# Microbiology

# of

# Acute

# Pyogenic Meningitis


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**Microbiology of Acute Pyogenic Meningitis**

## Meningitis :

is an infection of the meninges around the brain and spinal cord ( pia matter , arachnoid matter + subarachnoid space which contain CSF ) . Meningitis is usually caused by an infection with a virus, with a bacterium or even with fungi.

## Pyogenic meningitis :

- 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.
- Usually caused by bacterial infections
- May be preceded by URTI.
- Can be fatal if untreated.

## Common etiological agent :

Three main bacterial species :

1- ***Neisseria meningitidis***
2- ***Sterptococcus pneumoniae*** } usually from URT
3- ***Hemophilus influenzae***

### Properties :

- They are capsulated
- They have vaccine ⟶ so it 's preventable
- They all sensitivee to Ceftriaxone ⟶ so it is the first drug of choice

## Causes According to the Age :

| | |
|---|---|
| **Newborns** | **Group *B Streptococcus*, *E.coli* (and other gram negative bacilli ) , *Listeria monocytogenes*, ( they can be in the genital tracts of the mother so the child will present of septicemia meningitis ) (New borns don't get H.influenzae in the first 6 months because of the IgG's from the mother )** |
| **Infants / Children** | *S.pneuomiae, N.meningitidis, H.influenzae* |
| **Adults** | *S.pneumoniae, N.meningitidis* |
| **Special circumstances** | *S.aureus, S.epidermidis, S.pneumoniae*, anaerobes, *P.aeruginosa* |

For best treatment you need to know the most common organism

## Meningitis- Epidemiology :

- There are 1.2 million cases annually worldwide.
- 135,000 deaths.
- Bacterial meningitis is 1 of the top 10 infections causes death worldwide.

- Half of the survivals suffer neurological damage, and /or permanent side effects
- And it is still kill the people

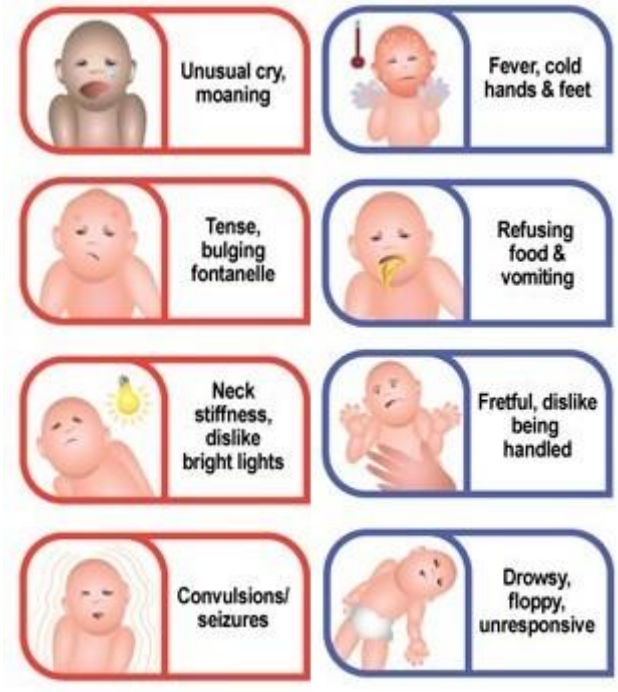
( people who died due to meningitis , they die due to STRONG IMMUNE response of their body which kill the body before killing the organism )

## Signs/Symptoms of Acute Meningitis :

(*Symptoms of meningitis can come on very quickly or take a couple of days to appear. Most cases of meningitis occur in the first 5 years of life, with the peak incidence between 3 and 5 months* )

In the adults and children :


In infants :

