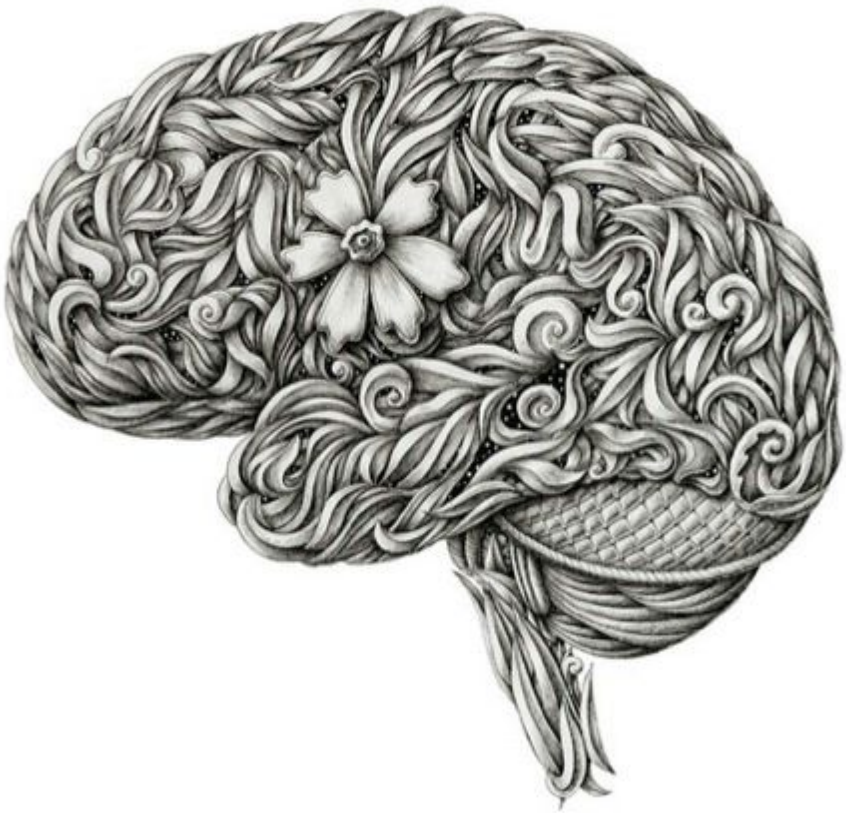
Meningitis



Objectives:

- Revise the spectrum of organisms that can cause meningitis.
- Explain the terms used in the description of CNS infections patterns.
- Understand the pathology of acute bacterial and tuberculous meningitis and the information that can be obtained from investigation of cerebrospinal fluid in suspected meningitis.

Important note: **Please check out this link before viewing the file to know if there are any additions or changes. The same link will be used for all of our work: Pathology Edit**

Red: Important
Grey: Extra notes

CNS Infections.

The Infection agent of nervous system could be either **Relative to nervous system such (rabies)** or **affect any organ as** well as the brain such as **(staphylococcus aureus).**

Infection agent may reach CNS through :

- **Hematogenous spread:** the most common and can by either arterial or venous system
- **Direct implantation:** due **traumatic** and rarely iatrogenic [1]
- **Local extension:** secondary to **air sinus** (most often mastoid and frontal), infected tooth or middle ear and CNS malformation
- **Through the peripheral nervous system into the CNS:** certain viruses, such as **rabies and herpes zoster.**

Meningitis.

