SALMONELLA & SHIGELLA

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Objectives

1- Develop an algorithm using biochemical tests to identify and classify *Salmonella* and *Shigella*

2- Describe the antigenic structures and virulence factors of *Salmonella* and *Shigella*

3- Compare the pathogenesis of various species of *Salmonella* and *Shigella*

4-Describe the clinical features and risk factors for the infection with the two organisms

5- Describe the general concepts for the management of gastroenteritis caused by both organisms.
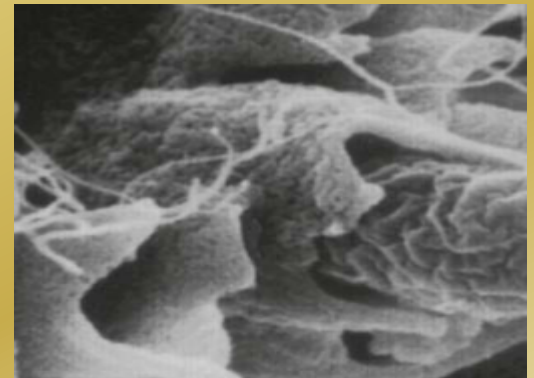
Salmonella

Salmonella

➢ **Gram negative ,motile ,facultative anaerobic bacilli**

➢ **Non lactose fermenting colonies**

➢ **highest during the rainy season in tropical climates and during the warmer months in temperate climates.**
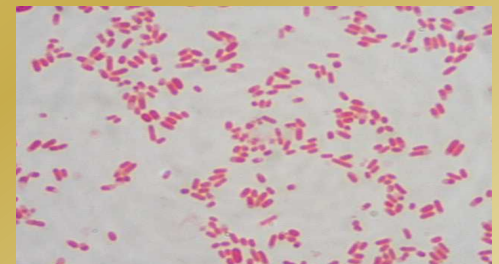
VIRULENCE FACTORS

- **Fimbria - Adherence**
- **Endocytosis**
  - **SPI 1** (Salmonella pathogenicity island 1) **T3SS** (type 3 secretory system) :Virulence ,invasion & enteritis)
  - **TLR** (Toll like receptor) : IC survival ,growth & systemic infection)
- **Replication in microphage**
- **Enterotoxin**

Histopathology
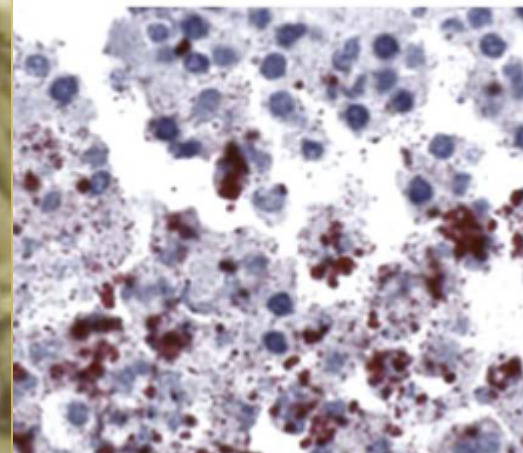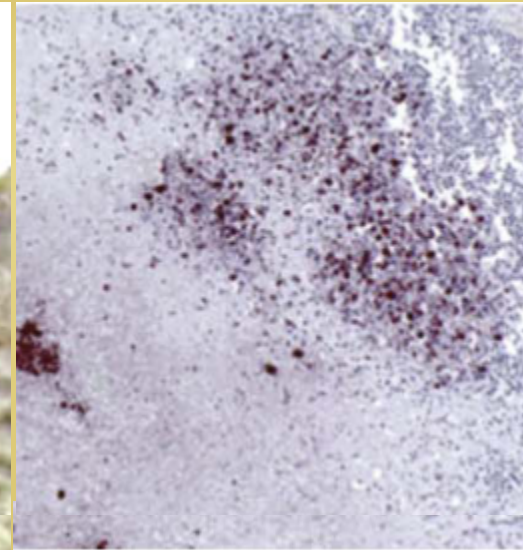
Classification

