Diseases of NERVOUS SYSTEM

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OUTLINES

- **Hydrocephalus**
- **Inflammatory diseases**
  - Meningitis
  - Brain abscess
  - Encephalitis
- **Vascular disorders**
  - Cerebral atherosclerosis
  - Intracranial haemorrhage
  - Cerebral infarction
  - Cerebral aneurysm
- **Tumours**
- **Increased intracranial tension (ICT)**

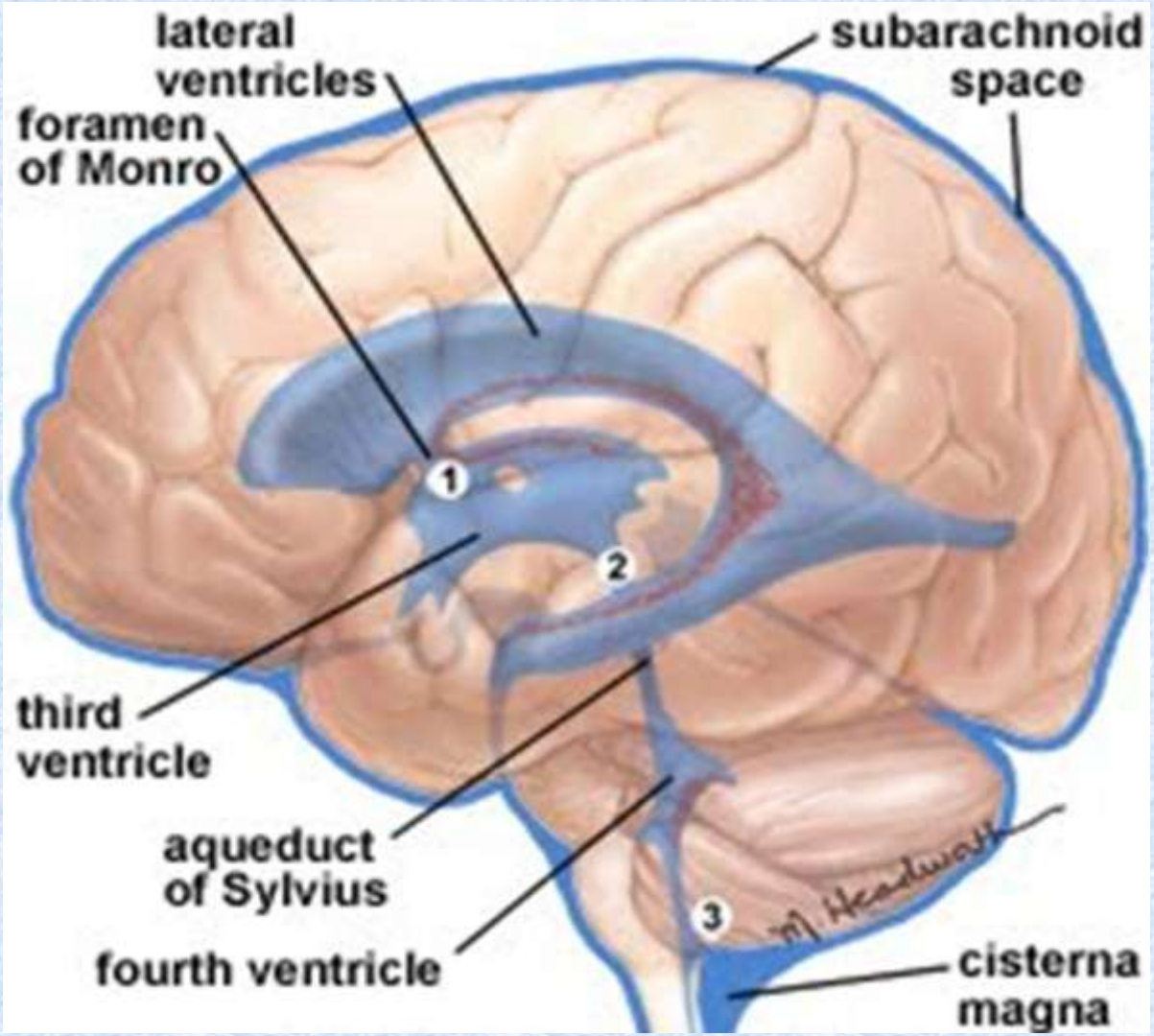
HYDROCEPHALUS

Normal CSF

- **Production and circulation:**
  - Produced by choroid plexus in the lateral ventricles
  - Pass from lateral to third ventricle through foramina of Monro (inter-ventricular foramen)
  - Pass from third to fourth ventricle through aqueduct of Sylvius.
  - Pass from fourth ventricle to sub-arachenoid space through foramina of Magendie and Luschka
  - CSF then drains to superior sagittal sinus through arachenoid villi or granulations.

HYDROCEPHALUS

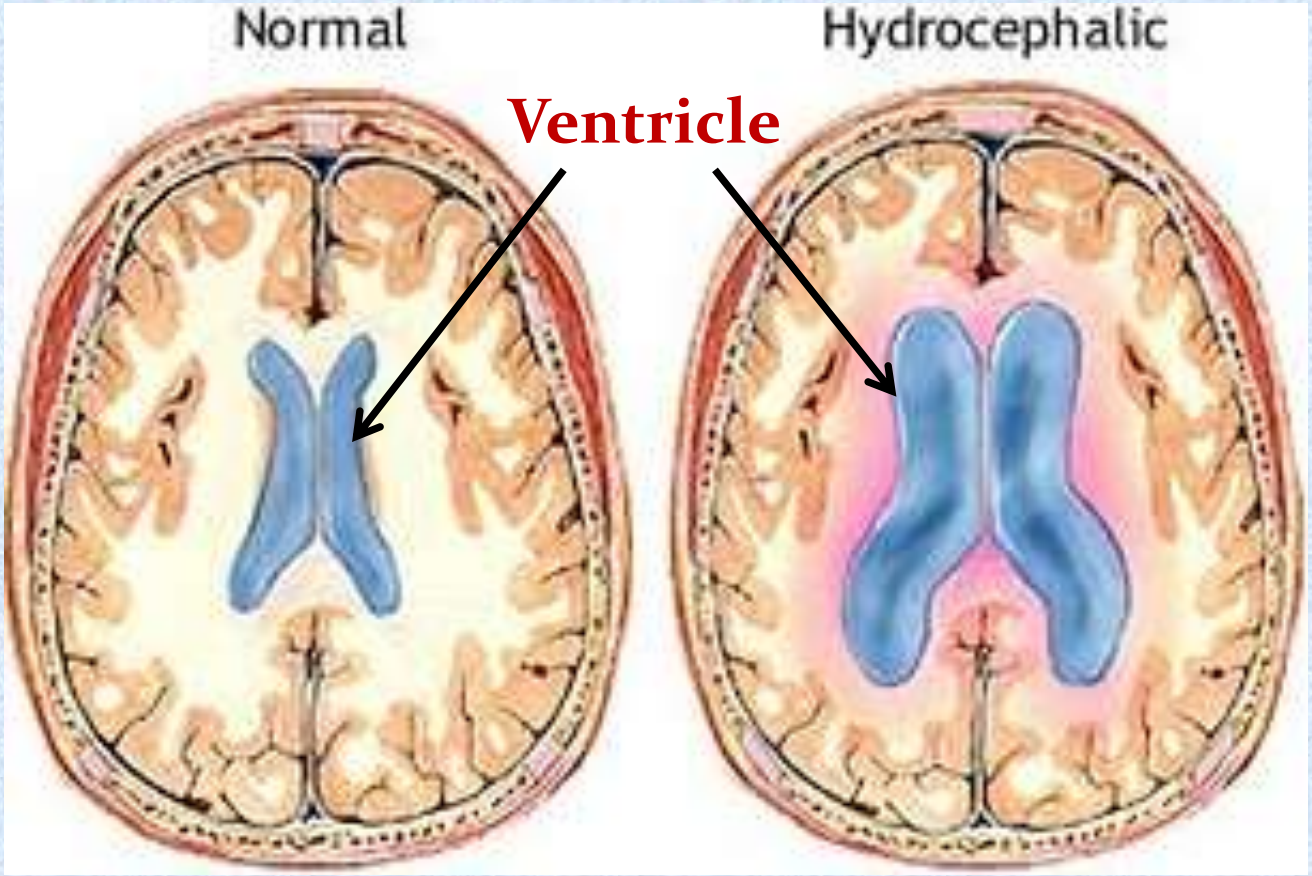
Normal CSF



HYDROCEPHALUS

Definition

- Abnormal dilatation of brain ventricular system by excess CSF fluid associated with atrophy of brain tissue



