
INTERNATIONAL SURGICAL
ANATOMY TEACHING
SERIES



ISATS HANDOUT 2024/25

Neuroanatomy: Brain

High Yield | Surgical Relevance | CPD Accredited

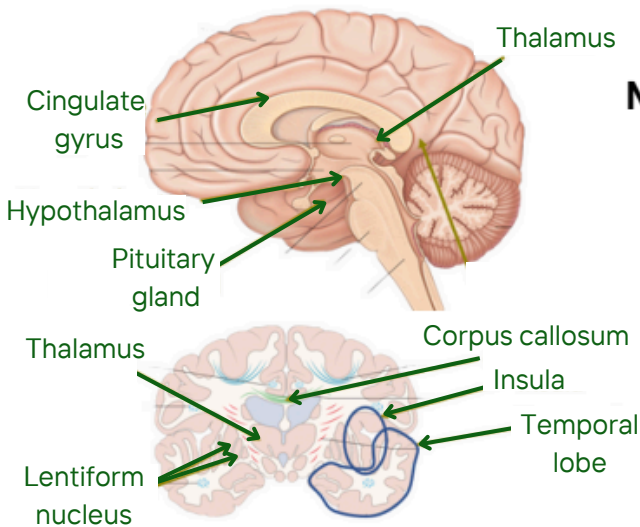
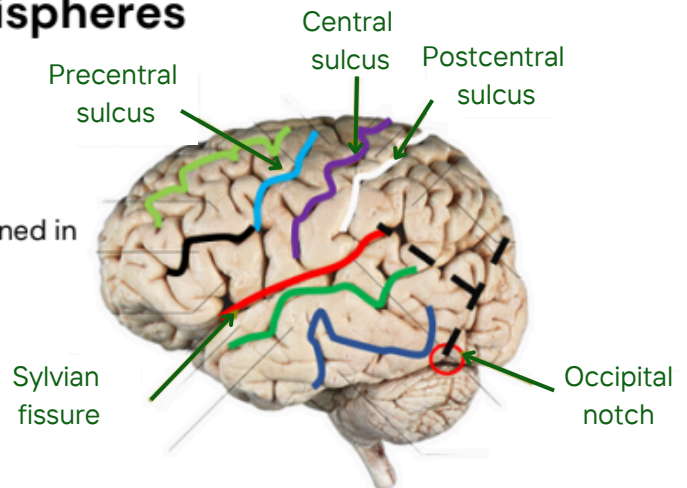
BRAIN ANATOMY

Objectives: Appreciate the fundamental anatomy of the brain and its surroundings, including the skull, cranial base and meninges. Detail the vascular supply to the brain and the ultrastructure of the ventricles. Apply anatomical knowledge to the setting of common neurological procedures.

Topography of the Hemispheres

Lateral View

- **Gyrus** = bump
- **Sulcus** = groove / infolding
- Primary sulci are anatomically maintained in most individuals and divide the lobes
- **Sylvian fissure** (lateral sulcus)
 - Frontal & parietal from temporal
- **Central sulcus**
 - Frontal from parietal



Medial and Coronal Views

- To truly understand neuroanatomy you need **multiple views**
- **Medial view**
 - Brainstem
 - Deep brain grey
 - Grey matter within sagittal sulcus
- **Coronal view**
 - Ventricles
 - Insula
 - True anatomy of temporal lobe
 - Basal ganglia

Eloquent Topography

- Eloquent areas = localised hubs of specialised functional neurones
- The highest cognitive function requires the whole cortex and white matter to function and integrate
- Eloquent topography is helpful for surgery



