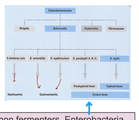
Micro1

Salmonella

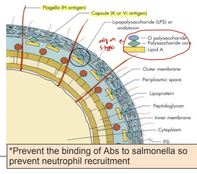
- Classification
  - **Family** : Lactose non fermenters, Enterobacteria
    Genus : Salmonella, named after Daniel E Salmon(USA)



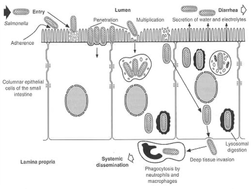
  - Species
    - 1-Salmonella enterica , 5 subspecies, 2500 serovars(serotypes)
      - Generally classified to Typhoid(human only)and Non-typhoid(human &animal)
      - Most of the human pathogenic Salmonella serovars belong to the S. enterica subspecies. These subspecies include;
        - 1-S.Typhi, (enteric fever) — Typhoid
        - 2-S.Paratyphi A, B, C (enteric fever) — Typhoid
        - 3-S.Enteritidis(food poisoning) — Non-Typhoid
        - 4-Typhimurium, (food poisoning) — Non-Typhoid
        - 5-S.Choleraesuis(septicemia) — Salmonella septecimias
    - 2-Salmonella bongori

- Overview/ Bacteriology
  - 1-rod-shaped
    2-non- spore-forming
    3-Gram-negative bacterium
    4-Aerobic and facultative anaerobe
    5-Motility: Predominantly motile by peritrichous flagella (H antigen).
    6-Non capsulated except for S.Typhi
    7-biochemical characteristics:
    *Glucose-fermenting
    *Non lactose fermenters
    *Non sucrose fermenters

- Antigenic Structure
  - *Test name: Kauffmann-White antigenic scheme(a system that classifies the genus Salmonella into serotypes)
    * For classification of salmonella
    * Done by agglutination reactions with specific antisera against Salmonella antigens
    * Scientists determine the serotype based on the distinct combination of O and H antigens
  - The antigens
    - **O antigens** :
      1-O polysaccharide unit in LPS.
      2-It is the variable part where the antibody binds to.
      3-In s.typhi only
    - **H antigens** :
      1-flagellar antigens (protein)
      2-may occur in one of two phase variations.
      3-For s. typhi and para typhi
    - **Vi or K antigen** :
      1-capsular polysaccharide
      2-produced by some virulent members of S. para Typhi B
      3-protect from phagocytosis
      - *Prevent the binding of Abs to salmonella so prevent neutrophil recruitment

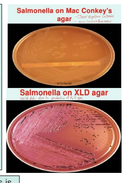


- Enteric fever (S.Typhi and paratyphi)) (Only in humans)
  - person-to-person spread:(feco -orally or/from feces to insects)
    *contamination with human faeces
    *usual vehicle is contaminated (water, milk and food occasionally)
    *contaminated food (usually handled by an individual who harbours S. typhi)
    *and sometimes also by flying insects feeding on faeces.
    *asymptomatic carrier (Typhoid mary)
  - *This bacteria is sensitive to acidity, so it must be in high number to be infectious.
    Infectious dose:1million bacteria
    Much lower if the:
    1-stomach PH is raised
    2-vehicle for infection is chocolate(*protects the bacteria in their passage through the stomach,
    *an infectious dose of about 100 bacteria)
  - **carrier state**:
    *may last from (many weeks-years)with fecal shedding
    *chronic carrier=Asymptomatic carrier(~3% of persons infected with S. typhi)
    *Typhoid Mary" Mallone. She was the first person in the USA identified as an asymptomatic carrier of the typhoid fever. She infected 53 people as a cook.
  - *The main pathophysiology is dissemination of bacteria from intestine to the blood (mainly septicemic disease) • Adhere and infect the small intestine lining causing diarrhea • Secreted in feces and urine
    Septicaemicphase:
    1-Bacteria invade mucosa or Peyer's patches of small intestine.
    2-where they survive and multiply within macrophages (fucultative intracellular)
    3-they pass into mesenteric lymph nodes then to thoracic duct then enters the blood stream.
    4-Secondary settlement of bacteria in biliary tract leads to seeding the intestine with large numbers of bacteria.
    5-Involvement of intestinal lymphoid tissue spleen and liver may lead to necrosis and ulceration.



