

Bacterial Infection of Central Nerve System

3rd Year Medical Students

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Central Nerve System infections-1

- Infections of CNS..brain and spinal cord can cause dangerous inflammation.. This inflammation can produce a wide range of symptoms, including fever, headache, neck stiffness, confusion, vomiting..
- Any delay in treatment may cause brain damage, stroke, seizures, death. CNS infections divided into the following clinical features:
- Meningitis results from infection of meninges.. the membranes that surround the brain and spinal cord.
- Encephalitis inflammation of the brain itself.

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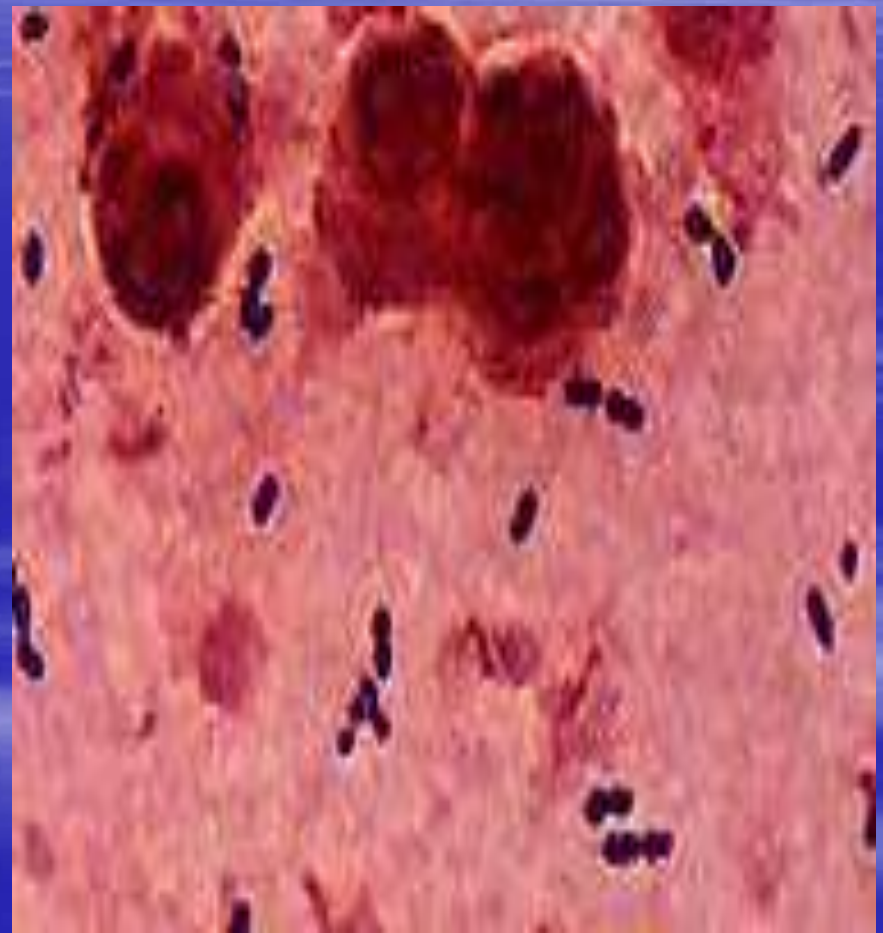
- Myelitis is infection or inflammation of the spinal cord..Encephalomyelitis includes inflammation of both the brain and the spinal cord.
- This inflammation can harm or destroy nerve cells and may cause bleeding in the brain.
- Meningitis is mostly caused by **viruses** (95%), **bacteria** (2-5%), **Fungi-Protozoa** (1-2%).. All ages.. majority children..**Encephalitis** rarely caused by bacterial infection.. mostly **viral infection.**
- Most Pathogens travel through the blood stream to the spinal cord.. brain.. following **Resp.Tract Infections** or surgical procedures.

