

SALMONELLA & SHIGELLA

Prof. Hanan Habib & Dr. Khalifa Binkhamis
Department of Pathology
College of medicine

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

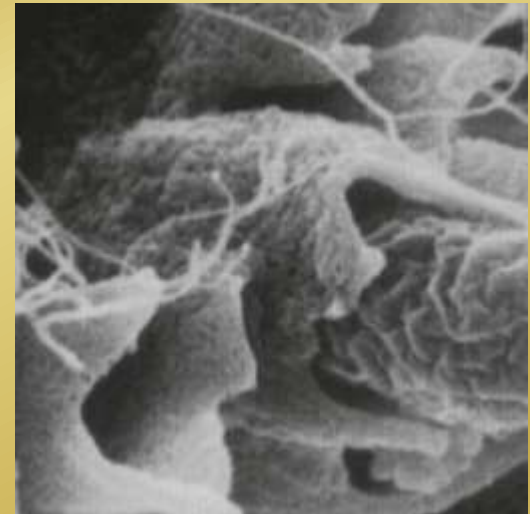
Salmonella

- 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 T3SS
 - TLR
- ▣ Replication in microphage
- ▣ Enterotoxin



Classification

Two species of Salmonella :

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

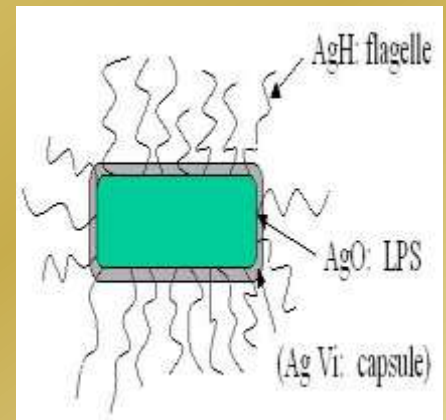
Found in cold blooded animal, birds, rodents, turtles, snakes and fish

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



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 reticulo endothelial 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
- ❖ Biliary tract → GIT
- ❖ Organism isolated from stool .



Management & Antibiotics

Enteric fever:

- ▣ Ceftriaxone
- ▣ Ciprofloxacin
- ▣ Trimethoprim - 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 only.

COMPLICATIONS

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

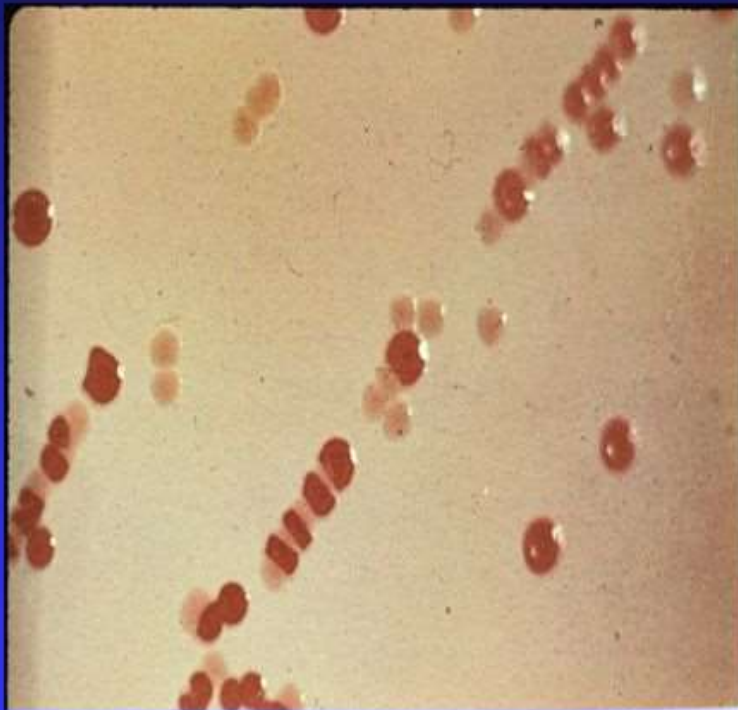
Shigella

- ▣ **Shigella** is non lactose fermenting Gram negative bacteria.
- ▣ Cause bacillary dysentery (blood, mucus and pus in the stool)

