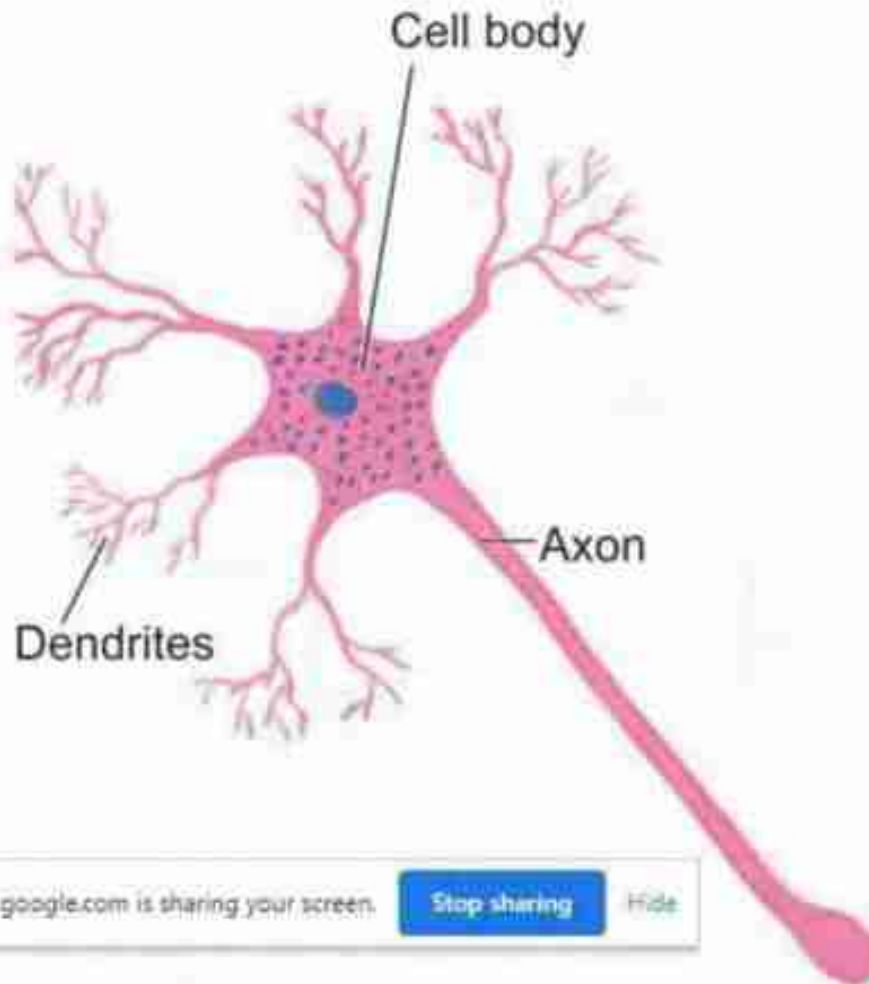


Pathology of central nervous system

NORMAL CELLS

Neuroectodermal – Neurons



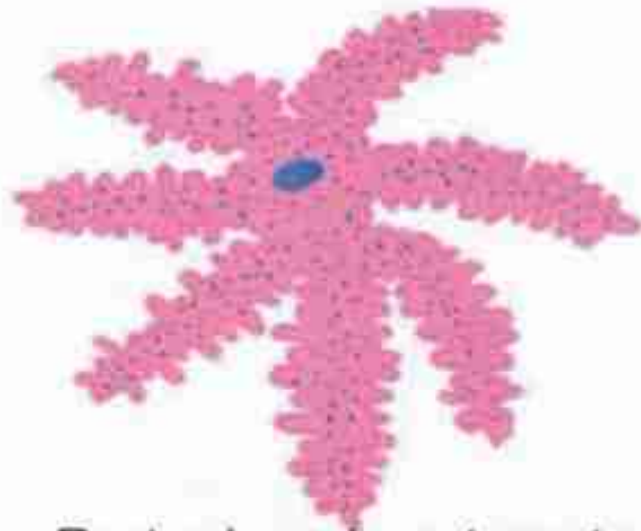
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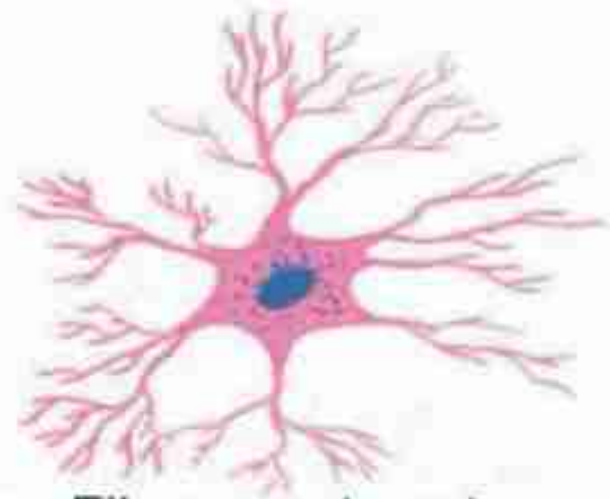
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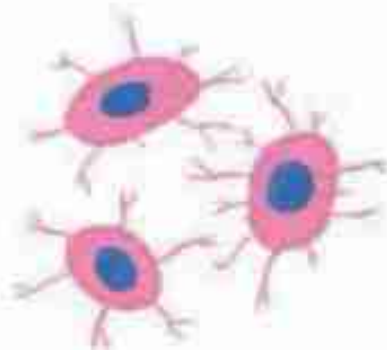
- Neuroglia- astrocytes
Oligodendrocytes
Ependymal cells



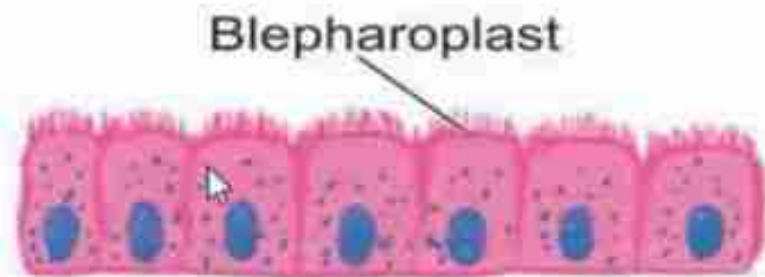
Protoplasmic astrocyte



Fibrous astrocyte



Oligodendrocytes

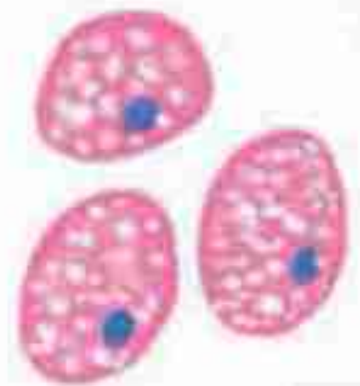


Ependymal cells

- Mesodermal cells- Microglia
- Dura mater
- Pia- arachnoid –leptomeninges



Microglial cells



Glial cells

I.-Developmental anomalies

- Spina bifida
- Meningocele
- Meningomyelocele

II-Hydrocephalus (Primary & Secondary)

- Increased volume of CSF
- Accompanied by dilatation of the ventricles.
- Majority -increased intracranial pressure - *internal hydrocephalus*.
- A localised collection of CSF in the subarachnoid space - *external hydrocephalus*.

Mechanisms – primary hydrocephalus

- *Obstruction to flow – M.C.
- *Increased production
- *Decreased reabsorption

Non-communicating hydrocephalus

- Site of obstruction of CSF pathway - third ventricle or at the exit foramina in the fourth ventricle
- ventricular system enlarges and CSF cannot pass into the subarachnoid space.

