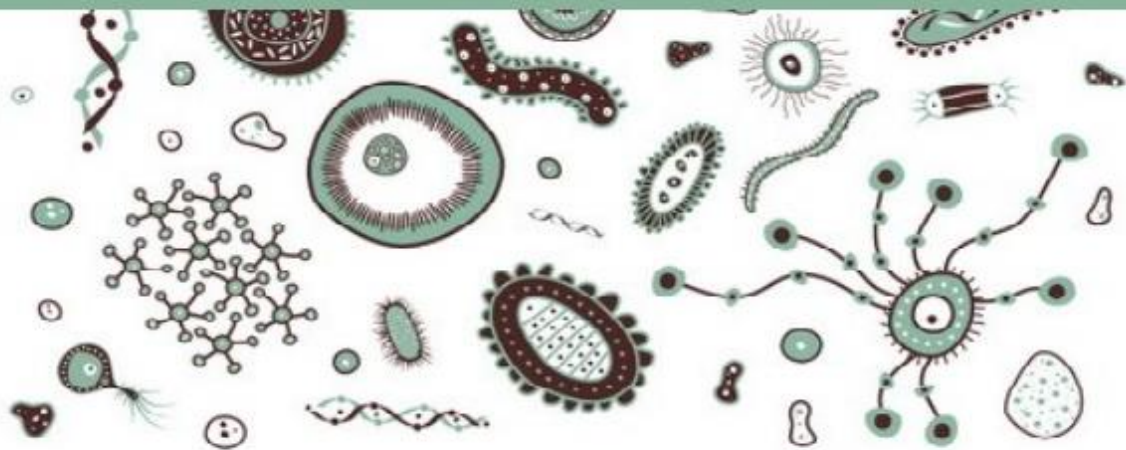




Microbiology



☒ Sheet

☐ Slides

Number : 13

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Subject: G-ve cocci & Enteric Bacteria 1

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Hello everyone!

I'll be sharing some random mnemonics on remembering the previous lecture then going to complete the topic:

*It seems better to study this sheet online to get more interesting with mnemonics!

-including all info. Found in the Dr's slides (2014 slides):

Meningitis: most common organisms NHS:

Neisseria meningitidis

Hemophilus Influenzae

Streptococcus pneumonia

• The cause of the most **Severe** meningitis is **Streptococcus**.

• Extra Note: NHS is an acronym for National Health Service in several countries.

13.1) Neisseria:

- *Neisseria* are usually arranged in pairs, non-motile, facultative anaerobes that are gram negative.
- They are **catalase and oxidase positive**.

About morphology:

N. meningitidis - Adjacent sides are flattened as lung. (found in the respiratory tract)

N. gonorrhea - Adjacent sides concave and they are kidney shaped

THE MORPHOLOGY OF NEISSERIA MENINGITIDIS AND NEISSERIA GONORRHOEAE... TROUBLE REMEMBERING?



N. Gonorrhoeae
Adjacent sides concave
Kidney shaped



N. Meningitidis
Adjacent sides are flattened



: cause irritation to CNS (as what happens at taking a cup of coffee).

No vaccine is available.



