Meningitis

Pathology

CNS Infections

- Portals of entry of infection into the CNS:
  - *Hematogenous spread*
    - the most common
  - *Direct implantation*
    - traumatic or in congenital CNS malformation
  - *Local extension*
    - occurs secondary to an established infection in a near by organ (air sinus, an infected tooth or middle ear)
  - Through the *peripheral nervous system into the CNS*
    - certain viruses, such as rabies and herpes zoster.

CNS Infections

Meningitis

An inflammatory process of the leptomeninges and CSF within the subarachnoid space.

→ *Meningoencephalitis?*

CNS Infections

Pyogenic meningitis

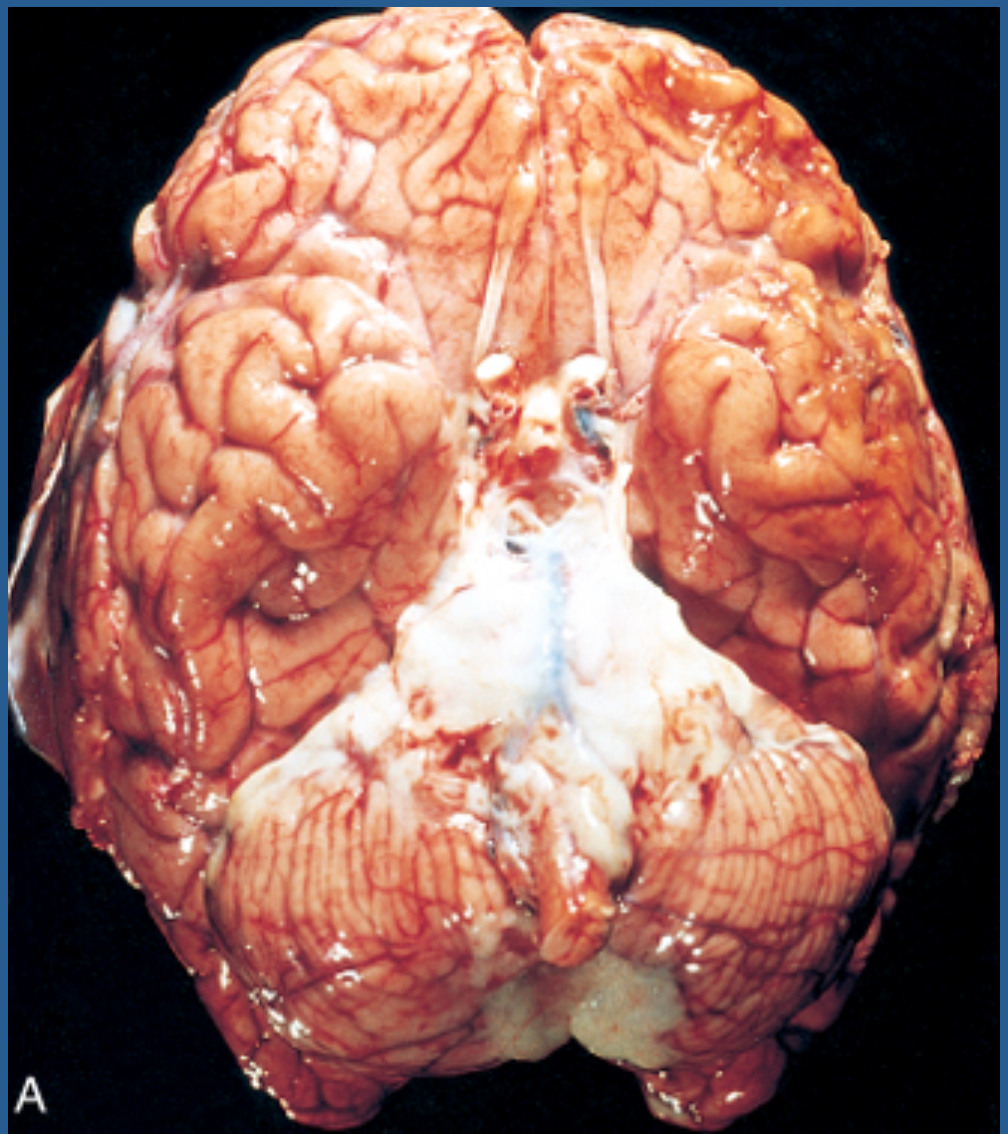
- Medical emergency
- The causative microorganisms (2013 Robbins):
  - **Neonates** : *Escherichia coli* and group B streptococci
  - **Adolescents and young adults:** *Neisseria meningitidis* (Meningococcal meningitis)
  - **Elderly:** listeria monocytogenes and *Streptococcus pneumoniae*