HYDROCEPHALUS

Aetiology

↑CSF production — e.g. choroid plexus tumours as papilloma

Obstruction of CSF flow

-***Congenital***:
- -Narrow aqueduct of Sylvius
- -Narrow foramina of 4rth ventricle

-***Acquired***:
- 1-Meningitis
- 2-Brain abscess
- 3-Brain tumours

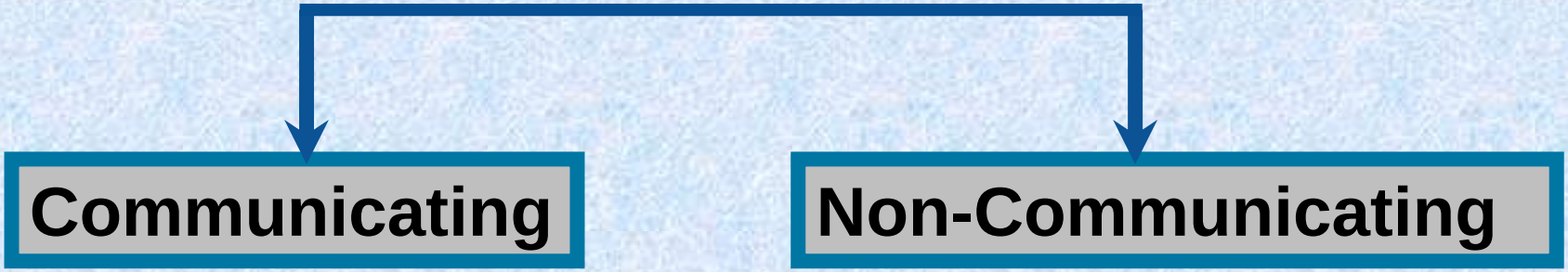
↓CSF drainage

-***Congenital***:
- -Aplasia of choroid plexus villi

-***Acquired***:
- -Damage to arachenoid villi
- -Thrombosis of superior sag. sinus

HYDROCEPHALUS

Types

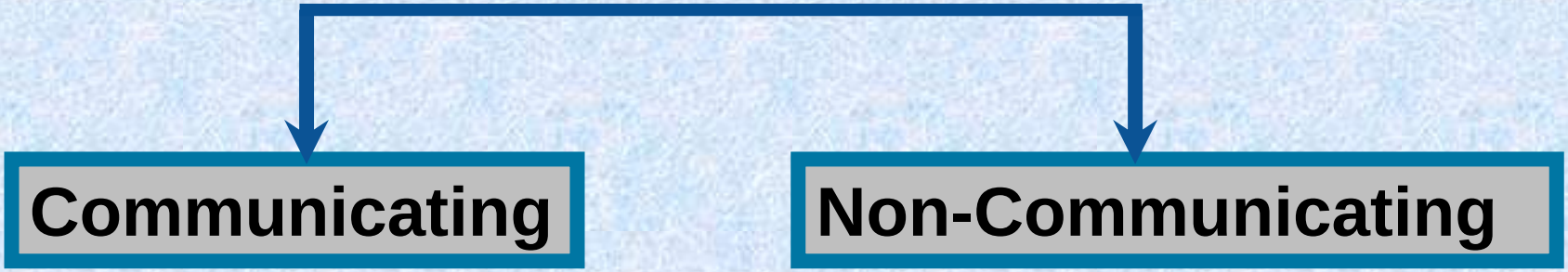


CSF can pass from ventricular system to subarachenoid space

Can not

HYDROCEPHALUS

Types



- **Obstructive**: arachenoid villi obstruction
- **Non-obstructive**: ↑ CSF production

- **Only obstructive**: obstruction within ventricular system

HYDROCEPHALUS

Clinically

INFLAMMATIONS

Meningitis

Brain abscess

Encephalitis

INFLAMMATIONS

Meningitis

- **Definition**:

  Inflammation of the meningeal coverings of the brain and spinal cord

  Pachymeningitis Inflammation of dura matter (rare)

  Leptomeningitis Inflammation of pia and arachenoid

- **Types:**

  Septic → **bacterial**

  Aseptic → **TB meningitis**, **Viral meningitis**, **Syphilitic**

INFLAMMATIONS

Septic meningitis

- **Causes**:
  - ***Organism:***
    - Meningococcal: commonest organisms leading to meningococcal meningitis (**can lead to epidemic meningitis**).
    - Non-meningiococcal (rare): as strept., staph., pneumococci and H. influenza bacilli.
  - ***Routs of infection***

    Varies according to the causative organism

INFLAMMATIONS

Septic meningitis

- **Causes**:
  - ***Routs of infection***

Meningiococci → Droplet infection from a carrier → Nasopharyngitis → blood stream → Meninges

Other organisms

1. Hematogenous: from a distant septic focus
2. Direct: from a nearby septic focus (sinusitis, otitis media or brain abscess
3. a complication of compound skull bone fracture

INFLAMMATIONS

Septic meningitis

- **Pathology of meningiococcal meningitis**:
  - ***Grossly***
    - Thick red meninges covered with purulent exudates .
    - Dilated and congested meningeal and cortical vessels.
    - Subarachnoid space is filled with a yellowish purulent exudates, mostly at base of the brain (effect of gravity).
    - Brain is swollen and edematous.
    - Ventricles are dilated.
    - Cerebrospinal fluid is turbid and mixed with pus.

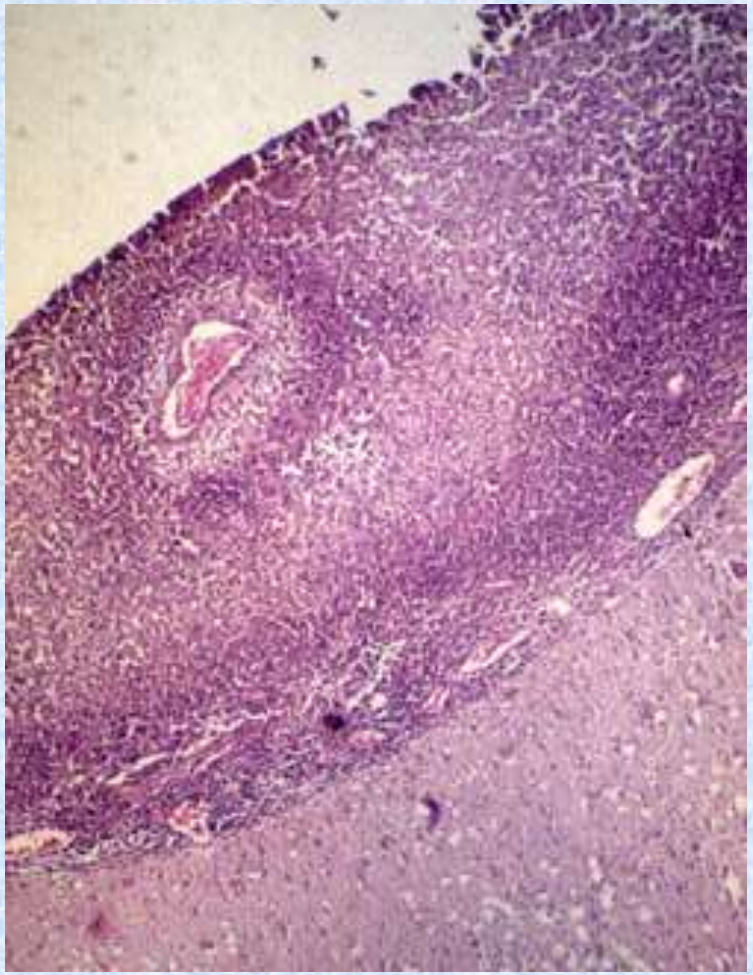
INFLAMMATIONS

Septic meningitis

- **Pathology of meningiococcal meningitis**:
  - ***Microscopically***

The subarachnoid space shows:

- Dilated congested vessels
- Heavy infiltration by many:
  - polymorphs
  - histiocytes,
  - plasma cells
  - fibrin threads.



