

CNS II

Microbiology Lecture I

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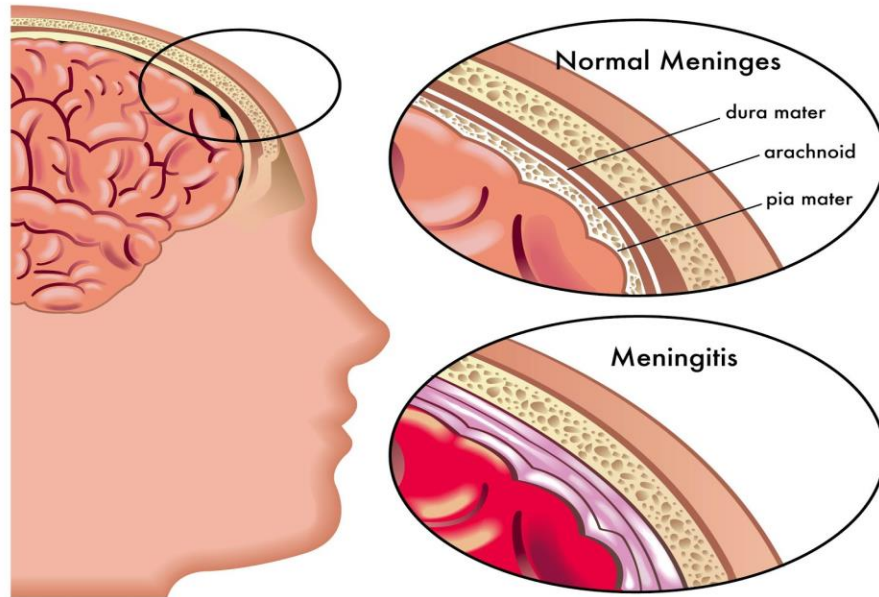
Central nervous system infections

- Meningitis (lectures 1 and 2)
 - Purulent
 - Aseptic
 - Chronic
- Encephalitis “meningioencephalitis” (lecture 3)
- Prion Diseases (lecture 4)
- Others CNS infections (lecture 5):
 - Brain abscess
 - Parameningeal infections
 - Toxoplasmosis
 - African trypanosomiasis
 - Cerebral malaria



Meningitis

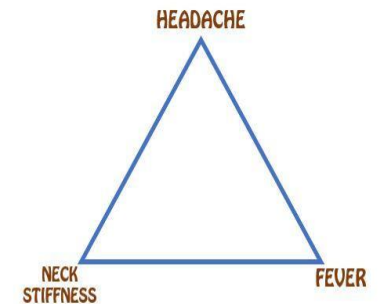
- Meningitis is a clinical syndrome characterized by inflammation of the meninges.



Presentation

- Meningitis usually presents as a classic triad of fever, headache, and neck stiffness.
- Other symptoms include the following:
 - Nausea
 - Vomiting
 - Photophobia: discomfort when the patient looks at bright lights
 - Altered mental status: sleepiness, confusion, irritability, delirium and coma.
- Atypical presentations:
 - **Infants** may present mainly with restlessness, poor feeding, vomiting, bulging fontanelle and altered breathing patterns.
 - The **elderly** may present mainly with a decline in the level of awareness.