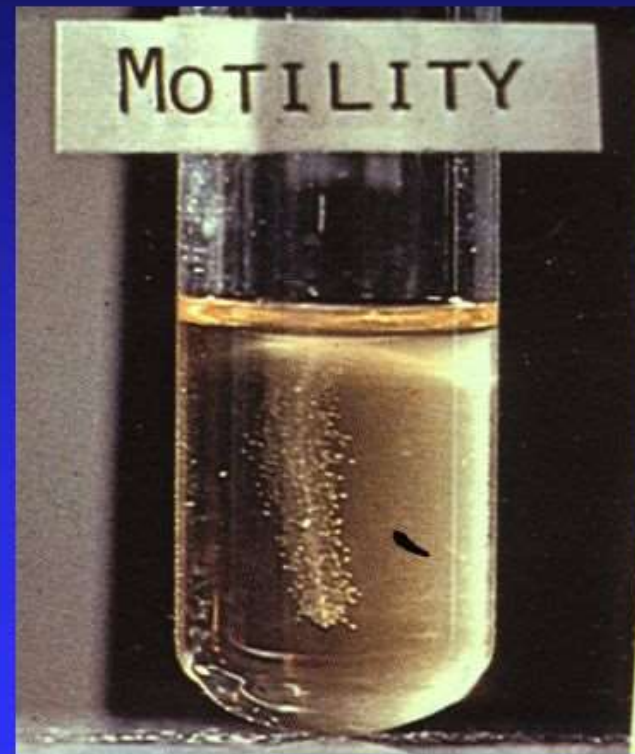
ANTIGENIC STRUCTURES

- ▣ *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

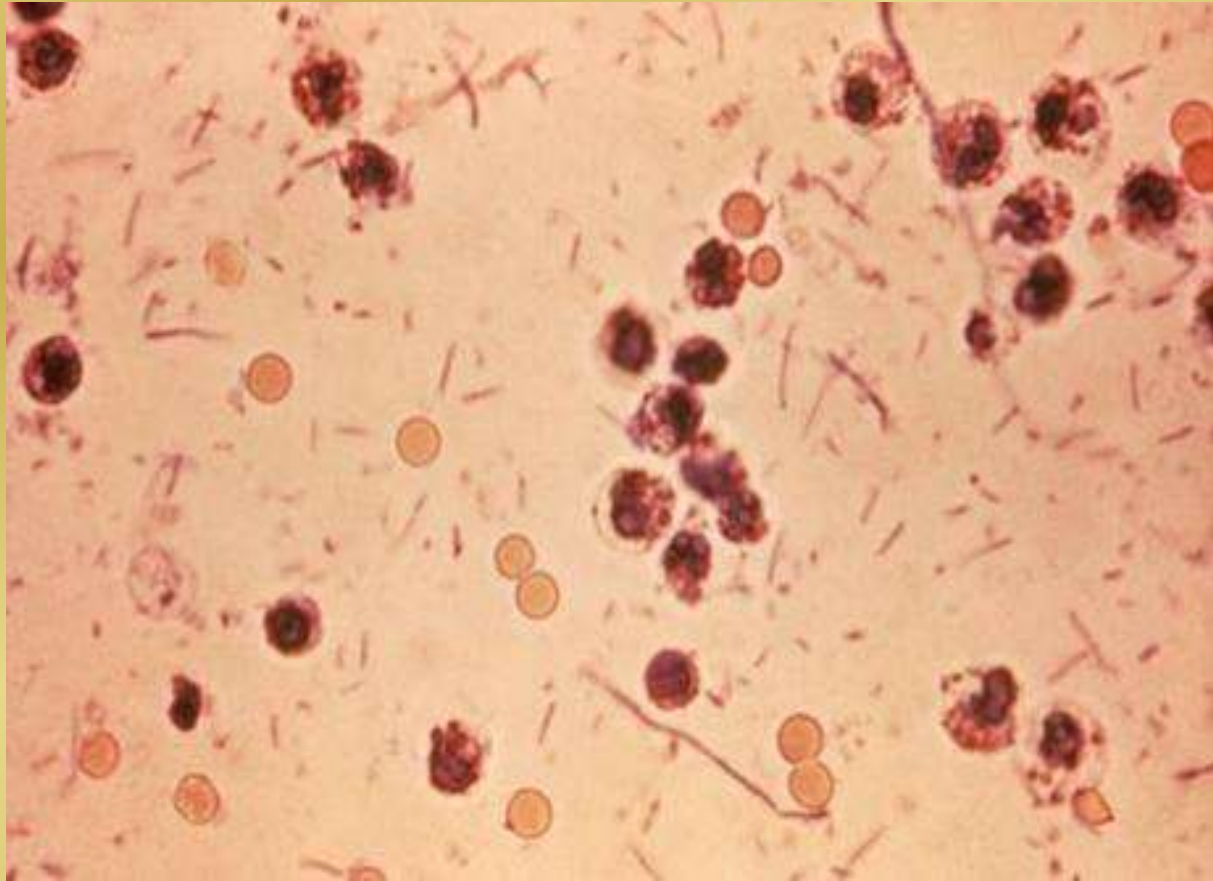
- ▣ *S. sonnei* (group D1) most predominant in USA (fever, watery diarrhea)
- ▣ *S. flexneri* (group B15) 2nd most common
- ▣ Young adult (man who have sex with man)
- ▣ *S. dysenteriae* (group A 6) and *S. boydii* (group C 20) are most common isolates in developing countries
- ▣ *S. dysenteriae* type 1 associated with morbidity and mortality.
- ▣ Human is the only reservoir