Communicating hydrocephalus

- Obstruction to the flow of CSF - subarachnoid space at the base of the brain
- Enlargement of the ventricular system
- CSF flows freely between dilated ventricles and the spinal canal

SECONDARY HYDROCEPHALUS

- Much less common
- Defined as compensatory increase of CSF due to loss of neural tissue without associated rise in intracranial pressure (normal pressure hydrocephalus)
- e.g. cerebral atrophy and infarction.

Increased CSF volume

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graph TD; A[Increased CSF volume] --> B[Increased CSF pressure]; B --> C[Decreased perfusion]; B --> D[Herniation];
```

Increased CSF pressure

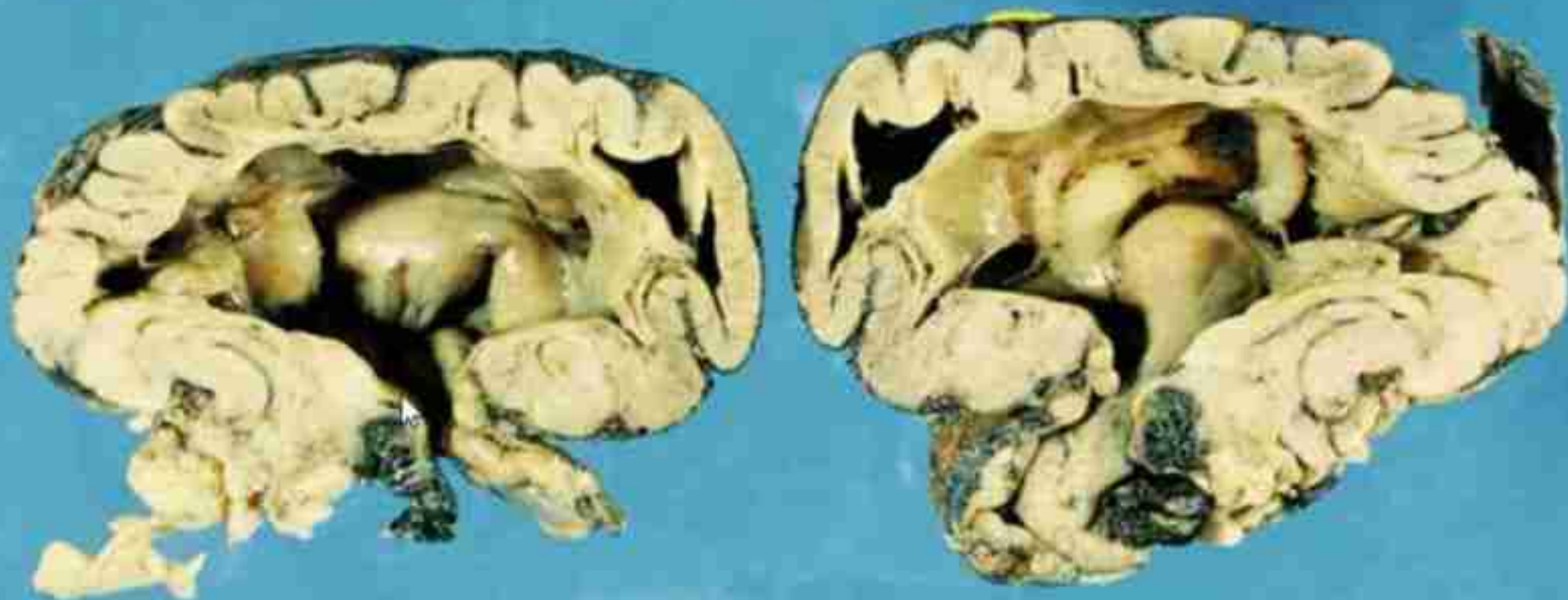
Decreased perfusion

Herniation

- Infant before closure of sutures—increased head circumference (HC)
- Older children & adults – expansion of ventricles & increased intracranial pressure - HC normal

Morphology

Dilated ventricles, thinning & stretching of brain



III -Infections

- Routes : Blood stream
Direct implantation
Local spread
Through nerves



Patterns:

- Meningitis
- Encephalitis
- Meningo encephalitis

Linker Case – Integrated Block - Meningitis

- An 18-year-old student presented to accident and emergency department for the third time in 3 days. She gave a history of gradually increasing frontal headaches that over the past 4 days had become unbearable and associated with fever and chills. She had vomited once, and had some mild neck pain and photophobia. Three weeks earlier she had returned from West Bengal, where she had undertaken voluntary work in an orphanage. She had travelled to Kolkata and a small rural area near it. She was bitten relentlessly by flying insects, but not ticks and had no history of animal bites or freshwater contact. She was well while in West Bengal, other than a brief episode of diarrhea. Her travelling companions and her family were all well.