Common Cause of Acute Bacterial Meningitis

- Pneumococcal meningitis / *Strept.pneumoniae*.. Gram+ve diplococcus.. 85 capsular serotypes.. Common Respiratory Healthy carriers.. All ages
- Cause most common form of bacterial serious meningitis in humans.. High fatality without treatment.
- The disease mostly endogenous infection.. followed **pneumonia, septicemia, ear and sinus tract infections.**
- High risk children under **age 2-year**, Elderly, All ages with a weakened or suppressed immune system..
- Delay in treatment pneumococcal meningitis often results in **neurological damage** ranging from deafness to severe brain damage..3-G Cephalosporins

S.pneumoniae

Blood culture+Optochin/ Gram-stain



1-*Neisseria meningitides*

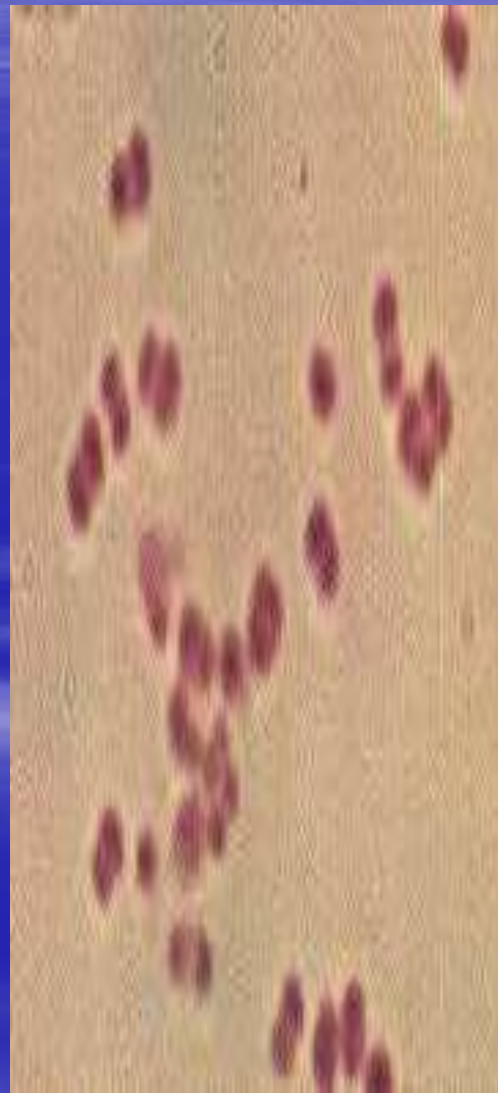
- **Meningococcal meningitis**: *N. meningitides*.. Gram-negative diplococci..susceptible to low & high temperature & dryness.. 4 common epidemic serotypes (A, C, Y W135) type..infects only humans.
- **Pathogenicity**: Multi-virulence factors
- Few % Respiratory Healthy carriers.. highly contagious disease.. droplets of respiratory or throat secretions..crowded places..schools and military camps.. causes local epidemics..in winter-spring
- High-risk groups include children and young adults, persons with **suppressed immune systems**.. travelers to certain endemic countries. meningitis belt of sub-Saharan Africa..Rare cases in Jordan

2-*Neisseria meningitides*

- **Acute disease**.. Throat infection.. incubation often period 2-4 days..First features: Septicemia-Meningitis.. stiff neck, high fever, sensitivity to light, confusion, headaches, vomiting.. haemorrhagic rash .. rapid circulatory collapse.. hemorrhaging of the adrenal glands, leading to Waterhouse-Friderichsen syndrome
- Between 10 -15 % of cases are fatal.. another 10-15 % causing brain damage and other serious side effects..
- Prevention: Capsular polysaccharide vaccine (bivalent A+C or tetravalent A, C, Y W135).. Recommended for age group 1-29 years.
- Treatment: Penicillin, Cefotaxime / ceftriaxone.
Rifampicin for carriers/contact persons

