THE NERVOUS SYSTEM

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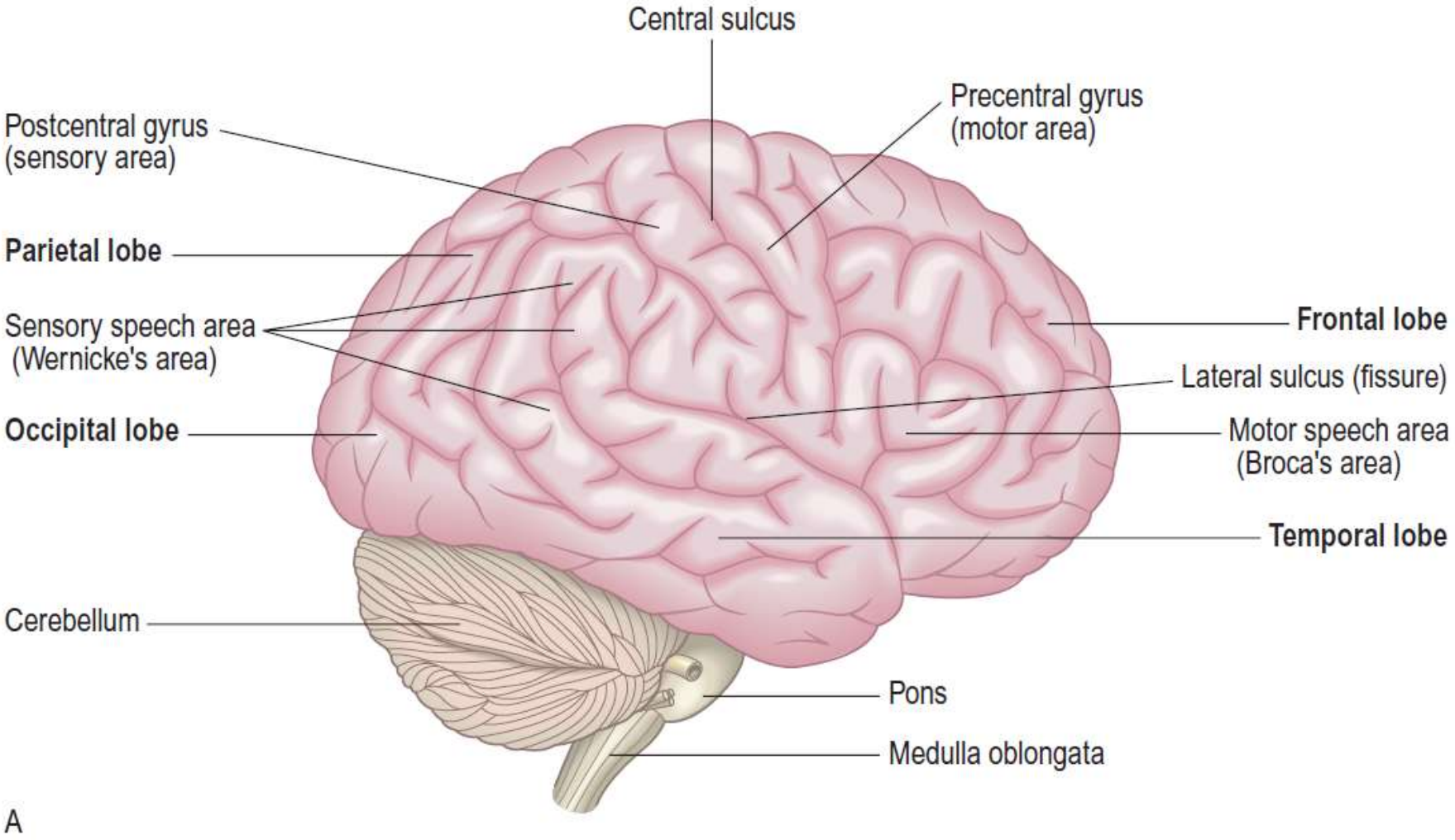
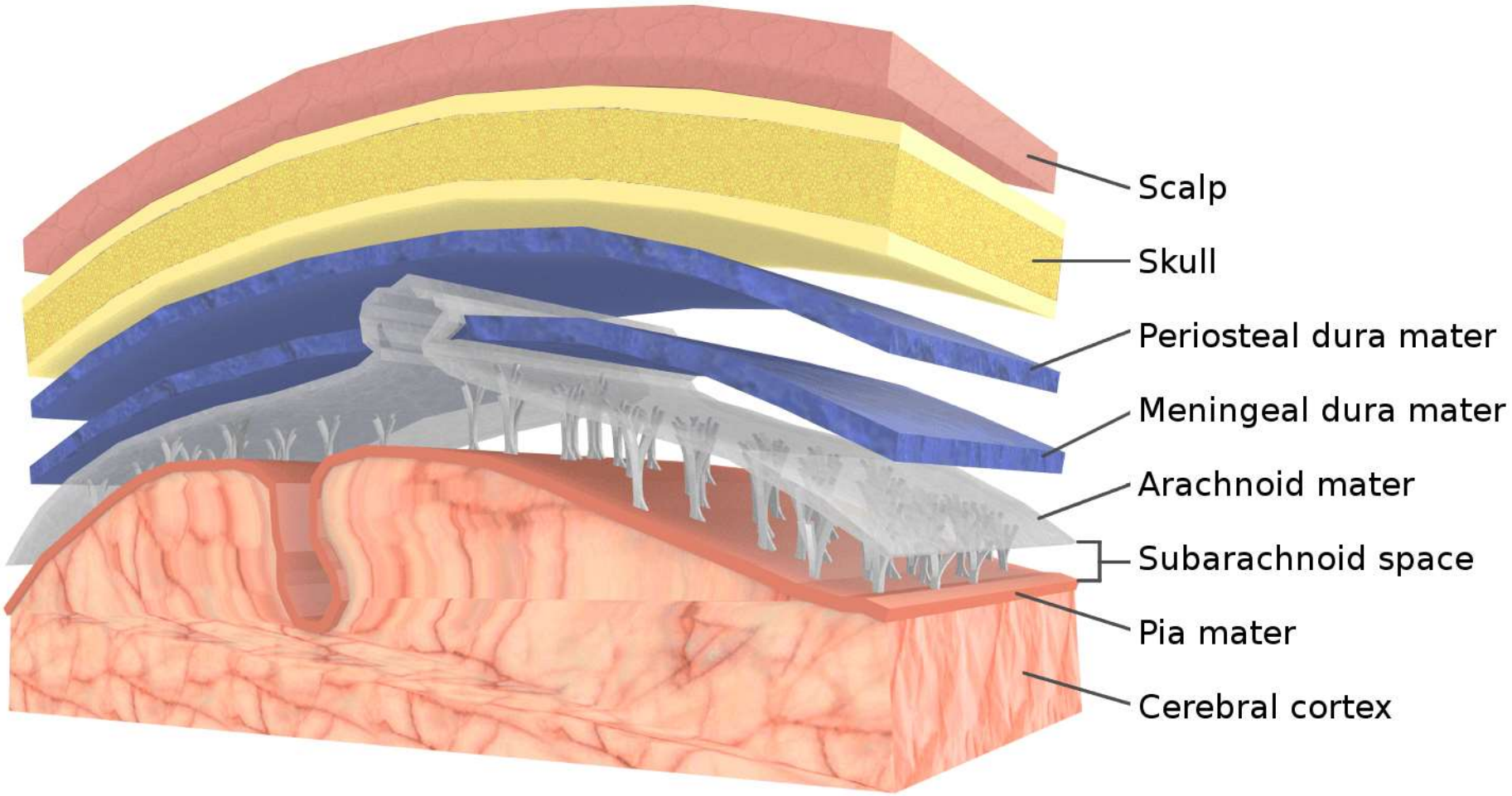
ANATOMY AND PHYSIOLOGY

- CNS (Brain, Spinal Cord)
- PNS (Sensory Nerves, Motor Nerves, Autonomic Nerves)

