

PHYSIO CITY

NEUROANATOMY

Complete Syllabus Overview

26 Chapters • All Major Pathways • Clinical Correlations • Exam Prep

26

Chapters

100+

MCQ Facts

15+

Syndromes

6

Sections



COURSE OVERVIEW



1. FOUNDATIONS

Nervous tissue, Neuroglia, BBB, Neurotransmitters, Functional components, Divisions of NS

2. SPINAL CORD

Gross features, Meninges, Rexed laminae, Ascending & descending tracts, Cord syndromes

3. BRAINSTEM

Medulla, Pons, Midbrain cross-sections, All CN nuclei, Vascular syndromes

4. HIGHER CENTRES

Cerebellum, Cerebrum, Brodmann areas, Aphasia, Diencephalon, Basal ganglia, Internal capsule

5. COVERINGS & SUPPLY

Meninges, CSF, Ventricles, Circle of Willis, Stroke territories, Hydrocephalus

6. CLINICAL & EXAM

UMN vs LMN, Reflexes, Dermatomes, Visual system, ANS, Neurogenic bladder, 100+ MCQ facts



SECTION 1: FOUNDATIONS OF NEUROANATOMY



Nervous Tissue

Neurons: dendrites, soma, axon, myelin. Gray vs white matter. Neuronal types: unipolar, bipolar, multipolar.

Neuroglia

CNS: Astrocytes (BBB, support), Oligodendrocytes (myelin), Microglia (immune), Ependymal (CSF). PNS: Schwann cells, Satellite cells.

Blood-Brain Barrier

Tight junctions of endothelium + astrocyte end-feet. Permeable to: O_2 , CO_2 , lipids, alcohol. Impermeable to: large proteins, bacteria.

Neurotransmitters

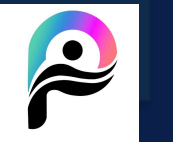
ACh (NMJ, ANS), DA (reward, movement), 5-HT (mood), NE (arousal), GABA (inhibition), Glutamate (excitation), Substance P (pain).

Functional Components

GSA, GVA, GSE, GVE (somatic/visceral, afferent/efferent). SSA (hearing, balance), SVA (taste, smell), SVE (branchial muscles).

Divisions of NS

CNS (brain + spinal cord) vs PNS (cranial + spinal nerves). ANS: Sympathetic (T1-L2) vs Parasympathetic (craniosacral). ENS.



SECTION 2: SPINAL CORD TRACTS



ASCENDING TRACTS

Tract	Modality	Crosses
DCML	Fine touch, proprioception, vibration	At medulla (gracile/cuneate)
Spinothalamic	Pain, temperature, crude touch	Within 2 levels of entry
Spinocerebellar	Unconscious proprioception	Ipsi (post) / both (ant)
Spinoreticular	Diffuse pain (affective)	Bilateral

DESCENDING TRACTS

Tract	Function	Lesion Effect
Corticospinal	Voluntary movement (skilled)	UMN signs
Rubrospinal	Limb flexor control	Contralateral weakness
Vestibulospinal	Balance, extensor tone	Loss of equilibrium
Reticulospinal	Posture, gait, autonomic	Variable

SPINAL CORD SYNDROMES

Complete Transection

All motor, sensory & autonomic loss below lesion

Brown-Séquard

Ipsilateral UMN + DCML loss;
Contralateral pain/temp loss

Central Cord

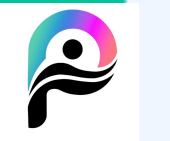
UE > LE weakness; sacral sparing; bladder dysfunction

Anterior Cord

Motor + pain/temp loss;
preserved proprioception (DCML intact)

Posterior Cord

Loss of fine touch, vibration, proprioception; motor intact



SECTION 3: BRAINSTEM & CRANIAL NERVES



MEDULLA

CN IX, X, XI, XII • Gracile & cuneate nuclei • Pyramid decussation • Inferior olivary • NTS, DMV, NA • Cardiorespiratory centres

PONS

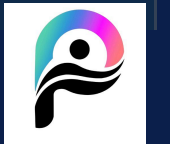
CN V, VI, VII, VIII • Basilar pontine nuclei • MLF (gaze coordination) • Superior/inferior olivary • Pontine reticular formation

MIDBRAIN

CN III, IV • Superior/inferior colliculi • Red nucleus • Substantia nigra • PAG (pain modulation) • Pretectal area (pupil reflex)

KEY VASCULAR SYNDROMES

Syndrome	Artery	Features
Lateral Medullary (Wallenberg)	PICA	Ipsi face pain/temp loss, dysphagia, Horner's; Contra limb pain/temp loss
Medial Medullary (Dejerine)	Ant spinal / vertebral	Contra hemiplegia (saves face); Ipsi hypoglossal palsy; Contra DCML loss
Weber (Midbrain)	PCA	Ipsi CN III palsy; Contra UMN hemiplegia
Parinaud (Dorsal Midbrain)	Superior cerebellar a.	Upgaze palsy, light-near dissociation, lid retraction