N.meningitidis-Pili

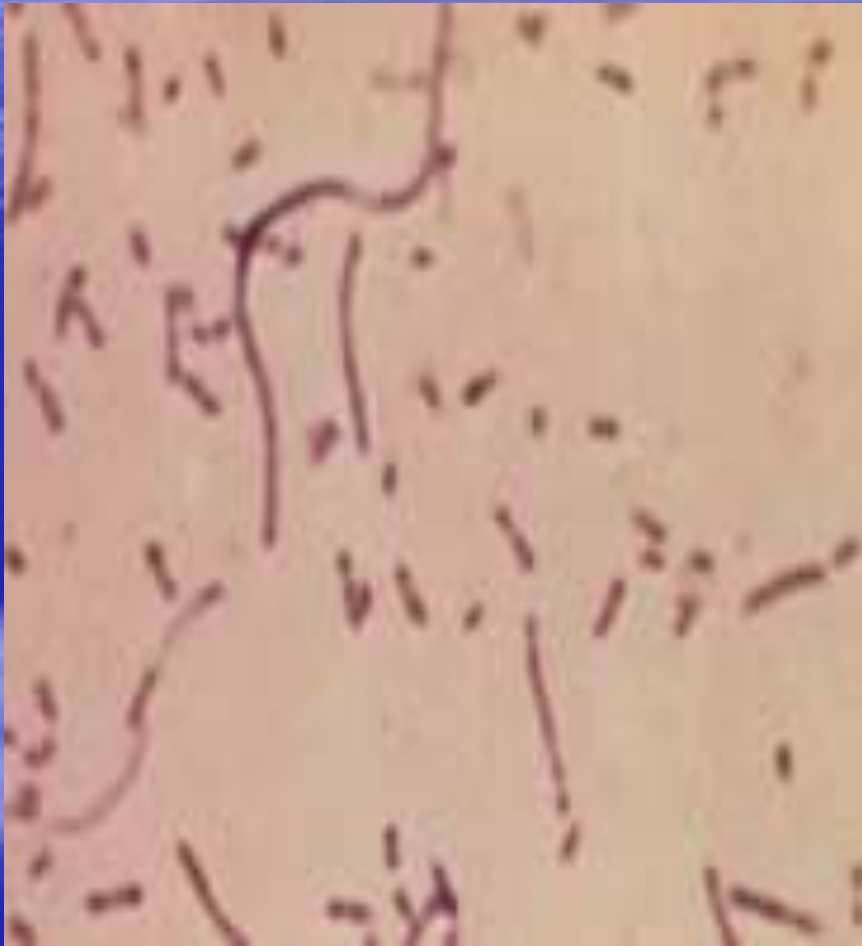
Gram-stain/intracellular



Haemophilus influenzae

- *H. influenzae b.* *Gram-ve coccobacilli.* Short filaments.. Susceptible to dryness.. Respiratory Healthy carriers for encapsulated type b. Invasive.. Multi-virulence factors.. High-risk children ages 6 months-5 years.. Rare adults.
- **Acute disease** ..started as sore throat / pneumonia, chronic bronchitis, empyema, septicemia-meningitis, sinusitis, otitis media.. Lack specific antibodies..
- Before 1990 was the most common form of bacterial meningitis among children worldwide..Jordan
- Haemophilus b conjugate vaccine reduced the incidence of meningitis up to 95% & carrier rates
Immunization children up 2 months.
- Treatment: Third G-Cephalosporins.

H. Influenzae - Listeria monocytogenes



Virulence of Common Pathogens

Virulence Factors	<i>S. pneumoniae</i>	<i>N.meningitidis</i>	<i>H. Influenzae</i> Type b
Capsule	+ Large	+ Thin	+ Thin
IgA Protease	+	+	+
Pili	-	+	+
Endotoxin- outermembranes proteins	-	+	+

Less Common bacterial Meningitis-1

- *Streptococci Group B* : Gram+ve streptococci.. Colonize 10-30% women vagina.. common cause of fatal neonatal sepsis & meningitis.. Common in preterm delivery babies, prolonged labor, swallow amniotic fluid during delivery..
- *Listeria monocytogenes* : Gram-positive coccobacilli.. Common in animals.. Infect human intestine by contaminated milk, dairy products.. Rarely may reside in female genital tract.. can cross the placental barrier and cause abortion.. baby stillborn.. septicemia, neonatal + adult meningitis.. Highly fatal.. Rare cases in Jordan.. more common in Europe.