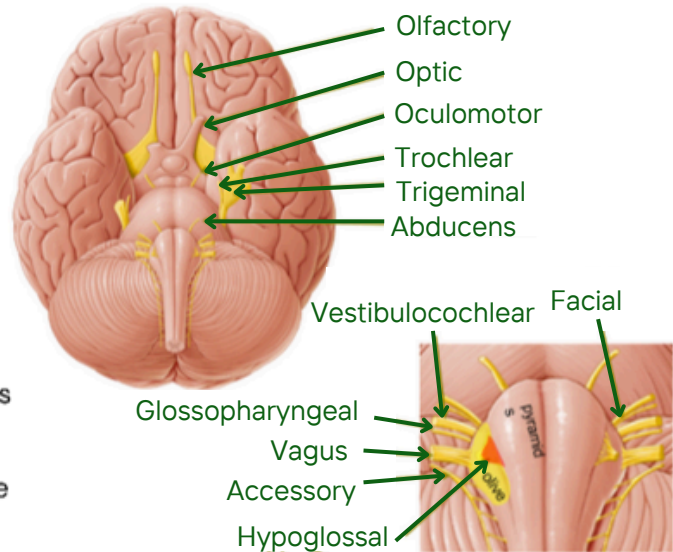
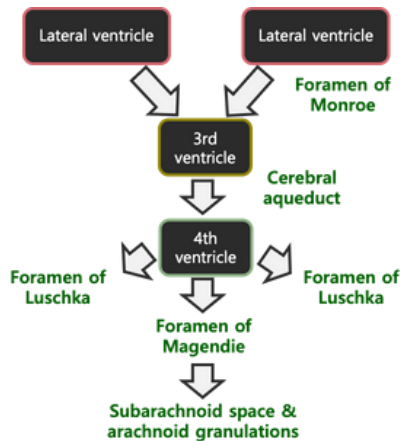
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Cranial nerves

Tips to remember:

- The first 2 cranial nerves emerge directly from the **cerebral hemispheres**
- Remaining 10 from the **brainstem**
- **CNIII** – oculomotor is sensitive to herniation
- **CNIV** – trochlear exits at posterior brainstem
- **CNVIII** – vestibulocochlear is 2 nerves
- **CNXI** – accessory has spinal routes
- **CNXII** – hypoglossal is the only one between medullary pyramids and the olives

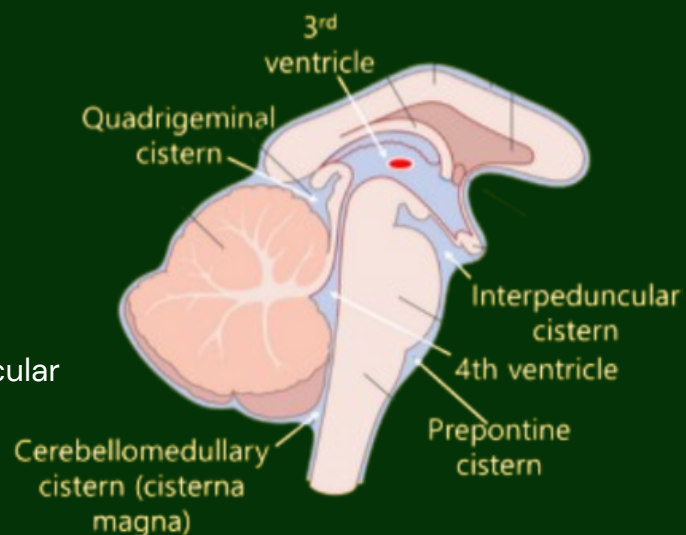


Ventricles

- **Function:** storage & production (choroid plexus) of CSF, protection and buoyance of the brain
- Hold **25ml** of the 150ml of CSF
- Foramen of Munro = **interventricular** foramen
- 3rd to 4th via: **Cerebral aqueduct**
- Foramen of Magendie = **median** aperture
- Foramen of Luschka = **lateral** apertures
- The ventricles drain CSF into the **subarachnoid cisterns**

