Assist. Prof. Dr. Ameer Mezher Hadi

Lecture. 5

Second Stage

Evaluation Lecturer

Al-Mustaqbal University

College of Health and Medical Techniques

Department of Medical Laboratory Technique

SHIGELLA AND SALMONELLA

1- *SHIGELLA*

Genus: *Shigella* , **Familly**: Enterobacteriaceae ,**Tribe**: Escherichia , **Genus**: Salmonella

Discovered by **Kiyoshi Shiga** in 1898. , It is the causative agent of **human shigellosis**.

Classification: There are more than **40 serotypes**. The classification of *Shigella* e relies on **biochemical** and **antigenic** characteristics (O antigens). The pathogenic species are *Shigella sonnei, Shigella flexneri, S. dysenteriae, and Shigella boydii*.

Important Properties:

Shigella e are

- **short Gram-negative rods**.
- **non–lactose-fermenting.**
- **Resistant to bile salts**
- **Divided into four groups: A, B, C, and D according to (O) antigen.**

Shigella can be distinguished from **salmonellae** by three criteria:

- They produce **no gas** from the fermentation of **glucose**
- They **do not** produce **H_2S**
- They are **non-motile**.

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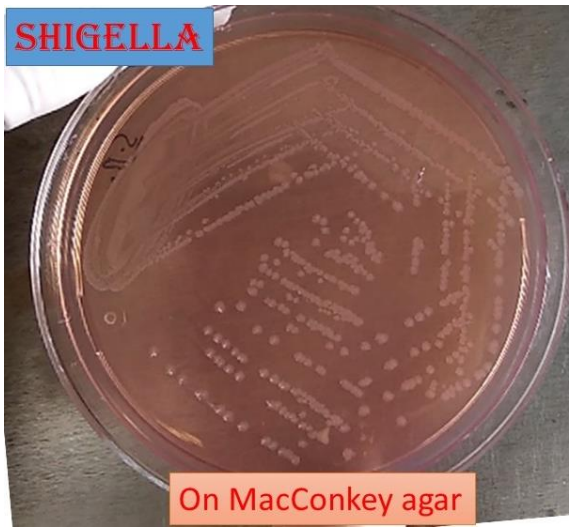
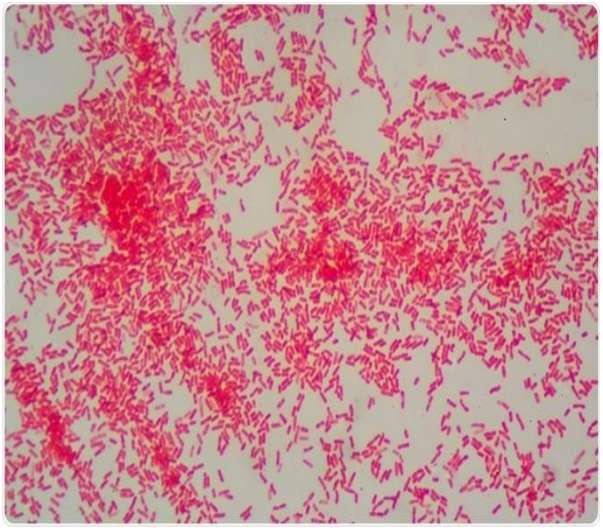
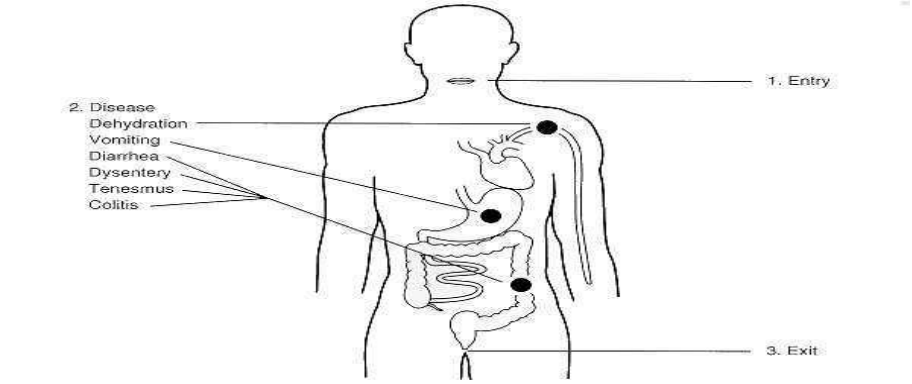




Virulence Factors:

1. K. capsular antigen
2. O. antigen (HL)
3. Shiga toxin: with **cytotoxic** and **neurotoxic** activity.

Pathogenesis of *Shigella* :