CNS Infections

Pyogenic meningitis

- **CSF Findings in spinal tap:**
  - cloudy or frankly purulent CSF
  - as many as 90,000 neutrophils /mm
  - raised protein level
  - markedly reduced glucose content
  - bacteria may be seen on a Gram stained smear or can be cultured, sometimes a few hours before the neutrophils appear

Acute meningitis

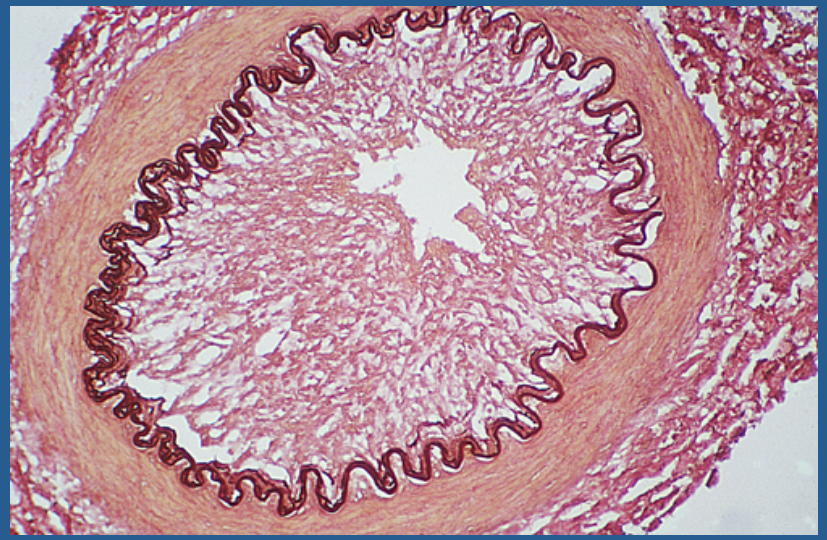


CNS Infections
Meningitis Clinical Features

- Systemic non-specific signs of infection
- Meningeal irritation signs and neurologic impairment:
  - Headache, photophobia, irritability, clouding of consciousness and neck stiffness
- Untreated, pyogenic meningitis can be fatal
- Effective antimicrobial agents markedly reduce mortality associated with meningitis

CNS Infections
Meningitis Complications

- Phlebitis may → venous occlusion → hemorrhagic infarction of the underlying brain
- Leptomeningeal fibrosis → hydrocephalus
- Septicemia → hemorrhagic infarction of the adrenal glands and cutaneous petechiae (known as Waterhouse-Friderichsen syndrome, particularly common with meningococcal and pneumococcal meningitis)
- Focal cerebritis & seizures
- Cerebral abscess
- Cognitive deficit
- Deafness



