

INTERNATIONAL SURGICAL
ANATOMY TEACHING
SERIES



ISATS HANDOUT 2025/26

Neuroanatomy: Brain

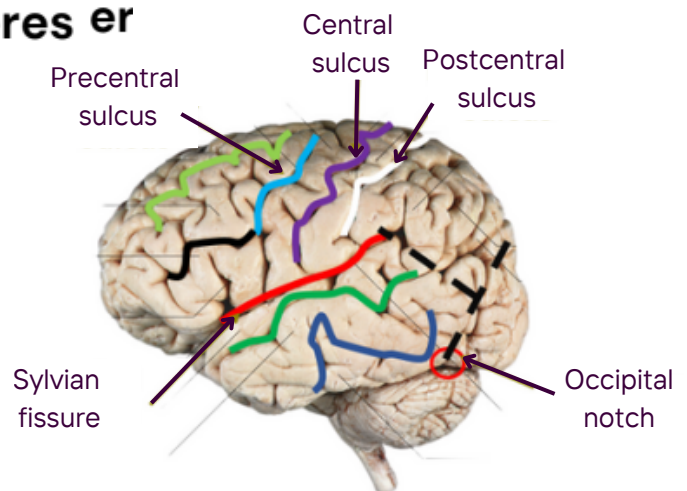
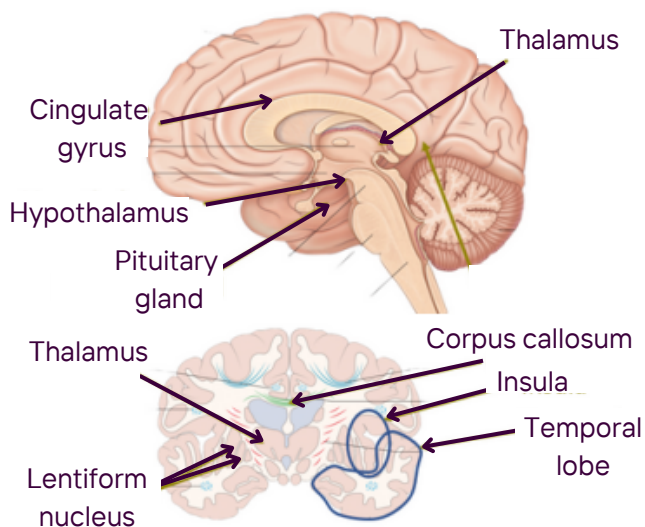
BRAIN ANATOMY

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

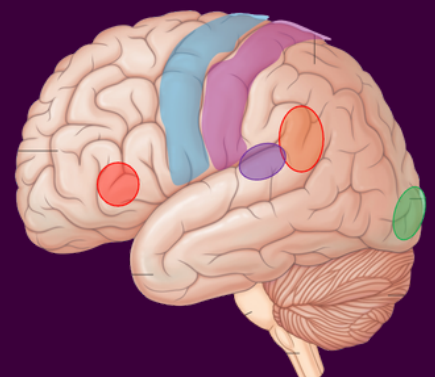
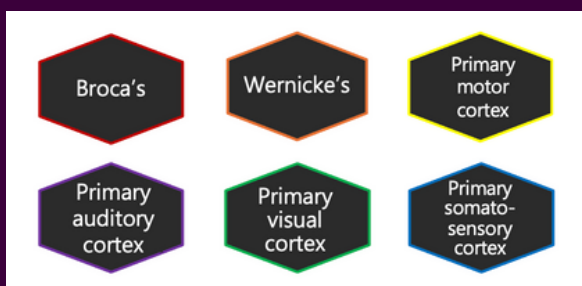