Two species of Salmonella :

- *S.enterica* (six *subspecies I, II, III, IV, V, VI*)
- *S.bongori* **(rare)**

Found in cold blooded animal, birds, rodents, turtles, snakes and fish

SALMONELLA SPECIES AND SUBSPECIES	NO. OF SEROTYPES WITHIN SUBSPECIES	USUAL HABITAT
S. enterica subsp. *enterica* (I)	1504	Warm-blooded animals
S. enterica subsp. *salmae* (II)	502	Cold-blooded animals and the environment[*]
S. enterica subsp. *arizonae* (IIIa)	95	Cold-blooded animals and the environment[*]
S. enterica subsp. *diarizonae* (IIIb)	333	Cold-blooded animals and the environment[*]
S. enterica subsp. *houtenae* (IV)	72	Cold-blooded animals and the environment[*]
S. enterica subsp. *indica*(VI)	13	Cold-blooded animals and the environment[*]
S. bongori (V)	22	Cold-blooded animals and the environment[*]
Total	2541	

Antigenic structures

- **O. Somatic antigen**
- **H. Flagellar antigen**
- **K. Capsular antigen**

- V_I in *Salmonella* serotype *typhi* (virulence heat-labile capsular homopolymer of N-acetyl-galactosamino-uronic acid) *vs* phagocytosis
- O Antigen (Heat – stable) is lipopolysaccharide in the outer membrane A,B,C1,C2,D,E
- H antigen (Heat labile)

AgH: flagelle

AgO: LPS

(Ag Vi: capsule)
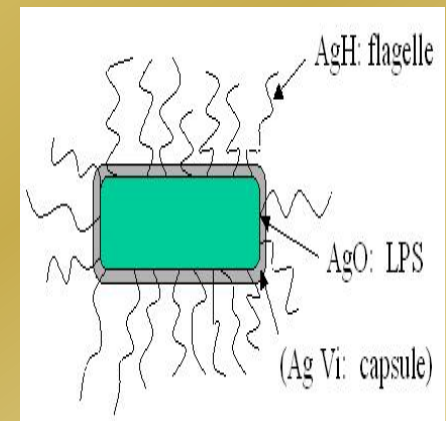
Clinical diseases

- Acute gastroenteritis
- Typhoid fever
- Nontyphoidal bacteremia
- Carrier state following *Salmonella* infection

Source

- **Water, food and milk contaminated with human or animal excreta.**

- ***S.typhi* and S.*paratyphi*, the source is human.**

Salmonella gastroenteritis

- Food poisoning through contaminated food
- *S. enterica* subsp. *enterica the common cause*
- Source :poultry, milk, egg & egg products and handling pets
- **Infective dose: 10^6 bacteria**
- Incubation period : 8 – 36 hrs.
- fever, chills, watery diarrhea and abdominal pain. Self limiting.
- In sickle cell ,hemolytic disorders , ulcerative colitis, elderly or very young patients; the infection may be very severe.
- Patients at high risk for dissemination and antimicrobial therapy is indicated.

Enteric fever (Typhoid fever)

- **Prolonged fever**
- **Bacteremia**
- **Involvement of the reticuloendothelial system (liver, spleen, intestines and mesentery)**
- **Dissemination to multiple organs**
- **Ingestion of contaminated food by infected or carrier individual**
- **Caused by *Salmonella* serotype *typhi* or *S. paratyphi* A, B and C (less severe)**
- **Common in tropical , subtropical countries, and travelers (sewage ,poor sanitation).**
- **IP : 9 – 14 days.**

First week: fever, malaise, anorexia, myalgia and a continuous dull frontal headache then,

- Patient develops constipation
- Mesenteric lymph node → blood stream liver, spleen and bone marrow
- **Engulfment of *Salmonella* by mononuclear phagocytes** .
- Bacteria released into the blood stream again and can lead to high fever . Blood culture is positive.