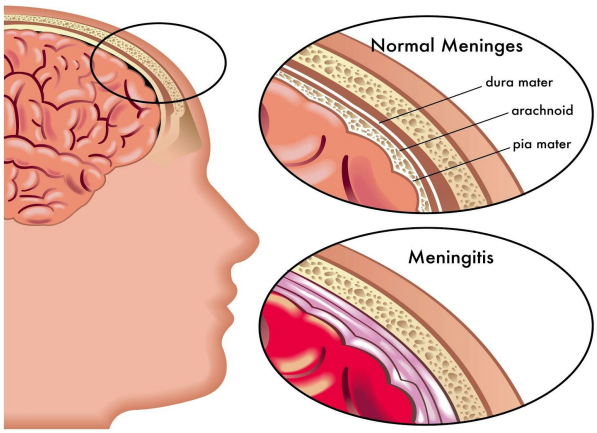
An inflammation of the **leptomeninges**[2] and CSF within the **subarachnoid space.** If the infection spreads into the brain then it's called ***meningoencephalitis.***

Infectious meningitis is divided into :

- **Acute pyogenic** (usually bacterial).
- **Aseptic** (usually viral).
- **Chronic** (usually tuberculous, spirochetal, or cryptococcal).

Pyogenic meningitis (Bacterial).

Medical emergency. and most likely organisms vary with patient age.



The causative microorganisms :

- Neonates : **Escherichia coli and group B streptococci.**
- Adolescents[3] and young adults : **Neisseria meningitidis** (the most common cause)
- Elderly : **listeria monocytogenes and Streptococcus pneumoniae**

Meningitis Clinical Features:

Systemic non-specific signs of infection including :

- **Meningeal irritation signs and neurologic impairment** such as **: (**Headache, **photophobia,** irritability, clouding of consciousness and **neck stiffness**.)
- **Untreated, pyogenic meningitis** can be **fatal**.
- **Effective antimicrobial agents markedly reduce mortality** associated with meningitis.

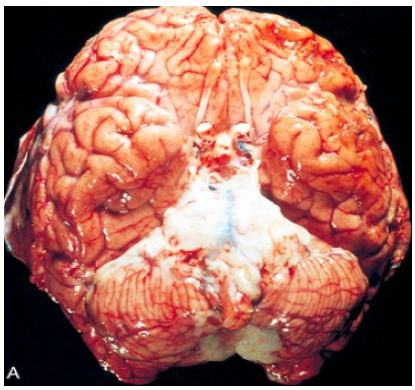
1

2 Pia and arachnoid matters.

3

CSF Findings in spinal tap:

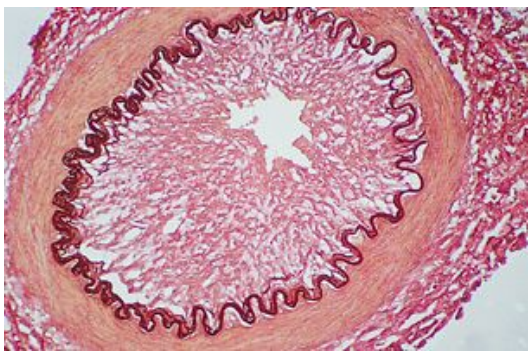
- **Cloudy or frankly** appearance CSF. (due bacterial infection)
- **abundant 90,000 neutrophils/mm.**
- **Elevated protein level.**
- **Markedly reduced glucose content** (due bacterial infection)
- **Bacteria may be seen o**n a Gram stained smear or can be cultured, sometimes a few hours before the neutrophils appear.



Acute Pyogenic meningitis: A thick layer of suppurative exudate covers the brainstem and cerebellum and thickens the leptomeninges.

Meningitis Complications

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



Management: Start broad antibiotic → culture → check the antibiotic sensitivity → shift to better antibiotic.

Aseptic Meningitis (Viral Meningitis).

Aseptic meningitis is a **misnomer**[4] and it is a clinical term for an illness associated with **meningeal irritation, fever,** and **alterations of consciousness** without recognizable organisms
The clinical course Milder than in pyogenic meningitis (**usually self-limiting,** and most often is treated symptomatically)
In approximately 70% of cases, a pathogen can be identified, most commonly an **enterovirus**
There are no distinctive macroscopic characteristics except for brain swelling, seen in only some instances.