Medial and Coronal Views

- 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



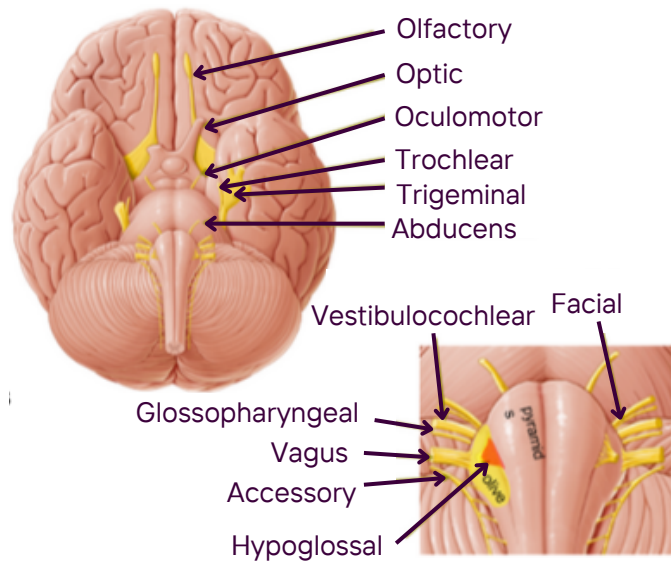
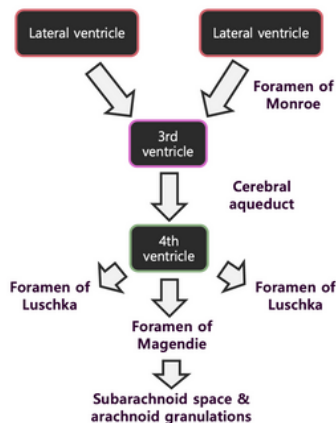
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Cranial nerves

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

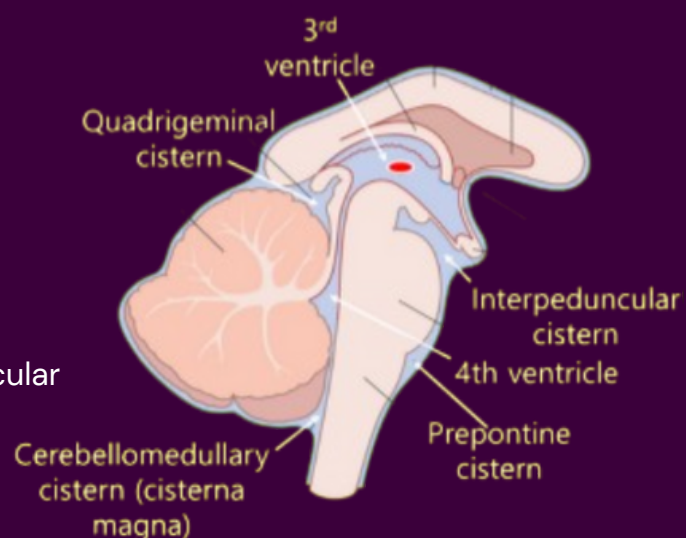


Ventricles

- **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**

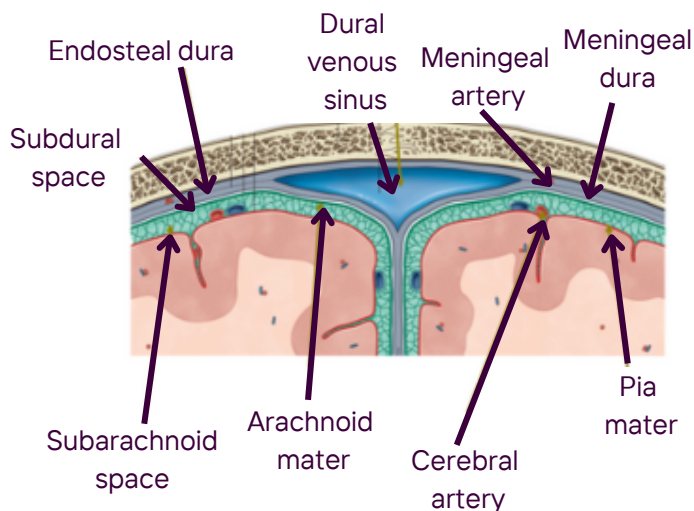
Subarachnoid Cisterns

- 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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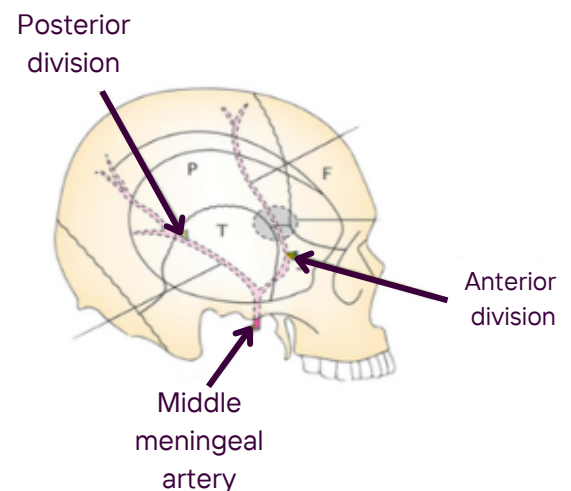