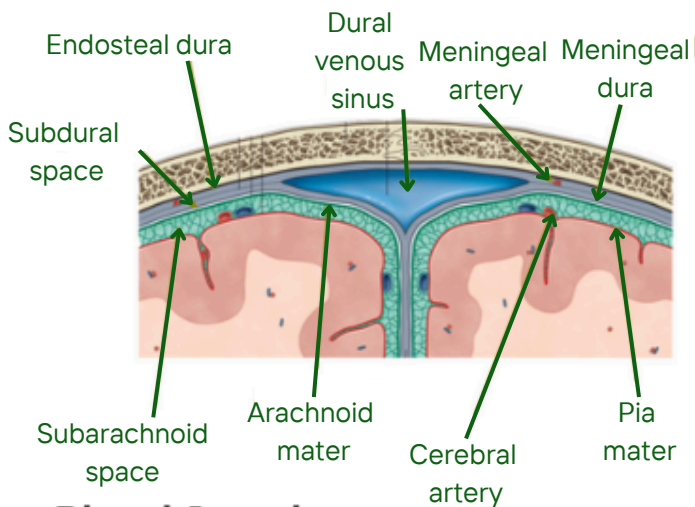
Subarachnoid Cisterns

- Some key cisterns
 - Cerebellomedullary
 - Quadrigeminal
 - Interpeduncular
 - Prepontine
 - Sylvian
 - Cerebellopontine (angle)
- Each subarachnoid cistern has important neurovascular contents that should be remembered
- They provide a road map of the brain for surgery



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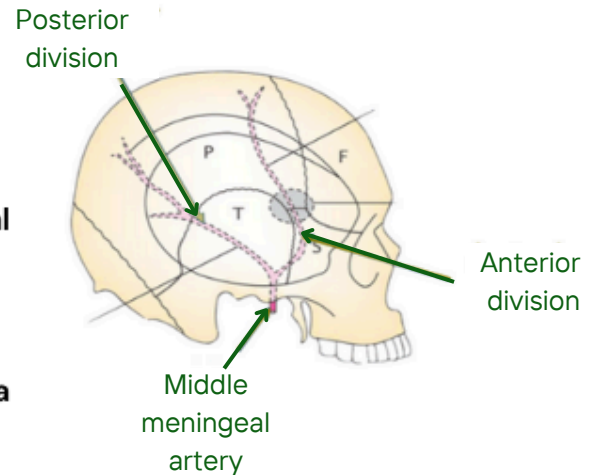


Meninges Layers

- **Dura mater** – thick fibrous, split into endosteal layer and meningeal layer
 - Subdural space – potential
- **Arachnoid mater** – thinner and looser, bridges over sulci
 - Subarachnoid space – actual
- **Pia mater** – microscopic layer, adheres closely to the brain

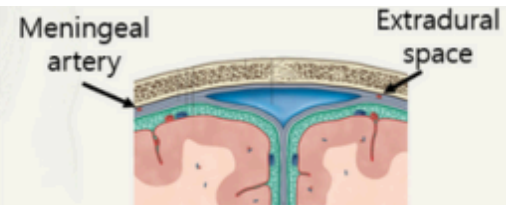
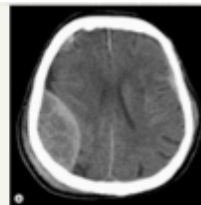
Blood Supply

- **Meningeal arteries** supply the dura mater and bones of the calvaria
- The most prominent of these is the **middle meningeal artery** (branch of maxillary artery)
 - The **anterior branch** runs close to the pterion of the skull
- Meningeal vessels can be found in the **endosteal dura**
- Cerebral vessels can be found in the **subarachnoid space**
- Emissary veins cross all levels – subdural **shear plane**



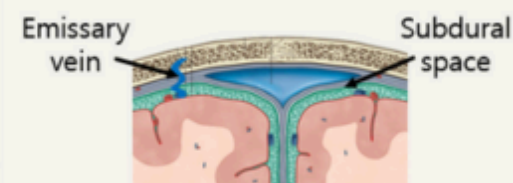
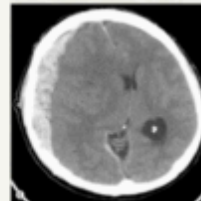
Extradural haematoma

- Most commonly pterional fractures
- Do not cross sutures – endosteal dura fixed
- Biconvex/lentiform appearance



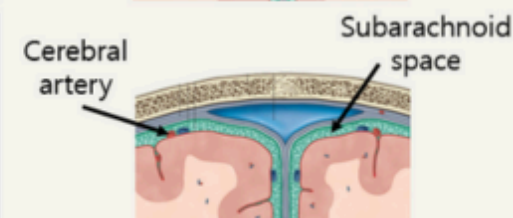
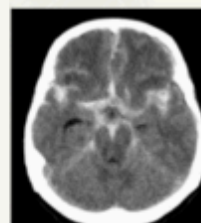
Subdural haematoma