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Microscopic examination shows either :

- no recognizable abnormality or a
- mild to moderate infiltration of the leptomeninges with lymphocytes.

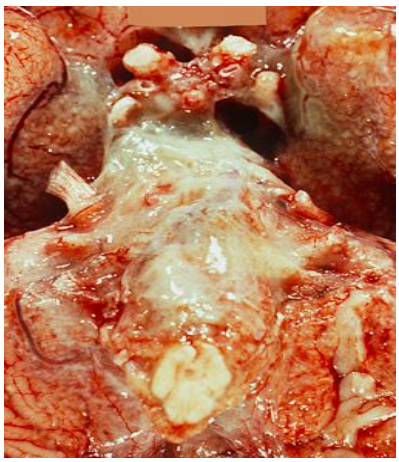
CSF Finding

- **increased number of lymphocytes** (**pleocytosis**)
- **protein elevation is only moderate**
- **glucose is nearly always normal**

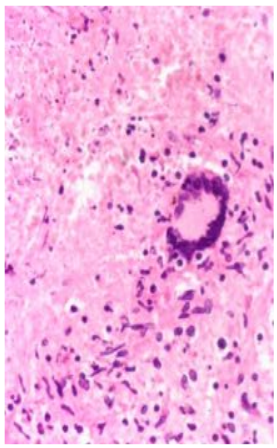
Tuberculosis.

- **Mycobacterium** may result well circumscribed intraparenchymal mass called **tuberculoma.**
- A tuberculoma may be up to several centimeters in diameter, causing significant mass effect
- Always occurs after hematogenous dissemination (Miliary TB) of organism from primary pulmonary infection.
- **Rupture of tuberculoma into subarachnoid space** results in **tuberculous meningitis**

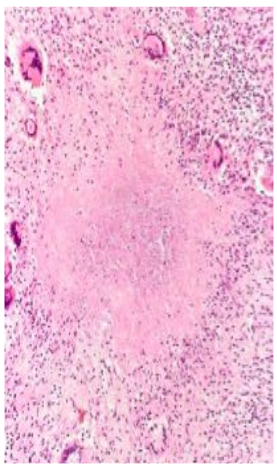
Microscopic/Macroscopic findings:



The subarachnoid space contains a **fibrinous exudate, most often at the base of the brain**.



Surrounded by a typical **tuberculous granulomatous reaction**



Central core of **caseous necrosis**

CSF Finding in TB:

- **moderate increase in cellularity of the CSF** (**pleocytosis**) made up of mononuclear cells, or a mixture of polymorphonuclear and mononuclear cells
- **The protein level is elevated,**
- **The glucose content t moderately reduced or normal** (because it's *intracellular* bacteria)

Brain abscess.

Streptococci and staphylococci are the most common organisms identified in *non immunosuppressed* populations. It's most common on cerebral hemispheres

- Present clinically with progressive focal neurologic deficits in addition to the general signs of raised intracranial pressure

Predisposing conditions:

- **Acute bacterial endocarditis** (usually give multiple micro-abscesses in the brain coming from the heart through the circulation).
- **Cyanotic congenital heart disease** in which there is a right-to-left shunt[5].
- **Loss of pulmonary filtration** of organisms (e.g, bronchiectasis).

Morphologically:

- Liquefactive necrosis
- The surrounding brain is edematous, congested & contains reactive astrocytes & perivascular inflammatory cells.

