Lecture – 2

Microbiology of Acute Pyogenic Meningitis

Microbiology Team - 430

Nervous System Block

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❖ Classification :

1. Acute pyogenic meningitis (bacterial).
2. Acute aseptic meningitis (viral).
3. Acute focal supportive infection (brain abscess, subdural and extradural empyema
4. Chronic bacterial infection (TB) + (Fungal)

❖ Definition :

- An inflammation of the meninges affecting Pia, Arachnoid and subarachnoid space.
- Fatal if untreated, should be treated immediately.
- Serious infection, associated with marked inflammatory exudation.
- May be preceded by URTI.

❖ Causative Organisms :

1. ***Neisseria meningitidis [N. meningitidis]***
2. ***Sterptococcus pneumoniae [S. pneumonia]***
3. ***Hemophilus influenzae [H. influenza]***

Age Group	Organism
Neonates (0 -1 month).	**Group B streptococcus + E.coli** + Listeria
2 – 18 months (Children).	N.meningitidis + S. pneumonia **+ H.influenza**.
Adults	N.meningitidis + S. pneumonia+ + H.influenza
Old patients	N.meningitidis + **S. pneumonia** + Listeria
Special circumstances.	S.aureus, S.epidermidis, S.pneumoniae, anaerobes, R.aeruginosa

- S.aureus → Pt. with history of fracture (trauma) or Immunocompromised Pt.
- S.epidemidis → Pt with history of shunt from the brain.
- S.pneumoniae → Immunocompromised Pt. (elderly)
- Anarobes → History of surgery, Pt. with abscess.
- P.aeruginosa → Immunocompromised Pt, history of O.M or skull trauma.

❖ Epidemiology :

- Bacterial meningitis is 1 of the top 10 infections that causes death worldwide.
- Half of the survival suffers neurological damage, and /or permanent side effects.

❖ Signs/Symptom :

Most Common in general	In infants	Advanced Disease
- Fever - Headache - Stiff neck - Nausea & vomiting	- Inactivity - Irritability - Vomiting - Poor feeding.	- Brian damage - Coma - Death

- Sensitivity to light ,Confusion	- They may present with hypothermia.	

❖ Pathogenesis / Risk Factors :

- Nasopharynx colonization.
- Through Blood [Septicemia, it cross the Blood Brain Barrier]
- Immune-compromised patients (they get the infection from carriers who carry colonized normal flora).
- Skull fractures [Trauma to the base of the skull --> weakest part] (Pt . will be presented with CSF nose leaking)(Pt. is susceptible to S. pneumonia)
- Loss of spleen [Patients with no spleen will lose the ability to opsonize the capsulated bacteria, that's why they should be vaccinated].

- Colonization of the nasopharynx (or from birth canal) ⟶ Septicemia ⟶cross BBB⟶Wide spread endothelial damage⟶ Activation of coagulation⟶Thrombosis & platelets aggregation ⟶Bleeding (skin rash & adrenal hemorrhage. (hemorrhage because number of platelets in the body reduced).

❖ N.meningitidis:

- A Gram negative diploococci present in the nasopharynx of 10 % of people.
- Transmitted by inhalation of aerosolized droplets (close contact).
- Serotypes: **B, C, Y, W135** cause isolated, sporadic small epidemics in close population. (Exp. In schools).
- Serotype **A** has an epidemic potential in sub-Saharan Africa (meningitis belt). (It's an area in Africa where this organism is spread widely).

❖ Pathogenesis –N.meningitidis:

- Carriers stimulate antibody production **
- Capsule resists Phagocytosis.
- 11-20 % of recovered patients suffer permanent hearing loss, mental retardation & 10 -14 %of the cases are fetal

** (They carry N.meningitidis as colonized normal flora in the nasopharynx ⟶ they have Antibody against it ⟶ no disease.) However, those people can transmit the organism to other people if they are Immunocompromised).

❖ S.pneumoniae:

- A Gram positive diplococcic, meningitis may follow pneumococcal pneumonia.