- Emissary veins
- Shear force between dura mater and arachnoid
- Cross suture lines – crescent sign



Subarachnoid haemorrhage

- Cerebral arteries burst (commonly aneurysm)
- Blood fills the subarachnoid space
- Cisterns can be seen filling with blood on CT



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Arterial Supply to the Brain

Circle of Willis

- The **Circle of Willis** is an in-built mechanism to allow for **collateral** supply to the brain
 - If there is restricted blood flow in one area, total ischaemia can be avoided
 - Terminal branches do not have this luxury
- The supply can be divided into **anterior** and **posterior** circulation
 - Each route has distinct **signs and symptoms** when obstructed

Vertebral artery branches (posterior circulation)

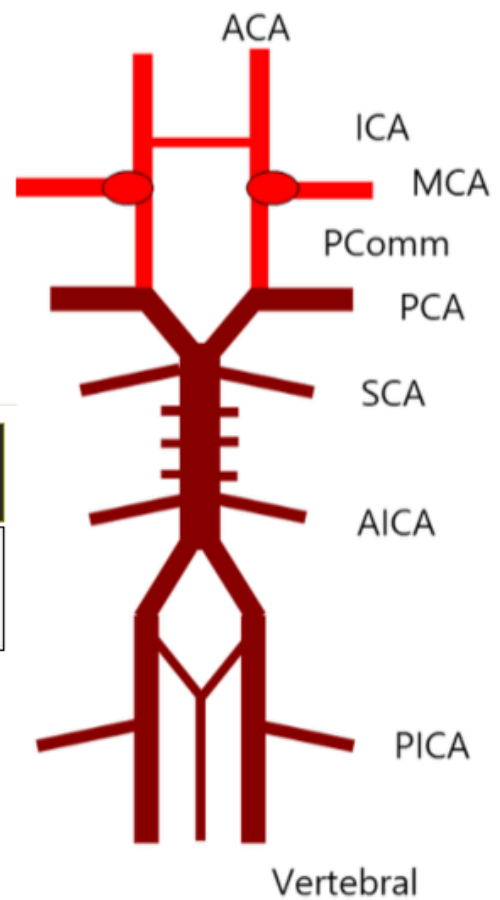
- Posterior inferior cerebellar artery (PICA)
- Anterior spinal artery
- Join to form: Basilar artery

ICA branches (anterior circulation)

- Anterior cerebral artery (ACA)
- Middle cerebral artery (MCA)
- Anterior communicating artery (A.comm)

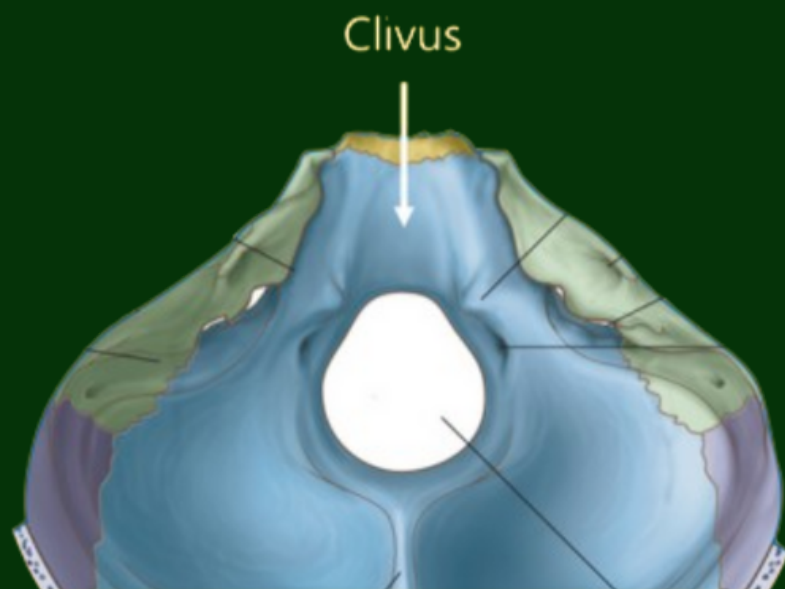
Basilar artery branches

- Anterior inferior cerebellar artery (AICA)
- Posterior cerebral artery (PCA)
- Pontine branches
- Superior cerebellar artery (SCA)
- Posterior communicating artery (PComm)