2nd and 3rd week

- ❖ Sustained fever & prolonged bacteremia.

- ❖ Invade gallbladder and Payer's patches

- ❖ Rose spots 2nd week of fever

- ❖ Billiary tract → GIT

- ❖ Organism isolated from stool .

Management & Antibiotics

Enteric fever:

▫ **Ceftriaxone**

▫ **Ciprofloxacin**

▫ **Trimelhoprim – Sulfamethoxazole**

▫ **Ampicillin**

▫ **Azithromycin or Ceftriaxone for patients from India and SE Asia due to strains resistant to Ciprofloxacin. Ciprofloxacin can be used for patients from other areas.**

Salmonella gastroenteritis:

▫ **Uncomplicated cases require fluid and electrolyte replacement <u>only</u>.**

COMPLICATIONS

- **Necrotizing cholecystitis**
- **Bowel hemorrhage and perforation**
- **Pneumonia and thrombophlebitis**
- **Meningitis, osteomyelitis, endocarditis and abscesses.**

Shigella

- **Shigella** is non lactose fermenting Gram negative bacteria.

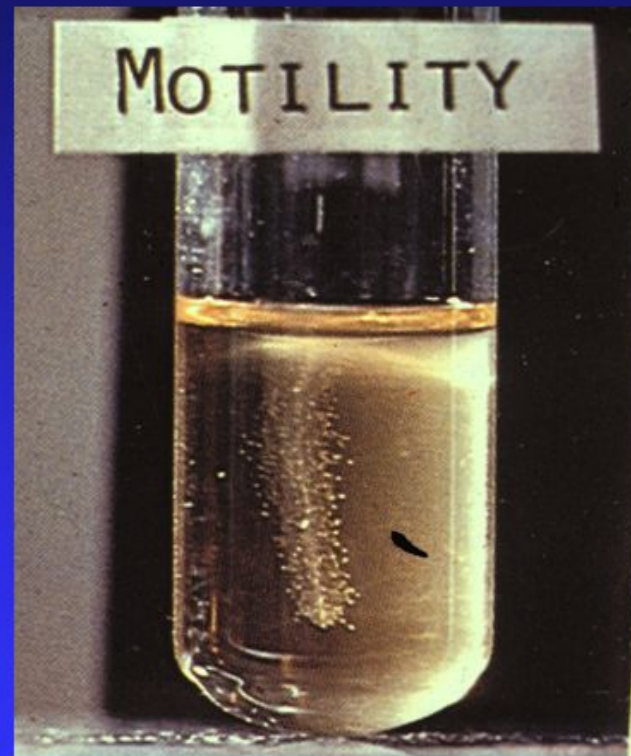- Cause bacillary dysentery (blood, mucus and pus in the stool)

ANTIGENIC STRUCTURES

- **Shigella has 4 species and 4 major O antigen groups:**
- **All have O antigens , some serotypes has K antigen(heat labile removed by boiling)**
- *Shigella* are **non motile** , lack H antigen