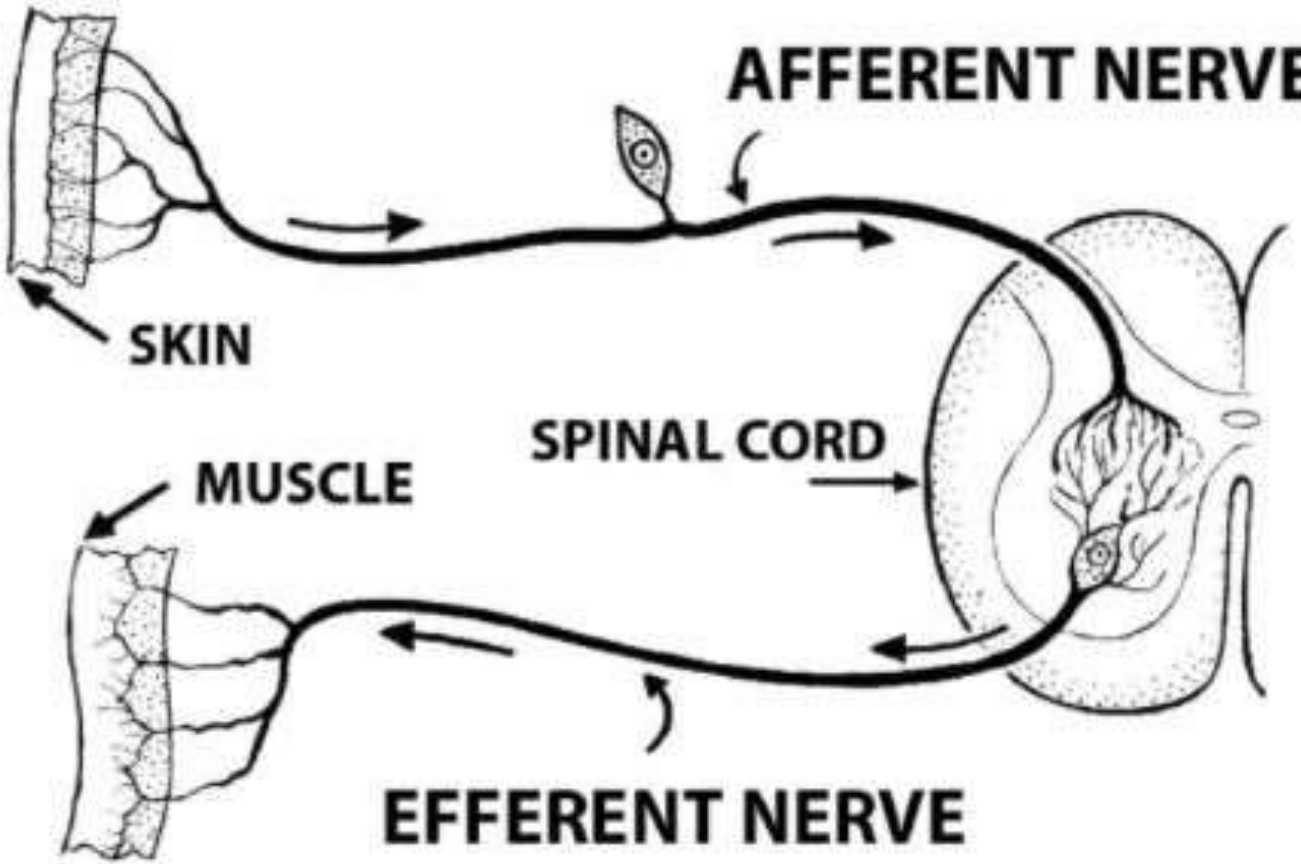
- Functional unit is a Neuron (Dendrites, Cell body, Axon, Terminals)
- Supportive cells:
  - CNS: Oligodendrocytes, Microglia, Astrocyte, Ependymal cells.
  - PNS: Schwann cells, Satellite cells


Central sulcus
Precentral gyrus
(motor area)
Postcentral gyrus
(sensory area)
Parietal lobe
Sensory speech area
(Wernicke's area)
Occipital lobe
Frontal lobe
Lateral sulcus (fissure)
Motor speech area
(Broca's area)
Temporal lobe
Cerebellum
Pons
Medulla oblongata
A

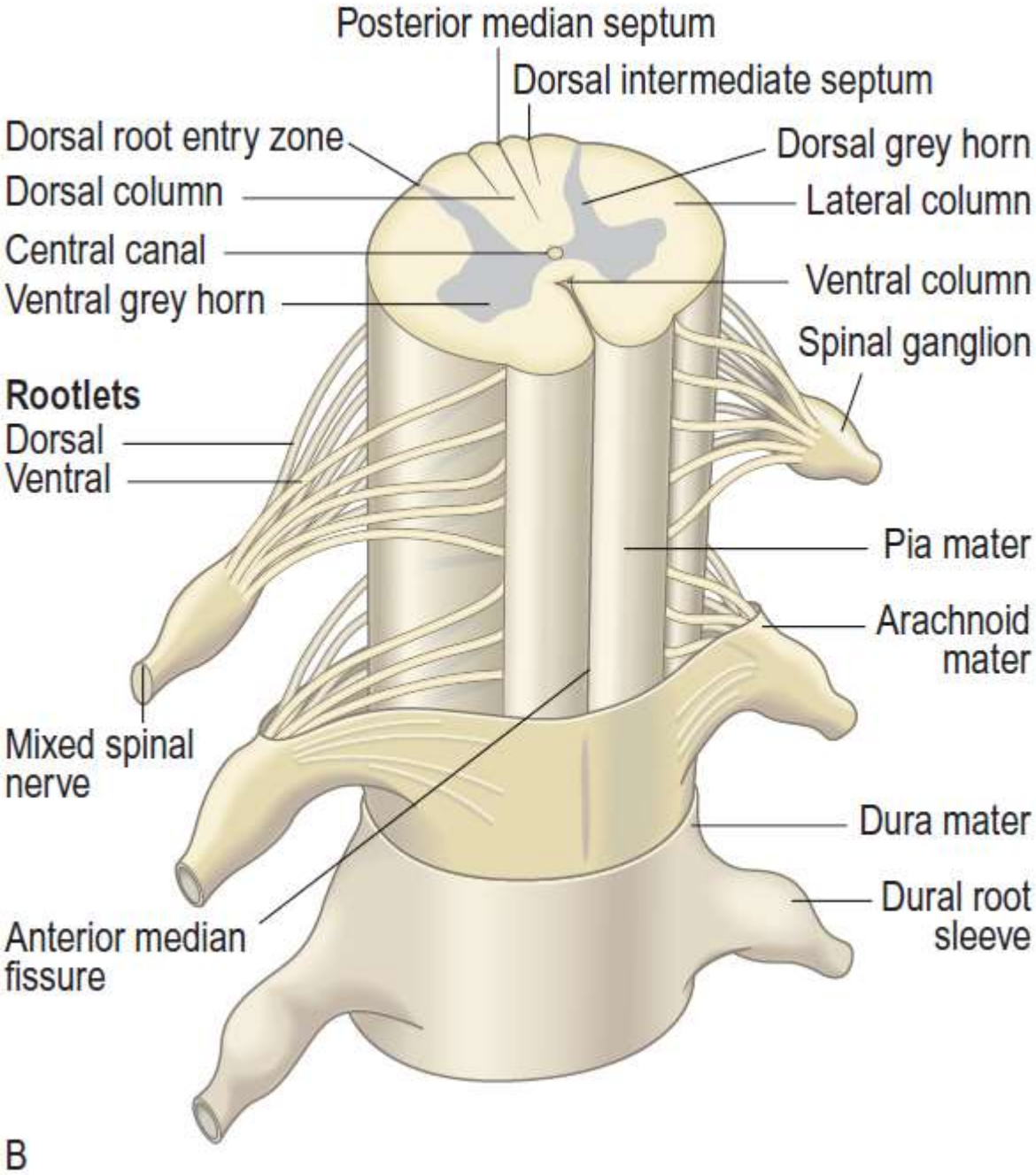

Scalp
Skull
Periosteal dura mater
Meningeal dura mater
Arachnoid mater
Subarachnoid space
Pia mater
Cerebral cortex