INFLAMMATIONS

Septic meningitis

- **Pathology of meningiococcal meningitis**:
  - ***CSF changes***
    (1) Increased tension.
    (2) Presence of many pus cells.
    (3) Elevated protein content.
    (4) Decreased sugar content.
    (5) Culture: +++ve for the organism
- **Clinically**

1. Headache
2. Irritability
3. Stiff neck
4. Disturbed conscious level
5. photophobia

INFLAMMATIONS

Septic meningitis

- **Complications**
  1. Thrombosis of pial arteries → Brain infarction
  2. Septic thrombophlebitis → Systemic pyemia.
  3. Blood spread of the bacteria → arthritis, bacterial endocarditis, pericarditis and empyema.
  4. Adrenal cortical hemorrhage → acute adrenal cortical insufficiency (Waterhouse-Friderichsen syndrome).
  5. Healing by fibrosis → meningeal adhesions leading to:
     - Compression of cranial and spinal nerve roots,
     - Obstruction of the flow of C.S.F. leading to hydrocephalus.

INFLAMMATIONS

Brain abscess

- **Definition**:
  - Localized suppurative inflammation of brain tissue
- **Aetiology:**
  - ***Causative organisms:***
    - Staph. aureus, streptococci, pneumococci, E.coli and bacillus pyocyaneus.
  - ***Routes of infections:***
    1. Direct spread: from otitis media, sinusitis and mastoiditis.
    2. Blood spread: from lung abscess, bronchiectasis and empyema through the vertebral system of veins.
    3. Infection from outside through compound fractures of the skull.

INFLAMMATIONS

Brain abscess

- **Sites:**

  Depends on source of infection

  1. Otitis media → temporal lobe abscess
  2. Mastoiditis → cerebellar abscess
  3. Systemic pyemia → multiple abscesses at the junction of the grey and white matter.

INFLAMMATIONS

Brain abscess

- **Pathological features:**
  - ***Early*** → edema, softening and heavy neutrophilic infiltration of the affected brain tissue.
  - ***Suppuration*** → an abscess cavity filled with pus and lined by necrotic tissue.
  - ***Grossly***:
    - The affected part appears swollen
    - Flattened brain convolutions
    - Thick and adherent meninges.
  - ***Microscopically***:
    - *Describe*

INFLAMMATIONS

Brain abscess

- **Pathological features:**
  - ***Fate***:
    - The abscess tends to spread inwards and rupture into the ventricles.
    - If pus is absorbed or evacuated → spontaneous healing by gliosis,
    - More commonly the abscess changes to a chronic one.

      → chronic abscess is surrounded by a thick wall of glial tissue and contains thick pus.

INFLAMMATIONS

Brain abscess

- **Complications:**
  - Increased intracranial tension
  - Spread of infection:
    - Local spread: Septic meningitis, subdural abscess, extradural abscess
    - Sinus thrombophlebitis.
    - Systemic pyemia
- **Clinically**

  Brain abscess is important clinically because it is:
  - Associated with increased ICT
  - Considered in the differential diagnosis of intracranial space occupying lesion (SOL)
  - Difficult treatment

INFLAMMATIONS

Encephalitis

- **Definition:**
  - Inflammation of the brain tissue
- **Caused by:**
  - Bacterial
    - Pyogenic infections as brain abscess.
    - Bacteria toxins as botulism.
  - Fungal infections as cryptococcosis.
  - Parasitic infections as malaria and toxoplasmosis.
  - Viral infections as rabies, poliomyelitis, herpes zoster and herpes simplex.

VASCULAR DISORDERS

Intracranial hemorrhage

Cerebral atherosclerosis General pathology

Cerebral aneurysm

Cerebral infarction General pathology

VASCULAR DISORDERS

Intracranial hemorrhage

- **Definition:**
  - Hemorrhage within the cranial cavity
- **Types:**

Meningeal Hemorrhage

-Extradural hemorrhage
-Subdural hemorrhage
-Subarachnoid hemorrhage

Cerebral Hemorrhage

- Petechial hemorrhage
- Massive cerebral hemorrhage

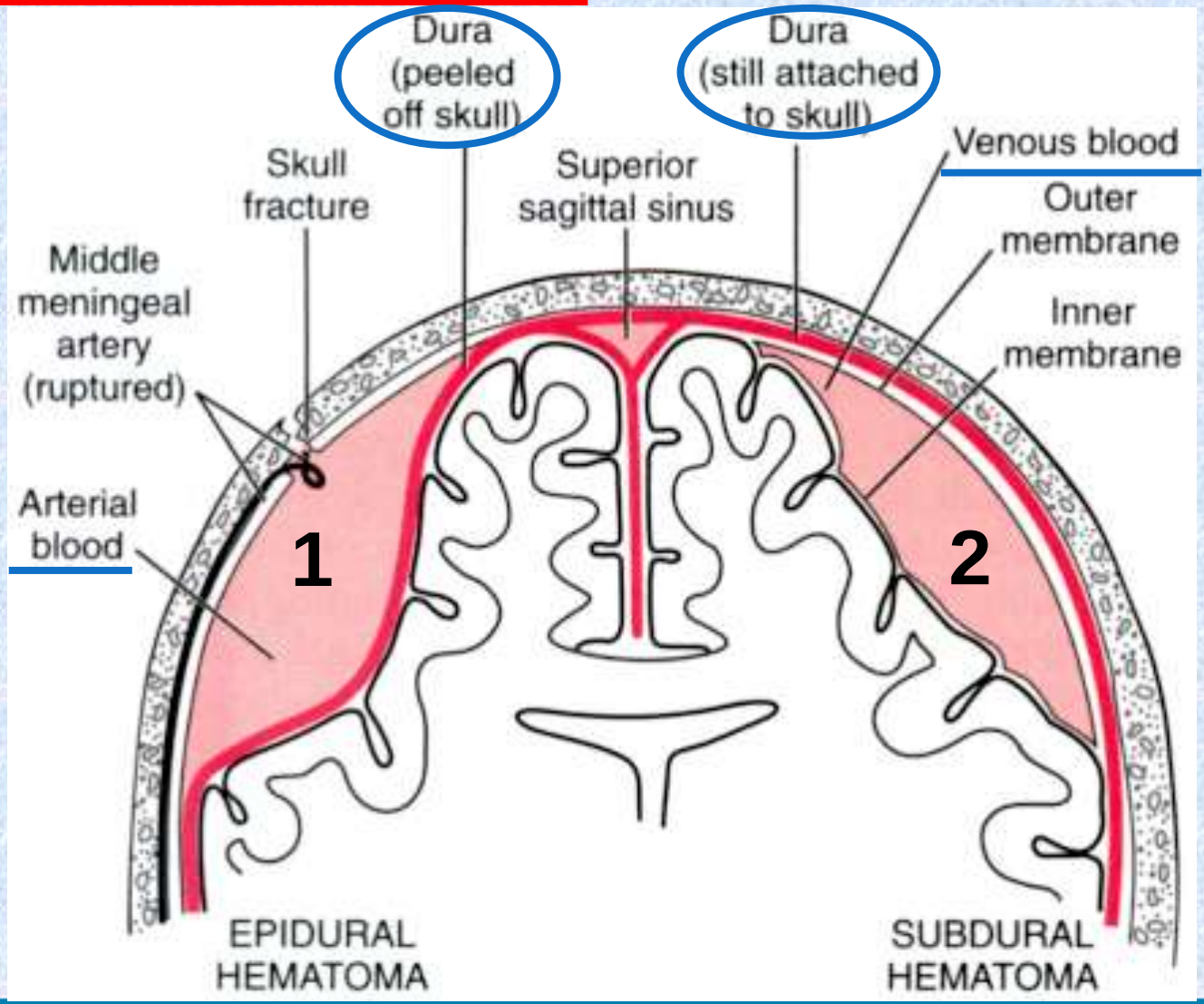
VASCULAR DISORDERS

Intracranial hemorrhage

- **Extradural (Epidural) hemorrhage:**
  - Blood accumulation between dura matter and skull
  - Commonly by traumatic rupture of middle meningeal artery
- **Subdural hemorrhage:**
  - Blood accumulation in subdural space.
  - Commonly by traumatic rupture of cerebral veins crossing the subdural space
- **Subarachenoid hemorrhage:**
  - Blood accumulation in subarachenoid space
  - Can be caused by
    - Traumatic lacerations of the brain.
    - Rupture of cerebral aneurysms.
    - Hemorrhagic blood diseases

VASCULAR DISORDERS

Intracranial hemorrhage



VASCULAR DISORDERS

Intracranial hemorrhage

- **Petechial cerebral hemorrhage:**
  - Capillary in origin
  - Caused by meningitis, encephalitis and hemorrhagic blood diseases.
- **Massive cerebral hemorrhage**
  - Occurs in most cases in one cerebral hemispheres due to hemorrhage from a branch of the middle cerebral artery.
  - Common causes:
    1. Hypertension (commonest in old age).
    2. Trauma.
    3. Rupture of cerebral aneurysm (commonest in young age).
    4. Hemorrhagic blood diseases.
    5. Bleeding into a degenerated tumor.