Shigella on MacConkey Agar
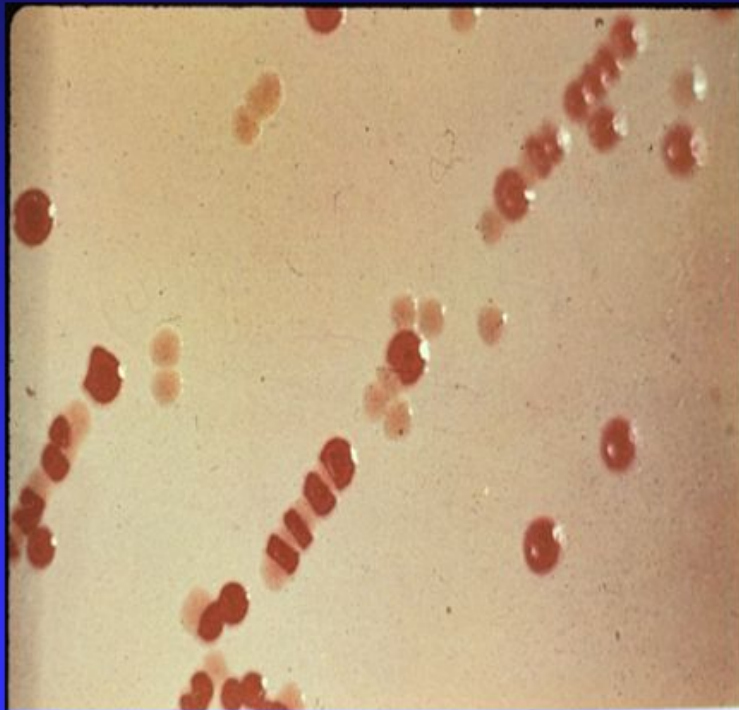

Non-lactose fermenter

Non-motile

CLINICAL INFECTION

- *S.sonnei* **(group D1) most predominant in USA (fever, watery diarrhea)**

- *S.flexneri* **(group B15) 2nd most common**

- **Young adult (man who have sex with man)**

- *S. dysenteriae (group A 6)***and** *S. boydii (group C 20)* **are most common isolates in developing countries**

- *S. dysenteriae* **type 1 associated with morbidity and mortality.**

- **Human is the only reservoir**

- **Person to person transmission through fecal –oral route .**

- **Flies, fingers (have a role in spread).**

- **Food and water.**

- **Young children in daycare, people in crowded area and anal oral sex in developed countries.**

- **Low infective dose < 200 bacilli**

- **Penetrate epithelial cells ,leads to local inflammation, shedding of intestinal lining and ulcer formation.**

SYMPTOMS

- **High fever, chill, abdominal cramp and pain accompanied by tenesmus , bloody stool with mucus & leukocytes.**

- **Incubation period : 24 - 48 hrs**

- **Can lead to rectal prolapsed in children**

- **Complications: ileus, obstruction dilatation and toxic mega colon**

- **Bacteremia in 4 % of severely ill patient**
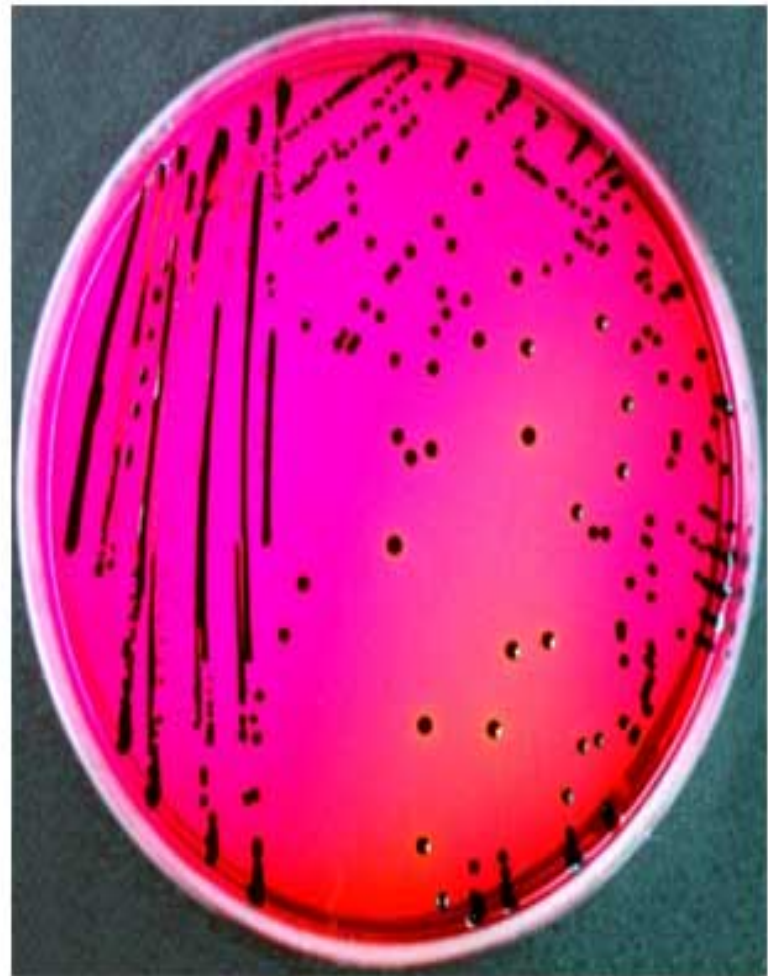
- **Seizures, HUS**