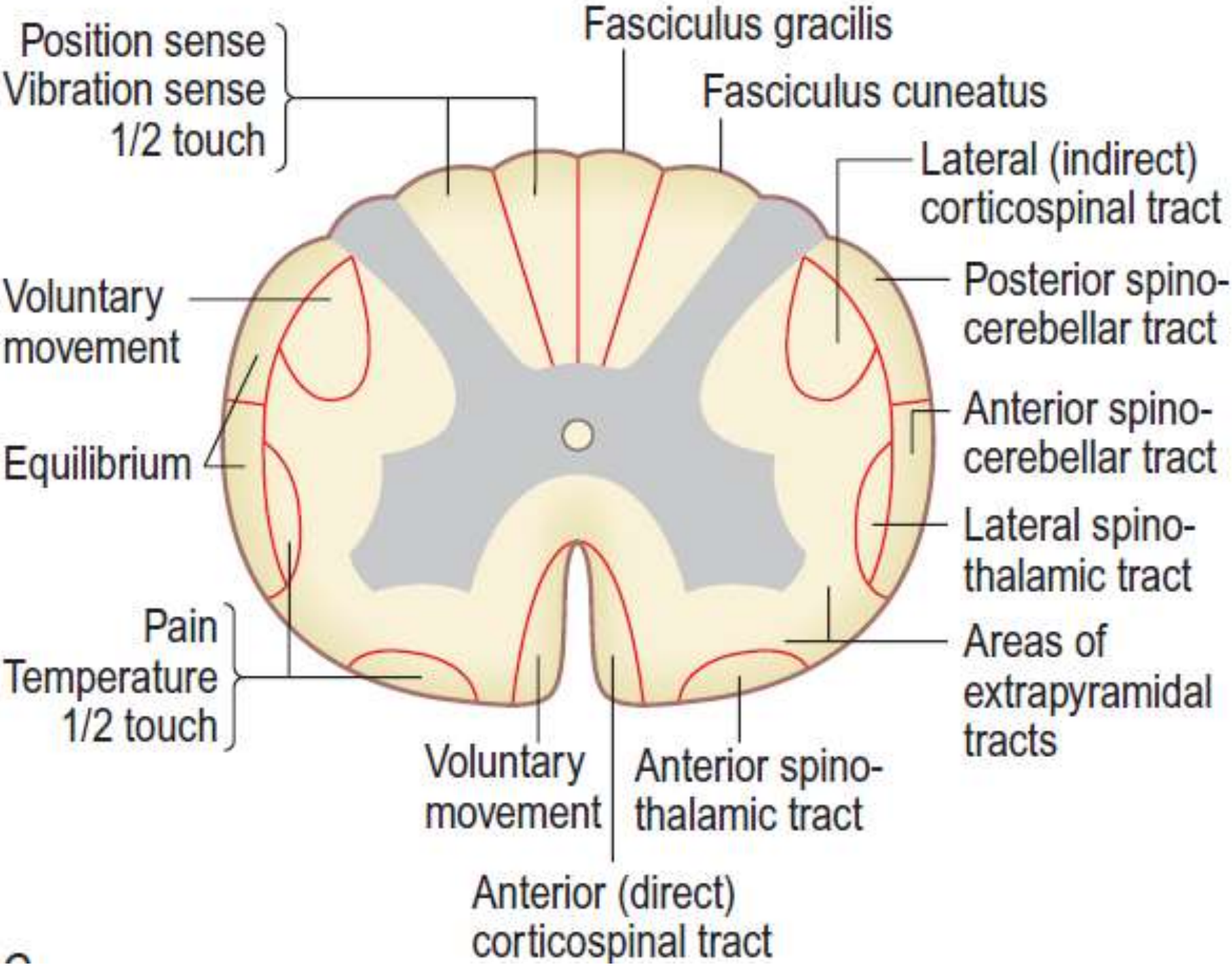
Afferent & efferent nerve pathways

- Afferents carry CNS inputs
- Afferents Arrive



- Efferents carry CNS outputs
- Efferents Exit


Posterior median septum
Dorsal intermediate septum
Dorsal root entry zone
Dorsal column
Central canal
Ventral grey horn
Dorsal grey horn
Lateral column
Ventral column
Spinal ganglion
Rootlets
Dorsal
Ventral
Pia mater
Arachnoid mater
Mixed spinal nerve
Dura mater
Dural root sleeve
Anterior median fissure
B


Position sense
Vibration sense
1/2 touch
Fasciculus gracilis
Fasciculus cuneatus
Lateral (indirect) corticospinal tract
Voluntary movement
Posterior spino-cerebellar tract
Equilibrium
Anterior spino-cerebellar tract
Lateral spino-thalamic tract
Pain
Temperature
1/2 touch
Areas of extrapyramidal tracts
Voluntary movement
Anterior spino-thalamic tract
Anterior (direct) corticospinal tract

SYMPTOMS

- Headache (causes can be primary or secondary)

- Disturbances of consciousness
  1. Syncope
  2. Seizures
  3. Dizziness
  4. Vertigo

Look for: Timing, Precipitating, Exacerbating, Relieving factors, Associated symptoms.

7.1 Clinical characteristics of headache syndromes

	Onset	Duration/periodicity	Pain location	Associated features
Primary syndromes				
Migraine	Evolves over 30–120 mins	Usually last < 24 h, recurrent with weeks/months symptom-free	Classically unilateral but may be anywhere including face/neck	Aura (usually visual), nausea/vomiting, photophobia and phonophobia
Cluster headache	Rapid onset, often waking patient from sleep	30–120 mins, 1–4 attacks within 24 h, clusters usually last weeks to months, with months to years of remission	Orbital/retro-orbital; always same side during cluster, may switch sides between clusters	Autonomic features, including conjunctival injection, tearing, nasal stuffiness, ptosis, miosis, agitation
Stabbing headache	Abrupt, rarely from sleep	Very brief, seconds or less	Anywhere over head	Common in migraineurs
Secondary syndromes				
Meningitis	Usually evolves over a day or two, can be abrupt	Depends on cause and treatment, usually days to weeks	Global, including neck stiffness	Fever, meningism, rash, false localising signs, signs of raised intracranial pressure
Subarachnoid haemorrhage	Abrupt, immediately maximal, rare from sleep	May be fatal at onset, usually days to weeks	Anywhere, poor localising value	20% isolated headache only; nausea/vomiting, reduced consciousness, false localising signs, III nerve palsies
Temporal arteritis	Gradual onset of temple pain and scalp tenderness	Continuous	Temple and scalp	Usually in those > 55 years; unwell, jaw pain on chewing, visual symptoms, tender temporal arteries, elevated erythrocyte sedimentation rate and C-reactive protein

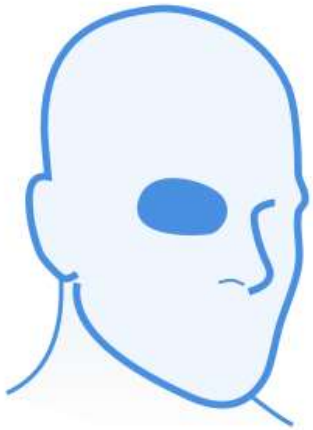
ONSET AND COURSE OF HEADACHES

Acute single episode	
Subarachnoid haemorrhage Acute meningitis	Vasodilator drugs Angle-closure glaucoma
Acute recurrent	
Migraine Sinusitis Neuralgias (e.g., trigeminal and post-herpetic)	Angle-closure glaucoma Cluster headache
Subacute single episode	
Infections (e.g., tuberculous meningitis, cerebral abscess) Raised intracranial pressure (e.g., tumour, hydrocephalus) Benign intracranial hypertension Temporal arteritis	

ONSET AND COURSE OF HEADACHES

Chronic
Chronic daily headache syndrome Depression Cervical spondylosis Drugs (e.g., nitrates, overuse of analgesics)

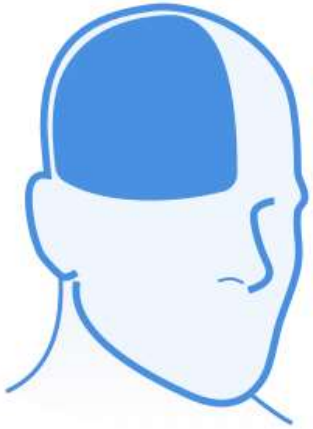
TENSION



CLUSTER

GIANT CELL ARTERITIS

SINUS



MIGRAINE

DISTURBANCES OF CONSCIOUSNESS

Syncope

- Alteration (or loss) of consciousness resulting from inadequate cerebral blood flow.

- Mechanism:
  - Reduced cardiac output (Cardiac syncope)
  - Peripheral vasodilatation (Vasovagal syncope)

CARDIAC SYNCOPE

- Provoked by exertion (severe aortic stenosis, HOCM) or sudden (arrhythmias).

- Recovery is usually rapid.

VASOVAGAL SYNCOPE

- Usually occurs whiles standing.
- Stimulation of the parasympathetic system e.g., pain, emotional upset.
- More common in warm environments.
- Often preceded by light-headedness, vision darkening, tinnitus, and nausea.
- It causes skin pallor.
- If kept flat, recovery is rapid.

