



Lecture Nine Pathology of Meningitis & Other CNS infections



432 Pathology Team

Done By: Latifah Al-Fahad

Reviewed By: Ahmad Al-Muhanna

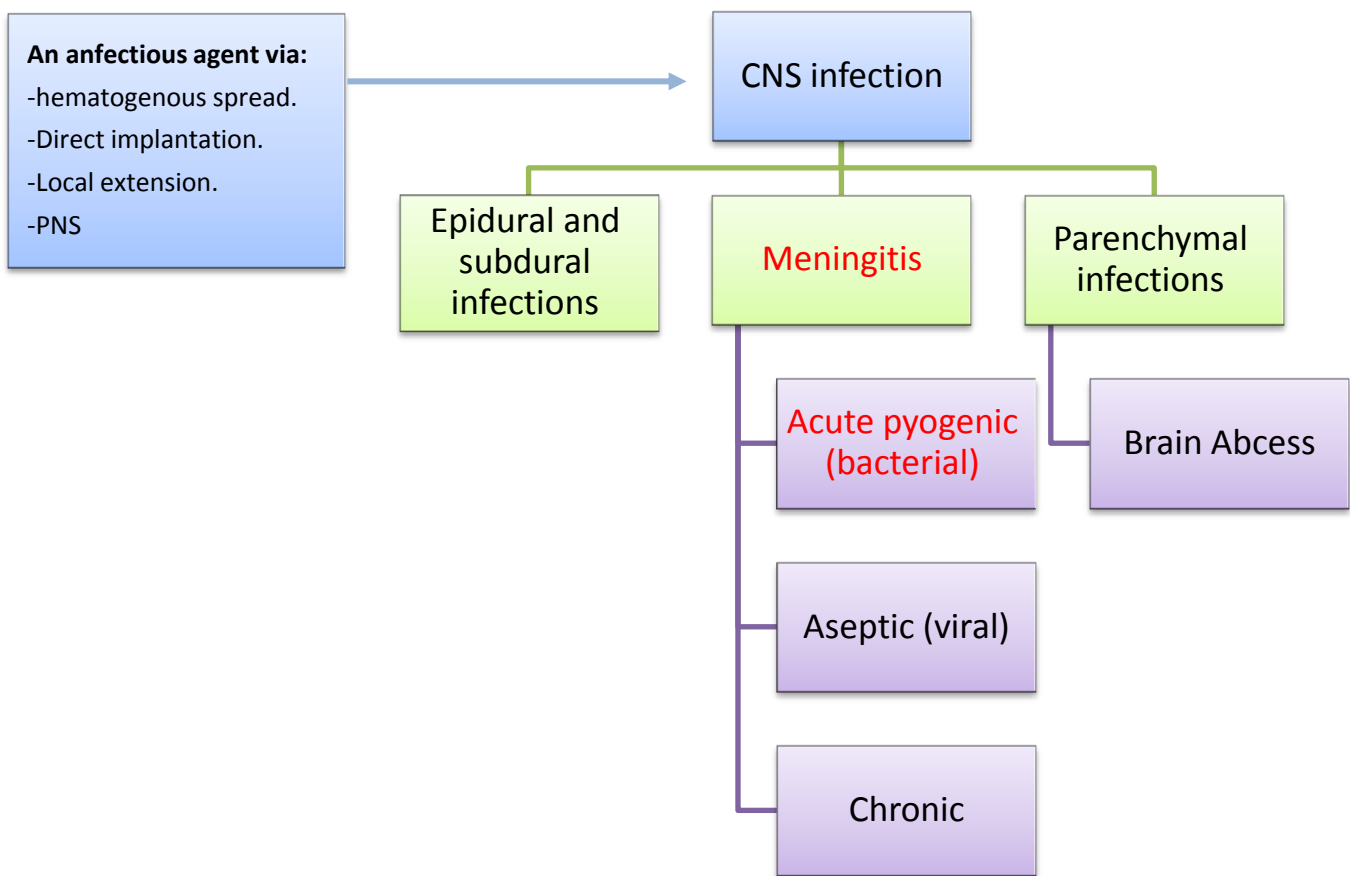
CNS Block



Color Index: female notes are in purple. Male notes are in Blue. Red is important. Orange is explanation.