VASCULAR DISORDERS

Cerebral aneurysm

- **Definition:**
  - Localized dilatation of one (or more) branches of cerebral artery
- **Types**

1. Congenital
2. Mycotic
3. Arteriosclerotic
4. Arteriovenous

VASCULAR DISORDERS

Cerebral aneurysm

1. **Congenital aneurysms**
   - Congenital weakness of the tunica media
   - Single or multiple small aneurysms (pin head)
   - Commonly at the bifurcation of the cerebral arteries

2. **Mycotic aneurysms:**
   - Commonly due to subacute bacterial endocarditis and polyarteritis nodosa
   - Due to inflammatory weakness of the vascular wall.

VASCULAR DISORDERS

Cerebral aneurysm

3. **Arteriosclerotic aneurysm:**
   - Fusiform aneurysms develops in association with atherosclerosis and hypertension
4. **Arteriovenous aneurysm:**
   - Communication between the internal carotid artery and cavernous sinus.

- **Complications:**
  1. Rupture leading to subarachnoid hemorrhage.
  2. Pressure effect (increased ICT).
  3. Thrombosis and calcification.

VASCULAR DISORDERS

Cerebral infarction

- **Definition:**
  - Focal ischemic liquifactive necrosis of the brain
- **Incidence:**
  - Fairly common
  - Responsible for 90% of cerebral strokes
- **Aetiology:**
  - Due to severe reduction or cessation of blood flow (cerebral thrombosis or embolism)
- **Pathology**
  - See general pathology
- **C/P:**
  - Hemiplegia
  - Difficulty or of speech

TUMOURS OF CNS

Normal cells of CNS

A.Neuroglial cells

1.Astrocytes
- Star-shaped
- Responsible for nutritional supply and insulation of neurons

2.Oligodendrocytes Form myelin sheath

3.Ependymal cells Line ventricular chambers, aqueduct, central canal of spinal cord

4. Microglia Native macrophages of the CNS

B.Neuronal cells

C.Meningeal cells

D.Endothelial cells

TUMOURS OF CNS

WHO classification

A. Tumors of neuroglia (**GLOMAS**)	• Astrocytoma. • Glioblastoma multiforme. • Oligodendroglioma. • Ependymoma. • Choroid plexus papilloma.
B. Tumors of neurons	• Neuroblastoma. • Ganglioneuroblastoma. • Ganglioneuroma.
C. Tumors of primitive undifferentiated cells	• **Medulloblastoma**
D. Tumors of meninges	• **Meningioma**. • Meningeal hemangiopericytoma. • Meningeal sarcoma.

TUMOURS OF CNS

WHO classification

E. Tumors of nerve sheath	• Schwannoma (neurilemmoma). • Neurofibroma.
F. Tumors of pineal cells	• Pineoblastoma. • Pineocytoma.
G. Lymphomas	• Primary lymphoma • Secondary lymphoma
H. Malformative tumours	• Craniopharyngioma. • Dermoid cyst. • Colloid cyst.
I. Metastatic tumours	

TUMOURS OF CNS

Gliomas

- **Astrocytoma**
  - Types
    1. Pilocytic astrocytoma (WHO Grade I)
    2. Fibrillary astrocytoma (WHO Grade II)
    3. Anaplastic astrocytoma (WHO Grade III)
    4. Glioblastoma multiforme (WHO Grade IV)
  - Clinically:
    - Seizures (convulsions)
    - Symptoms of ICT (Headache, vomiting, blurred vision)
    - Focal neurological deficit

TUMOURS OF CNS

Gliomas

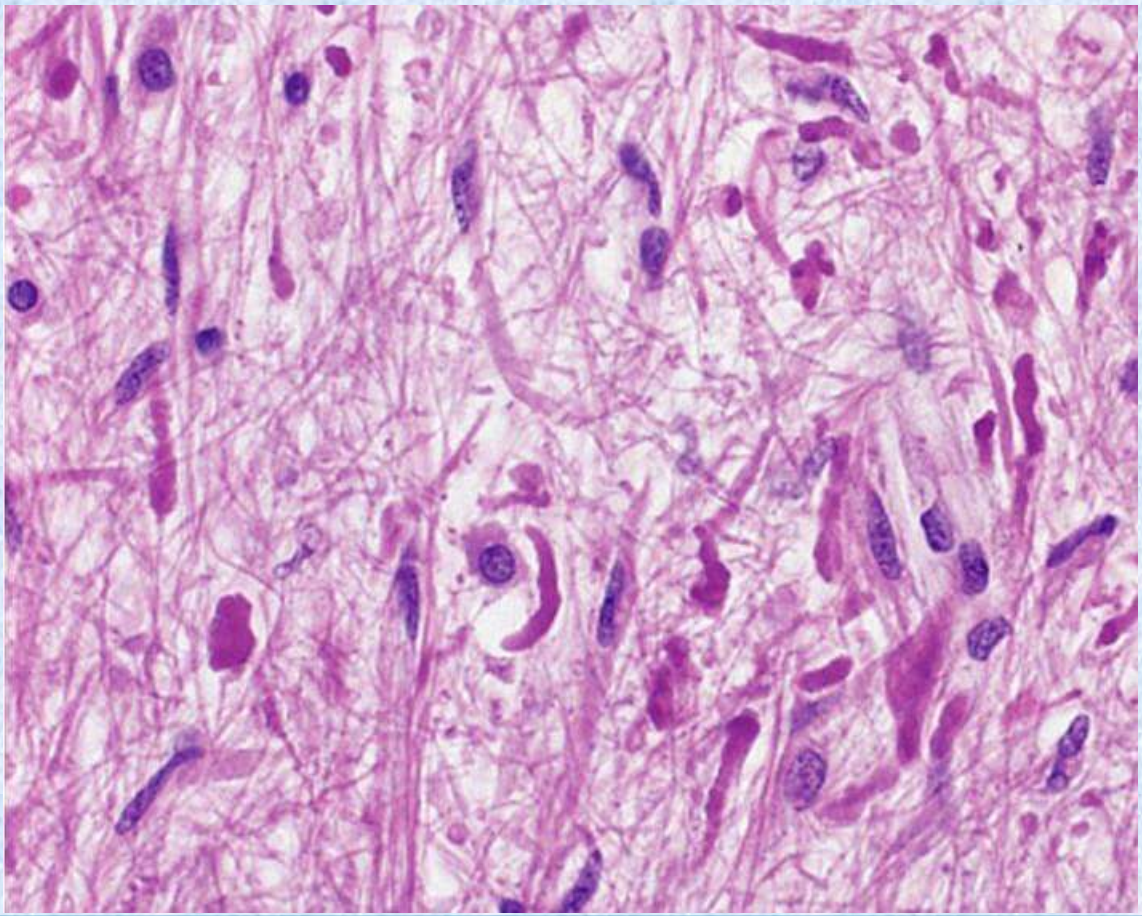
- **Astrocytoma**
  - ***A. Pilocytic astrocytoma (Grade I):***
    - Typically occurs in children and young adults.
    - The common site is the cerebellum.
    - Slowly growing and rarely infiltrative.
    - ***Grossly***: a circumscribed, often cystic tumor confined to a mural nodule in the wall of the cyst.
    - ***Microscopically***: tumor consists of bipolar cells with long, thin processes (hair cell) with no features of malignancy