Less Common bacterial Meningitis-2

- Enteric Bacteria: *Klebsiella*, *Enterobacter*, *Pseudomonas aeruginosa*.. Gram-ve bacilli.. Following surgical procedure in spinal cord.. Sepsis ..Burn cases.. Nosocomial Infection
- *E. coli* most common in new born baby.. transmitted through the birth canal.. Blood sepsis.
- *Staphylococcus* & other *Bacteria spp.* Rare.. following surgical infection.. sepsis.. compromised patients.

Chronic meningitis & Brain Abscess

- *Mycobacterium tuberculosis*: Acid-fast bacilli.. cause meningitis in children more than adults following miliary .. Less lung tuberculosis.. Mostly Developing countries..
- Brucellosis: *B. melitensis*, *B. abortus* .. Gram-ve coccobacillus.. Septicemia.. few percentage
- Syphilis: *Treponema pallidum*.. Spiral form bacteria.. Rare.. *Late stage*.. Congenital Syphilis.. Central Nerve Symptoms..meningitis.
- Nocardiosis: *N. asteroides*, Slightly Acid-fast bacilli, Brain abscess ..following lung infection common in soil.
- Lyme disease: *Borrelia burgdorferi*.. Tick bites.. Skin rash Septicemia-Meningitis-Encephalitis.. USA, Canada, Europe

Laboratory Diagnosis Bacterial meningitis

- CSF specimens should be sent **rapidly** for the following investigation: WBC count, Level of Glucose & Protein
- Glucose level is usually decreased (<40 mg/dL)
- CSF protein level is mostly elevated (>100 mg/dL)
- WBC count in bacterial meningitis is typically greater > 1,000/mm³ with a predominance of neutrophils.
- Lymphocytes predominance is found in fungal meningitis..
- Direct Gram stain.. AFStain in case of suspected TB
- Culture: Blood, chocolate, MaConkey Agar..

Bacterial Antigen Test

- Direct Antigen Tests are available to detect bacterial antigens in the CSF for diagnosis of *S. pneumoniae*, *N. meningitidis*, *H. influenzae* type b, group A, B *Streptococcus*.
- These tests should be confirmed by positive Gram-stain or culture
- Therefore, negative results for a specific bacterial antigen do not rule out bacterial meningitis.
- Molecular methods (PCR) that amplify bacterial DNA in CSF can improved sensitivity and specificity of results.. used mostly in reference laboratories.

Treatment Bacterial meningitis

- Prompt antibiotic therapy is essential. When bacterial meningitis is suspected..
- If the results of CSF Gram staining are unavailable or do not demonstrate organisms.. Empirical therapy should be started with antimicrobial agents that have activity against the most common causative pathogens known in community.
- Common used drugs : broad-spectrum cephalosporin.. ceftriaxone, cefotaxime, ampicillin+ aminoglycoside, chloramphenicol, vancomycin.

Fungal meningitis-1

- Cryptococcosis: *C.neoformans*.. Capsulated yeast , environment worldwide, particularly in soil contaminated with bird droppings.
- Enters the body most commonly through the Respiratory tract Infection /sinus or lung.. appears in immuno-compromised patients.. advanced AIDS.
- Cryptococcus can also cause infections of the lungs, skin, prostate gland.. Highly Fatal without treatment.
- Cryptococcal meningitis develop very slow.. vague symptoms may appear mild headache, fever, nausea.. often chronic meningitis & encephalitis .. Later brain abscess.

Capsulated Cryptococcus (India ink preparation)