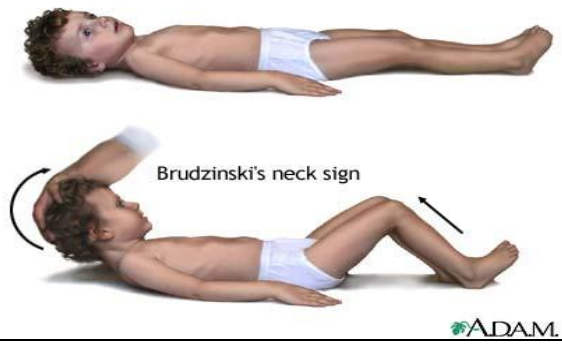
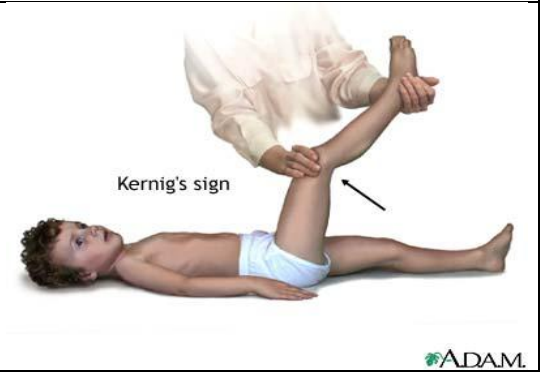


In advanced case : ( in infants , children and adults )

( bruises and rashes under skin & spread rapidly )

Can leads into advanced disease , such as: ( Brain damage , Coma , death)

New born present with hyperthermia but he adults mostly present with hypothermia

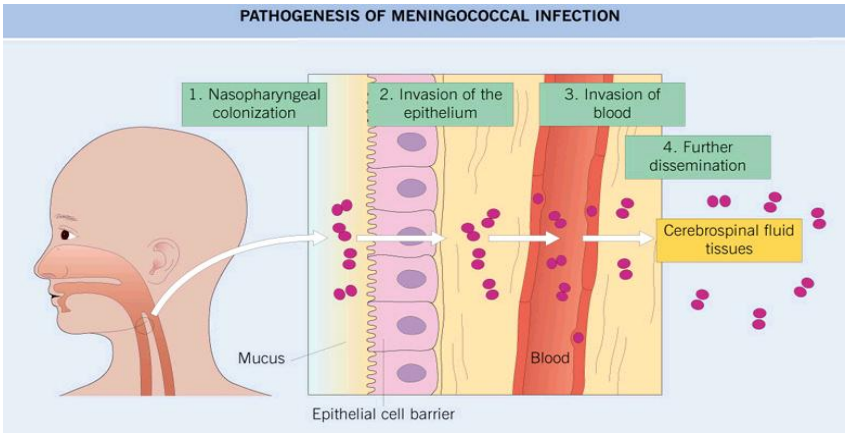
| Brudziński neck sign | Kernig's sign |
|---|---|
| clinical sign in which forced flexion of the neck elicits a reflex flexion of the hips. | when the leg is bent at the hip and knee at 90 degree angles, and subsequent further extension in the knee is painful (leading to resistance) |
|   |   |

Pathogenesis :

Colonization of nasopharynx ( or from birth canal) ⟶
Speticemia ⟶ BBB ⟶ Lead to :

Wide spread endothelia damge ⟶ Activation of coagulation ⟶ Thrombosis and platelets aggregation

(Meningococcal infection results from blood-born dissemination (meningococcemia) of N. meningitidis following an asymptomatic or mildly symptomatic nasopharyngeal carrier state or mild rhinopharyngitis. )

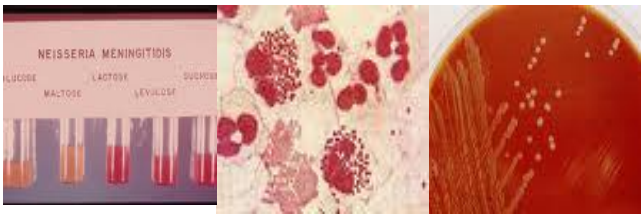



Why we don't get colonization of nasopharynx :

In the throat there is Normal flora ( Nesseiria ) which produce Antibody that can fight the other bacteria : ))

## *1- N.meningitidis* : ( NEISSERIA MENINGITISIS )

- 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 ( can occur in 20's too )
- Risk factor: susceptible individuals.
- Serotypes: **B,C,Y,W135** cause iso lated ,sporadic small epidemics in close population.
- T Serotype **A** has an epidemic potential in sub-saharan Africa (meningitis belt).
- We don't have vaccine for B
- W135 found here in KSA