TUMOURS OF CNS

Gliomas

- **Astrocytoma**

  A. Pilocytic astrocytoma (Grade I):



TUMOURS OF CNS

Gliomas

- **Astrocytoma**

A. Diffuse or fibrillary astrocytoma (Grade II):

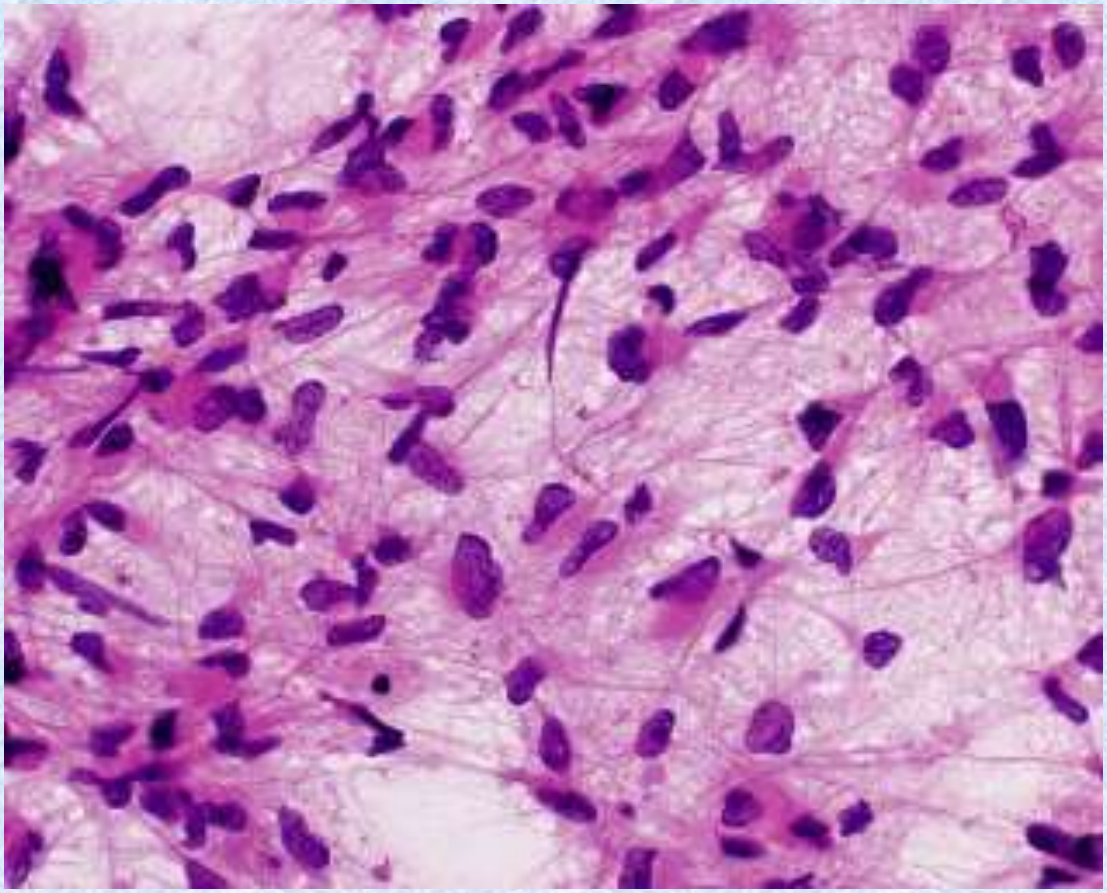
- Represent about 80% of young adult brain tumors.
- Common site is cerebral hemispheres in adults and brain stem in children.
- ***Grossly***: poorly defined, diffuse growth, gray white, infiltrative, expand and distort the brain tissue
- ***Microscopically***:
  - Histologically benign
  - Astroglial cell proliferation in a fibrillary stroma.
  - The nuclei are pleomorphic and hyperchromatic.
  - No mitotic figures.

TUMOURS OF CNS

Gliomas

- **Astrocytoma**

A. Diffuse or fibrillary astrocytoma (Grade II):



TUMOURS OF CNS

Gliomas

- **Astrocytoma**
  - ***A. Anaplastic astrocytoma (Grade III):***
    - An Aggressive tumor
    - Commonly affects adults
    - Site: cerebral hemispheres.
    - ***Microscopically***:
      - high cellularity
      - nuclear anaplasia
      - mitotic activity.

TUMOURS OF CNS

Gliomas

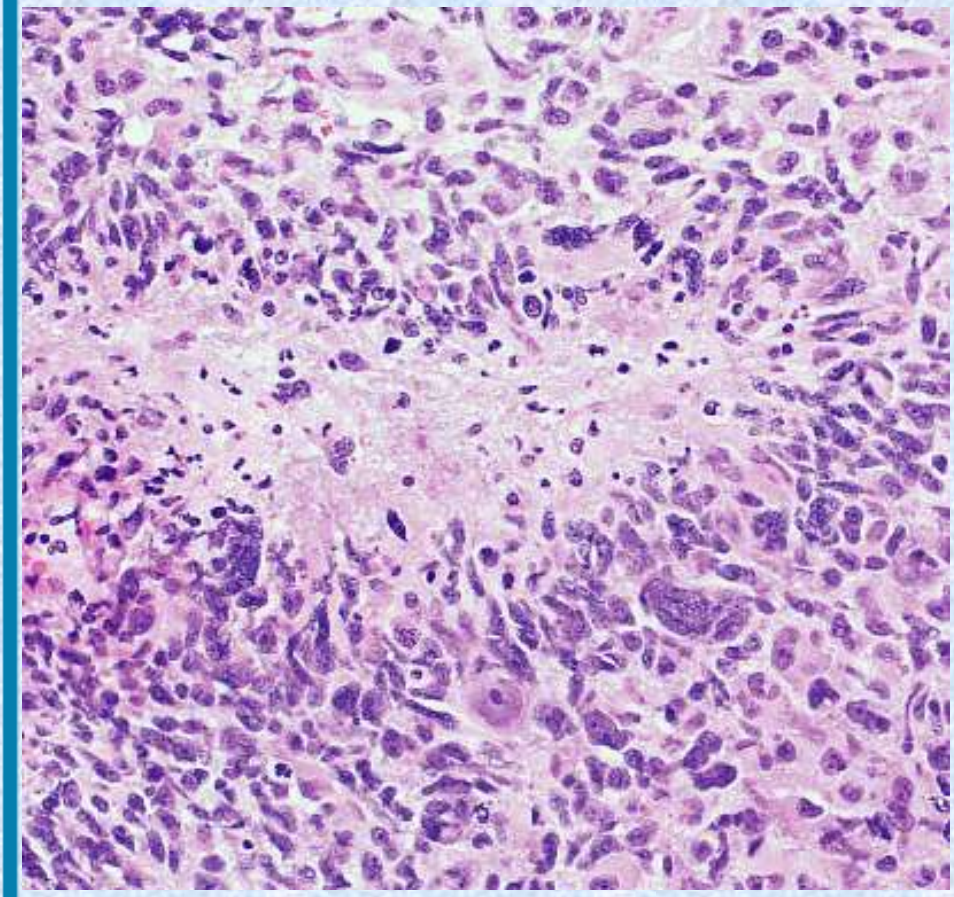
- **Astrocytoma**
  - ***A. Glioblastoma multiformis (Grade IV):***
    - The most malignant astrocytic tumors.
    - Commonly affects adult
    - Site: cerebral hemispheres.
    - ***Grossly***: solitary, butterfly with foci of hemorrhage, necrosis and cyst formation.
    - ***Microscopically***:
      - Highly cellular tumour, with prominent nuclear anaplasia, high mitotic activity and tumor giant cells.
      - Palisade necrosis helps diagnosis