On examination she appeared unwell. Her vital signs showed a temperature of 37.4°C, blood pressure of 105/70 mm Hg, pulse 100 bpm and oxygen saturation of 100% on air. She had marked photophobia and moderate neck stiffness, but Kernig's sign was negative. She had no rash, and on full examination no other external signs of disease.

- What are the CSF findings in:
- Acute pyogenic meningitis
- Acute lymphocytic meningitis
- Chronic meningitis

Meningitis (Leptomeningitis)

- A/c pyogenic
- A/c lymphocytic
- Chronic

Table 28.1

CSF findings in health and vari

FEATURE		NORMAL
1.	<i>Naked eye appearance</i>	Clear and colourless
2.	<i>CSF pressure</i>	60-150 mm water
3.	<i>Cells</i>	0-4 lymphocytes/ μ l
4.	<i>Proteins</i>	15-45 mg/dl
5.	<i>Glucose</i>	50-80 mg/dl
6.	<i>Bacteriology</i>	Sterile

A/c pyogenic (Purulent) meningitis

- Causative organism – vary with age
 - newborns – E.coli
 - H.influenzae – 3 months to 3 years
 - older – Streptococcus pneumoniae, Neisseria meningitides
 - Routes : Blood, local, Iatrogenic
- Pathology** : Pus in subarachnoid space
CSF findings/ Clinical

- Naked eye appearance of **cloudy or frankly purulent CSF**.
- **Elevated** CSF pressure (above 180 mm water).
- **Polymorphonuclear neutrophilic leucocytosis** in CSF (between 10 -10,000/ μ l).
- **Raised CSF protein level** (higher than 50 mg/dl).
- **Decreased** CSF sugar concentration (lower than 40 mg/dl).
- Bacteriologic examination by Gram's stain or by CSF culture reveals causative organism.

A



B



Acute Lymphocytic (Viral, Aseptic) Meningitis

- Children and young adults
 - Enteroviruses
 - Mumps
 - ECHO viruses
 - coxsackie virus
 - Epstein-Barr virus
 - herpes simplex virus-2
 - arthropode-borne viruses
 - HIV

- ***Grossly*** - swelling of the brain
 - no distinctive change.
- ***Microscopically,***
 - Mild lymphocytic infiltrate in the leptomeninges.



- Naked eye appearance of **clear** or slightly turbid CSF.
- CSF pressure **increased** (above 250 mm water).
- **Lymphocytosis** in CSF (10-100 cells/ μ l).
- CSF protein usually **normal or mildly raised**.