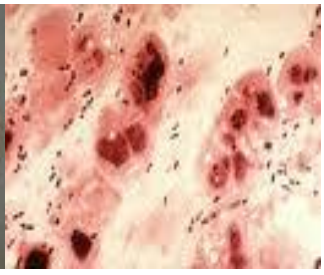


## Pathogenesis :

- 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 suffer permanent hearing loss, mental retardation.
- 10-14% of cases are fatal.
  ( if there is not WBC's that's mean the organism succeeded to suppress the immune system )

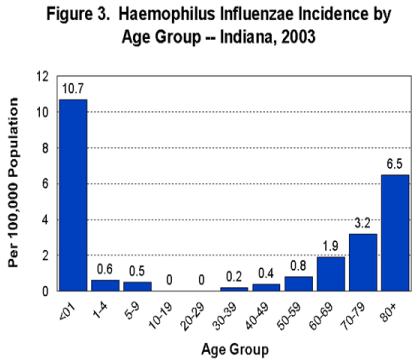
## 2- S.pneumonia ( Most dangerous )

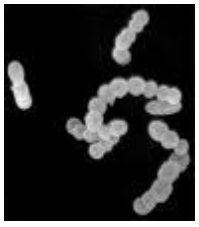
- a Gram positive diplococci ,meningitis may follow pneumococcal pneumonia ,or other site .
- May develop after trauma to the skull.
- High mortality rate >30% due to invasive disease.
- Capsule is polysaccharide polymer
- Pneumolysin decreases inflammatory immune response ⟶ severe infection.
- Infection rate decreases due to vaccination .
- Recovered cases develop sustain learning disabilities .

## 3- *H.influenzae ( less dangerous )* :

- 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 RPR ,cause acute life threatening invasive infections .
- Found in the nasopharynx normal flora
- Major cause of lower RTI, occasionally invade deeper tissues and cause bacteremia.
- Bacteremia----- CNS ,bones or other organs.
- 3-6% mortality rate
- 1/3 of survivals have significant neurological sequelae
- Infection rate decreases since the routine use of ***Hib***



## 4- Group *B Streptococcus :*

- Gram positive cocci in chains
- Resident in GIT & vagina ( 10-30%)
- Gain access to aminotic 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

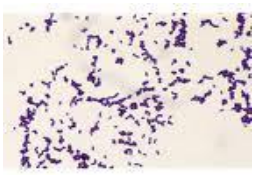
## 5- *E.coli :*

- A 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.

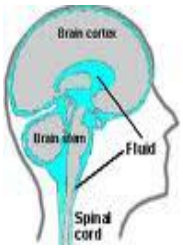
## 6 - *Listeria monocytogenes* :

- 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 dessimination in mother or from birth canal
- Has tropism to CNS.
- Prolong treatment ( 21 days )



## Diagnosis of Meningitis

- Specimen : **CSF** acquired through lumbar puncture and **blood culture** for :
- analysis of cells, protein, glucose ,
- culture and antimicrobial susceptibility testing.





## Findings of CNS analysis :

| **Normal CSF** | | **Pyogenic meningitis** |
|---|---|---|
| **Adults** | Neonates | |
| **WBC =0-5 /cmm3,**<br><br>**PMN= 0 %, glucose= > 60 % of blood,**<br><br>**protein =< 30 mg/dl** | *term* :<br>WBC =0-32 /cmm3,<br>PMN=>60 %,<br>glucose = >60 % of blood,<br>protein= 20-170 mg/dl<br>*Preterm*: WBC=0-29/cmm3,<br>PMN= <60 %,<br>glucose = >60 % of blood,<br>protein= 60-150 mg/dl | WBC= 5 - 5000/cmm3<br>PMN= > 60%<br>Glucose = < 45 % of blood<br>Protein= >60 mg/dl |

Management : (Empirical treatment )

- **Urgent , A MEDICAL EMERGENCY**
- Antibiotics after taking specimens for lab diagnosis
- Parenteral administration of Ceftriaxone (or Cefotaxime) + Vancomycin ( *cover the main 3 pathogens*) or ,
- Amplicillin + Gentamicin or Cefotaxime ( *neonates*)
- Duration : 10-14 days according to the medical condition
- Prevention: **vaccination , prophylaxis of contacts (*Hib& N.meningitidis*)**