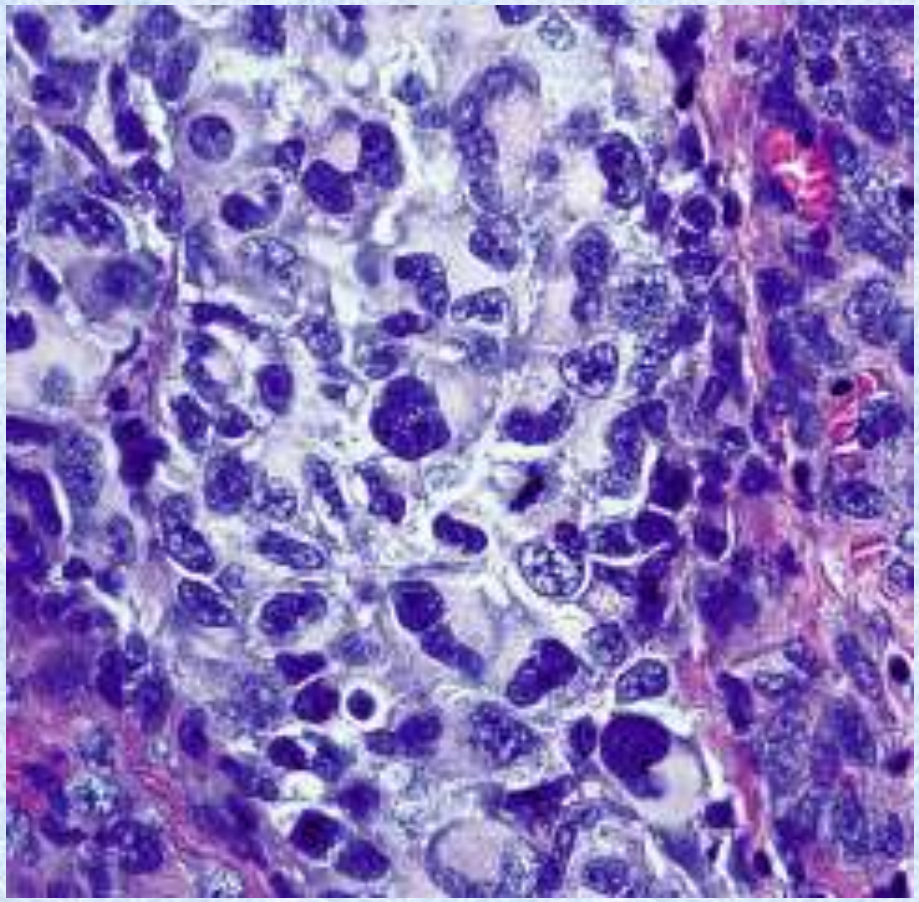
TUMOURS OF CNS

Gliomas

- **Astrocytoma**

A. Glioblastoma multiformis (Grade IV):





TUMOURS OF CNS

Gliomas

- **Astrocytoma**

	Pilocytic	Fibrillary	Anaplastic	Glioblastoma multiformis
Site	Cerebellum	Cerebral hemisphere sand brain stem	Cerebral hemisphere	Cerebral hemisphere and basal ganglia
Age	Children and young adults	Children and young adults	Adults	Adults
Gross	-Well defined nodule -May be cystic	-Poorly-defined -Infiltrative -Gray white	-Poorly-defined -Infiltrative -Gray white	-Poorly-defined -Infiltrative -Soft and firm areas -Hge and necrosis
MP	-Bipolar cells -With thin long processes -No mitosis	-Bipolar cells -Fibrillary stroma -Pleomorphic cells -No mitosis	-High cellularity -Pleomorphism -Mitosis	-High cellularity -Pleomorphism -Frequent mitosis -Giant cells -Necrosis

TUMOURS OF CNS

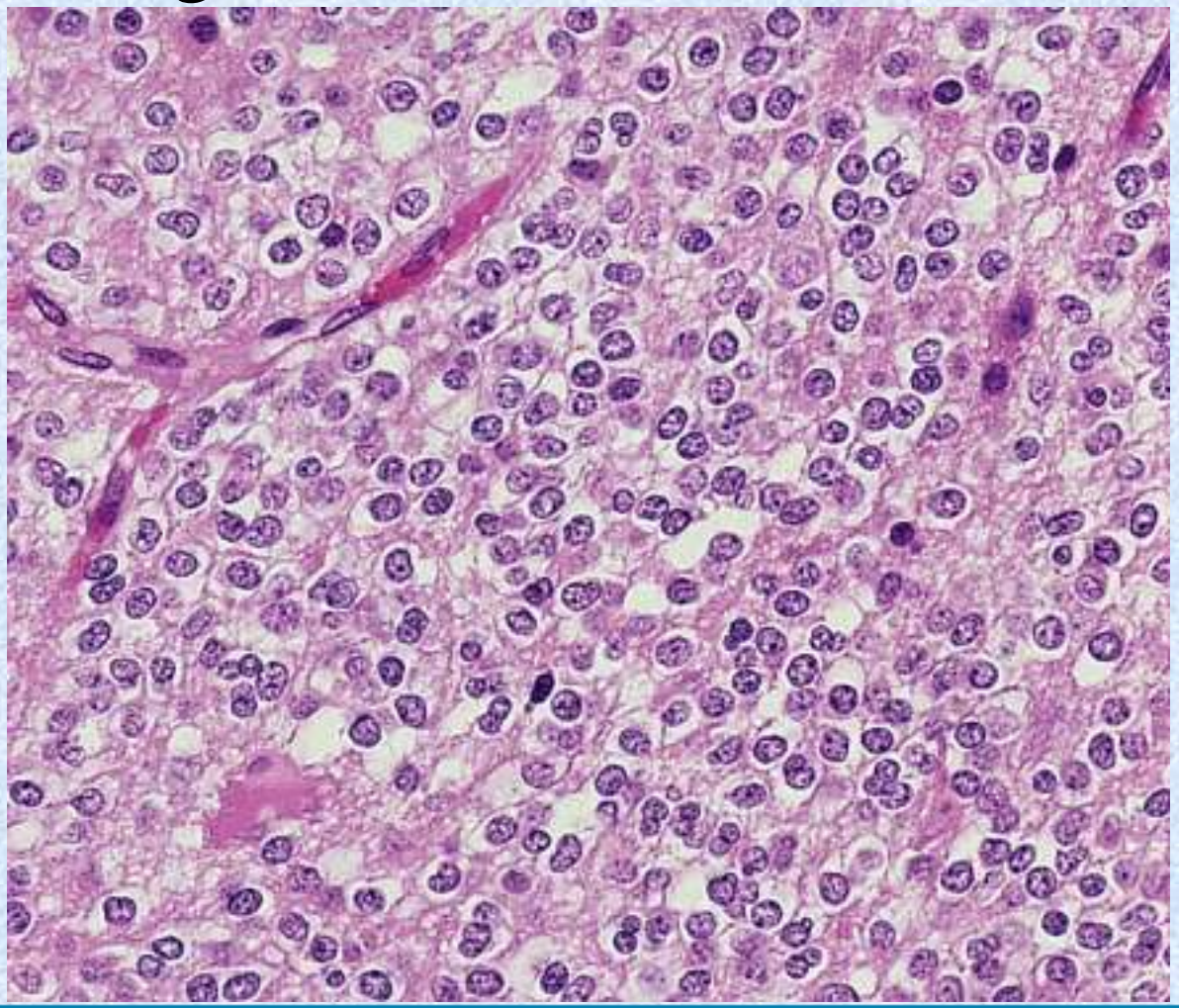
Gliomas

- **Oligodendroglioma**
  - A rare slowly growing tumor (WHO II)
  - Frequent cystic changes and calcification.
  - ***Microscopically***:
    - Sheets of rounded or polygonal cells with small rounded nuclei surrounded by peri-nuclear pale halo.
    - Scanty stroma with numerous thin walled blood vessels.
    - Anaplastic oligodendroglioma (WHO III) shows increased cellularity, mitosis and nuclear atypia

