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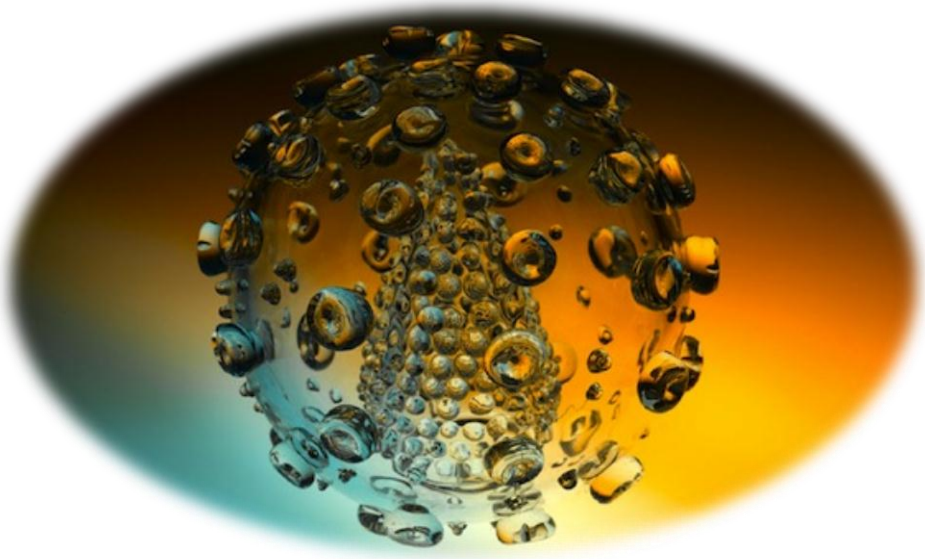
Microbiology Team

CNS BLOCK



ACUTE PYOGENIC MENINGITIS

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Definition :

- Pyogenic meningitis is an inflammation of the meninges affecting Pia, Arachnoid and subarachnoid space.
- A serious infection, associated with marked inflammatory exudation.
- Acute in onset (starts suddenly)
- Usually caused by **bacterial infections**.
- May be preceded by URTI.
- Can be **fatal** if untreated.

Viral or Parasitic meningitis called:
Aseptic Meningitis.
TB or Fungal meningitis called:
Chronic bacterial infection

Common Etiologic Agents

- *Neisseria meningitidis* (N. meningitidis)
- *Sterptococcus pneumoniae* (S. pneumonia)
- *Hemophilus influenzae* (H. influenza)

Causes According to the Age:

Newborns (0-1 month)	• ***Group B Streptococcus*** (beacuse it is in the genital tract of the mother • ***E.coli*** (and other gram negative bacilli) • ***Listeria monocytogenes***
Infants / Children	• ***S.pneuomiae*** • ***N.meningitidis*** • ***H.influenzae*** *(because children up to 5 years don't have antibodies against H.influenzae, but it still can cause meningitis in adults)*
Adults	• ***S.pneumoniae*** • ***N.meningitidis***
Elderly	• ***S.pneumoniae*** • ***N.meningitidis*** • ***Listeria monocytogenes***
Special circumstances (Trauma)	• ***S.aureus*** ➔ Patient with history of fracture (head trauma). • *S.epidermidis* ➔ Patient with history of shunt from the brain. • ***S.pneumoniae*** ➔ Immunocompromised patient or patient with ***otitis media.*** • anaerobes ➔ Pateints with abscess. • *P.aeruginosa.*

Epidemiology:

Worldwide , there are 1.2 million cases annually& 135,000 deaths.

Bacterial meningitis is one of the top 10 infections causes death worldwide.

Half of the survivals suffer neurological damage, and /or permanent side effects.

Signs/Symptoms of Acute Meningitis:

Most Common: • fever • Headache • Stiff neck • Nausea & vomiting • Sensitivity to light ,Confusion	**Advanced Cases:** • Bruises under skin • Rapidly spread
In infants: • Inactivity • Irritability • Vomiting • Poor feeding • In rare cases may present with hypothermia	**Advanced Disease:** • Brain damage • Coma • Death

Pathogenesis :

Colonization of nasopharynx (or from birth canal) ➔ Speticemia ➔ blood brain barrier ➔

Wide spread endothelia damage ➔ Activation of coagulation ➔

Thrombosis and 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.
- Common in children < 6 y
- Serotypes: **B,C,Y,W135** cause isolated ,sporadic small epidemics in close population.
- There are vaccines for all serotypes **except serotype B**
- Serotype A is the most common type in Africa.
- Serotype W135 is the most common type in south East Asia.

- Why do some people carry N.meningiditis without having meningitis ?!
Because they carry N.meningitidis as colonized normal flora in the nasopharynx, so they have antibody against it ➔ no disease. However, those people can transmit the organism to other people if they are Immunocompromised).

Pathogenesis of N.meningitidis :

- Carriers stimulate **antibody production**,

- In some, pili attach to microvilli of nasopharynx ➔ invasion ➔ bacteremia, **endotoxin (LPS)** produced ➔ **meninges.**

- Capsule resists phagocytosis.