2013

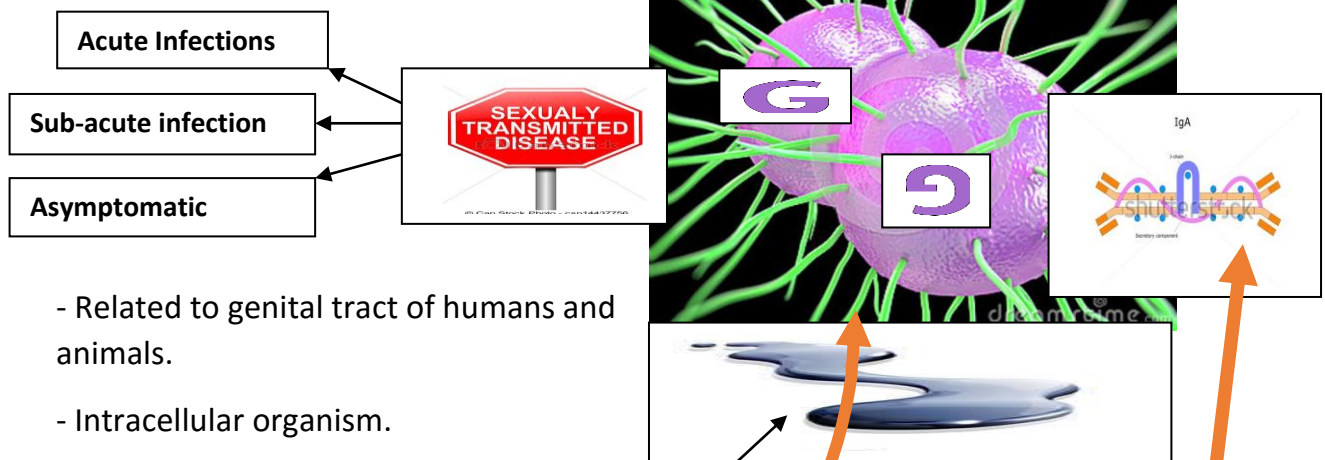
Both of them are pathogenic species.



Vaccine is available.



1) Neisseria gonorrhea:



- Related to genital tract of humans and animals.
- Intracellular organism.
- Causative agent for gonorrhea. (مرض السيلان)
- Gonorrhea: in relation to flow of fluids.

- **Virulent factors:**

- Attach to mucosa by pili: help adhering to epithelium and protect it from antibodies and phagocytosis.
- Release of enzyme called IgA-protease (damage receptor that prevent attachment, which allow to attach firmly)
- Release endotoxins (Lipooligopolysaccharides "LPS") which are shorter chains than lipopolysaccharides but produce the same effect, which is endotoxicity that contributes to the inflammatory process: "Inflammation in Genitourinary Tract, Rectum, and Throat".
- **Symptoms:** Uretral/Vaginal Discharge, Urethritis, Cervicitis, Salpingitis.. Common Reinfection... (Genital inflammation).

2) Neisseria meningitidis:

- In relation to meningitis. (التهاب السحايا)
- Might found in the respiratory tract without producing inflammation.



Invasive and causes
Exogenous Infection
in Respt.Tract,
Sore Throat,
Septicemia: if it
reaches to the blood.
***exogenous source**
not endogenous
causes infection.

- 5 years are more susceptible than adults to meningitis if they aren't immunized.
- In children ages 6 months also susceptible. "6 months - 5 years are susceptible"
 - > This is because infants before 6 months have immunity from the mother called maternal immunity.
- Start infection as sore throat, tonsillitis then might reach blood stream causing sepsis and CSF (cerebrospinal fluid.) causing meningitis.
- Similar in invasiveness with H.influnzae but more than group A streptococcus
 - * Always acute with high Mortality without treatment.

Note that

Meningitidis has some virulence factors but it usually blends in and becomes part of the **normal body flora of the nasopharynx** → these individuals (about 5% of population) are called **carriers** → carriers are lucky * * as this asymptomatic nasopharyngeal infection allow them to develop anti-meningococcal antibodies

****Extra note the last underlined info.**

((If one case discovered in any community we have to expect other 100 cases asymptomatic (other 100 cases undetectable) (highly infectious))).



Also, We are lucky in Jordan *_* as we have a dry weather so our country is not common in meningitis.

> But what are the high risk groups to meningitis?

1) Infants aged 6 months - 5 years.

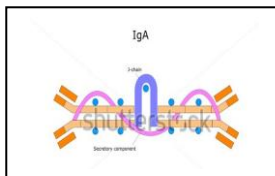
2) Army recruits (or the travelling persons): There is a **vaccine available** given for each person travelling to other areas "where this disease is common" → Persist for 3 years not more.

> But what are the **virulence factors** of the meningococcus (Neisseria meningitidis)?