- **Person to person 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

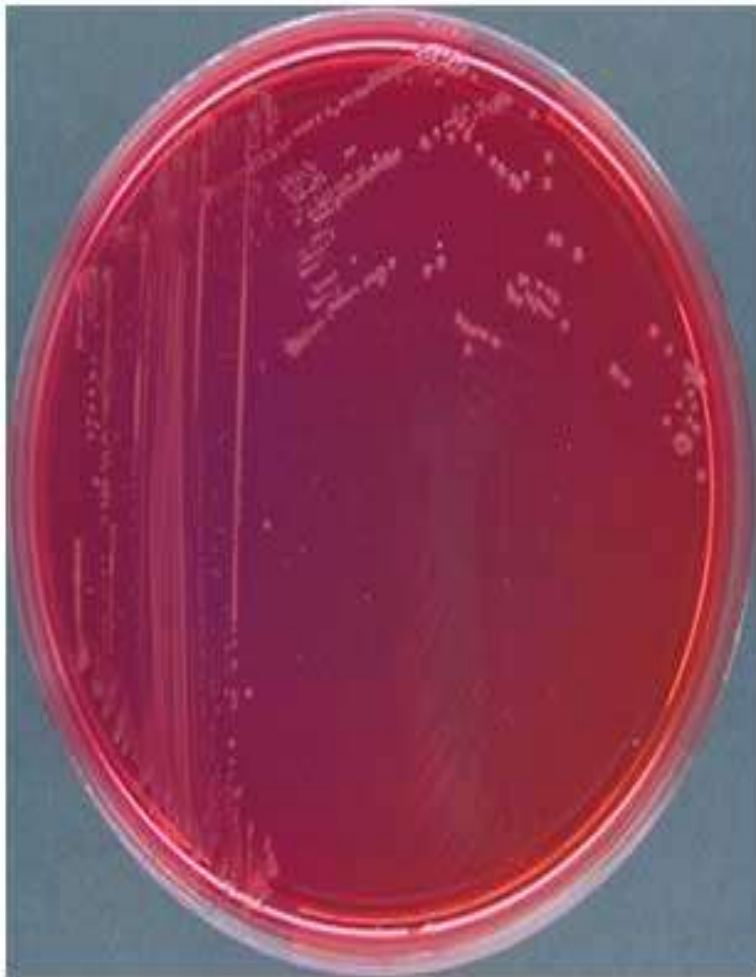
- ▣ High fever, chill, abdominal cramp and pain accompanied by **tenesmus, bloody stool with mucus & leukocytes.**
- ▣ Incubation period : 24 - 48 hrs
- ▣ Can lead to rectal prolapsed in children
- ▣ Complications: ileus, obstruction dilatation and toxic mega colon
- ▣ Bacteremia in 4 % of severely ill patient
- ▣ Seizures, HUS