- CSF sugar concentration usually **normal**.
- CSF bacteriologically **sterile**.

Chronic meningitis

- Tuberculous
- Cryptococcal

Tuberculous meningitis

- Children and adults
- Haematogenous spread of infection from tuberculosis elsewhere in the body
- Manifestation of miliary tuberculosis.
- Less commonly, the spread may occur directly from tuberculosis of a vertebral body

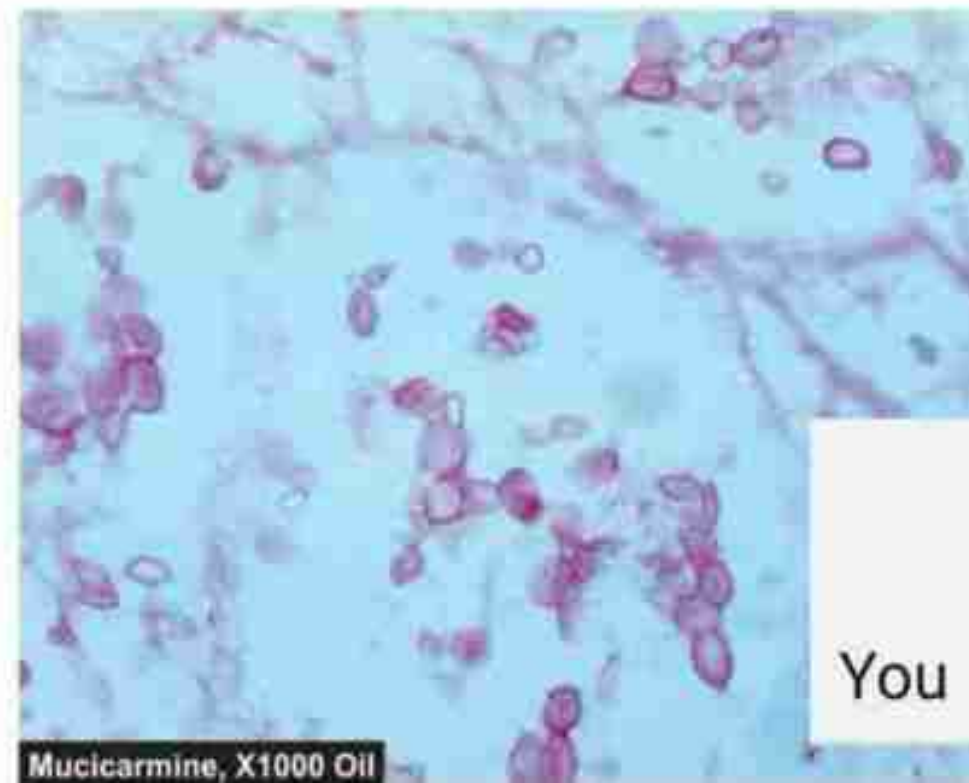


- ***Grossly*** - the subarachnoid space contains thick exudate, particularly abundant in the sulci and the base of the brain.
- Tubercles, 1-2 mm in diameter, may be visible, especially adjacent to the blood vessels
- ***Microscopically*** - exudate of acute and chronic inflammatory cells, and granulomas with or without caseation necrosis and giant cells

Cryptococcal meningitis

- Debilitated or immunocompromised persons
- Haematogenous dissemination from a pulmonary lesion.
- Important cause of meningitis in patients with AIDS.

- The exudate in cryptococcal meningitis is scanty, translucent and gelatinous
- characterised by infiltration by lymphocytes, plasma cells, an occasional granuloma and abundant characteristic capsulated cryptococci.



CSF findings in chronic meningitis

- Naked eye appearance of a clear or slightly turbid CSF which may form fibrin web on standing.
- Raised CSF pressure (above 300 mm water).
- Mononuclear leucocytosis consisting mostly of lymphocytes and some macrophages (100-1000 cells/ μ l).
- Raised protein content.
- Lowered glucose concentration.

ACUTE PYOGENIC (BACTERIAL) MENINGITIS	ACUTE LYMPHOCYTIC (VIRAL) MENINGITIS	CHRONIC (TUBERCULOUS) MENINGITIS
Cloudy or frankly purulent	Clear or slightly turbid	Clear or slightly turbid, forms fibrin coagulum on standing
Elevated (above 180 mm water)	Elevated (above 250 mm water)	Elevated (above 300 mm water)
10-10,000 neutrophils/ μ l	10-100 lymphocytes/ μ l	100-1000 lymphocytes/ μ l
Markedly raised	Mildly raised	Raised
Markedly reduced	Normal	Reduced
Causative organisms present	Sterile	Tubercle bacilli present