Meningeal Layers

- **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

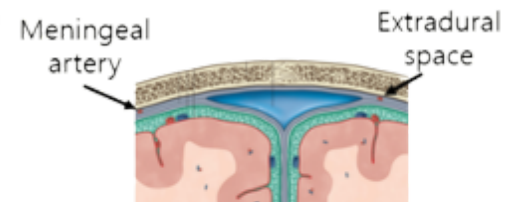
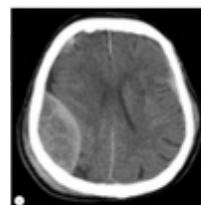
Blood Supply

- **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**



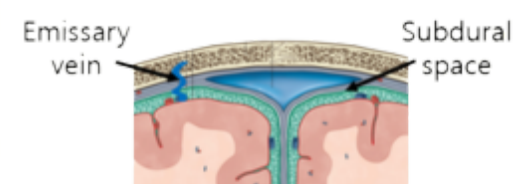
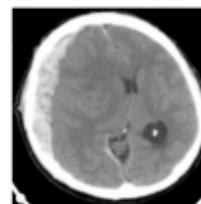
Extradural haematoma

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



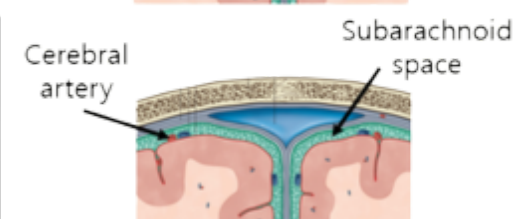
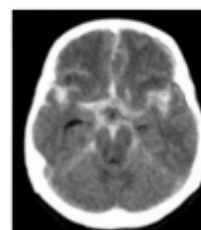
Subdural haematoma

- 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)

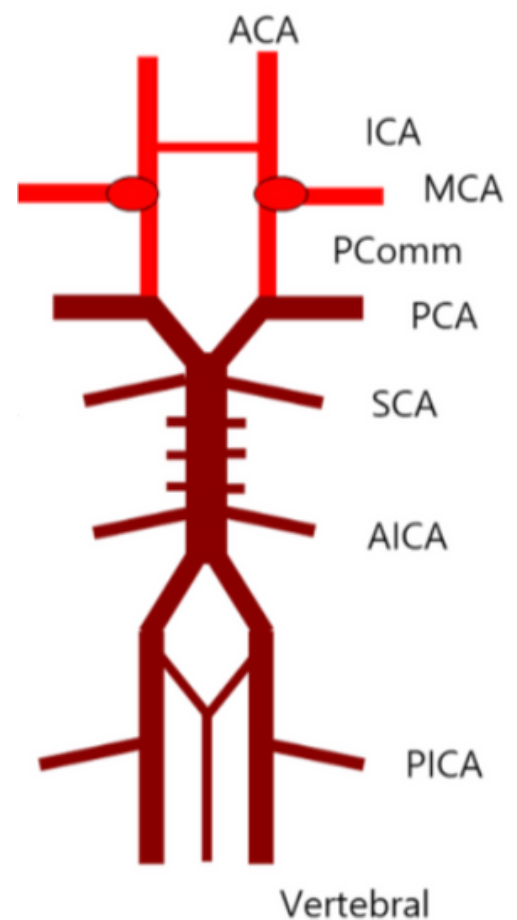
- Posterior inferior cerebellar artery (PICA)
- Anterior spinal artery
- Join to form: Basilar artery

ICA branches (anterior circulation)