The CSF findings:

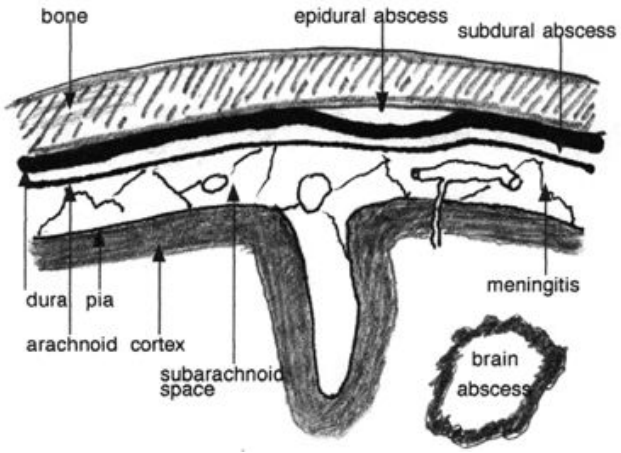
- Contains only scanty cells (few cells)
- ↑ protein.
- Normal level of glucose.

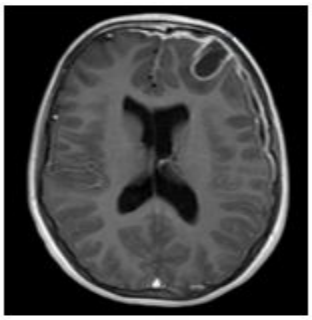
Complications of Brain abscess:

- Herniation (because it has mass effect).
- Rupture of abscess into subarachnoid space or ventricle.

[5] A cardiac shunt is a pattern of blood flow in the heart that deviates from the normal circuit of the circulatory system.

Epidural and Subdural Infections.





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

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** (especially chronic) or a **surgical procedure** (when there is no good sterilization).
- When the process occurs in the spinal epidural space, it may cause spinal cord compression and constitute a neurosurgical emergency.
- **Susceptible patients:** Elderly, immunocompromised, diabetic.

Empyema.

Infections of the skull or air sinuses may also spread to the *subdural space*, producing subdural empyema (Empyema means a lot of puss & necrosis).

- The underlying arachnoid and subarachnoid spaces are usually unaffected, but a large subdural empyema may produce a **mass effect**. (similar to tumors)
- In addition, **thrombophlebitis**[6] may develop in the bridging veins that cross the subdural space, resulting in venous occlusion and infarction of the brain.

Symptoms include those *referable to the source of the infection*. Most patients are ***febrile***[7], with ***headache*** and ***neck stiffness***, and if untreated may develop ***focal neurologic signs***, ***lethargy***[8], 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**[9] **treatment, complete recovery is usual.**

[6] inflammation of the wall of a vein with associated thrombosis, often occurring in the legs during pregnancy.
[7] having or showing the symptoms of a fever.
[8] a lack of energy and enthusiasm.
[9] done without delay; immediate.

Homework.

Meningoencephalitis: An inflammation of the brain and its membranes.

CSF findings	Meningitis (pyogenic)	aseptic meningitis	TB meningitis	Brain abscess	multiple sclerosis
Appearance	turbid	clear	Fibrin web	----------	Clear & colorless
Predominant cell	Polymorphs	lymphocytes		Scanty cells	- Pleiocytosis - ↑IgG
Protein	↑	Normal	↑	↑	Normal or slightly ↑ (**oligoclonal bands of γ-globulin.**)
Glucose	↓	Normal or slightly ↓	↓	Normal	----------

Summary.

Type	Site
Meningitis	**leptomeninges (pia and arachnoid)**
Tuberculosis	**The subarachnoid space at the base of the brain**
Brain abscess	**brain tissue**
Empyema	**subdural or extradural**

SUMMARY

Infections of the Nervous System

- Pathogens from viruses through parasites can infect the brain; in addition, prion disease is a protein-induced transmissible disease unique to the nervous system.
- Different pathogens use distinct routes to reach the brain, and cause different patterns of disease.
- Bacterial infections may cause meningitis, cerebral abscesses, or a chronic meningoencephalitis.
- Viral infections can cause meningitis or meningoencephalitis.
- HIV can directly cause meningoencephalitis, or indirectly affect the brain by increasing the risk of opportunistic infections (toxoplasmosis, CMV) or CNS lymphoma.
- Prion diseases are transmitted by an altered form of a normal cellular protein. They can be sporadic, transmitted, or inherited.