  - Signs & symptoms:
    * the course of untreated typhoid fever is divided into four individual stages, each lasting approximately one week.(patient heals after theses 4weeks)
    - **In the first week symptoms:**
      1-slowly rising temperature with relative bradycardia
      2-malaise headache, and cough.
      3-bloody nose (epistaxis) is seen in 1/4 of cases
      4-abdominal pain is also possible.
      5-There is leukopenia(increase monocytes & macrophages, decrease neutrophils)
    - **In the second week symptoms:**
      1-the patient lies prostrate with high fever in plateau around 40 and bradycardia.
      2-Delirium is frequent.
      3-frequently calm, but sometimes agitated.
      4-Diarrhea and hepatosplenomegaly
    - **In the third week symptoms**
      a number of complications can occur:
      1-Intestinal hemorrhage
      2-Intestinal perforation in the distal ileum this is a very serious complication and is frequently fatal
      3-Encephalitis
      4-Neuropsychiatric symptoms (described as "delirium")
      5-Metastatic abscesses, cholecystitis , endocarditis and osteitis:
      6-Dehydration causes the patient to be delirious (typhoid state).
      *If untreated the mortality rate because of dehydration and other complications may reach 30% in the 3rd week.
  - S.para Typhi
    - Clinical Features
      Enteric Fever **(paratyphoid A)**
      - Ip:(10-14)days
        * Paratyphoid fever resembles Typhoid Fever but presents with milder symptoms and a shorter course
        Symptoms:
        1-myalgia and headache,fever.
        2-leukopenia
        3-splenomegaly
        4-abdominal pain
        5-constipation
        6-Rose spots (macular rash on abdomen) in 30%
        7-1% fatal

    - Clinical features
      S. Paratyphi B
      - 1-diarrhea,2-vomiting,3-the entire intestinal tract can be inflamed especially in type B infections.
    - **S. Paratyphi** C causes:
      - *Mainly cause septicemia
        *Complications include abscesses, arthritis & inflammation of the gall bladder.
  - Laboratory Diagnosis
    - *Culture of blood, BM fluids, stool and urine
      • Appears as non-lactosefermenter
      1-Put the sample in nutrient broth for multiplication
      2-Then Subculture in MacConkey agar or similar selective agar
      *90% positive in 1st week to 25% in 4th week
      *On differential selective agars, produces clear, colorless, non-lactose fermenting colonies with black centers (if media contains indicator for hydrogen sulfide)
    - *Biochemical tests and serological tests must be done in parallel
      *Some other bacteria, e.g. Citrobacter, may have similar serological profiles
      Widal Test(serology test)
      *This tests for O & H antibodies in the patients serum and comes in handy when culturing facilities are not available in developing countries (unreliable).
      1-Positive only by the beginning of the second weak onwards.
      2-Should have 2 positive
      3-May have false positive in immunization
      4-Titer O>1/80, H>1/160
      *Phage typing done for epidemiological purposes E.g. to find source of outbreak



  - Treatment of enteric fever
    - *Third generation cephalosporins or quinolones is the current treatment
      *Surgical intervention to remove damaged cells
      * When untreated, typhoid fever persists for three weeks to a month. Death occurs in 10% to 30% of untreated cases(mostly on the 3rd week)
  - Prevention
    - 1-Remove source
      *Salmonella free life-stock
      *Vaccinate chicks
      2-Interrupt transmission
      *Good food hygiene
      *Cook food properly
      *Keep raw and cooked foods apart
      *Public Health: clean water
      3-Strengthen host
  - Salmonella vaccines
    - Three licensed vaccines:
      1-Traditional heat-killed(TAB vaccine)….. produce immunity against the diseases typhoid, paratyphoid A
      2-Vi subunit vaccine……protects against S.Typhi
      3-live oral vaccine……protects against typhoid
- Non-Typhod (Food poisoning or salmonellosis)
  gastroenteritis
  - *S. typhimurium and S.enteritidis
    *IP (hours-1day)
    *From animal to human
    *Nausea, vomiting, abdominal pain and diarrhea
    *A small number develop Reiter's syndrome, a disease that can last for months or years and can lead to chronic arthritis.
  - Causes
    - 1-Poultry, pork, beef and fish (seafood), if the meat is prepared incorrectly or is infected with the bacteria after preparation
      2-Infected eggs, egg products, and milk when not prepared, handled, or refrigerated properly
      3-Tainted fruits and vegetables
  - Diagnosis and Treatment
    - *A stool culture and blood tests may be done to confirm the diagnosis.
      *Rehydration and symptomatic treatment no need to antibiotic except if dissemination occurs
      *Recover without treatment in **7 days** .
      *the bacteria will continue to be present in the stool for weeks(on average 1month)after recovery of symptoms
- Salmonella septicemias (**S.cholera suis**)
  - *deep abscess,endocarditis.
    *isolation from blood and pus.
    *Tx:chloramphenicol (highly effective)