Meningitis TRIAD



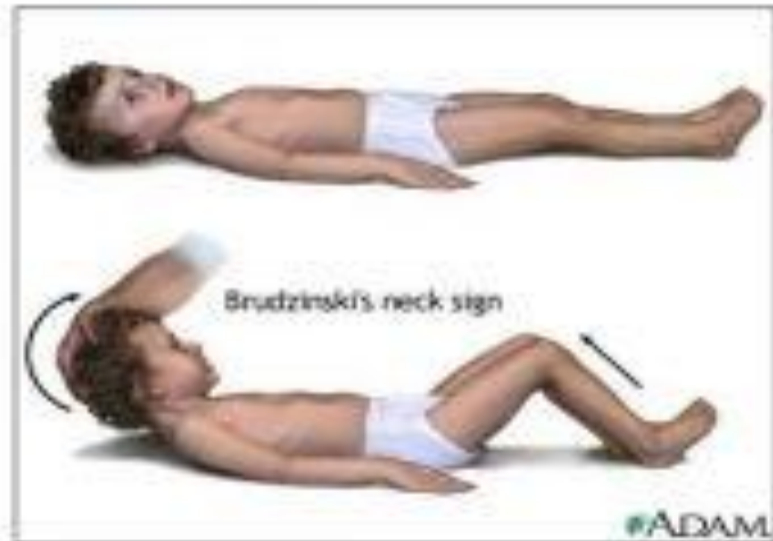
Physical exam

- Physical examination should target the following areas:
 - Vital signs; high temperature (fever).
 - The skin; looking for the petechial rash of meningococemia or genital lesions for HSV infection.
 - The tympanic membranes, looking for evidence of otitis media as a portal of entry for pneumococcal meningitis.
 - The optic disks, looking for evidence of papilledema (occurs due to increased intracranial pressure) as a relative contraindication to lumbar puncture.
 - Signs of meningeal irritation.



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- Meningeal irritation can be assessed in at least four ways:
 - **Anterior neck flexion:** With the patient supine, ask the patient to flex the head forward “Put his head on his chest”. Neck stiffness is present when the patient experiences pain on anterior flexion.
 - **The jolt test:** Ask the patient to turn his or her head from side to side at a frequency of 2 to 3 rotations per second. The jolt sign is present when this maneuver worsens the patient’s headache.
 - **Kernig’s sign:** With the patient supine and the hip flexed at 90 degrees, the knee is extended. Kernig’s sign is positive when the patient experiences pain or resistance in the lower back or posterior thigh.
 - **Brudzinski’s sign:** With the patient supine and holding the patient's head, flex the head so that the chin touches the chest. Brudzinski’s sign is positive when the patient flexes the knees and hips in response to this maneuver.





One of the physically demonstrable symptoms of meningitis is Brudzinksi's sign. Severe neck stiffness causes a patient's hips and knees to flex when the neck is flexed.

Another of the physically demonstrable symptoms of meningitis is Kernig's sign. Severe stiffness of the hamstrings causes an inability to straighten the leg when the hip is flexed to 90 degrees.



Laboratory tests

- If a patient is suspected to have meningitis; identification and treatment of the causative organism should be done as soon as possible. Meningitis is a **medical emergency**.
- If there are no radiological contraindications (no raised intracranial pressure), a **lumbar puncture** should be promptly performed. Three tubes are obtained one for the chemistry lab, one for the hematology lab and one for the microbiology lab.
- Other laboratory tests, may include:
 - Blood cultures (can support the result of CSF culture)
 - Special studies, such as serum serology and nucleic acid amplification (PCR), may also be performed, depending on clinical suspicion of the offending organism.



CSF Analysis

TABLE S-19 Findings of Cerebrospinal Fluid Analysis: Normal versus Infection					
CLINICAL SITUATION	LEUKOCYTES/ MM³	% POLYMORPHONUCLEARS	GLUCOSE (% OF BLOOD)	PROTEIN (MG/D)	<i>Appearance</i>
Children and adults					
Normal	0-5	0	≥60	≤30	Clear
Viral infection	2-2000	≤50 <i>mainly lymphocytes</i>	≥60	30-80	Clear
Pyogenic bacterial infection	5-5000	≥60 <i>mainly neutrophils</i>	≤45 ^b	>60	Cloudy
Tuberculosis and mycoses	5-2000	≤50 <i>mainly lymphocytes</i>	≤45	>60	Cloudy
Neonates					
Normal (term)	0-32	≤60	≥60	20-170 (90)	
Normal (preterm)	0-29	≤60	≥60	65-150 (115)	

^bUsually very low.



Nucleated White Blood Cells (leukocytes)

Polymorphonuclear Cells (Granulocytes)



Neutrophils



Eosinophils



Basophil

Mononuclear Cell



Lymphocyte



Monocyte



Meningitis

- Purulent meningitis:
 - *Streptococcus pneumonia*
 - *Neisseria meningitides*
 - *Hemophilus influenza type B*
 - *Streptococcus agalactiae*
 - *Listeria monocytogenes*
 - Gram negative rods (*E. coli*, *Klebsiella pneumonia*, *Proteus species*)
 - *Staphylococcus aureus*
- Aseptic meningitis.
- Chronic meningitis.



