Bacterial Infection of Central Nerve System

3rd Year Medical Students

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Meningitis & Encephalitis-1

- Bacterial Infections of the brain and spinal cord cause dangerous inflammation.. Encephalitis/ Meningitis or both **Meningoencephalitis**
- Acute bacterial meningitis is associated with a wide range of symptoms, including fever, headache, neck stiffness, confusion, vomiting, photophobia..within few hrs.. Rarely mild/chronic..without symptoms..
- **Meningitis** results from infection of meninges.. often through blood stream...Less respiratory tract or other body sites infection.. intravascular catheter
- **Meningitis** is mostly caused by viruses (95%), bacteria (2-5%), Fungi (1%).. Affect all ages.. majority Infants & children aged < 5 years .

Common Cause of Acute Bacterial Meningitis

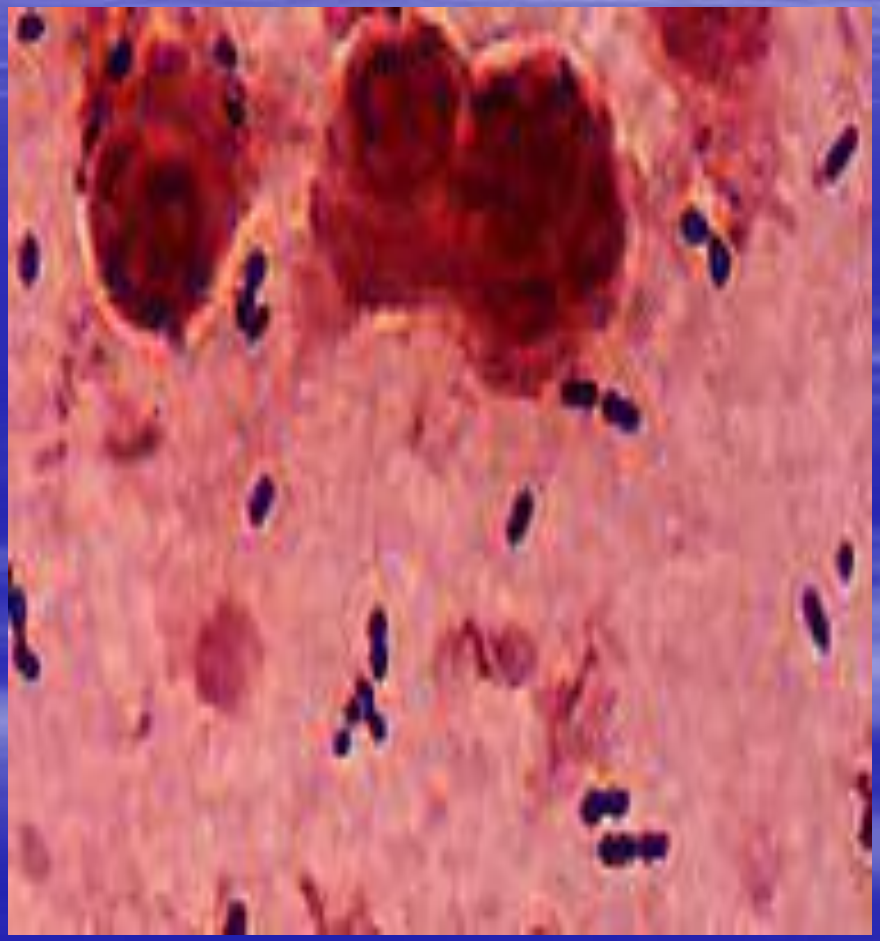
- **Pneumococcal meningitis** / *S. pneumoniae..* Gram+ve diplococcus.. Alpha-Hemolytic..Large polysaccharide capsule..numerous types..
- Most Pneumococcal invasive infections endogenous.. More serious than all causes of bacterial meningitis.. High mortality without rapid diagnosis & treatment
- Pneumococcal meningitis followed acute /sub acute pneumonia, septicemia, middle ear and nasal sinus infections
- **High risk factors:** children under age 5-year, elderly persons with immunodeficiencies, malignancy, sickle cell anemia, diabetes melitlitus, asplenia, ischaemic heart disease..**severe viral infections.. Measles, Influenza**