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

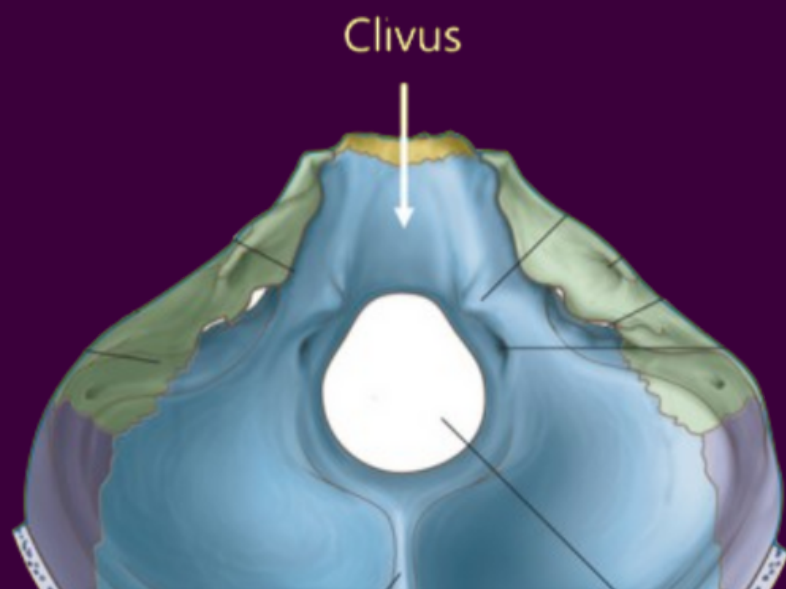
Basilar artery branches

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



Neurovascular Bundle

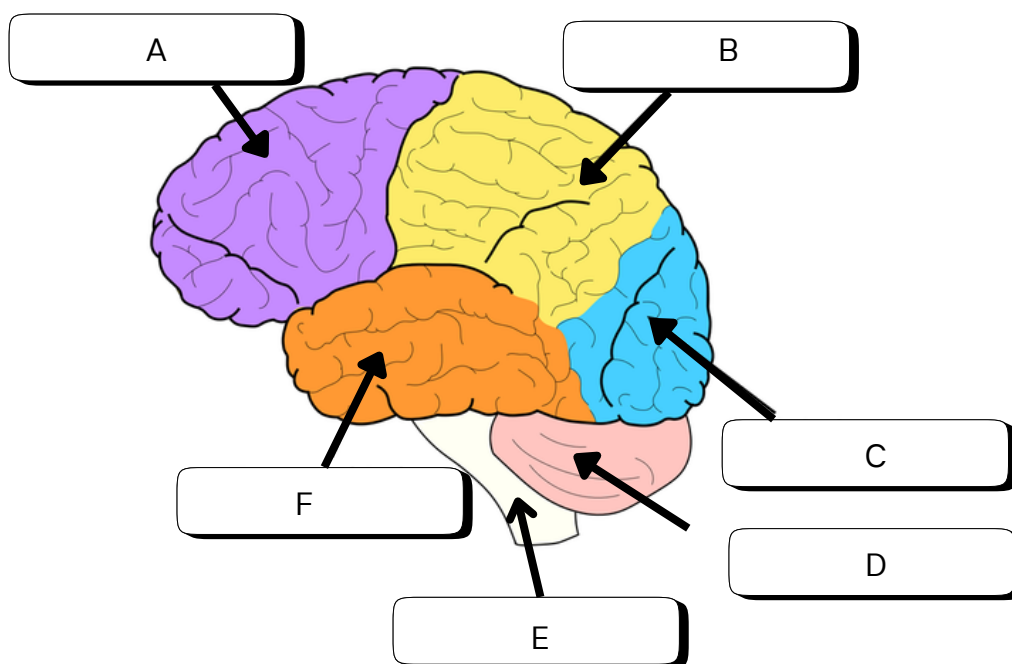
- The basilar artery is formed by the two vertebral arteries
- Sits ventral to the pons on the clivus of occipital bone
- Gives off pontine branches
- The internal carotid arteries enter the middle cranial fossa
- Just above the foramen lacerum (not through it)



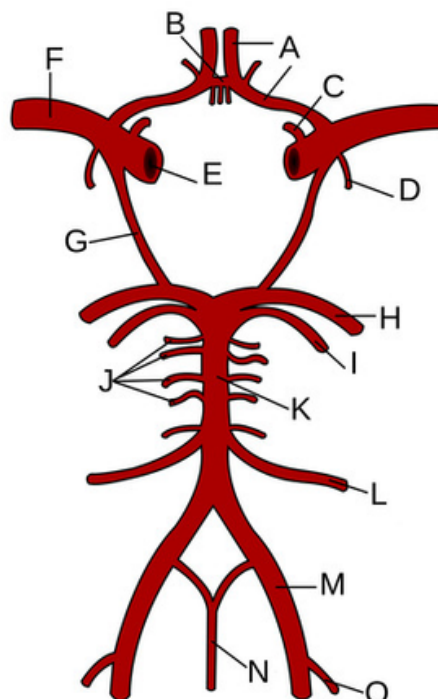
BRAIN ANATOMY

Test yourself

1) Label the lobes and structures of the brain:



2) Label the arteries within the Circle of Willis:



BRAIN ANATOMY

Test yourself

MCQ 1

A 68-year-old man suddenly develops weakness of the right face and arm, along with expressive aphasia. Which artery is most likely occluded?