DYSENTRY STOOL

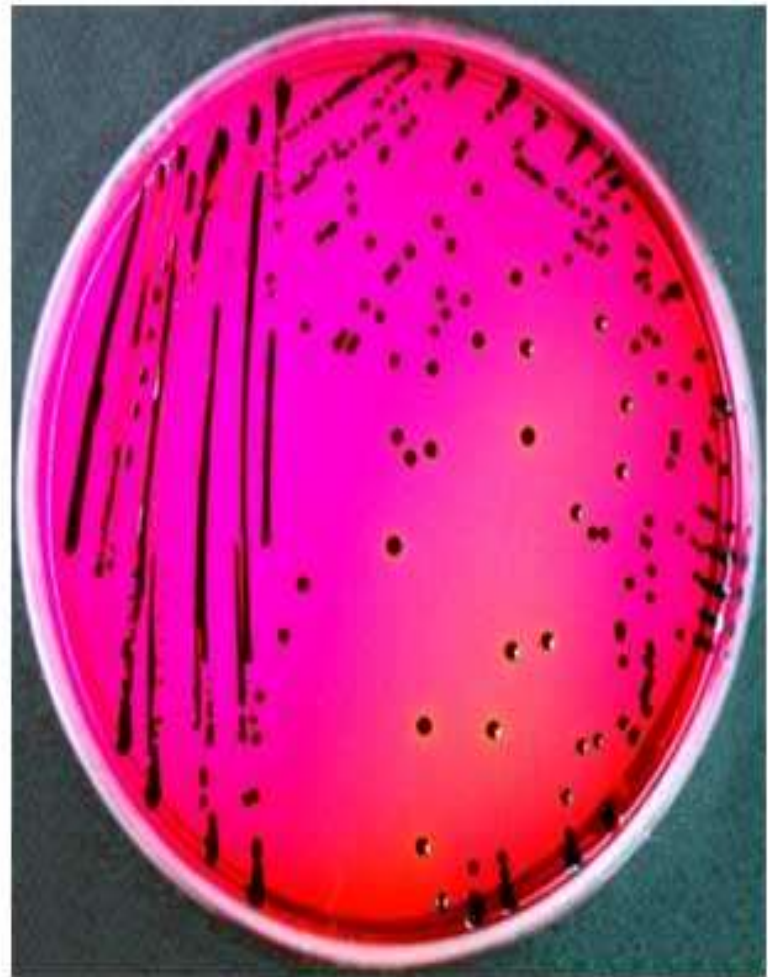


Laboratory diagnosis of *Salmonella* & *Shigella* from stool

- 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



api 20E REF: 20B

Origine / Source / Herkunft / Origen / Provenienza

bioMérieux

ONPG	ADH	LDH	ODC	[CIT]	H2S	URE	TDA	IND	[VP]	IGELI	GLU	MAN	INO	SOR	RHA	SAC	MEL	AMY	ARA	
+	-	-	+	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
1	2	4	1	2	4	1	2	4	1	2	4	1	2	4	1	2	4	1	2	4
1	2	4	1	2	4	1	2	4	1	2	4	1	2	4	1	2	4	1	2	4
1	2	4	1	2	4	1	2	4	1	2	4	1	2	4	1	2	4	1	2	4

Autres tests / Other tests / Weitere Tests / Altri tests / Outros tests

Ident: *Klebsiella pneumoniae pneumoniae*

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 and XLD, HEA, BS
- ▣ Sero-grouping based on O and H antigen
- ❖ Sereny test



TREATMENT

Antibiotics used to reduce duration of illness

- ▣ Ampicillin, IV ceftriaxone, oral TMP-SMX, Ciprofloxacin or Azithromycin

References

Ryan, Kenneth J.. Sherris Medical Microbiology, Seventh Edition. McGraw-Hill Education.

- Intestinal flora, part of chapter 1
- Enteric infections and food poisoning, part of the chapter on Infectious Diseases.
 - Typhoid fever
 - Dysentery