Motor Tracts (↓)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Anterolateral spinothalamic tract</strong></td>
<td><strong>Pyramidal Tracts</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Extrapyramidal Tracts</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Corticobulbar Tract</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Corticospinal Tract</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Facial muscles</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Voluntary Body Muscles</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Involuntary motor reflexes</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Walking about</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Complicated movements (especially in our hands)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Control of body posture</strong></td>
</tr>
</tbody>
</table>
Nerves travel together in bundles called ‘tracts’.

**Sensory Tracts (Ascending)**
Sensory input from the body to the brain

**Motor Tracts (Descending)**
Motor input from the brain to the body
The tract that transmits signals from the skin to the brain goes up through the *anterior* and *lateral* parts of the *spinal* cord to the *thalamus* known as the Antero-lateral spinothalamic tract.
1. Impulses originate in the various motor centres of the brain
2. Travel through upper motor neurons to ganglia in the CNS
3. Travel from ganglia through lower motor neurons to muscles
4. The lower motor neurons attach to muscle at the neuro-muscular junction.
The motor tracts are divided into two different types.

These different types take different pathways through the brain and have different functions.

The two different types of descending motor tracks are:

1. Pyramidal tracts
2. Extrapyramidal tracts
Pyramidal Tracts

1. Medullary brainstem has two “column-ish” things, called the *Medullary pyramids*

2. Some motor tracts *do* go through the pyramids (the pyramidal tracts), whereas, some other motor tracts *do not* go through the pyramids (the extrapyramidal tracts)

3. There are actually 2 Pyramidal tracts:
   - Corticobulbar tract
   - Corticospinal tract
Extra-Pyramidal Tracts

• There are several Extra-pyramidal tracts

• All these tracts have neurons that start in the lower part of the brain (the brainstem)

• Collectively, the tracts control:
  • Involuntary motor reflexes
  • Walking about
  • Complicated movements (especially in our hands) and
  • Control of body posture

EPS

• Normally there is an important balance maintained between dopamine and acetylcholine in our brains

• The imbalance between dopamine and acetylcholine can result in side effects in the extrapyramidal system (Extrapyramidal side effects).
Extra-Pyramidal Symptoms

Serious neurological symptoms that may occur after initiation of antipsychotic drugs:

- **4 hours** - Acute dystonia ...treated with anticholinergics
- **4 days** - Akinesia (Parkinson-like syndrome) ...treated with dopamine agonists
- **4 weeks** - Akathisia
- **4 months** - Tardive dyskinesia (often permanent)

**Acute Dystonic Reaction**

[youtube.com/watch?v=2krwEbm5hBo](https://youtube.com/watch?v=2krwEbm5hBo)

- Pseudo-parkinsonism
  - Stooped posture
  - Shuffling gait
  - Rigidity
  - Bradykinesia
  - Tremors at rest
  - Pill-rolling motion of the hand

- Akathisia
  - Restless
  - Trouble standing still
  - Paces the floor
  - Feet in constant motion, rocking back and forth

- Tardive dyskinesia
  - Protrusion and rolling the tongue
  - Sucking and smacking movements of the lips
  - Chewing motion
  - Facial dyskinesia
  - Involuntary movements of the body and extremities

- Acute dystonia
  - Facial grimacing
  - Involuntary upward eye movement
  - Muscle spasms of tongue, face, neck, and back (back muscle spasms cause trunk to arch forward)
  - Laryngeal spasms
Recap !!!

**Sensory Tracts (↑)**
- Anterolateral spinothalamic tract

When the sensory tracts are damaged we have a diminished (or lost) sense of touch (test the dermatomes).

**Motor Tracts (↓)**
- Corticobulbar Tract
- Corticospinal Tract

Babinski’s sign indicates corticospinal tract dysfunction.

De corticate posturing (which literally means ‘bad corticate’ posturing) also indicates (severe) corticospinal tract dysfunction.

Problems here result in Akathesia and Tardive Dyskinesia symptoms.

Problems here result in Parkinsonism symptoms.

Problems here result in acute dystonic symptoms (what drugs have they had?)

Facial weakness indicates corticobulbar dysfunction revealed (in our cranial nerve exam).

When the cerebrum of the brain is damaged we can see “de cerebrate” posturing (which literally means bad brain’ posturing).

When the motor tracts are damaged we have a diminished (or lost) ability to move (test the myotomes).

When the sensory tracts are damaged we have a diminished (or lost) sense of touch (test the dermatomes).

Control of our posture.

Walking about complicated movements (especially in our hands).

Involuntary motor reflexes.

Facial muscles,
Voluntary Body Muscles.
The Neurological Assessment

Neurological Soft Signs
Neurological soft signs (NSS) refer to subtle neurological abnormalities comprising of deficits in sensory integration, motor coordination, and sequencing of complex motor acts.

Heinrichs DW, Buchanan RW: Significance and meaning of neurological signs in schizophrenia. Am J Psychiatry 1988; 145: 11–18
<table>
<thead>
<tr>
<th>Sensory Integration</th>
<th>Motor Coordination</th>
<th>Motor Sequencing</th>
<th>Primitive Reflexes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audio-visual integration</td>
<td>Tandem walk</td>
<td>Fist-ring test</td>
<td>Gaze</td>
</tr>
<tr>
<td>Stereognosis</td>
<td>Rhythm tapping</td>
<td>Fist-edge-palm test</td>
<td>Palmo-mental</td>
</tr>
<tr>
<td>Agraphaesthesia</td>
<td>Finger-thumb opposition</td>
<td>Ozeretski test</td>
<td>Snout</td>
</tr>
<tr>
<td>Extinction</td>
<td>Finger Nose Test</td>
<td></td>
<td>Grasp</td>
</tr>
<tr>
<td>Right-Left confusion</td>
<td>Dysdiadochokinesia/</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rapid alternating movements</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Dazzan and Murray (2002)
NSS- Relevance to Psychiatry

“Soft signs are neurological abnormalities that are not readily localizable to a specific brain region”


“NSS are minor (‘soft’) neurological abnormalities in sensory and motor performance identified by clinical examination”


- By definition, they are **NOT** indicative of specific Central Nervous System pathology*

- They are **NOT additive** in the traditional sense- Two or more soft signs does not make a hard sign*

*Human Developmental Neuropsychology by et al, etc., Otfried Spreen (1984); Oxford University Press.
References

- DeMeyer’s Neurological Examination, 7th Edition
- Jarvis Physical Examination & Health Assessment, 8th Edition
- Clinical Examination Essentials, 4th Edition
- Macleod’s Clinical Examination, 14th Edition
- https://www.stroke.nih.gov


Thank You
For Your Attention