



- **Important terms:**

- **Meningitis:** it is inflammation of meninges (coverings of the central nervous system) caused by infection. They are classified to:
  - ✓ Pachymeningitis: involving the dura matter.
  - ✓ Leptomeningitis: involving the pia matter + arachenoid matter.
- **Encephalitis or myelitis:** these are infections of cerebral and spinal parenchyma
- **Meningoencephalitis:** infection of both meninges and brain parenchyma.

- **Causes and routes of infection in meningitis:**

- **Direct:** this happens when there is otitis media or infection of the mastoid sinus.
- **Indirect:** bloodborne infections and septicemia from infections elsewhere.
- **Neurosurgical settings:** shunt infection, head injury, CSF leak and postoperative.
- **Meningeal carcinomatosis/ lymphomatosis.**
- **Ruptured dermoid/ teratoma-chemical irritants.**

- **Infectious meningitis can be:**

- **Acute (pyogenic: producing pus):** bacterial.
- **Acute (aseptic):** viral.
- **Chronic:** TB, cyptococcal and spirochetel infections.  
Note: infectious causes can be bacterial, viral, fungal or protozoal.

- **Acute bacterial/ pyogenic meningitis:**

- It is the **commonest** type of meningitis.
- **Organism which are causing pyogenic meningitis in relation to age:**

ORGANISM	PEAK AGE INCIDENCE	GRAM STAIN
Escherichia coli	Neonates	Gram negative rods
Hemophilus influenzae	Infants and Children	Gram negative coccobacilli
Neisseria meningitidis	Adolescents and Young adults	Gram negative diplococci
Streptococcus pneumoniae	Older adults or Children	Gram positive cocci in chains

- **Morphology:**

- ✓ Gross:

- ❖ Engorged vessels.
    - ❖ *Exudates in:*

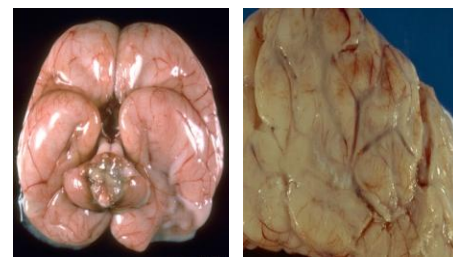
- ✚ Parasagittal areas.
      - ✚ Sylvian fissure (lateral fissure).
      - ✚ Between peduncles.
      - ✚ Cisterns.

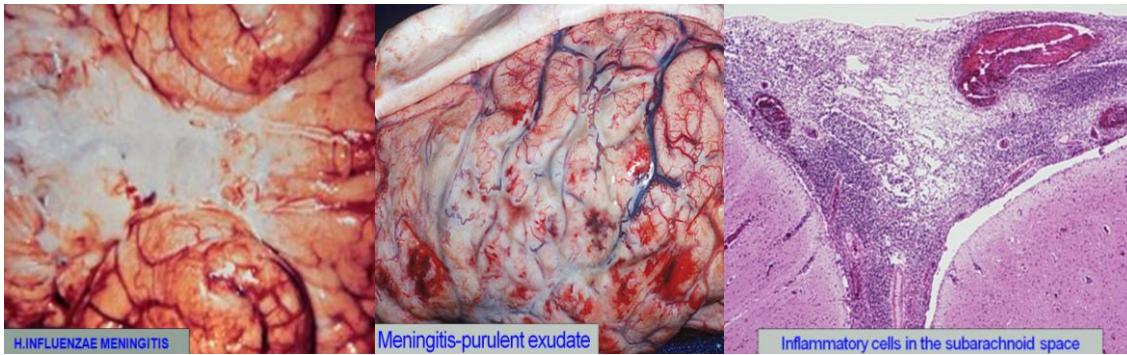
**Note:** this exudates is producing yellow-tan clouding of meninges.

Location of exudates differs:

- H.influenzae: basal exudates.
- S.pneumoniae: in cerebral convexities.
- Fulminant cases: ventricles+adjacent brain parenchyma.
- Untreated cases: leptomeningeal fibrosis & hydrocephalus.

- ❖ Inflammation usually does not extend to the brain.