EPILEPTIC SEIZURES

- Definition: paroxysmal electrical discharges from either the whole brain (generalized) or part of the brain (Focal)

Generalized tonic-clonic seizures pattern	
Prodromal phase	
Change of mood or 'odd' feeling (aura)	
Tonic phase	
Loss of consciousness	Cyanosis
Spasm of all muscles	Fall
Clonic phase	
Jerking of limbs and trunk	
Tongue biting	
Incontinence of urine	
Post-Ictal phase	
Flaccidity	
Confusion	
Headache	
Amnesia	

- Focal seizure:

  Simple focal

  Complex focal

Features of complex partial seizures
•Dream-like states •Disturbances of memory (déjà-vu, jamais vu) •Hallucinations of smell, taste or auditory •Emotional disturbance •Abnormal behavior

7.2 Features that help discriminate vasovagal syncope from epileptic seizure

Feature	Vasovagal syncope	Seizure
Triggers	Typically pain, illness, emotion	Often none (sleep deprivation, alcohol, drugs)
Prodrome	Feeling faint/ lightheaded, nausea, tinnitus, vision dimming	Focal onset (not always present)
Duration of unconsciousness	<60 s	1–2 mins
Convulsion	May occur but usually brief myoclonic jerks	Usual, tonic–clonic 1–2 mins
Colour	Pale/grey	Flushed/cyanosed, may be pale
Injuries	Uncommon, sometimes biting of tip of tongue	Lateral tongue biting, headache, generalised myalgia, back pain (sometimes vertebral compression fractures), shoulder fracture/ dislocation (rare)
Recovery	Rapid, no confusion	Gradual, over 30 mins; patient is often confused, sometimes agitated/ aggressive, amnesic

Item	Epileptic seizures	PNES
Eyes	Opened	Closed
Head	Fixed/unilateral	Side-to-side movements
Limbs	In phase/same direction	Out of phase
Body (axis)	Straight	Opisthotonus
Body (movement)	No rotation	Intense rotation in bed
Evolution of seizure	Continuous	Fluctuating

PNES, psychogenic non-epileptic seizures; ES, epileptic seizures.

DIZZINESS

May be due to:

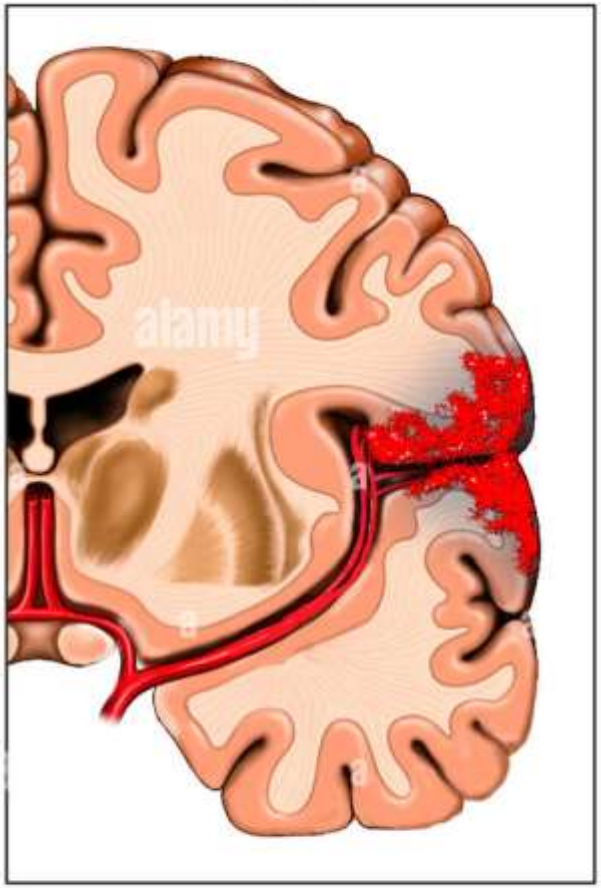
1. Postural hypotension
2. Cerebrovascular disease/vertebrobasilar insuffeceincy
3. Arrhythmia
4. Hyperventilation

VERTIGO (THE ILLUSION OF MOVEMENT)

Causes of vertigo
Central
•Migraine •Brainstem ischemia or infarction •Multiple sclerosis
Peripheral
•Méniére's disease (hearing loss , tinnitus , nausea and vomiting •Benign paroxysmal positional vertigo •Vestibular neuritis •Trauma •Drugs, e.g. gentamicin, anticonvulsants

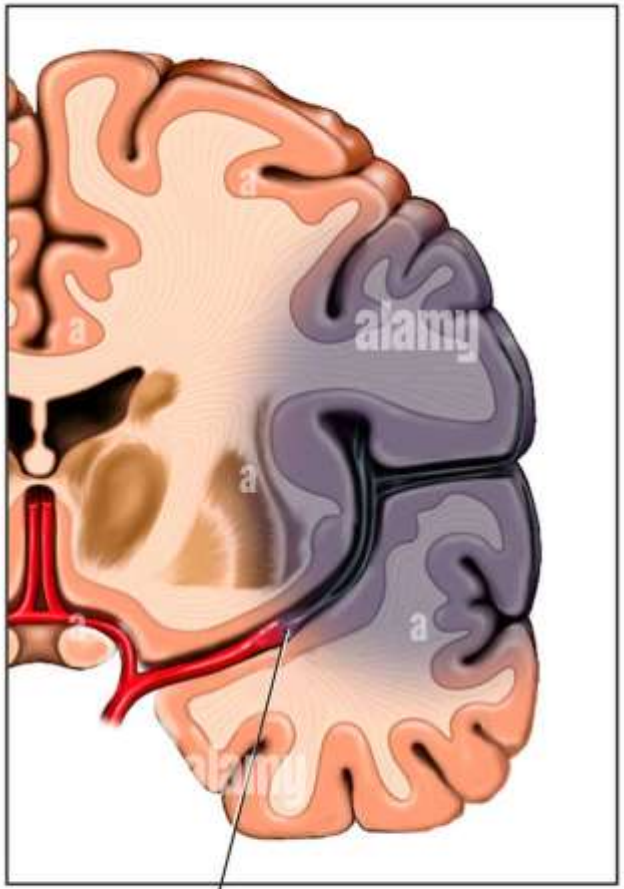
STROKE

Hemorrhagic Stroke



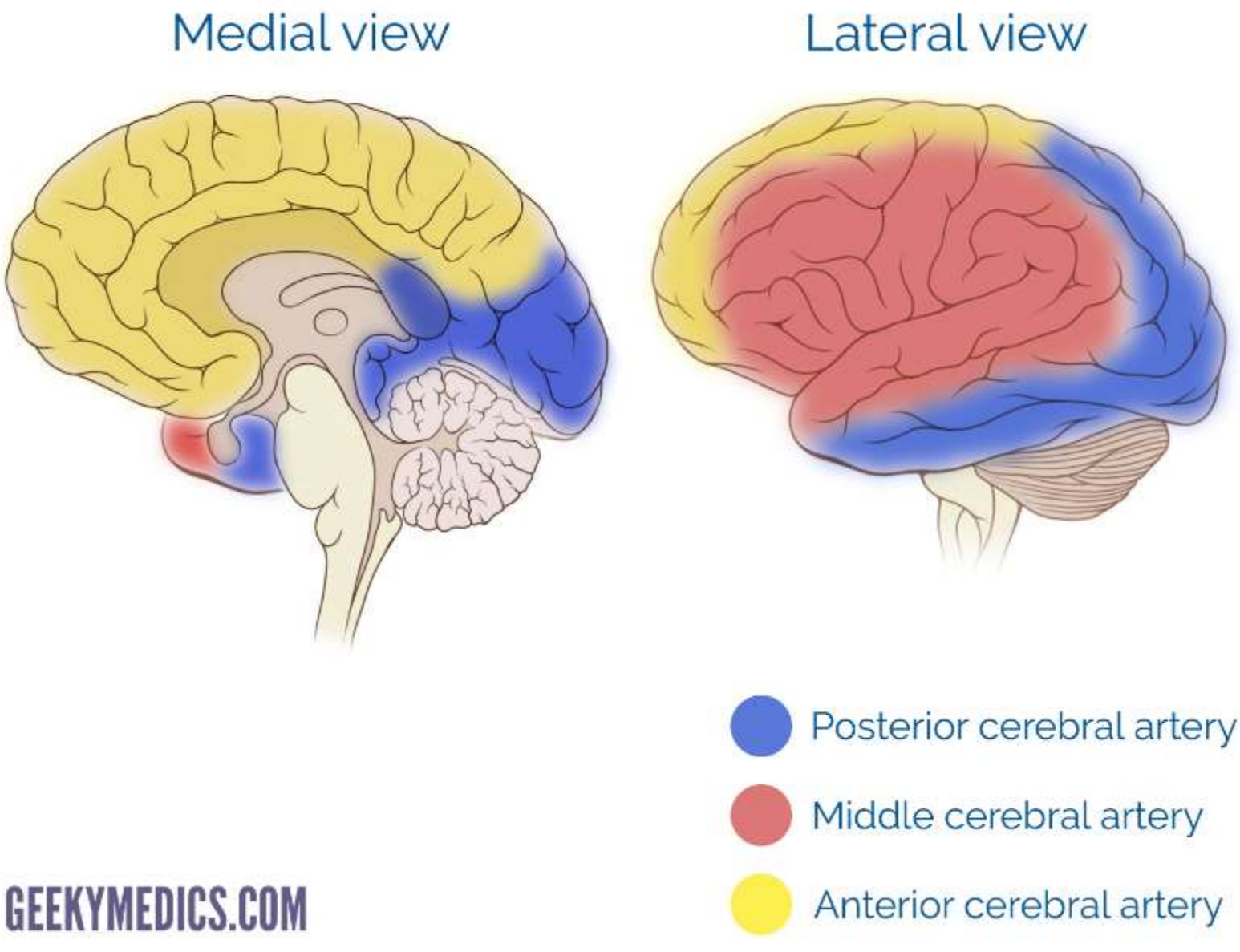
Hemorrhage/blood leaks into brain tissue

Ischemic Stroke



Clot stops blood supply to an area of the brain

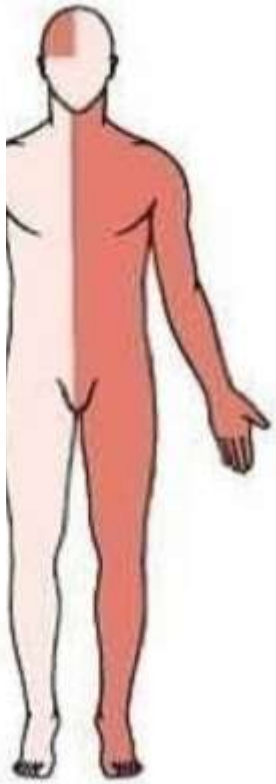
TERRITORY OF THE CEREBRAL VESSELS



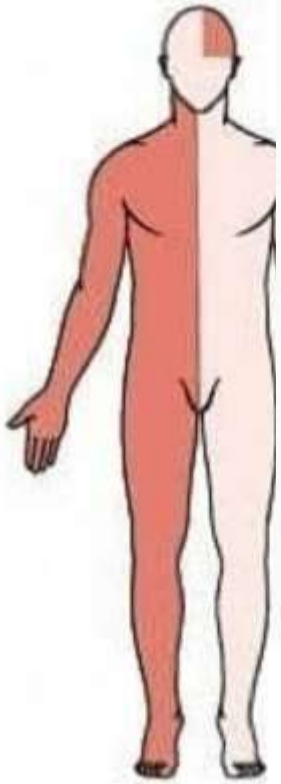
STROKE LEFT BRAIN

Right-brain damage
(stroke on right side of the brain)

- Paralyzed left side: hemiplegia
- Left-sided neglect
- Spatial–perceptual deficits
- Tends to deny or minimize problems
- Rapid performance, short attention span
- Impulsive; safety problems
- Impaired judgement



STROKE RIGHT BRAIN

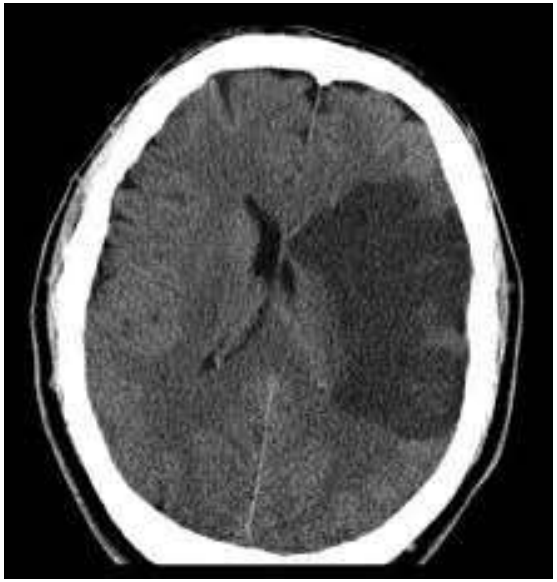


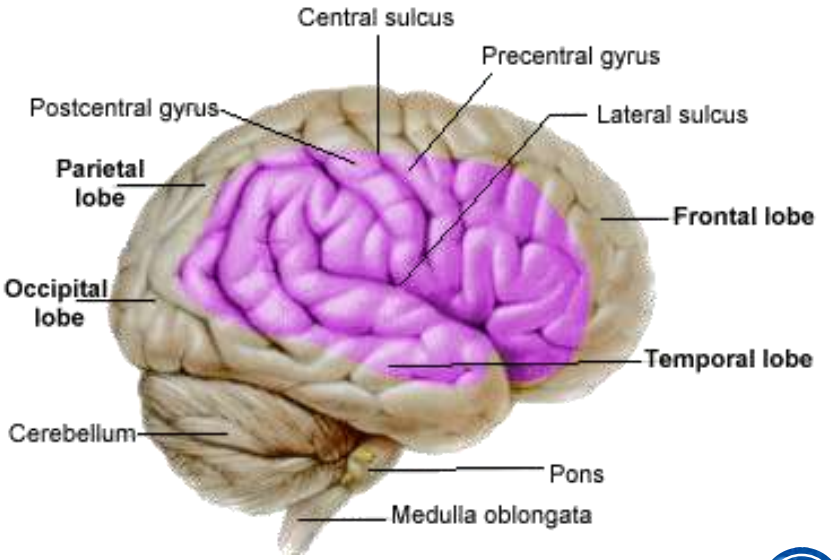
Left-brain damage
(stroke on left side of the brain)

- Paralyzed right side: hemiplegia
- Impaired speech–language (aphasias)
- Impaired right–left discrimination
- Slow performance, cautious
- Aware of deficits: depression, anxiety
- Impaired comprehension related to language, math

Middle Cerebral Artery (MCA) Occlusion

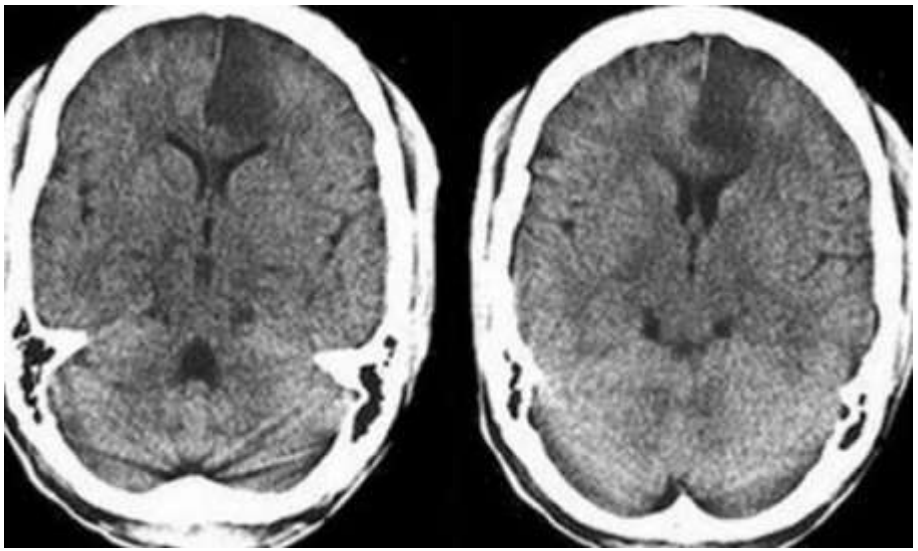
- Contralateral lower face weakness
- Contralateral hemiplegia
- Contralateral hemianesthesia
- Ataxia
- Speech impairments (usually the left brain)
- Perceptual deficits (usually the right brain)
- Visual deficits