- May develop after trauma to the skull.
- **High mortality rate >30% due to invasive disease**. (it's the most sever organism)
- Capsule is polysaccharide polymer
- Pneumolysin decreases inflammatory immune response ⟶ severe infection.
- Infection rate decreases due to vaccination.
- Recovered cases develop sustain learning disabilities (paralysis).

❖ H.influenzae

- Small Gram negative coccobacilli.
- Has polysaccharide capsule..
- Need blood for optimal growth, Hematin (factor X) and NAD (factor V)
- Many serotypes a-f.
- *H.influenza* type *b* has a capsule, a polymer of RPR, cause acute life threatening invasive infections.
- Found in the nasopharynx normal flora
- Infection rate decreases since the routine use of ***Hib*** vaccine. (Hib vaccination covers b serotype)

- Hematin = Factor in the RBCs.
- Factor V = comes from destroyed RBCs
- NAD = Factor in the RBCs needed for V factor growth.

❖ Group B Streptococcus:

- Gram positive cocci in chains.
- Resident in GIT & vagina (10-30%)
- Gain access to amniotic fluid during delivery or colonize newborn as it passes birth canal.
- *Risk factors*: premature rupture of membrane, prematurity, low infant innate immunity
- Cause sepsis & meningitis in the first few days of life or after 4 weeks.

We have to do screening tests for pregnant women after week 35 for GBS. If it's +, we have to give her prophylaxes. Otherwise, the organism will access to amniotic fluid during delivery causing sepsis & meningitis to the baby.

❖ E.coli:

- Gram negative bacilli.
- Most common cause of neonatal meningitis
- Many features similar to GBS.
- Vaginal *E.coli* colonize infant via rupture of amniotic membrane or during birth.

- Failure of preterm maternal IgM to cross placenta& special susceptibility of newborn.
- K1 sialic acid capsule of some strains ⟶ invade brain microvascular endothelial cells.

❖ Listeria monocytogenes:

- Gram positive rods.
- Wide spread among animals in nature including those associated with food supply.
- Human intestinal colonization (2-12%).
- Spread to fetus following hematogenous dissemination in mother or from birth canal.
- Has tropism to CNS.

❖ Diagnosis :

- Clinically
    - History of fever
    - URTI not treated.
    - Neck stiffness.
- Specimen:
    - Blood work [CBC] + [Blood culture]. (looking for septicemia & because only 30% of cases showing Positive SCF culture)
    - CSF sample [Lumbar Puncture]
        - Analysis of cells, protein, glucose, culture.
- Antimicrobial susceptibility testing.

Keep in mind that in SCF analysis the glucose will be dropped. While, the protein will be increased.

❖ Management :

- **The drug of choice = Cefotaxime,**
  except for neonates and old patients = Ampicillin.

Drug	Age Group
Cefotaxime + Vancomycin	Adults
Ampicillin + Gentamicin (we use Gentamicin to cover E.coli)	Neonates
Ampicillin	Elderly
Cefotaxime + Vancomycin	Children.

- The drugs of choice for treating meningitis is **ceftriaxone** in all age groups & if we suspected S.pneumoniae, add Vancomycin. If the Pt. is neonate or elderly we use **Ampicillin + Gentamicin**.

❖ Prevention :

- By vaccination against N.meningitidis and all its groups except for Group B *N.meningitidis.*

❖ Summary:

1. Common causative organisms in adults are ***N. meningitides, S. pneumonia, and H. influenza.***
2. Common organism in the neonate is E.coli & in children is H.influenza
3. Common signs and symptoms are Fever, Headache, Stiff neck, Nausea & vomiting and Sensitivity to light.
4. Diagnosis is reached :
    1. Clinically.
    2. Specimen:

- Blood work [CBC] + [Blood culture]
- CSF sample [Lumbar Puncture]

    3. Analysis of cells, protein, glucose, culture.

5. In the SCF analysis the glucose will be dropped & the protein will be high.
6. The drugs of choice for treating meningitis is ceftriaxone in all age group & if we suspected S.pneumoniae, add Vancomycin. If the Pt. is neonate or elderly use ampicillin + Gentamicin
7. Prevent the infection by vaccination against N.meningitidis and all its groups except Group B. N. meningitides.