- **The results of inflammation are:**

- ✓ Tissue and vascular injury (vasculitis): caused by lysosomal enzymes and free radicals released by granulocytes and monocytes.
  - ❖ Vasculitis will cause → infarcts.
- ✓ Increased intracranial pressure: due to increased vascular permeability + leakage of CSF and proteins in the interstitial space (cerebral edema).
  - ❖ Increased intracranial pressure causes → hypoxic-ischemic encephalopathy.

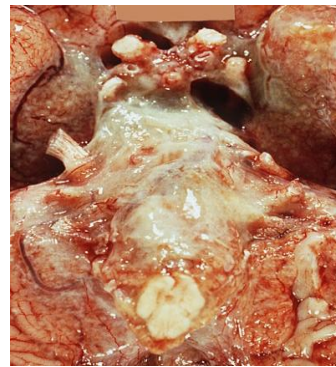
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- **Tuberculous meningitis:**

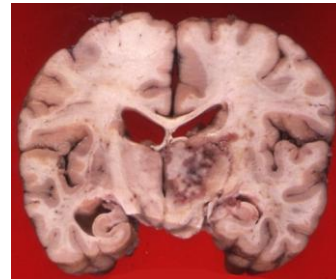
- **Spread:** hematogenous.
- **Tuberculoma.**
- **Pott's disease of spine.**
- **Hydrocephalus is the common complication.**
- **Morphology:**

- ✓ Gross:

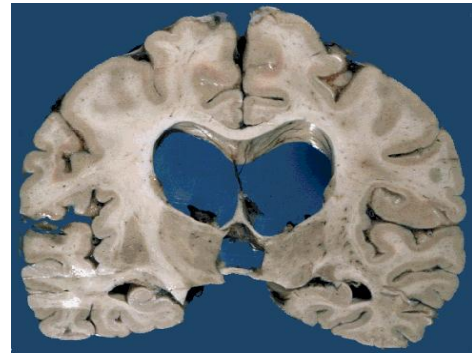
- ❖ *Thick exudate (see the image below):* it is difficult to see the vessels at the base of the brain because of overlying meningeal inflammation and fibrosis.



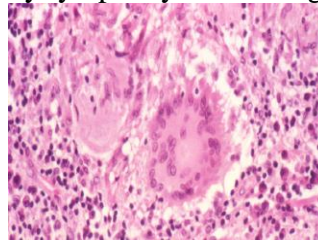
- ❖ *Tuberculoma (see the image below):* it is close to the ventricles causing pressure which will increase intracranial pressure and result in hydrocephalus.



- ❖ *Images below:* granuloma causing increased pressure on the spinal cord (left) complete dilatation of ventricles as a result of hydrocephalus.

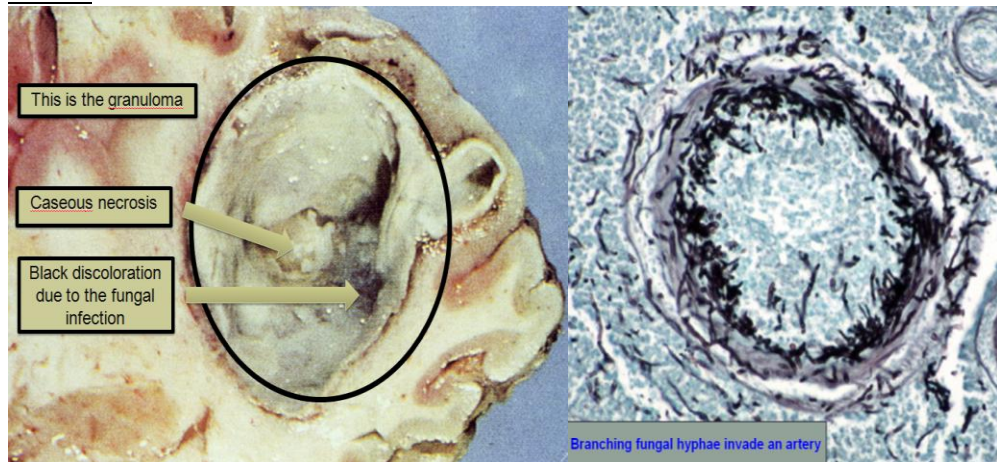
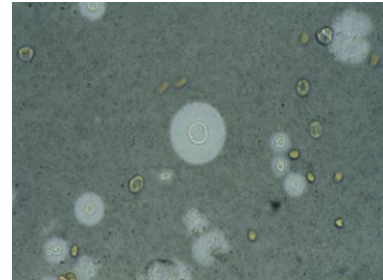


- ✓ Microscopically:
  - ❖ *TB granuloma*: epithelioid granuloma composed of epithelioid histiocytes surrounded by lymphocytes and Laghan's giant cells.