S. pneumoniae-2

- **Treatment:** Most *S. pneumoniae* strains in developing countries are Highly Penicillin-R, less resistance to erythromycin & tetracycline.. Mostly susceptible to vancomycin & Cefotaxime / ceftriaxone

- **Prevention: Pneumovax/Adults** contains 23-serotypes polyvalent polysaccharide bound to a protein, protection 60%–70% for one-year.
- **Prevenar /Children (**2 months to 2 year).. contains 13-selected polysaccharides serotypes.. 2 doses .. 90% protection.. Each 2-3 years.

S.pneumoniae Lab diagnosis
Blood culture-Optochin/ Gram-stain



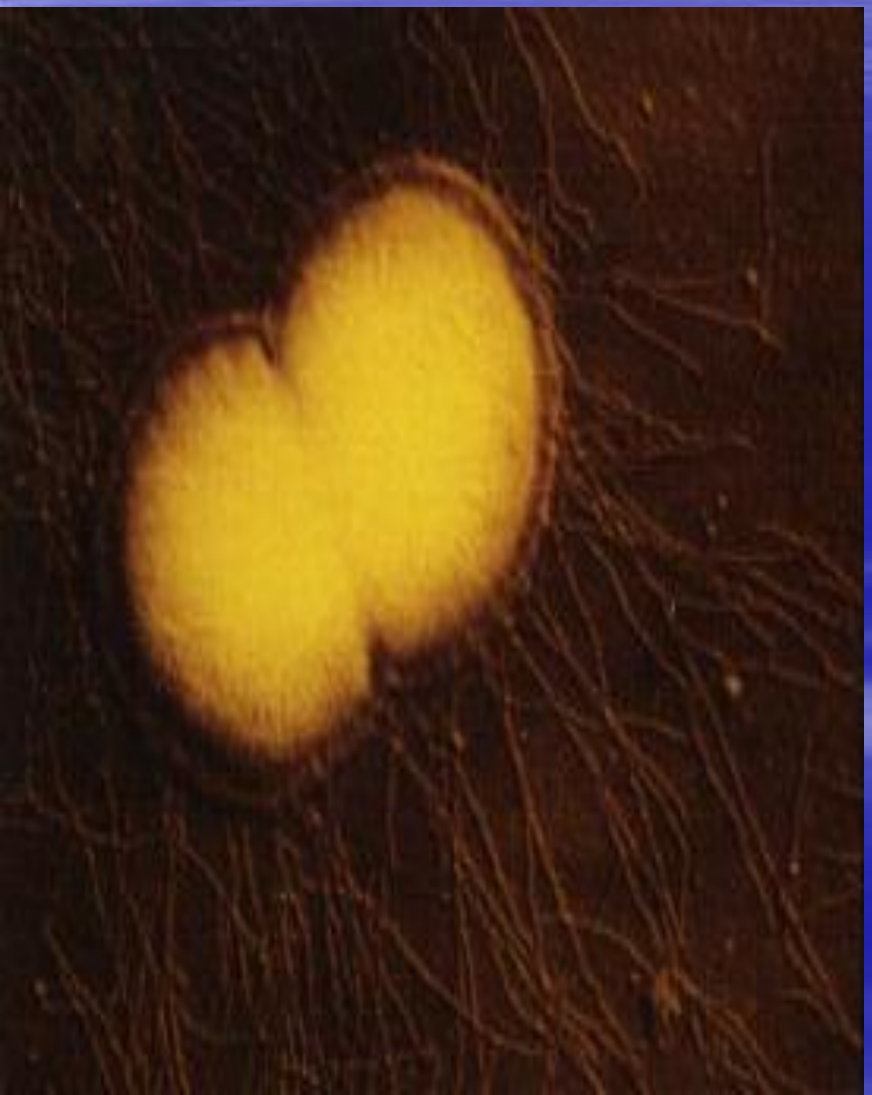
Meningococcal meningitis

- *Neisseria meningitidis*: Gram-negative diplococci..
- *Serotypes A, B. C, Y,W-135..* Nasopharynx.. Human only host.. Few% Respiratory Healthy carriers
- Highly susceptible to harsh conditions outside body.
- **highly contagious disease**.. Causing outbreak in schools, military camps. Endemic in tropics & subtropics countries in Africa and South America.
- **High-risk groups** include infants & children aged of 6 months - 3 year, Young adults & persons with suppressed immune systems..
- Non-pathogenic *Neisseria* species in nasopharynx contribute to host protection.

/2

- Clinical features: Mild sore throat..Headache, High fever, Neck stiffness, vomiting within 2 days.. Later without treatment.. Thrombosis small blood vessel, Disseminated Intravascular Coagulation (DIC), Hemorrhagic Skin Rash, Adrenal hemorrhage, Circulatory collapse & Death within hours.
- 10 -15 % of cases are fatal.. Another 10-15 % causing brain damage and other serious side effects.
- Capsular polysaccharide vaccine > 2 years & more
- **Treatment:** Generally low percentage of resistance to Penicillin, Cefotaxime / Ceftriaxone.. Rifampicin should be used in treatment of carriers/contact persons.

N.meningitidis-Pili
Gram-stain/intracellular



Haemophilus *influenzae*

- ***H. influenzae*** Nasopharynax.. Low % Healthy carriers for encapsulated type b.. More virulent & invasive than Other capsulated & non-capsulated strains.. High-risk children ages 5 months-5 years.. Rare adults.
- Acute menigitis followed .. Mild sore throat / pneumonia, chronic brochitis, empyema, sinusitis, otitis media, conjunctivitis in children
- Most common form of bacterial meningitis among young children worldwide before introduction **Hib vaccine 1990..** reduced the incidence of meningitis & carrier rate up to 95%.. Immunization children at age 2 , 4, 6 months. **Treatment:** Ceftriaxone, Cefotaxime

Virulence of Common meningitis Pathogens

Virulence Factors	*S. pneumonia*	*N.meningitidis*	*H. Influenzae* Type b
Capsule	+ Large	+ Thin	+ Thin
IgA Protease	+	+	+
Pili	-	+	+
Endotoxin & outermembrenes proteins	-	+	+

H. influenzae/ Coccobacilli-Short filaments - Listeria monocytogenes

Less Common bacterial Meningitis

- ***Group B Hemolytic Streptococci* (GBS)..**

  S. ***agalactiae ..*** Colonize 10-30% adult women vagina/ intestine.. common cause acute fatal neonatal pneumonia/ early-onset sepsis & meningitis.
- Infection is spread to infants mostly during delivery.. often swallow amniotic fluid during delivery.. higher among preterm infant.
- Any rapture of uterus following delivery may cause acute Endometritis.. Septicemia, Puerperal fever..
- Lab Diagnosis+ Treatment: CSF + Blood Culture ,Vaginal and rectal swabs women before delivery
- Amoxacillin, 2G-Cephalosporins

Listeria monocytogenes

- Gram-positive intracellular small bacilli.. Common in animals intestine.. Human Infection by contaminated milk/ dairy products.. Most infection found in immune suppressed host.
- Colonizing intestine.. May cause enteritis, mesenteric lymphadenitis, blood sepsis & meningitis in all ages.
- Rarely colonize female genital tract.. can cross the placental barrier..causing abortion in pregnant women or sepsis-meningitis in neonatal..High fatality without treatment..Difficult to detect infection.
- Lab Diagnosis+ Treatment: Blood /CSF Culture, Treatment: Co-trimoxazole, floroquinlones, aminoglycosides.

Less Common bacterial Meningitis-2

- **Enteric Bacteria:** Klebsiella, Enterobacter, Pseudomonas aeruginosa.. Gram-ve bacilli.. Following surgical procedure in spinal cord, Sepsis, Burn cases.. Mostly Nosocomial Infection, Multidrug Resistance
- *E. coli* : Common cause of sepsis & meningitis in **new born baby**.. Infant < 6 months.
- **Brucellosis:** Common *B. melitensis..* intracellular Gram-ve coccobacilli.. Septicemia.. few % associated with chronic meningitis & abscess in any body part .
- Treatment: combination Rifampin+Monocycline or ciprofloxacin.. Children co-trimoxazole .. 8 weeks.

Chronic meningitis & Brain Abscess-1

- **Mycobacteria tuberculosis** ....Less other types .. Acid-fast bacilli ..causes meningitis in young children with malnutrition more than adults following disseminated tuberculosis.. Less following lung tuberculosis.
- Culture growth: 2-6 weeks
- **Nocardiosis:** *N. asteroides,* Gram+ve coccobacilli slightly Acid-fast bacilli, Common in soil.. Inhalation, Chronic Lung lesions.. Immune suppressed..Chronic meningitis with brain abscess
- Culture growth :1-2 weeks
- Treatment: ciprofloxacin, Co-trimoxazole

Chronic meningitis & Brain Abscess-2

- Syphilis: *Treponema pallidum..* Tertiary stage or Congenital syphilis may cause Neurosyphilis with meningitis .. Diagnosed by serological test.. Difficult to be cured..Fatal

- **Lyme disease**: *Borrelia burgdorferi*.. Transmitted by Tick bites from animal skin/Deer.. skin rash mild sepsis.. Later involve joints, heart, CNS.
- Complication Meningitis-Encephalitis.. Common in USA, Canada, North Europe.
- **Lab Diagnosis:** Dark-field microscopy, Special fluid culture, Specific antibodies (IgG, IgM) ELISA, PCR
- Macrolides, Doxycyclines, Ceftriaxone

Fungal meningitis-1

- **Cryptococcosis:** *C.neoformans*..& other species.. This encapsulated yeast is found in the environment worldwide, particularly in soil contaminated with **bird droppings**. Enters the body most commonly through inhalation, start as lesion in sinuses/lung tissues. Infection develop slowly often in immuno-suppressed patients.. advanced AIDS, Lymphomas, Long-term corticosteroid & Toxic drugs therapy.
- Cryptococcus may spread from lung to meninges, skin, prostate gland.. Fatal without treatment.
- Cryptococcal meningitis & brain abscess develop very slow, chronic, CNS vague symptoms, mild/sever headache, fever. Clinical & laboratory diagnosis.

Fungal meningitis-2

- **Candidasis**: *C.albicans, C.glabrata*, Others.. Lung.. blood Infection.. Rare meningitis.. compromised host.
- **Histplasmosis:** *H. capsulatum,* Blastomycosis: *B. dermatitidis*.. Inhalation, mostly asymptomatic infection Diamorphic fungi (Yeast & filmentous forms).. Lung, Systemic, Oral mucosa ..Skin lesions..Meningitis, Immune deficiency, Both infection may ended in chronic meningitis.
- Lab Diagnosis: Direct CSF exam, Culture Sabouraud Dextrose agar, Blood agar.. Incubation 1-4 weeks.
- Serological methods are not useful.
- Treatment: Systemic Amphotericin B+ Flucytosine, fluconazole No Vaccine.

Laboratory Diagnosis of Bacterial meningitis

- **All CSF specimens** should be sent rapidly for the following investigation: WBC count, Level of glucose+ protein
- **Bacterial menigitis:**
- Cloudy fluid, glucose level ≤ 40 mg/dL (normal: 45-85), Protein level >50 mg/dL (normal:15-45), numerous WBCs /predominance neutrophils 200 > 20000/uL
- **Fungal meningitis:**
- Mild/not cloudy fluid, little change in glucose + protein levels.. 100-1000 uL WBCs.. mostly Lymphocytes.
- **Tuberculosis meningitis:** Mild cloudy fluid, little change in glucose + protein levels.. 100-1000 uL WBCs/ Lymphocytes
- **Late CNS Syphlis:** Clear fluid.. Normal Glucose.. slight elevation Protein.. Few WBCs

Bacterial Antigen Test

- Direct AntigenTests are available to detect bacterial antigens in the CSF for diagnosis of *S. pneumoniae, N. meningitidis, H. influenzae* type b, group A, B *Streptococcus , Listeria, Mycobacteria*
- 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) detect bacterial DNA now available mostly in reference laboratories.