1. Capsular Polysaccharides, has many Serotypes A, B, C,...

2. LPS... Endotoxin that cause vessels destruction >> hemorrhage >> sepsis.

3. IgA-Protease... Cleaves IgA in half.

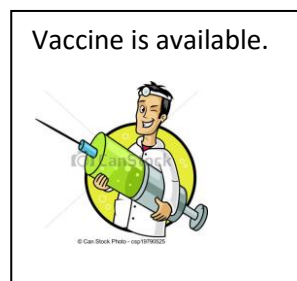


Capsular Polysaccharides

- Treatment:

- Antibiotics in hospital with supportive fluids and isolation for at least 48 hours (same thing as H. influenza and strep. pneumoniae).

- There is a vaccine especially for persons going to endemic areas for at least one year.

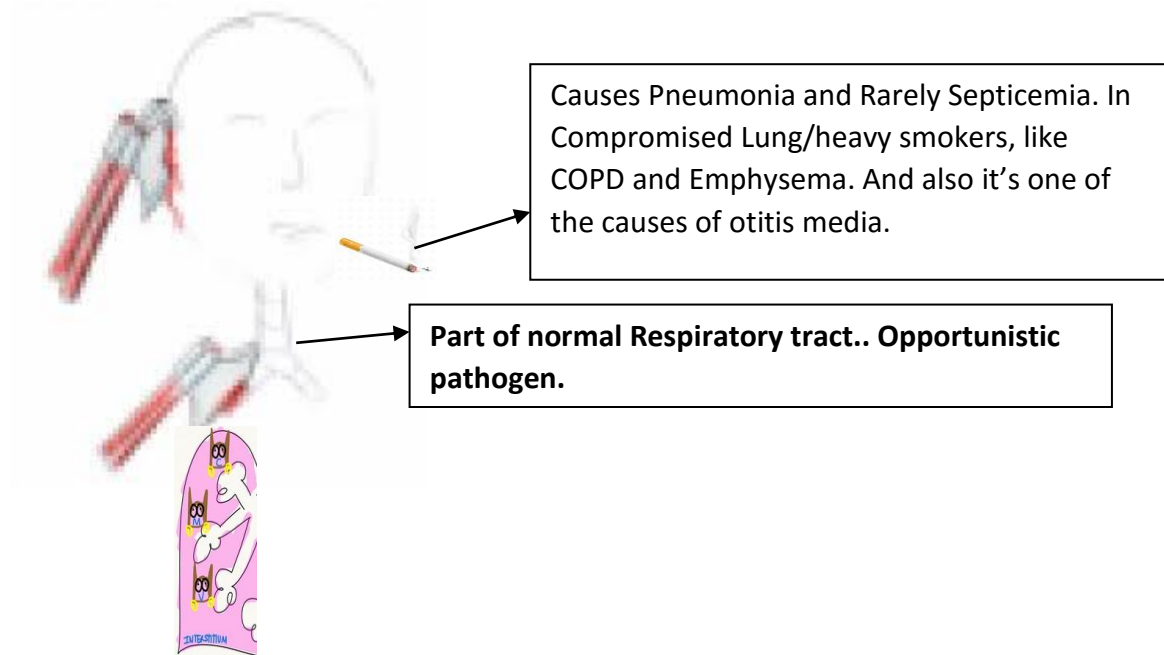


3) Moraxella catarrhalis:

Mnemonic: Moraxella catarrhalis: (more axis)

*Note: “look to the mnemonic figure below to know what I mean by these brackets”.