DYSENTRY STOOL
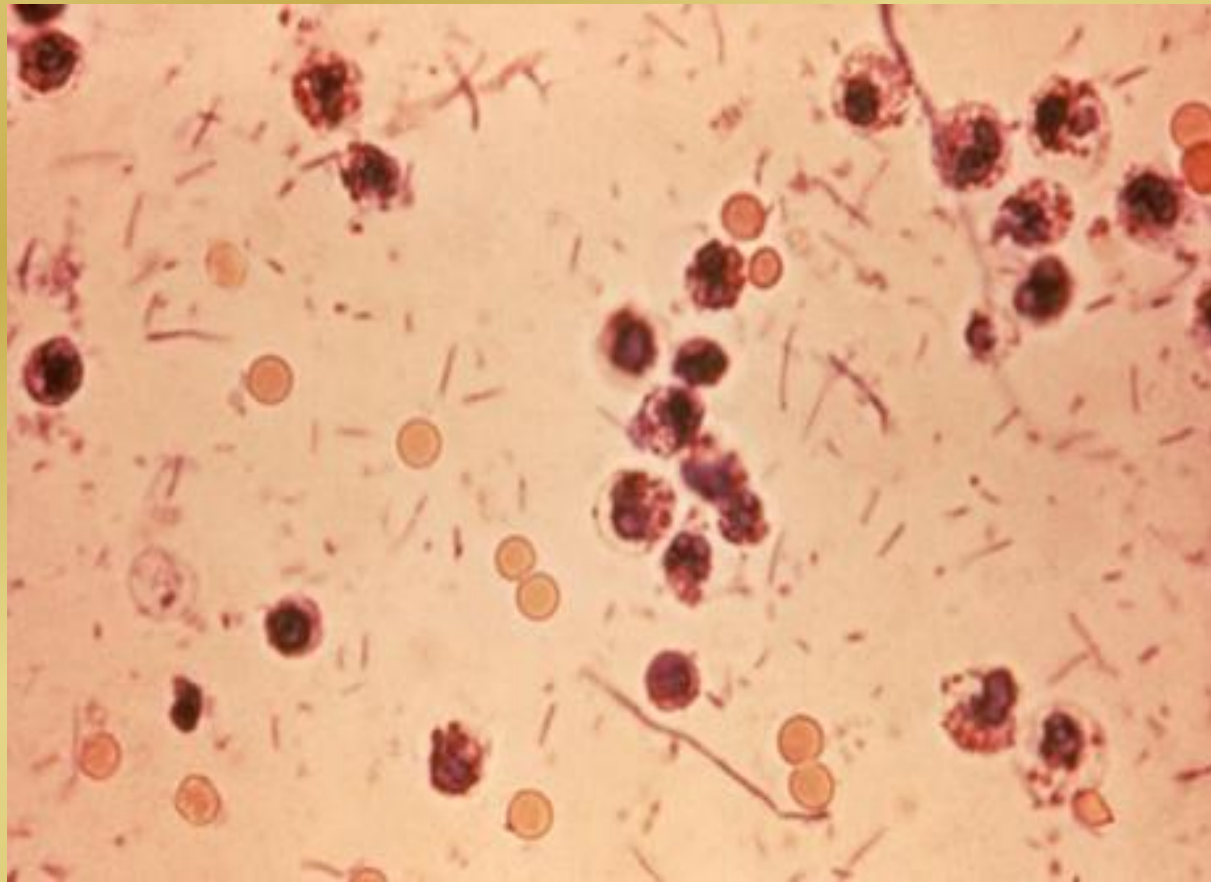
Laboratory diagnosis of *Salmonella* & *Shigella* from stool