SECTION 4: HIGHER CENTRES



KEY BRODMANN AREAS

Area	Location	Function
4	Precentral gyrus	Primary motor cortex
3,1,2	Postcentral gyrus	Primary somatosensory
17	Occipital pole	Primary visual cortex
41,42	Heschl's gyrus	Primary auditory

APHASIA TYPES

Type	Fluency	Comp.	Repetition
Broca	Non-fluent	Intact	Impaired
Wernicke	Fluent	Poor	Impaired
Conduction	Fluent	Intact	Severely impaired
Global	Non-fluent	Poor	Impaired

BASAL GANGLIA CIRCUITS

Direct Pathway

Striatum → GPI inhibition → thalamus disinhibited → MOVEMENT FACILITATED

Parkinson's Disease

↓ Dopamine from SNpc → indirect pathway overactive → ↓ movement, rigidity, tremor

Indirect Pathway

Striatum → GPe → STN → GPI activation → thalamus inhibited → MOVEMENT SUPPRESSED

Huntington's Disease

Loss of striatal neurons (indirect pathway) → direct pathway unopposed → chorea (↑ movement)



CEREBELLUM — FUNCTIONAL DIVISIONS



VESTIBULOCEREBELLUM (Archicerebellum)

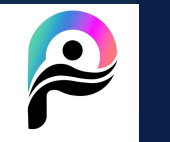
Region:	Flocculonodular lobe
Input:	Vestibular nuclei, Visual system
Output:	Vestibular nuclei → spinal cord (VST)
Function:	Balance, equilibrium, eye movements
Lesion:	Truncal ataxia, nystagmus, gait instability

SPINOCEREBELLUM (Paleocerebellum)

Region:	Vermis + paravermal zone
Input:	Spinocerebellar tracts, Spinal cord
Output:	Fastigial & interposed nuclei → RST, VST
Function:	Regulation of ongoing movement & muscle tone
Lesion:	Limb ataxia, dysmetria, intention tremor

CEREBROCEREBELLUM (Neocerebellum)

Region:	Lateral hemispheres
Input:	Pontine nuclei (from cortex via corticopontine)
Output:	Dentate nucleus → VL thalamus → motor cortex
Function:	Motor planning, timing, cognitive functions
Lesion:	Decomposition of movement, dysdiadochokinesia, scanning dysarthria



SECTION 5: BLOOD SUPPLY, CSF & STROKE TERRITORIES



STROKE TERRITORIES

Artery	Territory	Deficits
MCA (M1)	Lateral cortex, internal capsule, basal ganglia	Contralateral hemiplegia (arm > leg), hemisensory loss, aphasia (dominant), neglect (non-dominant)
ACA	Medial frontal & parietal lobe	Contralateral leg > arm weakness, abulia, urinary incontinence
PCA	Occipital, medial temporal, thalamus	Contralateral hemianopia, thalamic syndrome, memory impairment

CSF FACTS

- Volume: 150 mL total; 500 mL produced/day
- Produced by: Choroid plexus (lateral → 3rd → 4th ventricle)
- Normal pressure: 70 – 180 mmH₂O (lumbar)
- Protein: 15 – 45 mg/dL; Glucose: 2/3 of blood glucose
- Flow: Lateral → 3rd ventricle → Aqueduct of Sylvius → 4th ventricle → Subarachnoid space → Arachnoid granulations → Venous sinuses

HYDROCEPHALUS TYPES

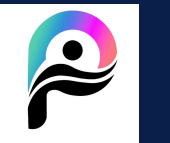
Type	Cause / Features
Communicating	Impaired CSF absorption (meningitis, SAH). All ventricles dilated.
Non-communicating (Obstructive)	Block within ventricular system (aqueduct stenosis, tumor). Dilated proximal to block.
Normal Pressure (NPH)	Triad: Gait apraxia, dementia, urinary incontinence. (ventricles, no cortical atrophy.
Ex Vacuo	Brain atrophy → ventricles expand to fill space. Not t...