CNS Infections

Mind Map:



Infections of the nervous system

Portals of entry of infection into the CNS:

1) **Hematogenous spread**

⇒ the most common.

2) **Direct implantation**

⇒ Post-traumatic or in congenital CNS malformation.

3) **Local extension**

⇒ occurs secondary to an established infection in a nearby organ (air sinus, an infected tooth or middle ear)

4) **Through the peripheral nervous system into the CNS**

⇒ A property of certain viruses, such as **rabies and herpes** zoster.

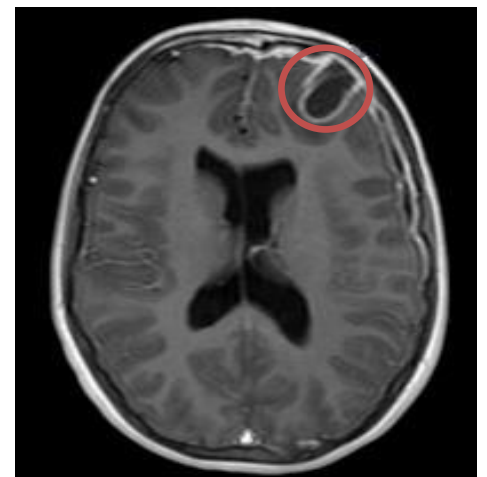
Epidural and Subdural Infections

These spaces can be involved with bacterial or fungal infections, usually as a consequence of direct local spread.

1- Epidural abscesses are 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.

2- Subdural empyema can result from the spread of skull or air sinuses infections. 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 = the collection of pus in a cavity**).



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

Symptoms:

They're 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.

Treatment:

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.

Note: a mass effect results from of a growing mass within a closed space such as the skull.

Meningitis

Meningitis is an inflammatory process of the leptomeninges and CSF within the subarachnoid space.

REMEMBER: Meningoencephalitis develops with spread of infection from meninges into underlying brain (Robbins).

1- Acute Pyogenic Meningitis:

Acute pyogenic meningitis is a bacterial infection of the meninges. It is:

1- Medical emergency

2- The causative microorganisms (2010 Robbins):

- **Neonates:** *Escherichia coli* and *Group B streptococci*
- **Infants:** *Streptococcus Pneumoniae*
- **Adolescents and young adults:**
Neisseria meningitidis (Meningococcal meningitis) and
Haemophilus influenzae (becoming less due to immunization).
- **Elderly:** *Listeria Monocytogenes* and *Streptococcus Pneumoniae*.

REMEMBER: Strep. Pneumoniae causes meningitis in the extremities of age; infants and elderly.

CSF findings:

1. Cloudy or frankly purulent CSF.
2. As many as 90,000 **neutrophils** /mm
3. **Raised protein level.**
4. **Markedly reduced glucose content.**
5. Bacteria may be seen on a Gram stained smear or can be cultured, sometimes a few hours before the neutrophils appear.

Clinical Features:

1. Systemic non-specific signs of infection.
2. Meningeal irritation signs and **neurologic impairment**:
Headache, photophobia, irritability, clouding of consciousness and neck stiffness.

Note: Untreated, pyogenic meningitis can be fatal. Effective antimicrobial agents markedly reduce mortality associated with meningitis.

2- Aseptic Meningitis:

Aseptic meningitis is a viral infection of the meninges. 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.

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.

Clinical course:

less fulminant than in pyogenic meningitis, is usually **self-limiting**, and most often is treated symptomatically

CSF Findings:

CSF shows an increased number of **lymphocytes (pleiocytosis)**, the protein elevation is only moderate, and glucose content is nearly always **normal**.

(Pleiocytosis: presence of a greater than normal number of cells in cerebrospinal fluid.)

3- Chronic Meningitis:

Chronic meningitis is associated with several pathogens, including **M.Tuberculosis**.

Characteristics:

- 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 tuberculous 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.