- *Shigella* causes **bacillary** dysentery , **Low** infective dose < **200 bacilli** (can be transmitted **easily** unlike salmonella (**More serious and virulent** than salmonella)

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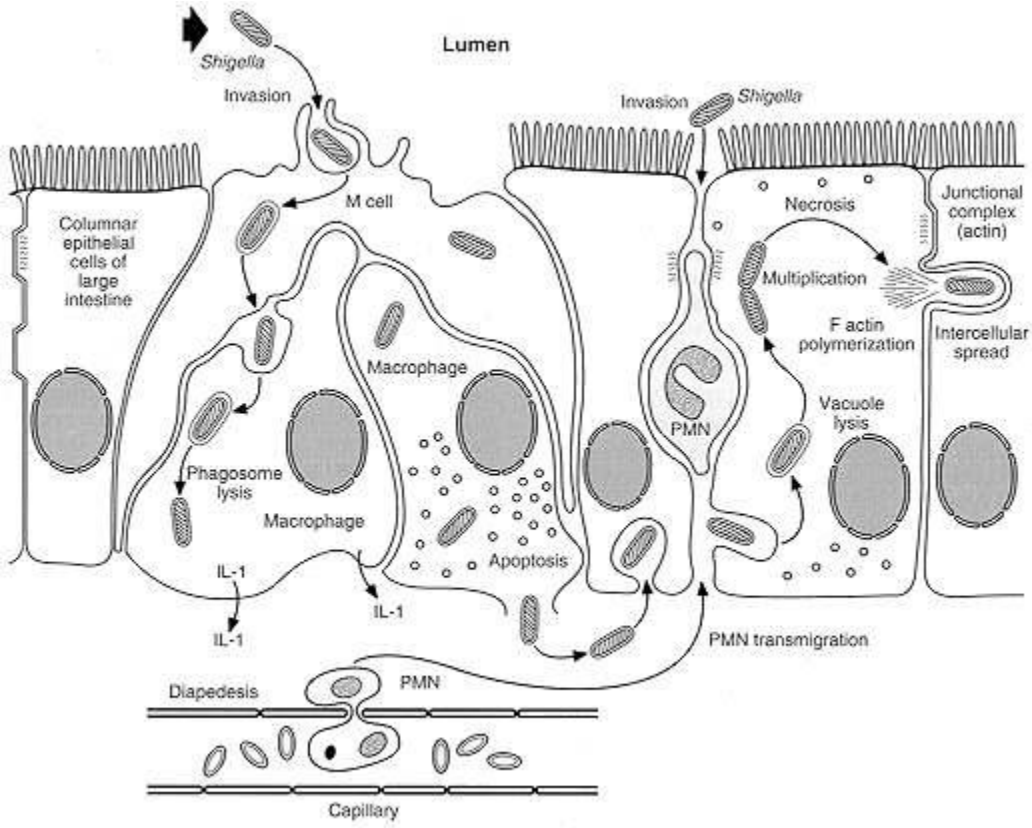
- Incubation period = 1-3 days

- Upon ingestion, the bacteria **pass** through the **gastrointestinal** tract until they reach the **small intestine**. There they begin to **multiply** until they reach the **large intestine**. In the large intestine, the bacteria cause cell **injury** and the beginning stages of Shigellosis via two main mechanisms: **direct invasion of epithelial cells** in the large intestine and **production of enterotoxin** 1 and **enterotoxin** 2. High fever, chill, abdominal cramp and pain accompanied by tenesmus, bloody stool with mucus & WBC and HUS are involved.



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Laboratory Diagnosis:

Specimens: include **fresh stool**, **mucus flecks**, and **rectal swabs** for culture. **Large numbers** of **fecal** leukocytes and some red blood cells often are seen microscopically.

Culture: The materials are streaked on differential media (eg, MacConkey or EMB agar) and on selective media (Hektoen enteric agar or xylose-lysine-deoxycholate agar), which suppress other Enterobacteriaceae and Gram-positive organisms. **Colorless** (lactose-negative) colonies are inoculated into TSI agar. Organisms that **fail** to produce H_2S, that **produce acid** but **not gas** in the **butt** and an **alkaline** slant in TSI agar medium.

Salmonella *Shigella* (SS) Agar: *Shigella* **Clear**, **colorless**, **transparent**.

XLD- Agar: *Shigella flexneri* **Red Colonies**

TSI-Agar: Salmonella **Alkaline** slant/**acidic** butt (K/A); **- H_2S** and **Gas-**

2- Genus: *Salmonella*

Introduction: The organisms are named after the American veterinary pathologist **Daniel Elmer Salmon** in 1885. Currently, there are three recognized species: *S. enterica, S. bongori and S. subterranean*. Salmonella is found worldwide in cold- and warm-blooded animals (including humans), and in the environment. They cause illnesses such as **typhoid fever**, **paratyphoid fever**, and foodborne illness.