MCQ's.

Q1: Meningitis refers to inflammation of the brain

A: True
B: False

Ans: B
Explanation: The term encephalitis refers to an inflammation of the brain. Meningitis is an inflammation of the membranes (called meninges) that surround the brain and spinal cord.

Q2: Meningitis in a 4 days old neonate is most likely to be caused by which organism:

A. Group B streptococcus
B. Mycobacterium
C. Staphylococcus
D. Herpes simplex

Ans: A
Explanation: Bacterial infections by GBS result from swallowing of infected amniotic fluid or maternal secretions during delivery by infants of mothers who have vaginal colonization of GBS, although later infections may be acquired through nosocomial transmission.

Q3: Causes of aseptic meningitis include:

A. Antibiotic treated Haemophilus influenzae
B. Mycobacterium tuberculosis
C. Fulminant Neisseria meningitidis infection
D. Cryptococcus neoformans
E. A serious Enterovirus infection

Ans: E
Explanation: Aseptic meningitis is also known as viral meningitis. The name is derived from the original failure to (i) observe turbidity in CSF samples from viral meningitis patients and (ii) culture microorganisms from infected CSF.

Q4: The most common route of infection in meningitis is:

A. via peripheral nerves.
B. via the paranasal sinuses.
C. via the ears.
D. through the skin.
E. via the bloodstream.

Ans: E
Explanation: The critical step in the pathogenesis of meningitis is for the microorganisms to be able to cross the blood-brain barrier. The most common method for this to occur is from the presence of significant numbers of microorganisms in the bloodstream.

Q5: A cerebrospinal fluid specimen was examined and the following preliminary results were obtained:
Description: 3x 2.4mL, clear
- Protein: 0.55 g/L
-Glucose: 2.9 mmol/L
-WCC: 6 x 108 /L
-30% PMN
-70% Monocytes
This report is consistent with:

A. a poorly collected specimen
B. an uninfected CSF specimen
C. bacterial meningitis
D. viral meningitis
E. a normal CSF

Ans: D
Explanation: Several results indicate that this may be a viral infection. Firstly, the CSF is clear. This either means that a viral infection is present or,indeed, that there is no infection. The protein level is higher than normal (normal range 0.15 - 0.45 g/L). The glucose level is in the normal range, which suggests that it is not bacterial in nature. Noticeably, the WBC count is also above the threshold for infection. This data combined suggests a viral infectious agent.

Q6: All of the following CSF findings are present in tuberculous meningitis, except:

A. Raised protein levels
B. Low chloride levels
C. Cob web formation
D. Raised sugar levels

Ans: D
Explanation: Glucose levels are decreased in tuberculous meningitis.

Q7: Which of the following is a morphologic feature of brain abscesses?

A: wedge shaped areas of infarction
B: meningeal fibrosis
C: reactive astrocytes and perivascular inflammatory cells
D: A+B

Ans: C

Q8: William Mountain, age 65, arrives at the emergency department with fever, headache, and stiff neck. His wife tells you he has also been experiencing nausea, vomiting, photophobia, and an altered mental status.
Which of the following organisms is most likely causing the disease?

A: E. coli
B: Neisseria meningitidis
C: Listeria monocytogenes
D: Group B streptococci

Ans: C

Now that you're done with pathology lectures :)
Your final step is to test yourself in this link:
http://library.med.utah.edu/WebPath/EXAM/MULTORG/cns1frm.htm

We hope you a very good luck in your finals..
You can do it super doctors!

For any suggestions or questions please don't hesitate to contact us on: Pathology434@gmail.com
Twitter: @Pathology434
Ask us: www.ask.fm/Pathology434

Done by:
Lina Al-jurf
Maha Al-Rabiah
Moneera Al-Draheim
Mashael Hussein
Reema Al-Nasser
Hussain Al-Kaff