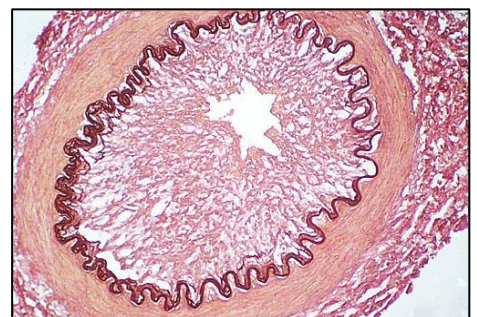
Exudate at the base of the brain

CSF Findings:

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

Complications of Meningitis:

1. **Phlebitis**: may lead to venous occlusion → hemorrhagic infarction of the underlying brain.
2. Leptomeningeal **fibrosis** → hydrocephalus.
3. Septicemia → hemorrhagic infarction of the adrenal glands and **cutaneous petechiae** (known as Waterhouse-Friderichsen syndrome, particularly common with meningococcal and pneumococcal meningitis).
4. Focal cerebritis & seizures.
5. Cerebral abscess.
6. Cognitive deficit.
7. Deafness.



Vascular narrowing after meningitis

Parenchymal Infections: Brain Abscess

Brain Abscess is caused commonly by Streptococci and Staphylococci (most common organisms identified in non-immunosuppressed populations). It is most common on cerebral hemispheres.

Predisposing conditions:

1. **Acute bacterial endocarditis** (usually give multiple microabscesses).
2. **Cyanotic congenital heart disease** in which there is a right-to-left shunt.
3. **Loss of pulmonary filtration of organisms** (e.g. bronchiectasis).

Morphologically:

1. **Liquefactive necrosis** (typical for brain necrosis).
2. The surrounding brain is **edematous, congested & contains reactive astrocytes** (producing Rosenthal fibers. [See lecture 1]) and **perivascular inflammatory cells**.
3. Present clinically with **progressive focal neurologic deficits** in addition to the general signs of **raised intracranial pressure** (Because the abscess is a **space occupying lesion** causing a mass effect. Increased ICP can be detected by fundus examination [papillary edema])

CSF Findings:

1. **Contain only scanty cells** (few cells)
2. **↑ protein**
3. **Normal level of glucose**

Complications of Brain abscess:

1. **Herniation.** (because it's a space occupying lesion)
2. **Rupture of abscess into subarachnoid space or ventricles.**

Comparison of CSF Findings

Disease	Appearance	Predominant cell	protein	glucose	other
Bacterial men.	cloudy	↑↑↑ Neutrophils	↑	↓↓	Bacteria are seen
Viral men.	clear	↑ Lymphocytes	↑ or normal	~ normal	-
TB men.	fibrous	↑ Lymphocytes	↑↑	↓ or normal	-
Brain abscess	-	Scanty cells	↑	normal	-
MS	-	-	↑↑	-	↑↑ γ-globulins

Summary (from Robbins Basic Pathology)

Infections of 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.

Questions from Pathology Recall book

1/ what is the organism is common in bacterial meningitis of the children and elderly?

In children: *S. pneumoniae*, *H.influenzae* is now rare because most children are immunized.

In elderly: *Listeria monocytogenes* & *Pneumococcus*.

2/ what are the 3 findings in CSF diagnostic for bacterial meningitis?

Increased protein – decreased glucose – many polymorphonuclear neutrophils.

3/ what organisms are seen in CSF in case of brain abscess?

None are usually seen, unless rupture of abscess has occurred.

4/ what can occur if infection spreads beyond abscess wall?

Encephalitis

5/ what part of the nervous system is the most common site of tuberculous infection?

Meninges

6/ what are the CSF findings in meningeal tuberculosis?

Increased lymphocytes – significantly increased protein – decreased glucose – acid fast bacilli in CSF

7/ what is the microscopic pathology in meningeal tuberculosis?

Granulomas composed of lymphocytes and large mononuclear cells – tubercle bacilli

8/ what is another name for viral meningitis?

Aseptic meningitis

9/ what are the CSF findings in viral meningitis?

Increased lymphocytes – moderate increase in protein – Normal glucose

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Good Luck ^_^