TUMOURS OF CNS

Gliomas

- **Oligodendroglioma**



TUMOURS OF CNS

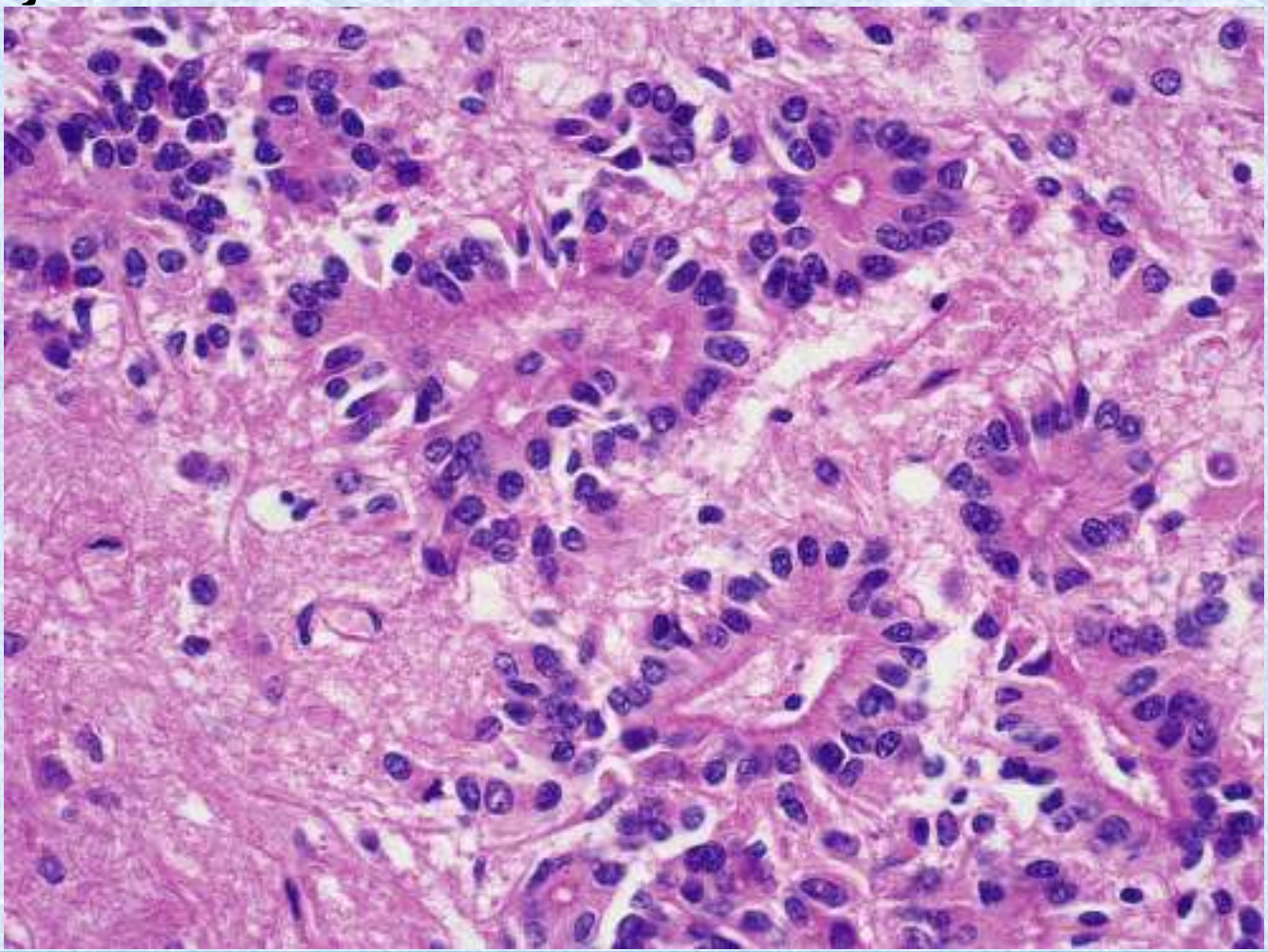
Gliomas

- **Ependymoma**
  - Arises from ependymal lining of the ventricles.
  - Affects children and young adult
  - Associated with hydrocephalus
  - ***Grossly***: gray fleshy mass.
  - ***Microscopically***
    - Cellular tumour.
    - Tumor cells have regular round to oval nuclei with abundant granular chromatin.
    - Cytoplasmic processes of tumor cells condense around blood vessels to form pseudo-rosettes, or around central lumen to form rosettes (diagnostic).

TUMOURS OF CNS

Gliomas

- **Ependymoma**



TUMOURS OF CNS

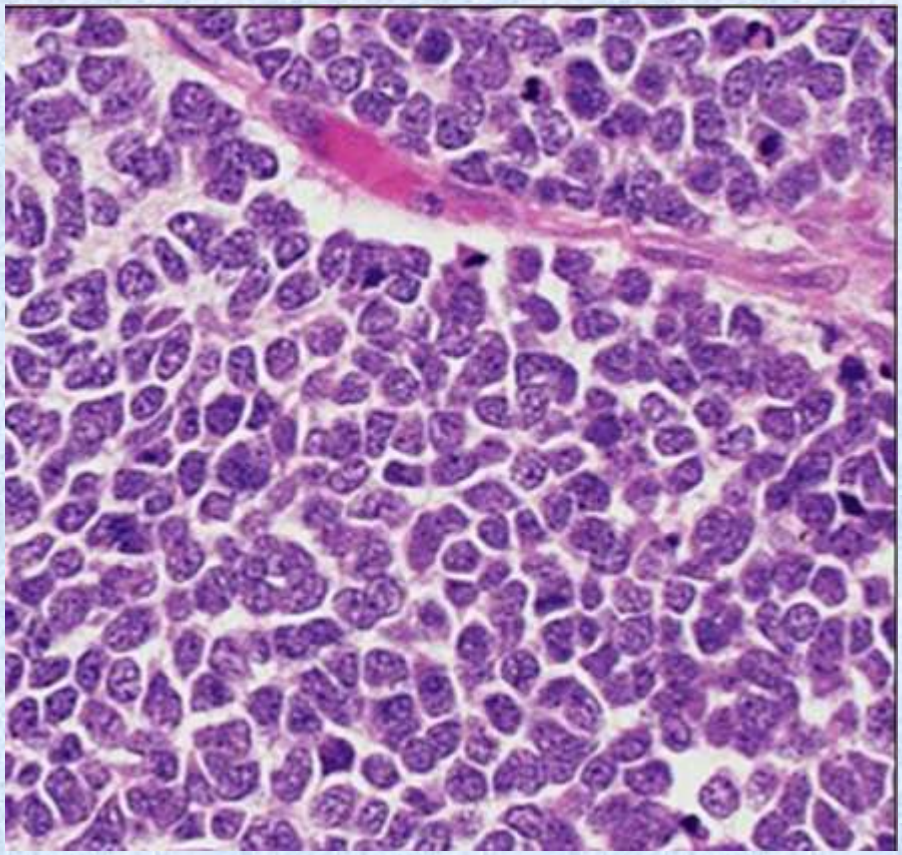
Tumors of primitive undifferentiated cells

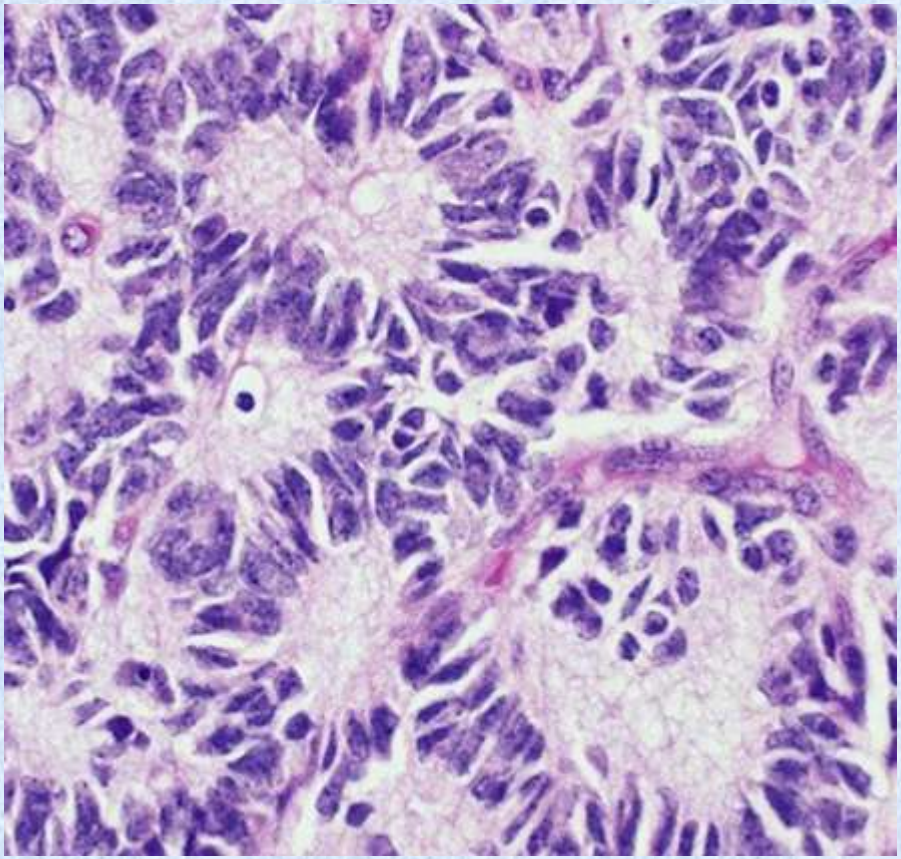
- **Medulloblastoma**
  - One of blastomas that affect children
  - Rapidly growing malignant neoplasm (WHO grade IV)
  - Site: commonly cerebellum
  - ***Grossly***:
    - Fleshy grayish pink mass projecting into lumen of fourth ventricle and obstructing the pathway of the C.S.F.
    - The tumor disseminates through the C.S.F.
    - The cut surface shows hemorrhage and necrosis.
  - ***Microscopically:***
    - Cellular tumor with scanty cytoplasm and small round or oval hyperchromatic nuclei.
    - Tumours cells may arrange in pseudo-rosettes around blood vessels.