- Gram negative bacteria that usually occurs in pair: (2 red axes)
- Otitis media: (chopping at the air)
- Upper respiratory tract infection: (chopping at the bronchus)



So,

*Moraxella catarrhalis:

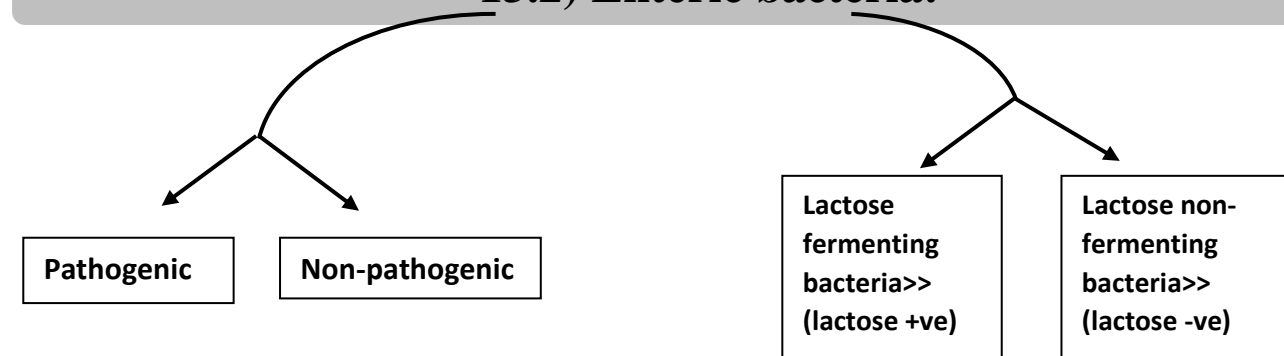
- First called Neisseria catarrhalis but then it is changed due to change of classification of this organism.
- Catarrhalis: in relation to catarrhal stage –inflammation in the larynx.
- Moraxella same as Neisseria gram –ve diplococcic.
- In certain persons who are heavy smokers or have damage in lungs (have compromised lung).
- Despite that it is a part of the normal flora, of less pathogenicity compared to N.meningitidis and H.influenzae but might be associated with infection in the larynx and might produce pneumonia.

- **Lab diagnosis:**

- 1) Gram staining.
- 2) Culturing / chocolate agar.
- 3) Biochemical test (oxidase and catalase) → It is +ve for these test.
- 4) Full biochemical test.

- **Treatment:** Antibiotics

13.2) Enteric bacteria:



May reach the blood and cause Septicemia



We are Gram –ve bacteria! And we are **mostly commensal body flora!** But in certain cases we contribute to **50%** of infection!

Some of these bacteria are capsulated & ∴ inhibit phagocytosis & also inhibit the immune response.

May reach the urinary tract and cause diarrhea.



There are also types of enteric bacteria resides in the intestinal tract of animals, birds, in addition to human as a part of commensal flora >>but contamination with feces by urethra, vagina..etc is possible



- This group includes many species of **gram –ve, facultative anaerobes**, rapidly-growing anaerobic bacteria.
 - They are mostly found in the intestines of humans & animals (Normal intestinal flora).
 - Many of these species are found in the environment especially in association with water resources, and sewage, soil, vegetation.
- ∴ This group is always in a close contact with our body and so is important to us.
- Part of the enteric bacteria is considered as **a part of our commensal flora** however under certain circumstances they cause infections and are called **opportunistic pathogens** (when reaching the blood stream or the urinary tract..) especially in health conditions related to malignancy or when introducing surgical procedures or during cystoscopy \ catheters (endoscopy of the urinary tract).
 - Catalase +ve.
 - Oxidase –ve.
 - Can grow rapidly / with short period (in the presence of nutrients).

- Identification of these bacteria in the lab (biochemical classification):

* **They are classified by ability to ferment lactose** and convert it into gas and acid, which can be visualized by introducing a dye that changes its color when the PH changes.

The 2 mediums that you should know:

1) EMB agar (eosin methylene blue): inhibit the growth of G+ve bacteria.

2) MacConkey agar: **Bile salts** in the medium inhibits G+ve bacteria, **and lactose fermenters develop a pink colony.**

Grow pink colonies on MacConkey agar. Examples include: **K**lebsiella, **E**. coli, **E**nterobacter.

Mnemonic:

*Lactose is **KEE**.

*Test with MacCon**KEE**s agar.