- A. Left anterior cerebral artery
- B. Right anterior cerebral artery
- C. Left middle cerebral artery *
- D. Right middle cerebral artery
- E. Left posterior cerebral artery

MCQ 2

A 58-year-old woman reports numbness and tingling over her right hand and face. Which cortical area is most likely involved?

- A. Left precentral gyrus
- B. Right precentral gyrus
- C. Left postcentral gyrus, lateral surface
- D. Left superior parietal lobule
- E. Right postcentral gyrus, medial surface

MCQ 3

A 22-year-old man is brought to the emergency department after a motorcycle accident. He was briefly unconscious, then awake and talking, but later became comatose. CT scan shows a biconvex (lens-shaped) hyperdense lesion. What type of hemorrhage is most likely?

- A. Subdural hemorrhage
- B. Subarachnoid hemorrhage
- C. Intracerebral hemorrhage
- D. Intraventricular hemorrhage
- E. Epidural hemorrhage

MCQ 4

A 40-year-old man presents with headache, nausea, and papilledema. MRI shows dilatation of the lateral and third ventricles, while the fourth ventricle appears normal. Where is the obstruction most likely located?

- A. Cerebral aqueduct (of Sylvius)
- B. Foramen of Magendie
- C. Foramen of Luschka
- D. Interventricular foramen (of Monro)
- E. Central canal of the spinal cord

MCQ 5:

A 60-year-old woman has loss of taste and sensation on the posterior third of her tongue and an absent gag reflex on the right side. Which cranial nerve is damaged?

- A. Vagus (X)
- B. Facial (VII)
- C. Glossopharyngeal (IX)
- D. Hypoglossal (XII)
- E. Trigeminal (V)

MCQ 6

A 58-year-old man speaks fluently but his sentences make no sense, and he cannot understand spoken language. Which function is most likely impaired?

- A. Speech production
- B. Motor planning
- C. Hearing
- D. Writing
- E. Language comprehension

BRAIN ANATOMY

Test yourself

OSCE Station – Case Based Discussion

A 58-year-old man suddenly collapses at work. He briefly regains consciousness but appears confused and complains of the “worst headache of his life.” In the emergency department, he becomes drowsy and develops neck stiffness. On examination, his pupils are equal and reactive, and there is no limb weakness.

A CT brain shows blood in the basal cisterns and around the circle of Willis.



Q1. What imaging study is vital for diagnosis and what would you expect to see?

Q2. Explain the anatomy of this pathology with reference to the meningeal layers.

Q3. What is the most common cause of this condition, and which vessel is usually involved?

Q4. What is the main immediate danger to the brain following this event?

Q5. What specific drug is given to reduce the risk of this complication, and how does it work?

Q6. What monitoring and further investigation does this patient require after stabilization?

Answers
Labels
 1. A) Frontal B) Parietal C) Occipital D) Cerebellum E) Brainstem F) Temporal
 2. A) ACA B) AComm C) Ophthalmic D) Anterior choroidal E) Internal carotid F) MCA G) PComm H) PCA I) SCA J) Pontine
 arteries K) Basilar L) AICA M) Vertebral N) ASA O) PICA
MCQs: 1) C, 2) E, 3) C, 4) A, 5) C, 6) E
OSCEs:
 1) Imaging: Non-contrast CT brain, Findings: Hyperdensity in the subarachnoid spaces
 2) Bleeding occurs into the subarachnoid space, between the arachnoid mater and pia mater.
 3) Commonly due to rupture of a berry (saccular) aneurysm
 4) Vasospasm, leading to secondary cerebral ischemia.
 5) Nimodipine, calcium channel blocker that prevents cerebral vasospasm
 6) Neurological monitoring, CT angiography or digital subtraction angiography to identify the aneurysm for definitive treatment (coiling or clipping)