Classification:

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- The members of the genus Salmonella were originally classified on the basis of **epidemiology**; **host range**; **biochemical reactions**; and **structures** of the O, H, and Vi (**when present**) antigens.

- *Salmonella* spp. have both H and O antigens. There are over 60 different O antigens, and individual strains may possess several O and H antigens; the latter can exist in variant forms, termed '**phases'**. *Salmonella* serotype **Typhi** also has a **capsular polysaccharide** antigen referred to as 'Vi' (for **virulence**), which is related to **invasiveness**

- Over 2500 serotypes are distinguished, most of which belong to the species *S. enterica*. However, many of these have been given binomial names (e.g. *Salmonella typhimurium* and *Salmonella enteritidis*), although they are not separate species. In clinical practice, laboratories identify microorganisms according to their binomial name.

Important Properties: Salmonellae are **motile** rods that characteristically ferment **glucose** and **mannose** without producing **gas** but do not ferment **lactose** or **sucrose**. Most salmonellae produce **H_2S**. They are often pathogenic for humans or animals when ingested.

Virulence Factors:

1. Type III secretion systems: which **facilitate** secretion of virulence factors of Salmonella into host cells.

2. Endotoxin: Endotoxin is responsible for many of the systemic manifestations of the disease caused by *Salmonella* spp.

3. Fimbriae: The species-specific fimbriae **mediate binding** of *Salmonella* to M (**microfold**) **cells** present in **Peyer patches** of the **terminal part** of the **small intestine**.

SHIGELLA AND SALMONELLA

These M cells typically **transport** foreign antigens, such as **bacteria** to the underlying **macrophages** for clearance.

4.Acid tolerance response gene: The acid tolerance response(ATR) gene protects *Salmonella* spp. from **stomach acids** and the **acidic** pH of the **phagosome**, thereby facilitating survival of bacteria in phagosomes

5. Enzymes: **Catalase** and **superoxide dismutase** are the enzymes that protect the bacteria from **intracellular killing** in **macrophages**.

Pathogenesis of Salmonella: The three types of Salmonella infections (**enterocolitis**, **enteric fevers**, and **septicemia** وجود البكتريا بمجرى الدم وتكاثرها) have different pathogenic features.

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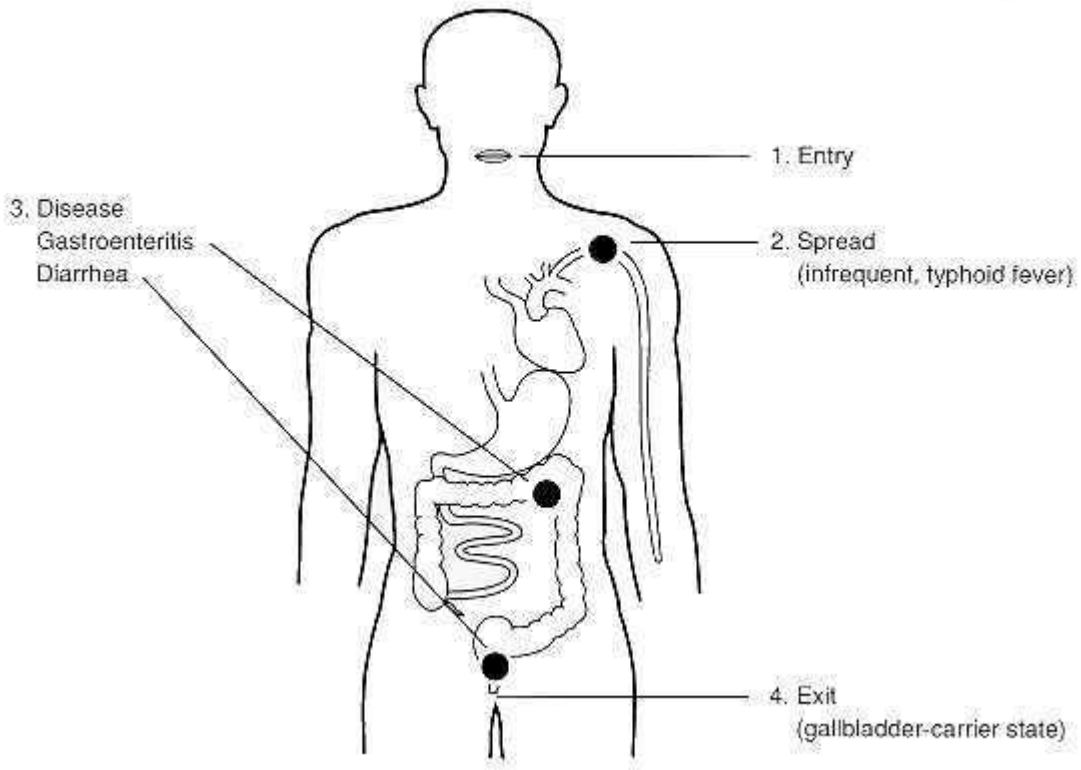

(1) **Enterocolitis**: is characterized by an **invasion** of the **epithelial** and **sub-epithelial tissue** of the small and large intestines.