E. coli produces **beta-galactosidase**, which breaks down lactose into glucose and galactose.

∴ This medium "MacConkey agar" can identify all enteric bacteria by a simple characteristic.

But note that the gram stain does not help us in distinguishing between enteric bacteria species because all enteric bacteria are gram –ve coccobacilli to bacilli.

The MacConkey agar contains bile salts, lactose & a neutral red dye, **a colour change from coloreless\rose to red occurs if lactose fermentation products are present.**

∴ Red colonies on the surface of the agar indicate the presence of lactose fermenting bacteria (lactose +ve) which are able to utilize lactose, and if **no colour change (transparent colonies)** then the bacteria present is lactose –ve, and so this simple test subdivides enteric bacteria into to sub groups.

> What is the **Pathogenicity** of Enteric bacteria?

- Various Enterotoxins (inside intestine).
- Endotoxins: "LPS" LIPID a PORTION OF LIPOPOLYSACCARIDE.
- Capsule (e.g **capsulated E.coli**)
- K-antigen, H-antigen, O-antigen: Develop specific antibodies following blood infections>>>Used in clinical diagnosis.
- Flagella (MOTILE + ADHERENCE)

What we can do if infected? Patients should be cured by antibiotics.

- Enteric bacteria groups:

A) Coliform group:

- This group includes the part of enteric bacteria that utilizes lactose and are considered **lactose +ve**.
- One of the most common species of this group which reside in our intestines tract is the **E.coli (Eschericia coli)**.



1) E.coli (Escherichia coli):

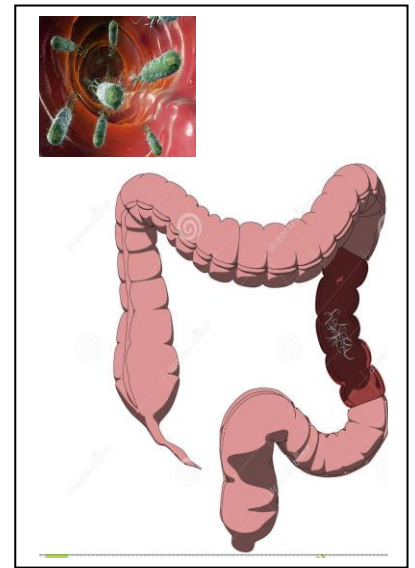
- Coli refers to colon.

The E.coli is named after its original discoverer the pediatrician "Theodor Escherich" and the second part of its name "coli" comes from the fact that most of the enteric bacteria are found in the colon and not in the intestine but at that time it was difficult to identify other bacterial species and was named accordingly.

Hence, the E.coli is found in intestines and excreted with the feces and might manage to reach the opening of the urethra especially in women ((women have shorter urethra than men and this allows the organism to adhere easily, and if there is any change in vaginal flora they may reach the bladder and cause infections)).

They cause ascending infection (from the opening of the urethra ascending to the upper part of the urethra).

Up to 70% of UTI in the community (not in hospitalized patients) are caused by E.coli.



E.Coli Strains:

Generally, E.coli is not considered a pathogen and is part of our commensally intestinal flora. However, there are certain clones / strains called **diarrheagenic E.coli** (these cause either bloody or watery diarrhea) and there are **6 important subspecies** of diarrheagenic E.coli in people & **children are more prone to this type of E.coli than adults**. And Diarrheagenic E. coli types are:

MNEMONIC:

PTH:

ePec - pediatric : "related to infant" (P)

eTec – traveler disease (T)

eHec – hemorrhagic + HUS "mentioned later"(H)

A- Enteropathogenic E.coli: "EPEC"

- This is a common cause of diarrhea in infants less than 6 months old **CAUSING** Watery diarrhea, less Vomiting.

- In Chronic cases / fatal: Chronic diarrhea >> death of infant **or** E.coli can easily penetrate the large intestinal mucosa of neonates & reach the blood stream & cause sepsis & meningitis.

Note: any infant suffers from repeat diarrhea "chronic diarrhea", he should be supported by certain therapy.