SECTION 6: UMN vs LMN — MASTER COMPARISON



Feature	UMN (Central)	LMN (Peripheral)
Location	Cortex → brainstem/spinal cord	Anterior horn cell → peripheral nerve → muscle
Tone	↑ Spasticity (velocity-dependent)	↓ Flaccidity
Power	Weakness (patterns: extensors in arm, flexors in leg)	Weakness (segmental / myotomal distribution)
Deep Reflexes (DTR)	↑ Hyperreflexia	↓ or absent hyporeflexia
Plantar Response	Extensor (Babinski +ve)	Flexor (normal)
Wasting	Mild (disuse only)	Severe (denervation atrophy)
Fasciculations	Absent	Present (active denervation)
Clonus	Present (sustained)	Absent
Bladder	Spastic / reflex (small capacity)	Flaccid (overflow incontinence)
Examples	Stroke, MS, cord compression, cerebral palsy	GBS, polio, MND (LMN), peripheral neuropathy, radiculopathy



VISUAL SYSTEM & PUPILLARY REFLEXES



VISUAL FIELD DEFECTS

Lesion Site	Field Defect
Optic nerve	Monocular blindness (ipsilateral)
Optic chiasm (central)	Bitemporal hemianopia
Optic tract	Contralateral homonymous hemianopia
Meyer's loop (temporal lobe)	Superior quadrantanopia ('pie in the sky')
Parietal radiations	Inferior quadrantanopia ('pie on the floor')
Occipital cortex (complete)	Contralateral homonymous hemianopia with macular sparing

PUPILLARY ABNORMALITIES

Homer's Syndrome

Ptosis, miosis, anhidrosis. Lesion of sympathetic pathway (hypothalamus → ciliospinal of Budge → superior cervical ganglion → eye).

CN III Palsy

Fixed dilated pupil, 'down-and-out' eye, ptosis. Parasympathetic fibres run on outside of CN III (compressed first by PCoA aneurysm or uncal herniation).

Argyll Robertson Pupil

Accommodates but doesn't react to light. Neurosyphilis. Lesion in pretectal area.

RAPD (Marcus Gunn)

Swinging flashlight test — affected eye dilates when light shone on it. Optic nerve lesion ipsilateral to dilating pupil.

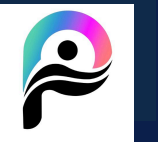
Adie's (Tonic) Pupil

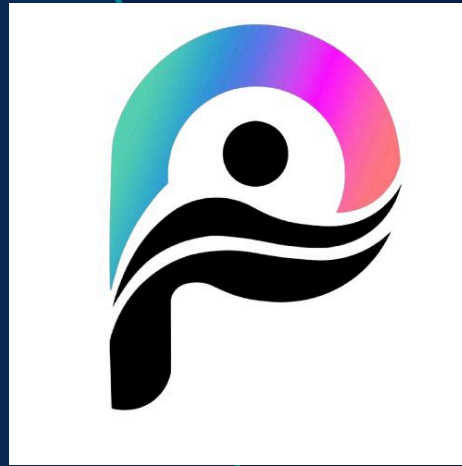
Slowly reacting dilated pupil. Post-ganglionic parasympathetic lesion. Associated absent knee/ankle jerks (Holmes-Adie syndrome).





- DCML crosses in medulla (gracile + cuneate nuclei)
- Spinothalamic crosses within 2 levels of cord entry
- Dorsal column carries IPSILATERAL fine touch
- Anterior 2/3 of cord = anterior spinal artery territory
- PICA occlusion → Lateral medullary (Wallenberg) syndrome
- Weber syndrome: ipsi CN III + contra hemiplegia
- Broca's area (BA44,45) = expressive/non-fluent aphasia
- Wernicke's area (BA22) = receptive/fluent aphasia
- Direct pathway → movement facilitation
- Loss of indirect pathway neurons → chorea (Huntington's)
- Babinski sign = UMN lesion (extensor plantar)
- Fasciculations = active denervation (LMN)
- Clonus = UMN sign (spasticity)
- Argyll Robertson = syphilis (accommodation not light)
- Horner's = ptosis + miosis + anhidrosis (sympathetic)
- CN III compression → dilated fixed pupil (PCoA aneurysm)
- Macular sparing in occipital lesions (dual blood supply)
- NPH triad: gait + dementia + urinary incontinence
- Dentate nucleus → VL thalamus → motor cortex (cerebellar output)
- Parasympathetic fibres of CN III run on outside (first compressed by herniation)
- Cerebellar lesions = IPSILATERAL signs (same side falls)
- Rexed lamina II = substantia gelatinosa (pain modulation)
- Rexed lamina IX = anterior horn motor neurons
- Ependymal cells line ventricles; produce CSF
- Choroid plexus: main CSF producer (500 mL/day)
- Internal capsule posterior limb: corticospinal fibres
- Genu of IC: corticobulbar fibres (face, jaw, pharynx)
- Lenticulostriate arteries = arteries of stroke (hypertension)
- Syringomyelia: central cord → cape-like dissociated sensory loss
- MNEMONICS: 'PICA = Posterior Inferior → Lateral medullary'





PHYSIOCITY

Neuroanatomy — Complete Syllabus

Equipping Future Physiotherapists with Clinical Neuroscience