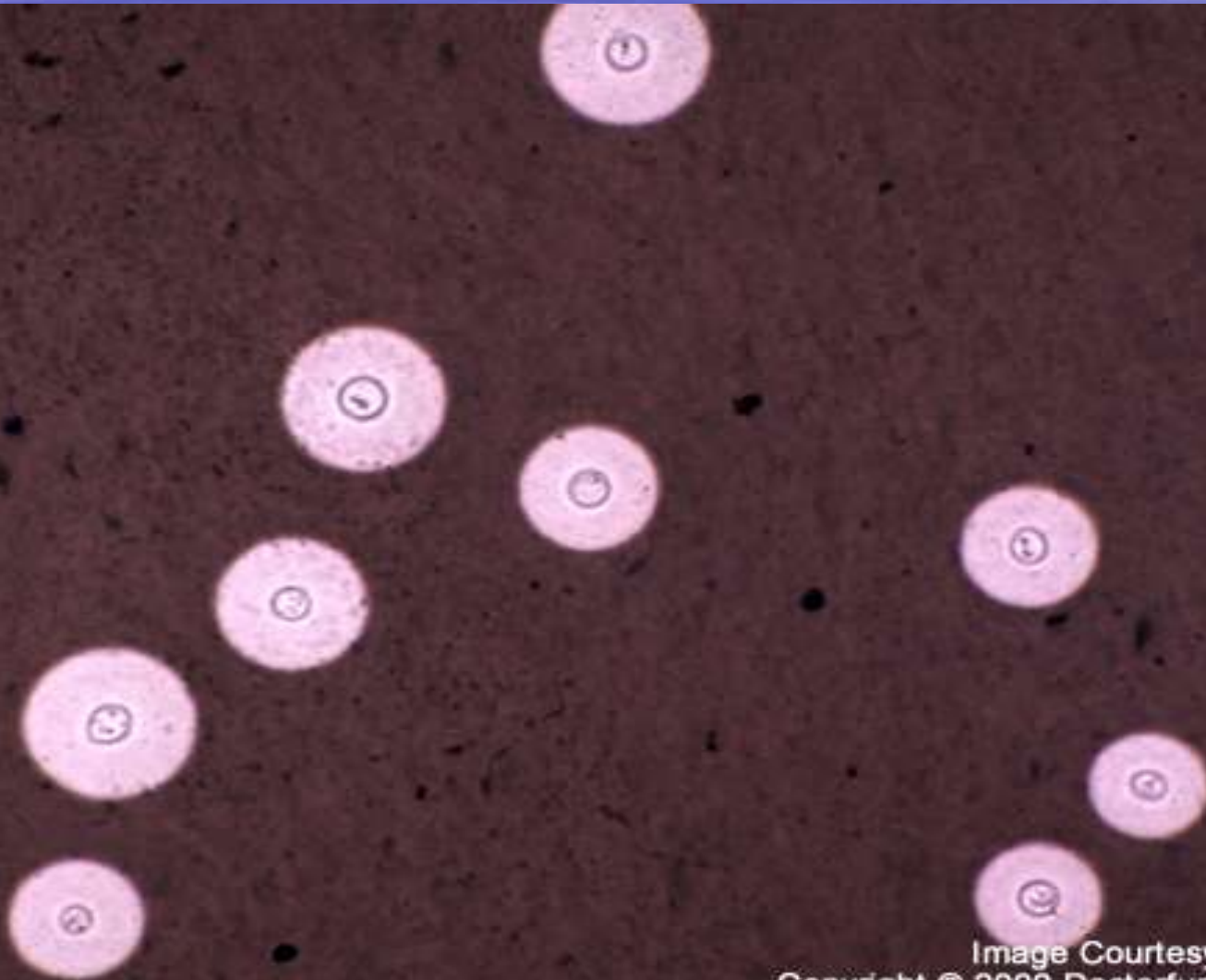


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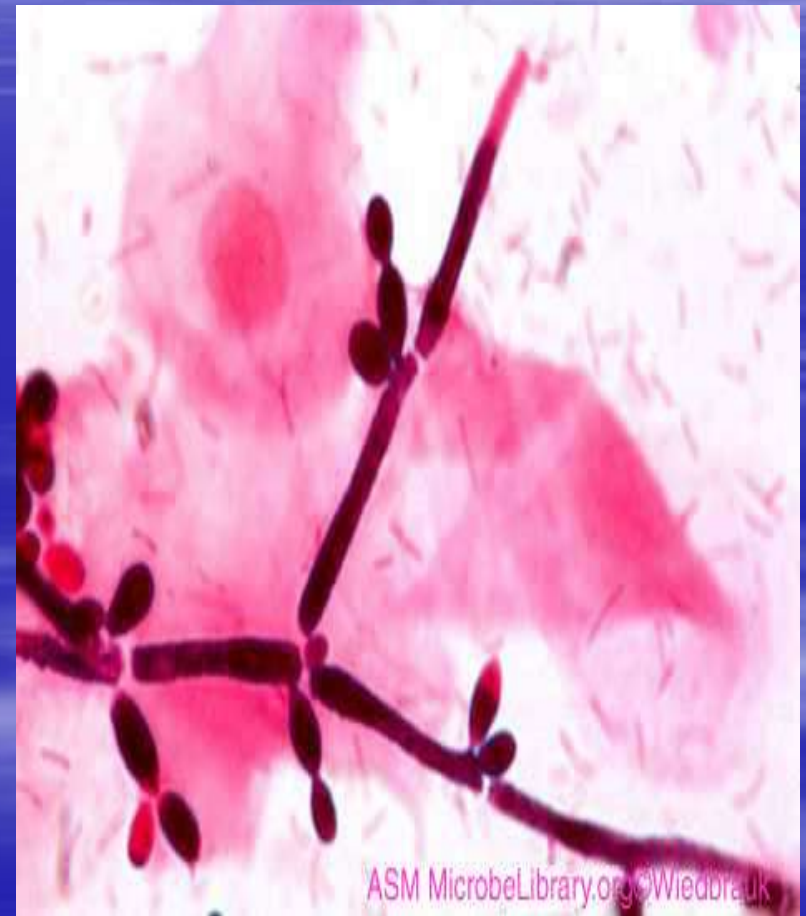
Fungal meningitis-2

- **Candidiasis**: *C.albicans*, *C. glabrata*, *C. parapsilosis* *C. tropicalis*.. Endogenous more than exogenous infection .. Oral cavity spread to Lung & blood.. meningitis.. Common neonates, immunocompromised host.. Chronic meningitis..Contamination associated with surgery, Ventricular drainage devices, lung intubation.
- Invasive candidiasis is the most frequent opportunistic mycosis which affects CNS
- The initial symptoms of acute meningitis by *Candida* are indistinguishable from those produced by bacterial

Fungal meningitis-3

- Infection and its diagnosis requires a high level of suspicion in the cases of isolation of *Candida*..CSF
- Histoplasmosis: *H. capsulatum* ..Lung, Systemic, Skin
- Blastomycosis: *B. dermatitidis*, Lung, Systemic, Skin
- Lab Diagnosis: Direct CSF wet test..Mild change Level of Glucose & Protein, WBCs counts/more lymphocytes Culture Sabouraud Dextrose agar, Blood agar.. Incubation 1-4 weeks..Serological methods are not useful..Candida antigen detection