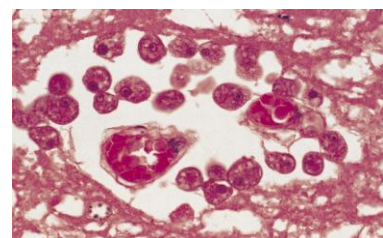
- Fungal meningitis:

- **Mostly occurring in:** immunocompromised hosts.
- **Causative organisms are:**
  - ✓ Aspergillosis.
  - ✓ Mucormycosis.
  - ✓ Cryptococcosis: encapsulated spheres (5-15 micrometers in diameter) seen in CSF in india ink stain.
- **What happens in this disease?**
  - ✓ Granulomatous meningitis: with caseous necrosis and black discoloration due to fungal infection.
  - ✓ Blood vessels develop endarteritis obliterans leading to infarction in parenchyma: there will be branching fungal hyphae invading arteries.
- **Morphology:**
  - ✓ Gross:



- Protozoal meningitis (amoebic meningoencephalitis):

- Naegleria.
- Acanthamoeba (see the image).
- Entry through cribriform plate from water.



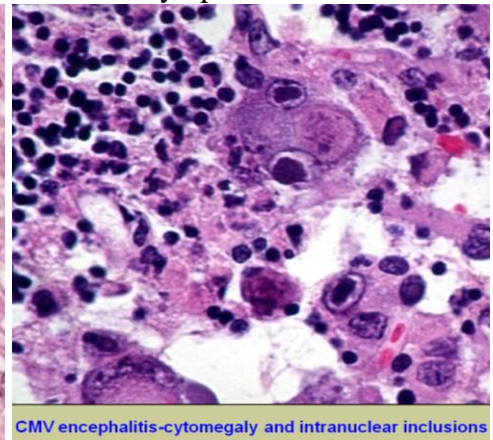


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- **Viral meningitis (also known as aseptic meningitis because bacteria are not present):**

- **Viruses reach the central nervous system through:**
  - ✓ Bloodstream.
  - ✓ Along nerves.
- **Common viruses which might lead to viral meningitis are:**
  - ✓ HIV
  - ✓ Polio
  - ✓ Herpes
  - ✓ Rabies
  - ✓ Cytomegalovirus (CMV).
- **Morphology:**
  - ✓ Microscopically:
    - ❖ Lymphocytes + macrophages: especially around blood vessels.
    - ❖ Formation of microglial nodules.
    - ❖ Individual cells necrosis to diffuse brain necrosis.
    - ❖ Certain viruses cause intranuclear and intracytoplasmic inclusions.



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- **Complications of meningitis:**

- **Acute:**
  - ✓ Papilledema: due to hydrocephalus.
  - ✓ Involvement of cranial nerves (especially optic and vestibulocochlear).
  - ✓ Raised intracranial pressure.
  - ✓ Inappropriate ADH secretion.
  - ✓ Seizures.
- **Subacute:**
  - ✓ Cerebral abscess:
    - ❖ Localized area of suppurative inflammation in the brain substance.
    - ❖ The cavity contains thick pus formed from necrotic, liquefied brain tissue and large numbers of neutrophils and is surrounded by a fibroglial wall.
    - ❖ The location of the abscess corresponds to its source.
  - ✓ Subdural hygroma.
  - ✓ Seizures.
- **Long-term:**
  - ✓ Deafness.
  - ✓ Blindness.
  - ✓ Hydrocephalus.
  - ✓ Epilepsy.
  - ✓ Cognitive impairment.
  - ✓ Physical handicap.

- Cerebral abscess:

