Bacterial Infection of Central Nerve System

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Meningitis & Encephalitis

- 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** 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 melititus, 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.
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** Nasopharynx.. 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

<table>
<thead>
<tr>
<th>Virulence Factors</th>
<th>S. pneumonia</th>
<th>N. meningitidis</th>
<th>H. Influenzae Type b</th>
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<tbody>
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<td>Capsule</td>
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H. influenzae/ Coccobacilli-Short filaments - Listeria monocytogenes
Less Common bacterial Meningitis

- **Group B Hemolytic Streptococci (GBS)**
  - 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
  - **Amoxicillin**, 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, floroquinolones, 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.
- **Treatment**: combination Rifampin+Monocycline or ciprofloxacin. Children co-**trimoxazole**. 8 weeks.
Chronic meningitis & Brain Abscess

- **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 & filamentous 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 meningitis:**
- 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 Syphilis:** Clear fluid.. Normal Glucose.. slight elevation Protein.. Few WBCs
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*, *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.