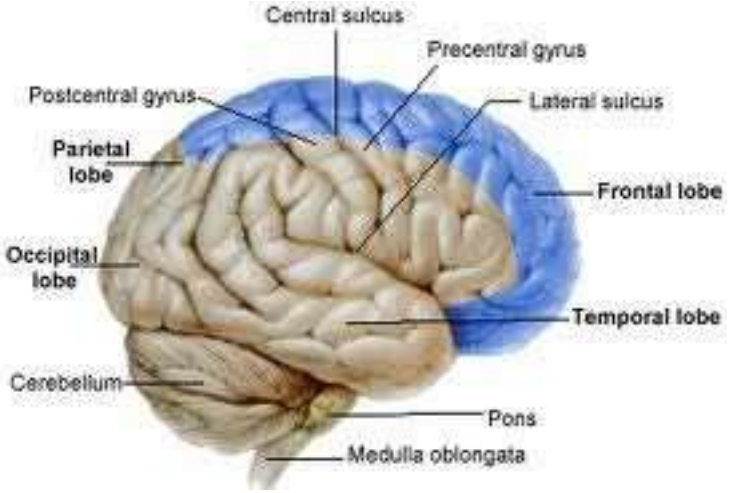




ANTERIOR CEREBRAL ARTERY (ACA) OCCLUSION

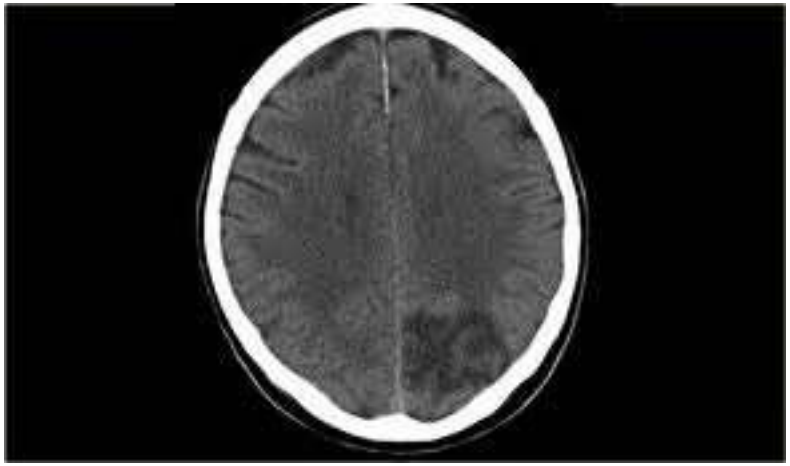
- Weakness of foot and leg
- Sensory loss of foot and leg
- Ataxia
- Incontinence

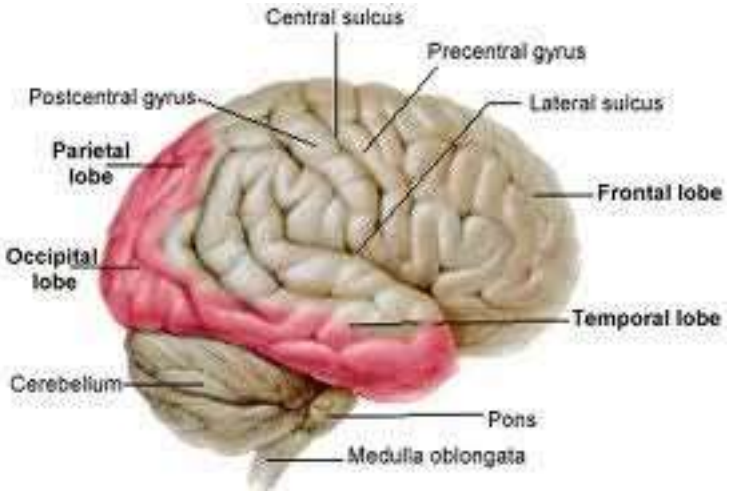




POSTERIOR CEREBRAL ARTERY (PCA) OCCLUSION

- Midbrain syndrome (Weber's Syndrome) occlusion of the paramedian branches of the posterior cerebral artery
  - Ipsilateral Third nerve palsy
  - Contralateral hemiplegia
- Visual field deficits (macular sparing)
- Visual hallucinations
- Memory problems





7.3 Clinical classification of stroke

Total anterior circulation syndrome (TACS)

- Hemiparesis, hemianopia and higher cortical deficit (e.g. dysphasia or visuospatial loss)

Partial anterior circulation syndrome (PACS)

- Two of the three components of a TACS
- OR isolated higher cortical deficit
- OR motor/sensory deficit more restricted than LACS (see below)

Posterior circulation syndrome (POCS)

- Ipsilateral cranial nerve palsy with contralateral motor and/or sensory deficit
- OR bilateral motor and/or sensory deficit
- OR disorder of conjugate eye movement
- OR cerebellar dysfunction without ipsilateral long-tract deficits
- OR isolated homonymous visual field defect

Lacunar syndrome (LACS)

- Pure motor > 2 out of 3 of face, arm, leg
- OR pure sensory > 2 out of 3 of face, arm, leg
- OR pure sensorimotor > 2 out of 3 of face, arm, leg
- OR ataxic hemiparesis

FUNCTIONAL NEUROLOGICAL SYMPTOMS

- Neurological symptoms not due to a neurological disease
- Symptoms that aren't compatible with a disease

THE HISTORY

- Past medical history:
  - Neurological diseases and risk factors
- Drug history
  - Prescriptions, OTC, Recreational, Neurotoxic.
- Family history
  - First degree relatives, Consanguinity (AR).
- Social history
  - Alcohol, Smoking, Vit Deficiencies, Sexual history, Travel history.
- Occupational history
  - Exposure (lead, manganese…), adverse effects on occupation.

GENERAL APPROACH TO NEUROLOGICAL EXAMINATION

- General look of patient
- Vital signs
- Level of consciousness
- High cognitive functions
- Stance and gait
- Cranial nerves 1-12
- Motor system
- Sensory system
- Coordination and cerebellum

GENERAL LOOK OF PATIENT

Begins with your first contact with the patient and continues during history taking

- Facial expression
- General demeanour
- Posture
- Gait
- Speech
- Involuntary movements

ASSESSMENT OF CONSCIOUS LEVEL

two main components: state and content.

- The state of consciousness:
  - dependent on the integrity of RAS(reticular activity system, extend from brainstem to thalamus)
  - describes how awake a person is

- The content of consciousness:
  - depends on the cerebral cortex, thalamus and their connections.
  - describes how aware the person is

19.14 Glasgow Coma Scale

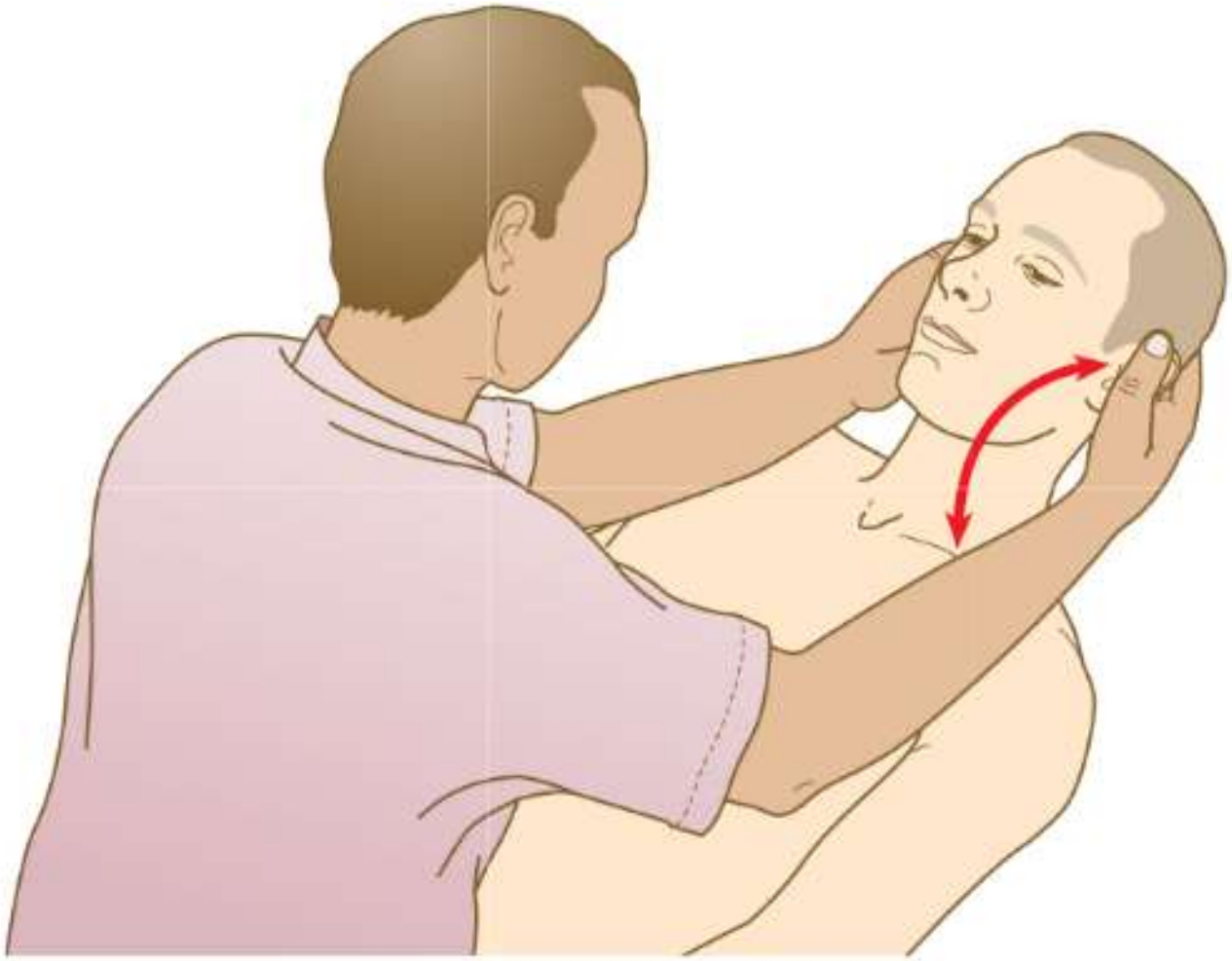
Eye opening	
Spontaneous	4
To speech	3
To pain	2
No response	1
Verbal response	
Orientated	5
Confused: talks in sentences but disorientated	4
Verbalises: words, not sentences	3
Vocalises: sounds (groans or grunts), not words	2
No vocalisation	1
Motor response	
Obeys commands	6
Localises to pain, e.g. brings hand up beyond chin to supraorbital pain	5
Flexion withdrawal to pain: no localisation to supraorbital pain but flexes elbow to nail bed pressure	4
Abnormal flexion to pain	3
Extension to pain: extends elbow to nail bed pressure	2
No response	1