Neurovascular Bundle

- The basilar artery is formed by the two vertebral arteries
- Sits ventral to the pons on the clivus of occipital bone
- Gives off pontine branches
- The internal carotid arteries enter the middle cranial fossa
- Just above the foramen lacerum (not through it)



BRAIN ANATOMY

Test yourself

1) Label the vascular structures of the

A)

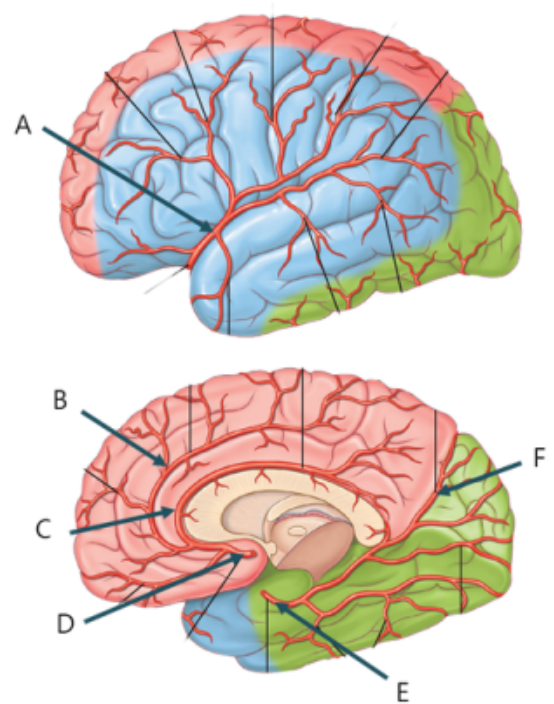
B)

C)

D)

E)

F)



2) Label the layers within the intercostal space:

BRAIN ANATOMY

Test yourself

MCQ 1

A subarachnoid haemorrhage is usually...

- A. Found in-between the endosteal and meningeal layers of dura
- B. Due to spontaneous rupture of a cerebral aneurysm
- C. Unable to cross the lines of the skull suture
- D. Due to an venous bleed
- E. Only found in comatose patients

MCQ 2:

Which structure passes through the foramen ovale?

- A. Optic nerve (CNII)
- B. Abducens nerve (CNVI)
- C. Maxillary nerve (CNVb)
- D. Middle meningeal artery
- E. Mandibular nerve (CNVc)

MCQ 3

Cortical regions that represent the motor supply to the leg are supplied by which artery?

- A. Callosomarginal branch of anterior cerebral artery
- B. Pericallosal branch of anterior cerebral artery
- C. Frontoparietal branches of middle cerebral artery
- D. Temporal branches of middle cerebral artery
- E. Calcarine branch of the posterior cerebral artery

MCQ 4

The central sulcus delineates which lobes of the brain?

- A. Frontal and temporal
- B. Parietal and occipital
- C. Temporal and occipital
- D. Frontal and insula
- E. Frontal and parietal

MCQ 5

If a patient fractures their pterion, which artery might be damaged and what is the sequelae?

- A. Posterior branch of middle meningeal artery - subdural haematoma
- B. Anterior branch of middle meningeal artery - extradural haematoma
- C. Posterior branch of middle meningeal artery - extradural haematoma
- D. Anterior branch of middle meningeal artery - subdural haematoma
- E. Accessory meningeal artery - extradural haematoma

MCQ 6

Which cranial nerve can be found emerging between the medullary olives and pyramids?

- A. Accessory nerve (CNXI)
- B. Vagus nerve (CNX)
- C. Hypoglossal nerve (CNXII)
- D. Glossopharyngeal nerve (CNIX)
- E. Vestibulocochlear nerve (CNVIII)