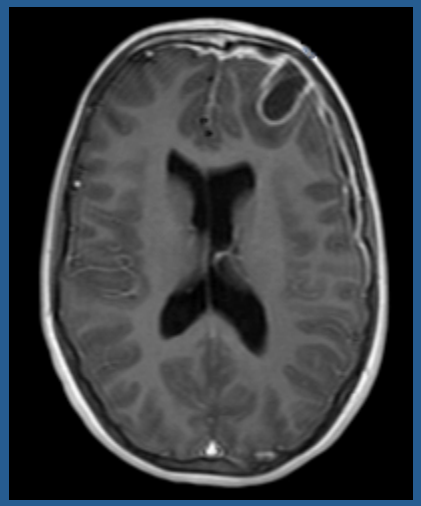
What is this complication →

CNS Infections
Brain abscess

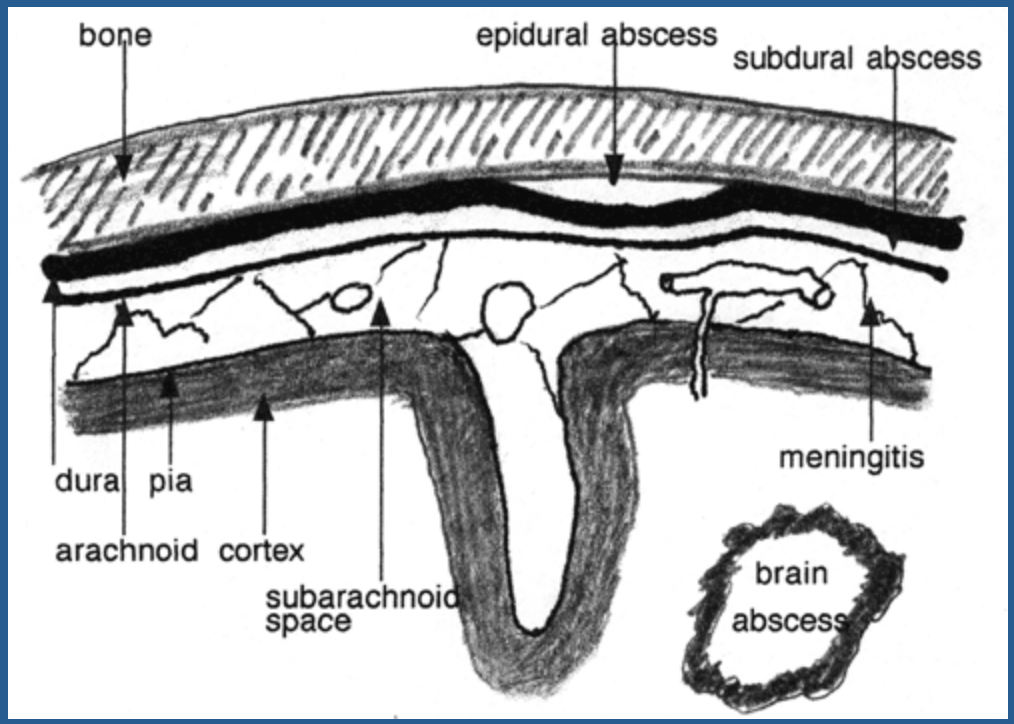
- Streptococci and staphylococci are the most common organisms identified in non-immunosuppressed populations
- Predisposing conditions:
  - Acute bacterial endocarditis (usually give multiple microabscesses)
  - Cyanotic congenital heart disease in which there is a right-to-left shunt
  - Loss of pulmonary filtration of organisms (e.g, bronchiectasis)
- Most common on cerebral hemispheres

CNS Infections
Brain abscess

- Morphologically,
  - Liquefactive necrosis
  - The surrounding brain is edematous , congested & contains reactive astrocytes & perivascular inflammatory cells
- Present clinically with progressive focal neurologic deficits in addition to the general signs of raised intracranial pressure
- The CSF
  - Contains only scanty cells
  - ↑ protein
  - Normal level of glucose
- Complications of Brain abscess:
  - Herniation
  - Rupture of abscess into subarachnoid space or ventricle



Subdural empyema (enhancing) and brain abscess in a patient with sinusitis.