-Both are Gram negative bacilli

-Culture on selective media (*Salmonella* produce black colonies due to H2S)

-Biochemical tests

-Motility test

-Serology for serotypes.
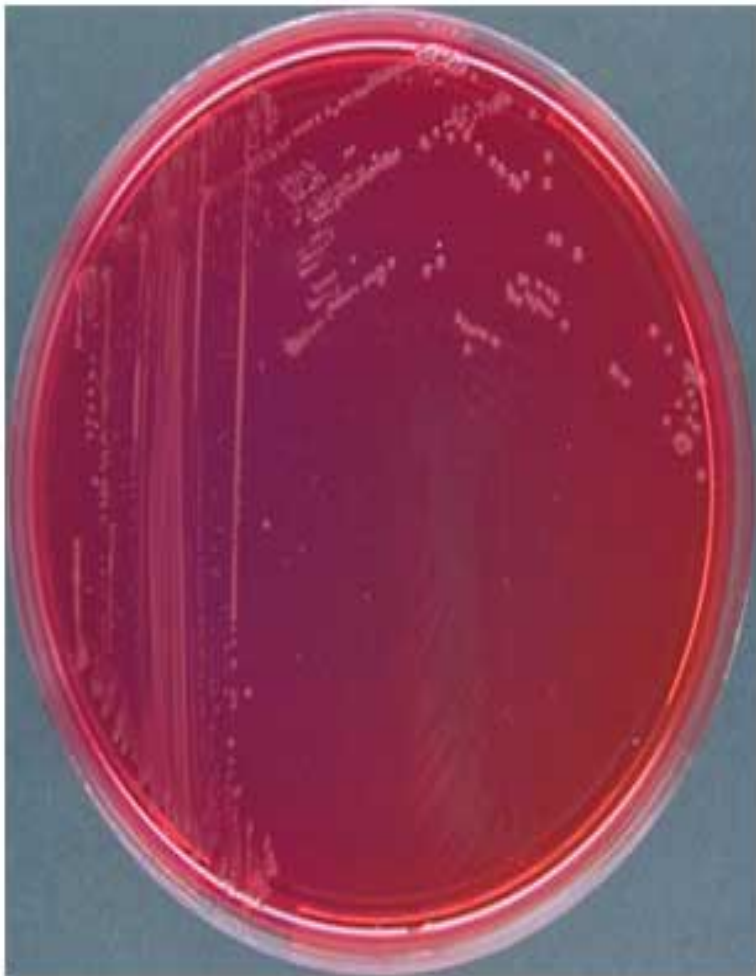
Shigella on XLD.

Salmonella on XLD.

Image Source: Faculty of Health and Medical Sciences - University of Copenhagen, Denmark

BIOCHEMICAL TESTS

Serology

Usually in **Salmonella, Shigella** and ***E.coli*** *the* final detection is by serotyping using agglutination Ag+Ab test.

Diagnosis

- Stool culture on selective selenite enrichment broth media ,MAC, SS(Salmonella/Shigella) and XLD,HEA(Hektoen enteric agar) BS (bile salt agar)

- Sero-grouping based on O and H antigen

1. Sereny test

TREATMENT

Antibiotic is used to reduce duration of illness ampicillin , oral TMP-SMX or IV ceftriaxone and ciprofloxacin or doxycycline.

References

Ryan, Kenneth J. Sherris Medical Microbiology, latest edition. McGraw-Hill Education.

- Intestinal flora, part of chapter 1

- Enteric infections and food poisoning, part of the chapter on Infectious Diseases.

 -Typhoid fever

- Dysentry