- Treatment: Amphotericin B, 5-Flucytosine, fluconazole are the most common drugs used. Fungal vaccines are still **not available**.

Candida growth- Gram stain



Bacterial neurotoxins-1

- **Tetanus**: *Cl. Tetani* .. Gram-positive spore-forming bacilli .. Widely distributed in environments..Release Neurotoxin/tetanospasmin .. toxin of enters the body through an wound.. ..incubation period often 1-2 weeks.. disseminated to blood, lymphatics.. Acute disease of CNS.
- Toxin Interferes with release of neurotransmitters, blocking inhibitor impulses.. Causing prolonged painful contraction skeletal muscle fibers.. muscle spasm ..difficulty swallowing.. First signs Lockjaw.. Later muscle spasms in other body parts.

Bacterial neurotoxins-2

- **Tetanus** Infection can be prevented by protective vaccine..Tetanus Toxoid..Recent contaminated injury requires administration of tetanus immunoglobulin & Tetanus Toxoid
- **Botulism** ..*Cl. Botulinum*, Gram-positive spore-forming bacilli ..Widely distributed.. vegetations. Toxin performed in ingestion food, **blocks acetylcholine release** from peripheral nerves.. affects motor & autonomic nervous system.. Respiratory tract **Paralysis, Death**.. Specific antitoxin treatment can be helpful if available.

Cl.tetani-Cl.botulinum