Epidural and Subdural Infections

- These spaces can be involved with bacterial or fungal infections, usually as a consequence of direct local spread
- Epidural abscess, commonly associated with osteomyelitis, arises from an adjacent focus of infection, such as sinusitis or a surgical procedure
- When the process occurs in the spinal epidural space, it may cause spinal cord compression and constitute a neurosurgical emergency

Empyema

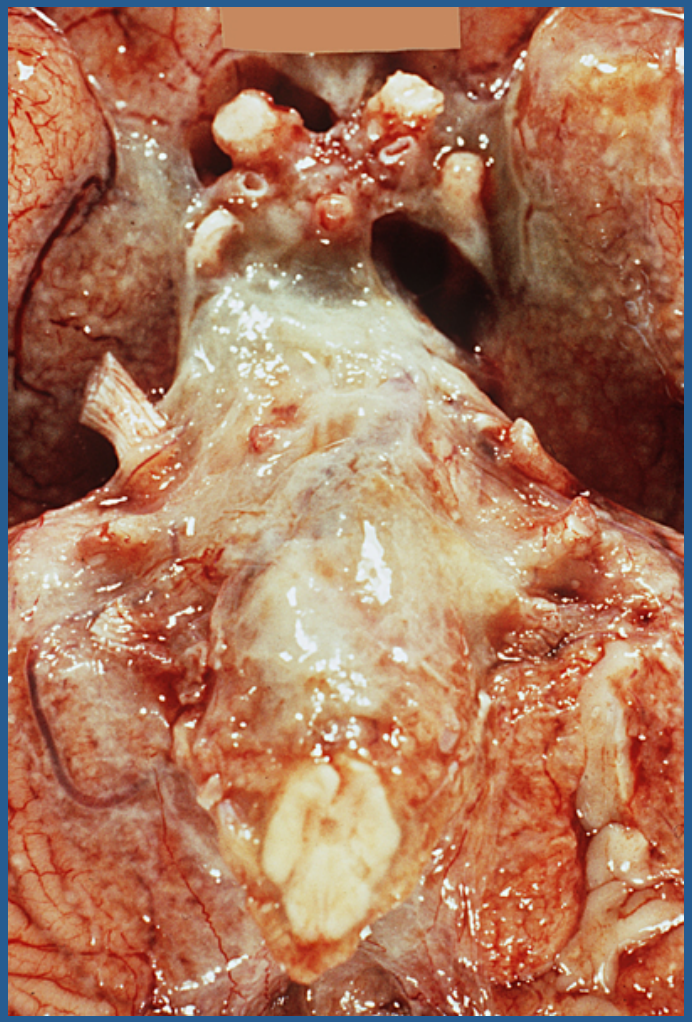
- Infections of the skull or air sinuses may also spread to the subdural space, producing subdural empyema
  - The underlying arachnoid and subarachnoid spaces are usually unaffected, but a large subdural empyema may produce a mass effect
  - In addition, thrombophlebitis may develop in the bridging veins that cross the subdural space, resulting in venous occlusion and infarction of the brain