Record the GCS as a total and its three separate components: e.g. GCS 9/15: E3, V2, M4

MENINGEAL IRRITATION SIGNS

- Neck stiffness
  - increased resistance to passive flexion of the neck
- Kernig's sign
  - increased resistance to passive extension of the leg
- Brudsiniski's sign
  - Flexion of the knees in response to neck flexion

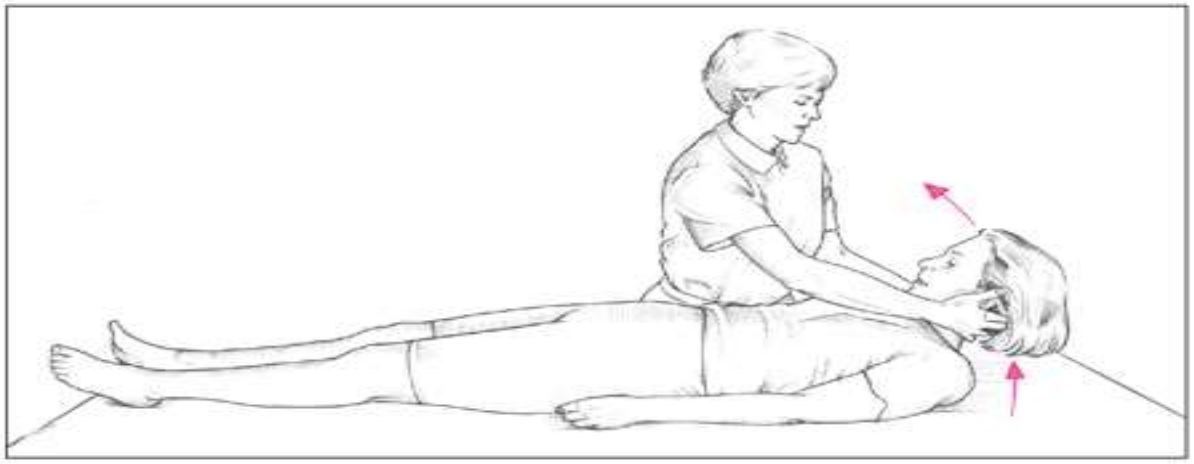
NECK STIFFNESS



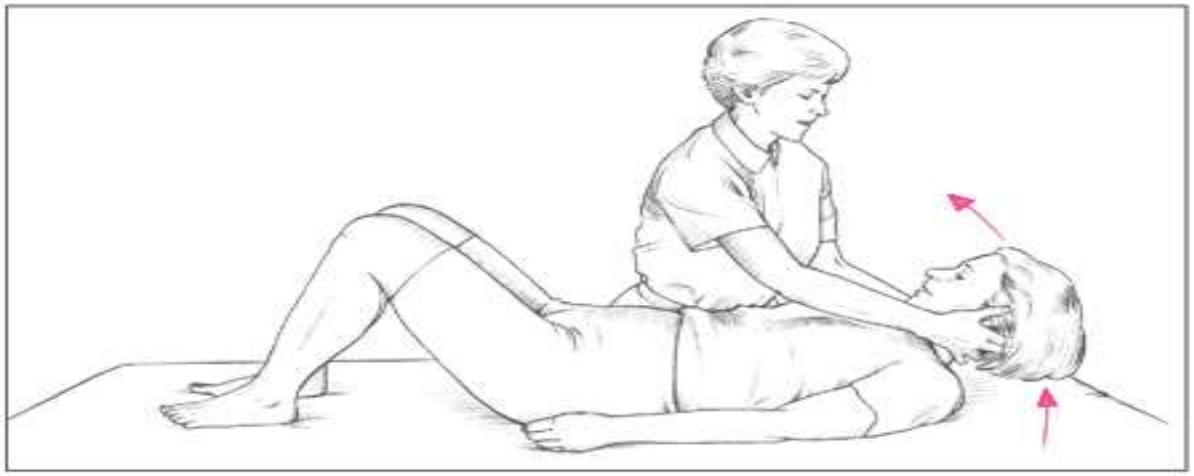
Testing for Brudzinski's sign

Here's how to test for Brudzinski's sign when you suspect meningeal irritation:

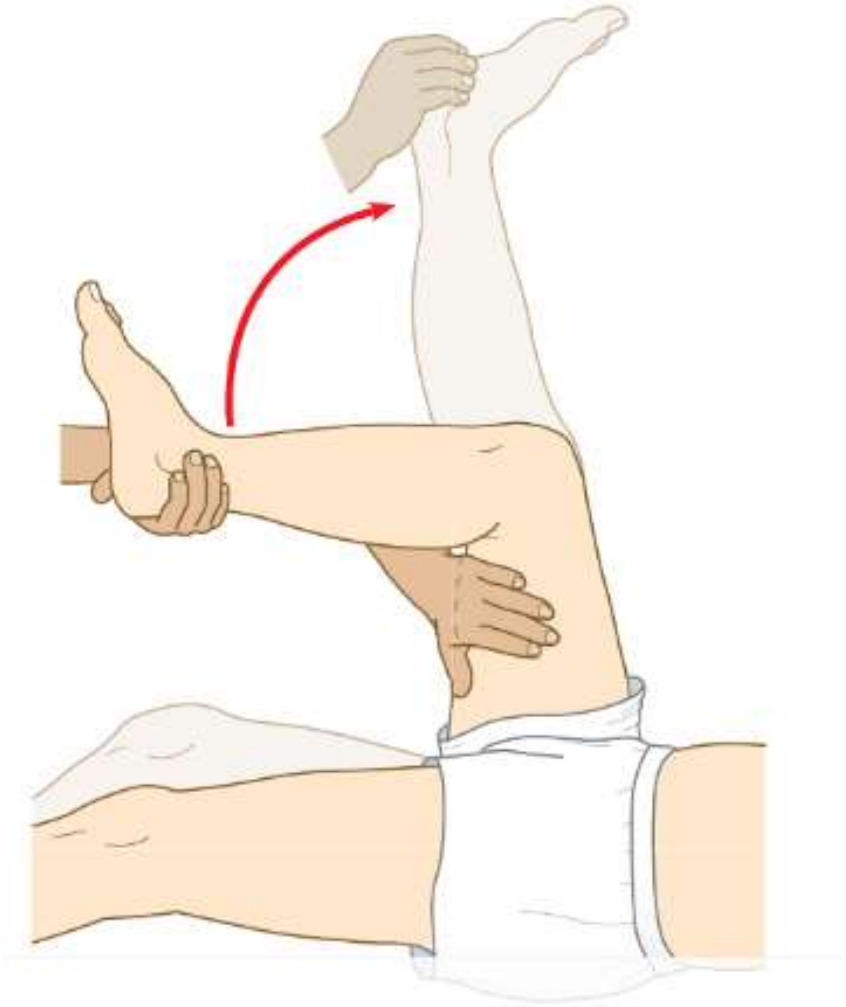
With the patient in a supine position, place your hands behind her neck and lift her head toward her chest.



