



INTRODUCTION

- **Meningitis**: it is inflammation of the meninges (coverings of the brain and spinal cord).
 - **Inflammation of dura matter**: pachymeningitis.
 - **Inflammation of arachenoid and pia matters**: leptomeningitis.
 Note: meningitis can be acute or chronic.
- **Other infections of CNS include:**
 - **Encephalitis**: when the brain parynchema is involved.
 - **Brain abscess (meningitis + encephalitis)**: meningoencephalitis.
- **Causes of meningitis:**
 - **Infectious**: this includes bacterial, viral, fungal and parasitic infections.
 - **Mechanical agents.**
 - **Drugs.**
 - **Cancer**
- **Routes of entry of organisms:**
 - **Direct extension**: penetrating wounds or skull fractures.
 - **Indirect**: blood-borne infections from elsewhere in the body to the central nervous system (respiratory infections, endocarditis or osteomyelitis)
 - **Otitis media and mastoid sinus infection.**

ACUTE PYOGENIC MENINGITIS (BACTERIAL)

- **The most common three causative organisms are:**
 - **H.influenzae**: gram (-) coccobacilli.
 - **N.meningitidis**: gram (-) diplococci.
 - **S.pneumoniae**: gram (+) diplococci.
- **There are another two causative organisms which are important especially in extreme ages:**
 - **Listeria monocytogenes**: in elderly.
 - **Streptococcus agalactiae**: in newborns (acquired through the birth canal).
- **Common causes of bacterial meningitis (according to age group):**

<u>Age group</u>	<u>Causes</u>
Newborns	Streptococcus agalactiae + E.coli
Infants/ children	H.influenzae + S.pneumoniae + N.meningitidis
Adolescents/ young adults	S.pneumoniae + N.meningitidis
Elderly	Listeria monocytoogenes + S.pneumoniae

- **Signs and symptoms of acute pyogenic meningitis:**

- **In adults:**
 - ✓ Headache.
 - ✓ Fever.
 - ✓ Nausea & vomiting.
 - ✓ Kernig’s sign.
 - ✓ Brudinski’s sign.
- **In infants:**
 - ✓ Fever.
 - ✓ Irritability and strange cry.
 - ✓ Convulsions and seizures.

- **Virulence factors (comparison):**

<u>Virulence factor</u>	<u>N.meningitidis</u>	<u>H.influenzae</u>	<u>S.pneumoniae</u>
Capsule	All (+)	All (+)	+
IgA protease			+
Pilli			-
Endotoxin			-
Outer membrane protein			-



- N.meningitidis:

- **Serotypes:** A, B, C, Y, W135 and X are causing meningococcal meningitis.
Note: serotypes B,C and Y are present in developed countries while serotypes A and W135 are present in developing countries.
- It is a gram (-) encapsulated diplococci.
- It is capable of generating large epidemics (spreading from person-to-person by droplets or overcrowding).
- **If it causes septicemia:** this will be called (meningococemia) which will be characterized by (non-blanching petechial rash).
Note: non-blanching means that the rash is not fading when pressed on the edge.

ACUTE ASEPTIC MENINGITIS (VIRAL)

- There are three important enteroviruses which can cause aseptic meningitis:

- **Coxsackievirus:**
 - ✓ It is present in two groups: group A (types 1-24 but notice that type 23 is not present) and group B (types 1-6).
 - ✓ It is causing maculopapular rash in the skin.
 - ✓ Treated with pleconaril.

- **Echovirus.**
- **Polio (transmission: feco-oral).**

- Pathogenesis of enteroviruses:

- **Entry:** through nasal or oral cavities.
- **Multiplying in:**
 - ✓ Upper respiratory tract.
 - ✓ GIT.
- **Primary viremia:** this term is used when the virus is present in the blood.
- **Secondary viremia:** this term is used when viruses multiply in their target organs.

- Arboviruses are also important causative organisms and they are transmitted by arthropods (مفصليات الأرجل كالحشرات والعناكب). An example is herpes simplex virus which is causing encephalitis.

Note: viral encephalitis can also be caused by rabies virus which is transmitted through dog bite (infected saliva).

MENINGITIS CAUSED BY PARASTITIC INFECTION

- Toxoplasma gondii:

- It is a parasitic protozoan from meat and cat's feces.
- Parasites ingested from undercooked meat → tachyzoites infecting liver cells → infected macrophages distribute tachyzoites throughout the body.
- **Leading to:**
 - ✓ Intracranial calcification.
 - ✓ Hydrocephalus.

- Cerebral malaria:

- **Caused by:** plasmodium falciparum.
- Leading to focal hemorrhages and capillaries packed with parasitized erythrocytes.

CHRONIC MENINGITIS

- Causative organisms:

- **Virus:** varicella-zoster (chicken pox).
- **Bacteria:** mycobacterium tuberculosis (Ziehl-Neelsen stain).
- **Fungi:**
 - ✓ Cryptococcus neoformans (india-ink stain): from pigeons and birds by inhalation.
 - ✓ Candida: especially in immunocompromized patients.



- **Parasite:** cysticercus (larva of Taenia solium which is a tape worm):
 - ✓ Resulting in fatal cerebral cysticercosis (cystic structures in the brain).
 - ✓ Humans are definitive hosts (in GIT) → eggs in feces → ingested by pigs (intermediate host) → uncooked pork (containing cystecerci) → adult worms in human intestine.
 - ✓ If human ingested eggs instead of cysticerci → cysticercosis in the brain.

LABORATORY INVESTIGATIONS OF CNS INFECTIONS

- Meningitis:

- **CSF:** obtained through lumbar puncture (unless it is contraindicated when there is increased intracranial pressure, space occupying lesion or herniation). This specimen is sent to the following:
 - ✓ Microbiology: culture and gram staining (fast). Culture:
 - ❖ Fungal meningitis: sabouraud agar.
 - ❖ TB meningitis: Lowenstein-Jensen medium.
 - ✓ Biochemistry.
 - ✓ Cytology.
- **Blood.**

	<u>Color</u>	<u>Cells</u>	<u>Glucose</u>	<u>Protein</u>
Normal	Clear	0-5 lymphocytes	2.2-3.3	0.4
Pyogenic meningitis	Turbid	Neutrophils	↓	↑
Tuberculous meningitis	Turbid ± fibrin web	Lymphocytes	Normal/↓	↑
Viral	Clear	Lymphocytes	Normal	↑

PREVENTION OF MENINGITIS: VACINES

- Meningococcal vaccine:

- **Serotypes:** A, C, Y and W135
- **For:**
 - ✓ Travelers to countries with epidemic meningitis.
 - ✓ Routine childhood immunization in Bahrain (2, 4 and 6 months).