ACUTE PYOGENIC MENINGITIS

<table>
<thead>
<tr>
<th>Faisal Al Rashed</th>
<th>Eman Al Shahrani</th>
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<tr>
<td>Abdullah Al Turki - Ahmed Saleem</td>
<td>Samiha Al Jetaiyl - Ghaida Alsugair</td>
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<td>Tariq Al Jorf - Faisal Al Dawood</td>
<td>Abeer Al Suwailen - Maymonah Alabdely</td>
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<td>Abdullah Al Sulaimani - Abdullah Al Sufian</td>
<td>Hayfa Alabdulkarim - Nourah Al Swaidan</td>
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<tr>
<td>Yazeed Al Qasim</td>
<td>Noha Khalil - sama Al ohali</td>
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Done by: Ghaida Al Sugair - Abdullah Al Turki
**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)
- *Streptococcus pneumoniae* (S. pneumonia)
- *Hemophilus influenzae* (H. influenza)

### Causes According to the Age:

| Newborns (0-1 month) | • Group B Streptococcus (because it is in the genital tract of the mother)  
|  | • *E. coli* (and other gram negative bacilli)  
|  | • *Listeria monocytogenes* |
| Infants / Children | • *S. pneumoniae*  
|  | • *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 ➔ Patients 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 causing death worldwide.

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

Signs/Symptoms of Acute Meningitis:

<table>
<thead>
<tr>
<th>Most Common:</th>
<th>Advanced Cases:</th>
</tr>
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<tbody>
<tr>
<td>• fever</td>
<td>• Bruises under skin</td>
</tr>
<tr>
<td>• Headache</td>
<td>• Rapidly spread</td>
</tr>
<tr>
<td>• Stiff neck</td>
<td></td>
</tr>
<tr>
<td>• Nausea &amp; vomiting</td>
<td></td>
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<tr>
<td>• Sensitivity to light, Confusion</td>
<td></td>
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</table>

<table>
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<tr>
<th>In infants:</th>
<th>Advanced Disease:</th>
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</thead>
<tbody>
<tr>
<td>• Inactivity</td>
<td>• Brain damage</td>
</tr>
<tr>
<td>• Irritability</td>
<td>• Coma</td>
</tr>
<tr>
<td>• Vomiting</td>
<td>• Death</td>
</tr>
<tr>
<td>• Poor feeding</td>
<td></td>
</tr>
<tr>
<td>• In rare cases may present with</td>
<td></td>
</tr>
<tr>
<td>hypothermia</td>
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Pathogenesis:

Colonization of nasopharynx (or from birth canal) → Septicemia → 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.
Pathogenesis of *N. meningitidis*:
- Carriers stimulate **antibody production**.
- In some, pili attach to microvilli of *nasopharynx* $\rightarrow$ invasion $\rightarrow$ bacteremia, **endotoxin (LPS)** produced $\rightarrow$ 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 $\rightarrow$ severe infection.
Infection rate decreases due to vaccination.
Recovered cases develop sustained learning disabilities.

**H. influenzae**:
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.

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

Hematin = Factor in the RBCs.
Factor V = comes from destroyed RBCs
NAD = Factor in the RBCs needed for V factor growth.
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 dissemination 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,
- **Ampicillin** (for Group B streptococcus) + Gentamicin (for E.coli) or Ampicillin + 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.

<table>
<thead>
<tr>
<th>Organism</th>
<th>Gram stain</th>
<th>Age Group</th>
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<tbody>
<tr>
<td>S.pneumoniae</td>
<td>Gram positive cocci in chains and pairs</td>
<td>Adults</td>
</tr>
<tr>
<td>N.meningitidis</td>
<td>Gram negative diploococci</td>
<td></td>
</tr>
<tr>
<td>E.coli</td>
<td>Gram negative bacilli</td>
<td>neonates</td>
</tr>
<tr>
<td>H.influenzae</td>
<td>Gram negative coccobasilli</td>
<td>Children</td>
</tr>
<tr>
<td>Listeria monocytogenes</td>
<td>Gram positive bacilli</td>
<td>Neonates or Elderly</td>
</tr>
</tbody>
</table>
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