If your patient has meningeal irritation, she'll flex her hips and knees in response to the passive neck flexion.



KERNIG'S SIGN



SPEECH EXAMINATION

- Listen to the patient's spontaneous speech, noting volume, rhythm and clarity.
- Ask the patient to repeat phrases such as 'yellow lorry' to test lingual (tongue) sounds and 'baby hippopotamus' for labial (lip) sounds, then a tongue twister, e.g. 'the Leith police dismisseth us'.
- Ask the patient to count steadily to 30 to assess fatigue.
- Ask the patient to cough and to say 'Ah'; observe the soft palate rising bilaterally.

SPEECH ABNORMALITIES

- Dysarthria:
  - slurred speech caused by articulation problems due to a motor deficit
- Dysphonia:
  - loss of volume caused by laryngeal disorders
- Dysphasia:
  - disturbance of language resulting in abnormalities of speech production and/or understanding
  - may also involve other language symptoms, e.g. writing and reading.

DYSARTHRIA

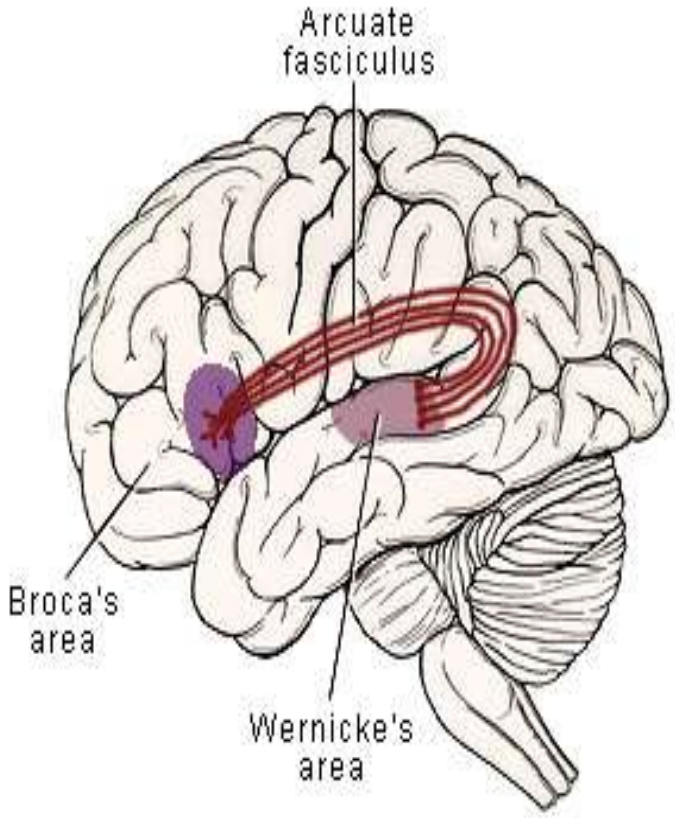
- Pseudobulbar palsy:
  - contracted, spastic tongue and difficulty pronouncing consonants
- Bulbar palsy:
  - Weakness of the tongue results in difficulty with lingual sounds, while palatal weakness gives a nasal quality to the speech.
- Cerebellar dysarthria:
  - slow and slurred, similar to alcohol intoxication.
- Myasthenia gravis:
  - fatiguing speech.
- Parkinsonism:
  - dysarthria and dysphonia, with a low-volume, monotonous voice

DYSPHASIA EXAMINATION

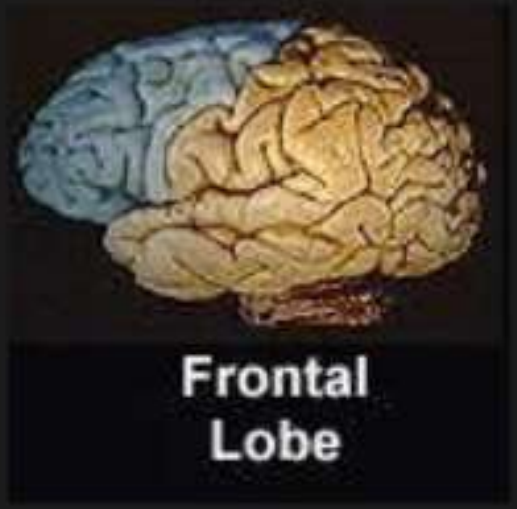
- Listen to the fluency and appropriateness of the content during speech.
- Ask the patient to name a common object
- Give a simple three-stage command
- Ask the patient to repeat a simple sentence
- Ask the patient to read a passage from a newspaper.
- Ask the patient to write a sentence; examine his handwriting.

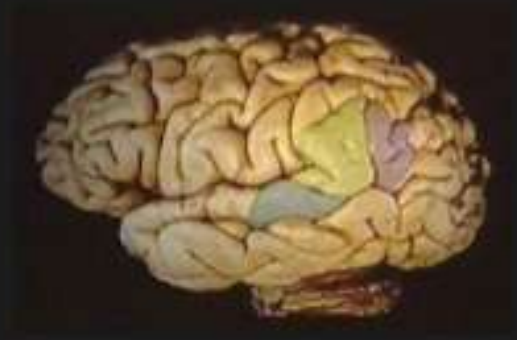
DYSPHASIA

- *Expressive* (*motor*) dysphasia
- *Receptive* (*sensory*) dysphasia
- *Conduction* dysphasia
- *Global* dysphasia
- *Dyslexia*
- *Dyscalculia*
- *Dysgraphia*



Speech





Broca's Area:

- In the left frontal lobe
- Controls production of speech sounds
- Lies close to motor areas

Wernicke's Area:

- Left temporal lobe
- Gets meaning from words and sentences
- Formulates ideas into speech

2 Parietal lobe

Dominant side

FUNCTION
Calculation
Language
Planned movement
Appreciation of size, shape, weight and texture

LESIONS
Dyscalculia
Dysphasia
Dyslexia
Apraxia
Agnosia
Homonymous hemianopia

Non-dominant side

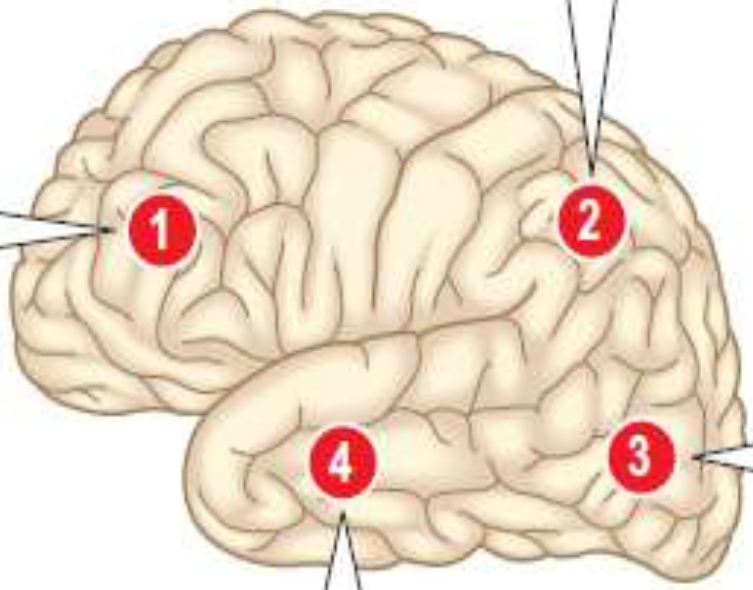
FUNCTION
Spatial orientation
Constructional skills

LESIONS
Neglect of non-dominant side
Spatial disorientation
Constructional apraxia
Dressing apraxia
Homonymous hemianopia

1 Frontal lobe

FUNCTION
Personality
Emotional response
Social behaviour

LESIONS
Disinhibition
Lack of initiative
Antisocial behaviour
Impaired memory
Incontinence
Grasp reflexes
Anosmia



3 Occipital lobe

FUNCTION
Analysis of vision

LESIONS
Homonymous hemianopia
Hemianopic scotomas
Visual agnosia
Impaired face recognition (prosopagnosia)
Visual hallucinations (lights, lines and zig-zags)

4 Temporal lobe

Dominant side

FUNCTION
Auditory perception
Speech, language
Verbal memory
Smell

LESIONS
Dysphasia
Dyslexia
Poor memory
Complex hallucinations (smell, sound, vision)
Homonymous hemianopia

Non-dominant side

FUNCTION
Auditory perception
Music, tone sequences
Non-verbal memory (faces, shapes, music)
Smell

LESIONS
Poor non-verbal memory
Loss of musical skills
Complex hallucinations
Homonymous hemianopia