-11-20 % of recovered patients suffers permanent hearing loss, mental retardation.

-10-14% of cases are fatal.

S.pneumoniae:

Alpha **hemolytic Gram positive diplococci**, meningitis may follow pneumococcal pneumonia, or other site.

May develop after trauma to the skull.

High mortality rate > 30% due to invasive disease. <-- (Most dangerous cause of meningitis)

Capsule is polysaccharide polymer which will protect the bacteria from phagocytosis

Pneumolysin decreases inflammatory immune response ➔ severe infection.

Infection rate decreases due to **vaccination** .

Recovered cases develop sustained learning disabilities .

H.influenzae:

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

A small **Gram negative coccobacilli**

Has polysaccharide capsule, other species has no capsule.

Need blood for optimal growth, Hematin (factor X) and NAD (factor V)

Many serotypes a-f,

H.Influenzae **type b** has a capsule, a polymer of PRP (polyribosyl ribitol phosphate), cause acute life threatening invasive infections.

H.Influenzae –continue …

Found in the nasopharynx normal flora

Major cause of **lower RTI**, occasionally invades deeper tissues and cause bacteremia.

Bacteremia ➔ CNS ,bones or other organs.

3-6% mortality rate (most mild cause of meningitis)

Infection rate decreases since the routine use of **Hib (H.influezae type B) vaccine**.

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 and after 4 weeks. (Also infant can get it from the **nursery**).

> 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:

A Gram negative bacilli

Most common cause of neonatal meningitis

Many features are 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 hematognous dessimination in mother or from birth canal

Has **tropism to CNS**.

Diagnosis of Meningitis:

- Clinically
- Specimen : **CSF** acquired through lumbar puncture for :

Analysis of cells, protein, glucose.

Culture and antimicrobial susceptibility testing.

Findings of CNS analysis:

Normal CSF:

Adults:

- WBC =0-5 /cmm3,
- PMN= 0 %,
- glucose= > 60 % of blood,
- protein =< 30 mg/dl
- chloride = 115-130 mmol/l

Neonates:

Term :

- WBC =0-32 /cmm3,
- PMN=>60 %
- Glucose = >60 % of blood,
- Protein= 20-170 mg/dl

Preterm:

- WBC=0-29/cmm3,
- PMN= <60 %, glucose = >60 % of blood,
- Protein= 60-150 mg/dl

Pyogenic meningitis:

- **WBC= 5 - 5000/cmm3**
- PMN= > 60%
- **Glucose = < 45 % of blood**
- Protein= >60 mg/dl **(High protein level)**
- Chloride= 110 mmol/l

CSF analysis the glucose will be dropped; protein and WBC levels are increased.

Management:

Urgent, A MEDICAL EMERGENCY

Antibiotics after taking specimens for lab diagnosis

- **Parenteral** (Injection, IV or IM) administration of **Ceftriaxone (or Cefotaxime) + Vancomycin (*cover the main 3 pathogens*) – [adults]** or,

- **Amplicillin** (for Group B streptococcus) **+ Gentamicin** (for E.coli) **or Amplicillin + Cefotaxime (*neonates*)**

It is better to give neonate patients cefotaxime rather than ceftriaxone! (Because ceftriaxone may cause **Jaundice**)

Duration : **10-14 days** (or more) according to the medical condition (less than 10 days cause relapse)

Prevention: **vaccination , prophylaxis of contacts (*Hib & N.meningitidis*)**

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**.

Summary:

- Common signs and symptoms are **Fever, Headache, Stiff neck, Nausea & vomiting and Sensitivity to light**.
- Diagnosis is reached :
  - Clinically.
  - Specimen:
- Blood work [**CBC**] + [**Blood culture**]
- **CSF sample** [Lumbar Puncture]
- Analysis of cells, protein, glucose, culture.
- **In the SCF analysis the glucose will be dropped & the protein and WBC will be high.**
- The drugs of choice for treating meningitis is **ceftriaxone in all age group &** if we suspected S.pneumoniae, add Vancomycin**. If the Patient is neonate we add ampicillin**
- Prevent the infection by vaccination against N.meningitidis and all its groups except Group B. N. meningitides.

Organisim	Gram stain	Age Group
S.pneumoniae	Gram positive cocci in chains and pairs	Adults
N.meningitidis	Gram negative diploococci	
E.coli	Gram negative bacilli	neonates
H.influenzae	Gram negative coccobasilli	Children
Listeria monocytogenes	Gram positive bacilli	Neonates or Elderly

Questions

Q1: A 24 year old medical student present with fever, headache, vomiting and irritation. CSF gram stain shows gram positive cocci in chains and pairs?

a- S.pneumoniae

b- N.meningitidis

c- E.coli

d- H.influenzae

e- Listeria monocytogenes

Q2: which one of the following Serotype does not have a vaccine?

a- Serotype Y

b- Serotype C

c- Serotype B

d- Serotype W135

Q3: In the CSF findings of a patient with Acute Pyogenic Meningitis which of the following will be deceased?

a- WBC

b- Glucose

c- Protein

d- PMN

Answers: 1-a, 2-c, 3-b