(2) In **typhoid** and other **enteric** fevers, infection begins in the **small** intestine, but few **gastrointestinal** symptoms occur.

(3) **Septicemia** accounts for only about 5−10% of Salmonella infections and occurs in one of two settings: a patient with an underlying **chronic disease**, such as **sickle cell anemia** or **cancer**, or a child with enterocolitis.

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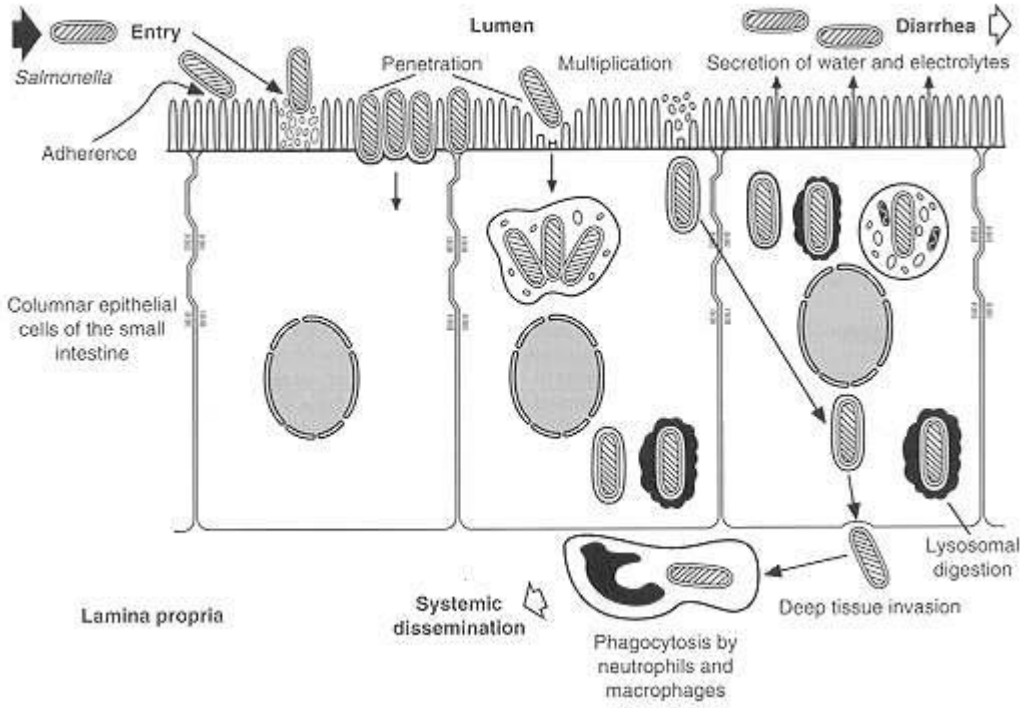

Laboratory Diagnosis:

In enterocolitis: the organism is most easily isolated from a stool sample in selective media e.g. XLD (Xylose lysine deoxycholate agar), DCA (deoxycholate citrate agar), salmonella-*Shigella* (SS) agar, and enrichment media, e.g. **selenite** broth; identification of *Salmonella* spp. by biochemical agglutination tests. Phage typing can be used for typing individual strain.

Salmonella *Shigella* (SS) Agar: salmonella **colorless**, **transparent**, with a **black center** if **H_2S** is produced

XLD- Agar: *Salmonella* Typhi **red Colonies**, **black** centers.

TSI-Agar: Salmonella **Alkaline** slant/**acidic** butt (K/A); + H_2S and Gas +.

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In the enteric fevers: a **blood culture** is the procedure most likely to reveal the organism during the first weeks of illness. **Stool cultures** may also be positive, especially in **chronic carriers** in whom the organism is secreted in the bile into the intestinal tract. **Urine culture** results may be positive after the second week.

Serologic Methods:

I. Agglutination test

II. Tube dilution agglutination test (Widal test): Serum agglutinins rise sharply during the **second** and **third** weeks of *S* serotype Typhi infection.