B- Enterotoxigenic E.coli : "ETEC"

- This bacteria produce **heat-labile exotoxin & heat-stable enterotoxin** & it is a **common cause of diarrhea** in both adults and children "BUT IN CHILDREN MORE" **during travelling** from countries of **high** standards of hygiene to countries of **low** standards of hygiene (fecal water contamination / vegetables / fresh food so it's an Indicator standard of hygiene), because of the wide spread of these E.coli in the environment especially in water & food , it causes mild diarrhea and only persisting for a short time.

- Self-limited diarrhea and no antibiotics treatment.

C- Enterohaemorrhagic (EHEC):

- Caused by a strain called E.coli O157:H7

- Virulence factor is **shiga-like** (also called **verotoxin**) toxin, which is similar to that found in **shigella**.

- These toxins are inhibiting protein synthesis in the epithelium so leading to intestinal cell death.

- Common in intestinal Cattle and can affect human:

- **Vero toxins**: presence of toxin in vero cells which originate from Monkey.

- Cows E.coli comes from contamination like burger to stomach of human.

- Not well pasteurized milk products.

(Contamination Ground meat/Hamburger, Dairy products).



- Results in bloody diarrhea, Haemolytic-uremic syndrome (**HUS**): **hemorrhagic bacteria**.

(Might produce severe inflammatory reaction in colon: necrosis)

Results in:

- Uremia and anemia >> Fatal.

Mnemonic :

E. coli: diseases caused **in presence of virulence factors** (only in the presence otherwise it's commensal) : E.coli"commensal flora"+Virulence factors= DISEASE.

"DUNG":

- Diarrhea
- UTI (40-80%).
- Neonatal meningitis
- Gram negative sepsis
- Dung, since contract E. coli from dung-contaminated water.

- E.coli can easily penetrate the large intestinal mucosa of neonates & reach the blood stream & cause sepsis &

To sum up:

- E.coli might be associated in food poisoning due the fact that it produces enterotoxins that might easily contaminate our food and water.
- Water must be free of E.coli to be safe.
- E.coli is considered an indicator pathogen to judge whether water is drinkable or not (if there was 1 E.coli cell in a Liter of water, this water shouldn't be drunk before treating with gamma rays... etc).
- Diarrhea to E.coli is self-limited in healthy persons who have no underlying diseases & ∴ there is no need for treatment using antibiotics. But it may be associated with severe complications in children & old patients & immunocompromised patients due to the fact that the diarrhea will result in severe dehydration & ∴ affecting the circulation of blood & ∴ affecting other organs.

-The Lecture Is Over-



Capsulated bacteria*revision including all bacteria taken in this semester:

Capsulated bacteria Capsulated pathogenic organisms are

"Some Bacteria Have An Effective Surrounding Membrane Pseudo, Bypassing Killing":

Strep pneumonia

Bacteroides

H. influenza

Anthrax (B. anthracis)

E. coli

Salmonella

Menigitidis (N. Menigitidis)

Pseudomonas

Brucella

Klebsiella

Food poisoning:

"Eating Contaminated Stuff Causes Big Smelly C ":

E. coli O157-H7 [undercooked meat, esp. hamburgers]

Clostridium botulinum [canned foods]

Salmonella [meat, eggs]

Bacillus cereus [reheated rice]

Staphylococcus aureus [meats, mayo, custard]

Clostridium perfringens [reheated meat]



-In the next sheets you will study:

Lactose fermenters

Pink colonies on Mac Conkeys media

1. **Escherichia coli** → DONE!
2. **Enterobacter species** Raised colonies .Non viscous colonies
3. **Klebseilla species** Very viscous mucoid Non motile

Non Lactose fermenters

Colorless colonies on Mac Conkeys

- **Shigella species:** Non motile
- **Salmonella species:** Motile
- **Proteus species:** Swarming, urea hydrolyzed.
- **Pseudomonas species:** Green pigment sweetish smell.