TUMOURS OF CNS

Tumors of primitive undifferentiated cells

- **Medulloblastoma**





TUMOURS OF CNS

Tumors of meninges

- **Meningioma**
  - **Origin**: arising from the meningothelial cells of the arachnoid
  - **Behaviour**: commonly benign tumor, but can be malignant
  - **Age**: The tumor occurs in adults.
  - **Site**: in relation to the superior sagittal sinus or at base of the brain.
  - **Gross Picture**:
    - Variable sized round or oval capsulated tumor attached to the under surface of the dura.
    - Firm in consistency.
    - Cut surface is greyish white and shows whorly appearance.

TUMOURS OF CNS

Tumors of meninges

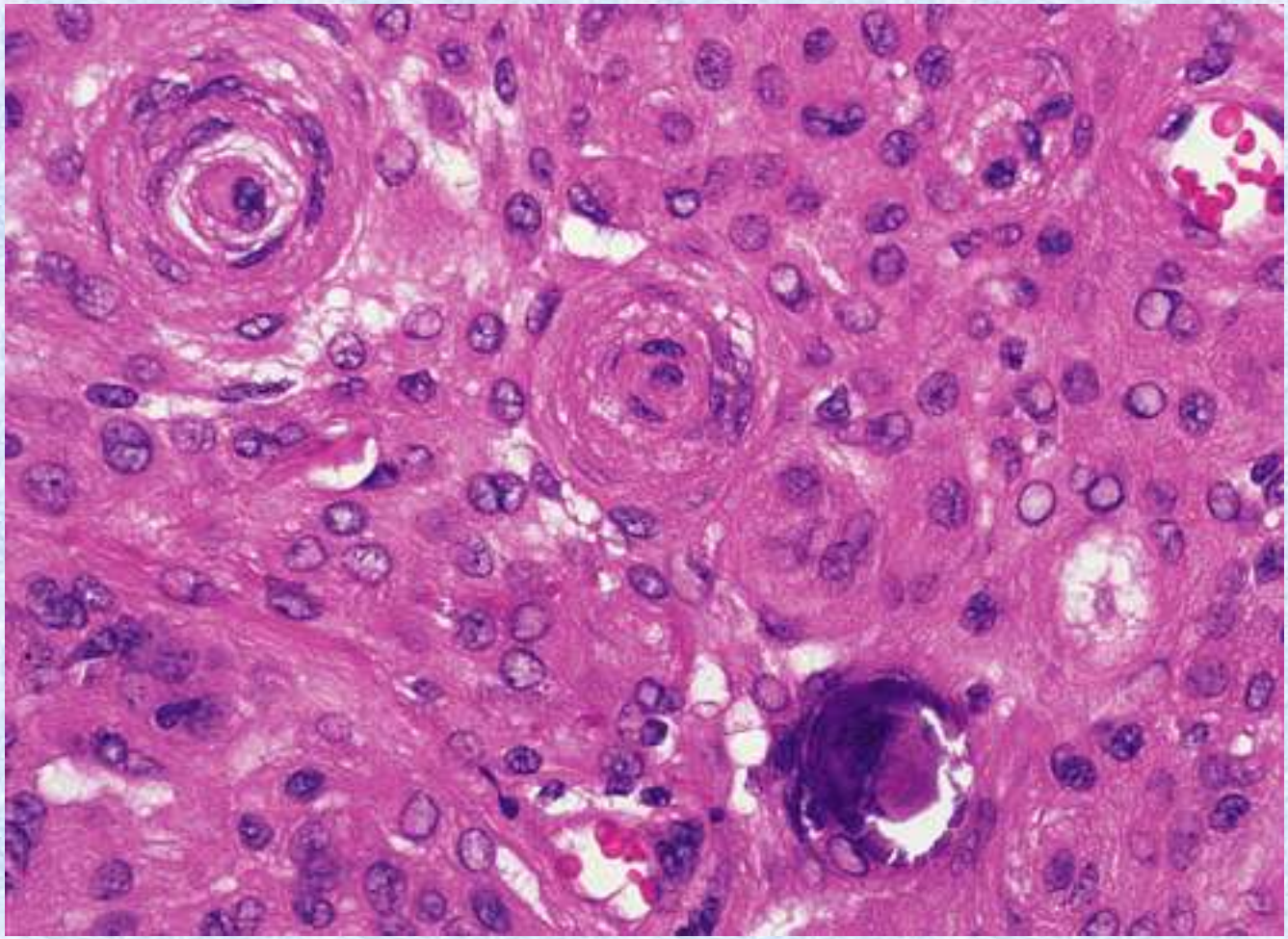
- **Meningioma**
  - **<u>Microscopic Picture</u>**:
    - Groups of large round or oval cells separated by variable amount of stroma
    - The cells arrange concentrically into rings or whorls (diagnostic)
    - The cells have indistinct cell borders, eosinophilic cytoplasm and small round or oval nuclei…..syncytial appearance
    - The central cells undergo hyalinosis and calcification, psammoma bodies (diagnostic).
    - Microscopic variants:

      1-Psammomatous 2-Fibroblastic
      3-Meningiothelial 4-Papillary
      4-Angiomatous

TUMOURS OF CNS

Tumors of meninges

- **Meningioma**



TUMOURS OF CNS

Metastatic tumors of CNS

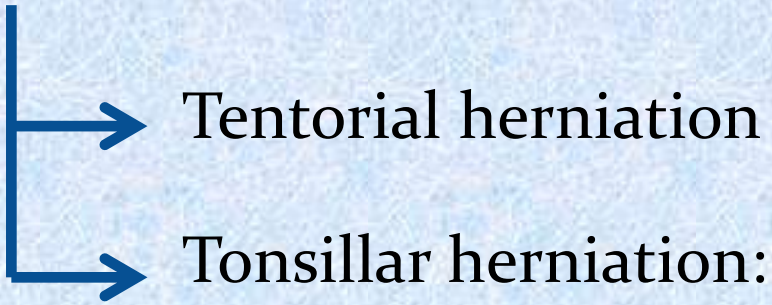
- Represents up to 30% of all intracranial tumors.
- They reach the nervous system by the blood stream:
  - Through the systemic arteries
  - Through para-vertebral system of veins.
- Common origin:
  1. Carcinomas of the bronchi (commonest), breast, kidney, uterus and placenta.
  2. Sarcomas.
  3. Leukemias and lymphomas.
- Grossly:
  - Multiple variable sized deposits in both hemispheres
- Microscopically:
  - Same like microscopic picture of the primary tumour

INCREASED ICT

- **Aetiology**
  - Intracranial tumours (**mention**)
  - Intracranial inflammation:
    - Acute: -Suppurative: as septic meningitis
      -Non-suppurative: as viral meningitis
    - Chronic: -Non-specific: as chronic abscess
      -Specific: as TB, Gumma of syphilis
  - Intracranial vascular disorders (**mention**)
  - Hydrocephalus
- **Symptoms:**
  - Persistent headache
  - Vomiting
  - Blurred vision

INCREASED ICT

- **Effects**
  1. Flattened brain convolution on the same side of the lesion
  2. Shift of midline structures to the opposite side
  3. Papillaedema: due to compression of retinal veins in the sub-arachenoid space
  4. Skull changes: as thining of skull bone over the lesion (in chronic cases)
  5. Intracranial herniation:



INCREASED ICT

- **Effects**

Tentorial herniation:

- Herniation of the cerebrum through tentorium cerebelli
- Occurs when the space occupying lesion is located above tentorium cerebelli
- Effects:

a. Compression of midbrain and aquiduct of Sylvious → Hydrocephalus
b. Compression of 4th and 6th cranial nerves → distorted eye movement
c. Compression of posterior cerebral artery → posterior cerebral infarction

Tonsillar herniation:

- Herniation of the brain stem through foramen magnum
  - Compression of medulla oblongata → compress respiratory center

Thank you

Good luck

Dr Ahmed Roshdi