

Introduction to Enterobacteraceae

KP & Proteus



Enterobacteraceae

Overview

- Gram negative rods related to enteric tract.
- Divided into three groups
 - Pathogens within the enteric tract.
 - Pathogens outside the enteric tract.
 - Pathogens both within and outside the enteric tract.
- *Salmonella*, *Shigella* and *Campylobacter* are the frequent pathogens of enteric tract while *E.coli*, *Vibrio* and *Yersinia* are the less common.

- Enterotoxigenic strains of E.coli are the common cause of diarrhea in developing countries. UTI is caused primarily by E.coli.
- Patients infected with Enteropathogens have high incidents of autoimmune diseases such as:
 - Rieters syndrome (Chlamydia)
 - Guillain barre syndrome (Campylobacter)

Enterobacteriaceae

- Large family of gram negative rods found in the colon of humans and animals. In most of the cases it forms normal flora.
- Major facultative anaerobe in large intestine.

Characteristics

1. Gram negative rods
2. Facultative anaerobe
3. Ferment Glucose
4. Oxidase negative (since they do not have cytochrome oxide)
5. Reduce nitrates to nitrites.

- Non-fermenter Gram negative rod include:
Pseudomonas aeruginosa is significant cause of UTI and sepsis in hospital infections. It is nonlactose fermenter, does not reduce nitrite, oxidase positive but strict aerobe.

Pathogenesis

- All members contain endotoxins in their cell wall. Few produce exotoxins e.g. E.coli and Vibrio which secrete powerful exotoxins (enterotoxins) that stimulates adenyl cyclase in small intestine to cause severe diarrhea and dehydration.

Antigens

- Three types of surface antigens
- 1. **O Antigens (somatic)**
 - It is present in the outer polysacchride portion of lipopolysacchrides.
 - Number of antigens vary e.g. salmonella has 1500 types and E.coli has 150 types.
- 2. **H Antigens**
 - It is flagellar protein and present only in motile flagellated organisms e.g. E.coi and salmonella.
 - Non motile organism like klebsiella, shigella do not have it.

Antigens

- Few strains of salmonella species have two types of H antigens i.e. phase 1,2 and can interchange to evade the immune system.

3. K Antigens (capsular)

- It is a polysaccharide antigen found in capsular organisms like klebsiella, which can be illustrated by quellung reaction.
- It is important for epidemiology purposes.

Vi Antigens

- It is virulence antigen found in S.typhi

Lab Diagnosis

- Inoculated on blood agar and MacConkey's agar plate or eosin-methylene blue agar (EMB).
- Non-fermenters e.g. salmonella and shigella form colorless colonies while fermenters of glucose, E.coli has red colonies.
- Growth of Gram positive organisms is depressed due to presence of bile salts and bacteriostatic dyes in the media.
- For further identification TSI and Urea agar is used.

Lab Diagnosis

- TSI contains ferrous sulphate and three sugars namely glucose, lactose and sucrose
- **Fast Lactose Fermenters**
 - E.coli, klebsiella pneumoniae, enterobacter.
- **Slow Lactose Fermenters**
 - Citrobacter, serratia, vibrio.
- **Non Lactose Fermenters**
 - Salmonella, Shigella, proteus, pseudomonas.

Lab Diagnosis

Motility:

- Proteus species are highly motile and growth swarms over the media after inoculation obscuring other colonies.
- Enterobacter and klebsiella can be identified by motility whereas klebsiella is non motile and enterobacter is motile.

Coliforms Bacteria

- This term includes E.coli and other colon inhabitants like enterobacter and klebsiella. It is an indicator of fecal contamination.
- E.coli is lactose fermenter with acid and gas production at 44.5° C and typical colonies on EMB agar.
- Colony count more than 4/dl in municipal drinking water indicates fecal contamination in water which is not fit for drinking.
- Enteropathogens are killed by chlorination of drinking water.

Proteus Species

Introduction:

- Gram negative rods.
- Non lactose fermenter.
- Urease producing + H₂S gas.
- Striking swarming growth on blood agar due to its high motility.
- O antigen present in the cell wall of certain strains of proteus OX₂, OXK, OX₁₉ cross react with antigens of several species of rickettsiae. This is called Weil Felix reaction and is used in the lab to diagnose rickettsiae diseases.

Proteus Species

- Four medically important species
 1. *Proteus morganii* - *Morganella morganii*.
 2. *Proteus rettgeri* - *Providencia rettgeri*.
 3. *Proteus vulgaris*.
 4. *Proteus mirabilis*.

Pathogenesis

- Proteus is present in human colon, soil and water. It can infect urinary tract of the body (UTI) and colonize in urethra.
- It can invade the urinary tract by its extreme degree of motility.
- It produces urease enzyme which is responsible for renal stones.

Clinical Features

- Patient can present with symptoms of urinary tract infections.
- It can cause pneumonia, wound infection, septicemia in immuno-compromised patients and hospital acquired infections (providentcia rettgeri).

Lab Diagnosis

- Culture on blood agar/MacConkey.
- Motility test.
- TSI
- Urease test

Treatment

- Most strains are sensitive to ampicillin, aminoglycosides, trimethoprin, cephalosporins.

Klebsiella Pneumoniae (KP)

Klebsiella Pneumoniae (KP)

- Member of enterobacteriaceae family that shares all the characters. Gram negative rods, non motile, lactose fermenter, capsulated (polysaccharide capsule).
- Grows on blood agar and MacConkey and produces large mucoid colonies.
- It is an opportunistic pathogen which can cause pneumonia (ventilator associated), wound infections, occasionally UTI, diarrhea, meningitis.

- Primarily it causes community & nosocomial infections.

Types of Klebsiella

- There are 4 types of Klebsiella.
 1. Klebsiella pneumoniae- causes pneumonia
 2. Klebsiella ozaenae- causes ozaenae (atrophy of nasal mucosa with foul nasal discharge).
 3. Klebsiella rhinoscleromatis – causes rhinoscleroma (granulomatous lesion of nose).
 4. Klebsiella oxytoca – Isolated from clinical specimens.

Pneumonia

- Klebsiella pneumonia is a serious disease with very high mortality. There is massive mucoid inflammatory exudate involving one or more lobes of the lung.
- Necrosis & abscess formation is quite frequent.

Lab Diagnosis

- Lactoses fermenter colonies on MacConkey's agar.
- Motility Test - Non Motile.
- Capsuled demonstration.

Treatment

- Hospital acquired strains are frequently multiple drug resistant.
- Aminoglycoside (gentamicine) and cephalosporin (cefotaxime) are given in combination.
- In severe enterobacter infections, combination of imipenem and gentamicin is often used.

Prevention

- Hospital acquired infections produced by gram negative rods can be prevented by following general measures.
 1. Changing the site of IV catheter.
 2. Removing urinary catheters when not required.
 3. Taking care of respiratory related instruments.

Vaccination

- No vaccine available.
- Only preventive measures can be beneficial.