Purulent meningitis

- Purulent meningitis is caused by bacteria.
- Most cases of purulent meningitis are **acute** in onset and progression and are characterized by fever, stiff neck, irritability, and varying degrees of neurologic dysfunction, which, if untreated, usually progress to a **fatal outcome**.
- Large numbers of PMNs (neutrophils) are present in the cerebrospinal fluid (CSF) of established cases.



TABLE S-16**Common Causes of Purulent Central Nervous System Infections**

AGE GROUP	AGENT
Newborns (<1 mo)	Group B streptococci (most common), <i>Escherichia coli</i> , <i>Listeria monocytogenes</i> , <i>Klebsiella</i> species, other enteric Gram-negative bacteria
Infants and children	<i>Streptococcus pneumoniae</i> , <i>Neisseria meningitidis</i> , <i>Haemophilus influenzae</i>
Adults	<i>S pneumoniae</i> , <i>N meningitidis</i>
Elderly	<i>S pneumoniae</i> , <i>Listeria monocytogenes</i>



Streptococcus pneumoniae

- *S. pneumoniae* are gram positive diplococci.
- *S. pneumoniae* is now the most common cause of community-acquired bacterial meningitis when all age groups are considered.
- It can colonize the nasopharynx and escape host defenses by virtue of its polysaccharide capsule.
- Meningitis caused by *S. pneumoniae* is usually preceded by bacteremia, sinusitis or otitis media.
- There are two pneumococcal vaccines available for high-risk groups.



Neisseria meningitidis

- *N. meningitidis* are gram negative diplococci.
- The second common cause of bacterial meningitis.
- Meningitis caused by *N. meningitidis* is associated with meningococemia and petechial hemorrhages.
- It can colonize the nasopharynx and escape host defenses by virtue of its polysaccharide capsule.
- Transmitted via respiratory and oral secretions. Easily spreads during close contact. High incidence of transmission at military recruiting centers, dorms, between family members, etc.
- There are two meningococcal vaccines available for high-risk individuals.



Hemophilus influenzae

- Does **not** cause the flu (influenza virus does).
- Gram negative coccobacilli.
- Different strains are present. Among other serious illnesses; *H. influenzae* type B is also a major cause of meningitis. Other strains cause other diseases such as otitis media.
- Widespread vaccination of young children against *H. influenzae* type B now makes this form of meningitis uncommon.
- *H. influenzae* type B can colonize the nasopharynx and to elude host defenses by virtue of its polysaccharide capsule. *H. influenzae* is transmitted via respiratory secretions.



Streptococcus agalactiae

- Group B streptococci or *S. agalactiae*.
- Gram positive streptococci (in chains)
- *S. agalactiae* colonizes the female genital tract at a rate of 5-40%, which explains why it is the most common agent of neonatal meningitis. Babies get infected as they pass the birth canal.



Listeria monocytogenes

- *L. monocytogenes* are gram-positive intracellular bacilli.
- *L. monocytogenes* is an important cause of meningitis in neonates (vaginal transmission during birth), the elderly and in immunosuppressed patients.
- Meningitis due to *Listeria monocytogenes* usually has a less dramatic, more sub-acute onset compared to meningitis caused by *S. pneumoniae*, *H. influenzae* type B, or *N. meningitidis*.
- Listeria infection can cause spontaneous abortions in pregnant females (transplacental transmission).



Treatment of purulent meningitis

- Empirical treatment: is given in cases strongly suspected of being meningitis **after** taking the lumbar puncture.
- Empirical treatment is age dependent:

Age	Empirical treatment
Less than 1 month	Ampicillin + cefotaxime
Children and adults	Vancomycin + third generation cephalosporin
Elderly >50 years	Vancomycin + third generation cephalosporin + Ampicillin

- Third generation cephalosporins: cefotaxime or ceftriaxone.



- Specific therapy

Causative agent	Treatment
<i>S. pneumonia</i>	Penicillin G or third generation cephalosporin
<i>N. meningitidis</i>	Ceftriaxone or cefotaxime
<i>H. influenza</i>	Ceftriaxone or cefotaxime
<i>S. agalactiae</i>	Penicillin G or third generation cephalosporin
<i>L. monocytogenes</i>	Ampicillin and gentamycin
Gram negative rods	According to culture and sensitivity results, usually a third-generation cephalosporin.



Thank you 😊