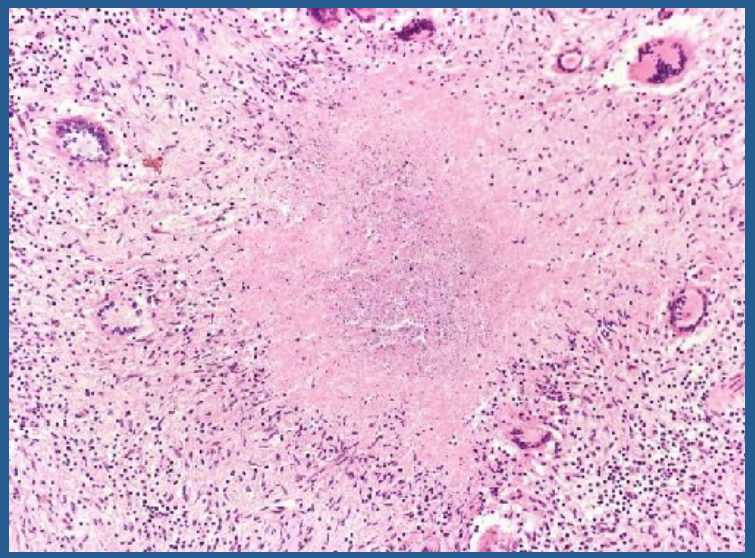
Empyema

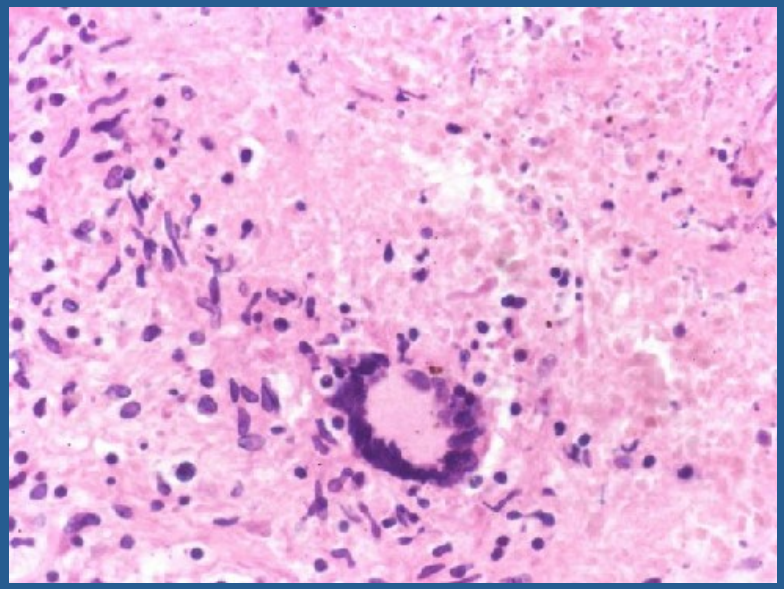
- Symptoms include those referable to the source of the infection. Most patients are febrile, with headache and neck stiffness, and if untreated may develop focal neurologic signs, lethargy, and coma
- With treatment, including surgical drainage, resolution of the empyema occurs from the dural side; if resolution is complete, a thickened dura may be the only residual finding. With prompt treatment, complete recovery is usual

CNS Infections
Tuberculosis

- The subarachnoid space contains a fibrinous exudate, most often at the **base** of the brain
- **Tuberculoma** is well-circumscribed intraparenchymal mass
  - Rupture of tuberculoma into subarachnoid space results in tuberculus meningitis
  - A tuberculoma may be up to several centimeters in diameter, causing significant mass effect
  - Always occurs after hematogenous dissemination of organism from primary pulmonary infection
- On microscopic examination, there is usually a central core of caseous necrosis surrounded by a typical tuberculous granulomatous reaction







TB meningitis

Exudate at the base of the brain

CNS Infections
CSF in TB

- There is only a moderate increase in cellularity of the CSF (pleiocytosis) made up of mononuclear cells, or a mixture of polymorphonuclear and mononuclear cells
- The protein level is elevated, often strikingly so
- The glucose content typically is moderately reduced or normal

Aseptic Meningitis (Viral Meningitis)

- Aseptic meningitis is a misnomer
- it is a clinical term for an illness comprising meningeal irritation, fever, and alterations of consciousness of relatively acute onset without recognizable organisms
- The clinical course is less fulminant than in pyogenic meningitis, is usually self-limiting, and most often is treated symptomatically

Aseptic Meningitis (Viral Meningitis)

- CSF:
  - increased number of lymphocytes (pleiocytosis)
  - protein elevation is only moderate
  - glucose content is nearly always normal
- In approximately 70% of cases, a pathogen can eventually be identified, most commonly an enterovirus
- There are no distinctive macroscopic characteristics except for brain swelling, seen in only some instances
- On microscopic examination, there is either no recognizable abnormality or a mild to moderate infiltration of the leptomeninges with lymphocytes.

Homework

- Create a table of CSF findings in Meningitis, aseptic meningitis, TB meningitis, Brain abscess and multiple sclerosis!