

Micro GIT

Summary

2nd year

Enteric Gram-Negative Bacterial Infections –

Summary:

1- Enterobacteriaceae:

- * Gram-negative rods
- * Facultative anaerobes
- * Non-spore forming
- * Ferment glucose
- * Oxidase negative
- * Catalase positive

بعضها طبيعي في الـ intestinal flora، وبعضها دائماً pathogenic مثل:

- * Salmonella Typhi
 - * Shigella
-

*Important Culture Features:

On MacConkey agar:

* Lactose fermenters:

- * E. coli
- * Klebsiella

* Non-lactose fermenters:

- * Salmonella
- * Shigella
- * Yersinia

Antigens in Enterobacteriaceae :

1-O antigen:

serotyping جزء من LPS → مهم بالـ

2-K antigen:

Capsule → immune evasion يساعد على

3-H antigen:

Flagellar antigen → موجود بالبكتيريا المتحركة

Major Virulence Factors

- * Endotoxin (LPS lipid A) → fever + shock
 - * Capsule → تمنع phagocytosis
 - * Adhesins → attachment
 - * Exotoxins → diarrhea
 - * Antimicrobial resistance
-

1-Escherichia coli :

:أنواع الـ E. coli diarrheagenic

1) ETEC (Enterotoxigenic E. coli)

:سبب مهم لـ

- * Traveler's diarrhea
- * Diarrhea بالـ النامية

Mechanism:

يلتصق بالأمعاء الدقيقة ثم يفرز toxins.

Heat-labile toxin (LT)

↑ cAMP

Heat-stable toxin (ST)

↑ cGMP

As a result:

→ secretion of water/electrolyte

Clinical picture:

- * Watery diarrhea
- * Non-bloody
- * cramps
- * nausea

لا يوجد invasion واضح

2) EPEC (Enteropathogenic E. coli)

مهم عند infants.

Mechanism

Cause:

attaching and effacing lesions

→ destruction of microvilli

Clinical:

* prolonged watery diarrhea

3) EAEC (Enterotoxigenic E. coli)

يعمل adherence بشكل:

"stacked brick pattern"

Clinical:

* persistent watery diarrhea

* fever

* abdominal pain

مهم لأنه قد يسبب سوء تغذية عند الأطفال.

4) STEC / EHEC

Cause :

* bloody diarrhea

* hemorrhagic colitis

:strain أشهر

O157:H7

Source:

1-undercooked beef

2-unpasteurized milk

Toxin:

Shiga toxin (Stx1, Stx2)

Complication:

HUS = Hemolytic Uremic Syndrome

Triad:

1-hemolytic anemia

2-thrombocytopenia

3-acute kidney injury

Important

✗ avoid antibiotics and antimotility drugs

5) EIEC (Enteroinvasive E. coli)



.Shigella يشبه

Mechanism

invades colonic cells

Clinical:

1-fever

2-bloody diarrhea

3-tenesmus

2-Salmonella:

1) Non-typhoidal Salmonella

.gastroenteritis يسبب

Source:

1-poultry

2-eggs

3-reptiles

Symptoms:

1-fever

2-diarrhea

3-abdominal cramps

.self-limited غالباً

2) Typhoidal Salmonella

Ex:

* Salmonella Typhi

* Salmonella Paratyphi

.Enteric (Typhoid) fever **يسبب**

Pathogenesis:

يدخل عبر Peyer patches ثم يعيش داخل macrophages وينتشر.

Clinical:

1-prolonged fever

2-headache

3-malaise

3-rose spots **أحياناً**

Diagnosis:

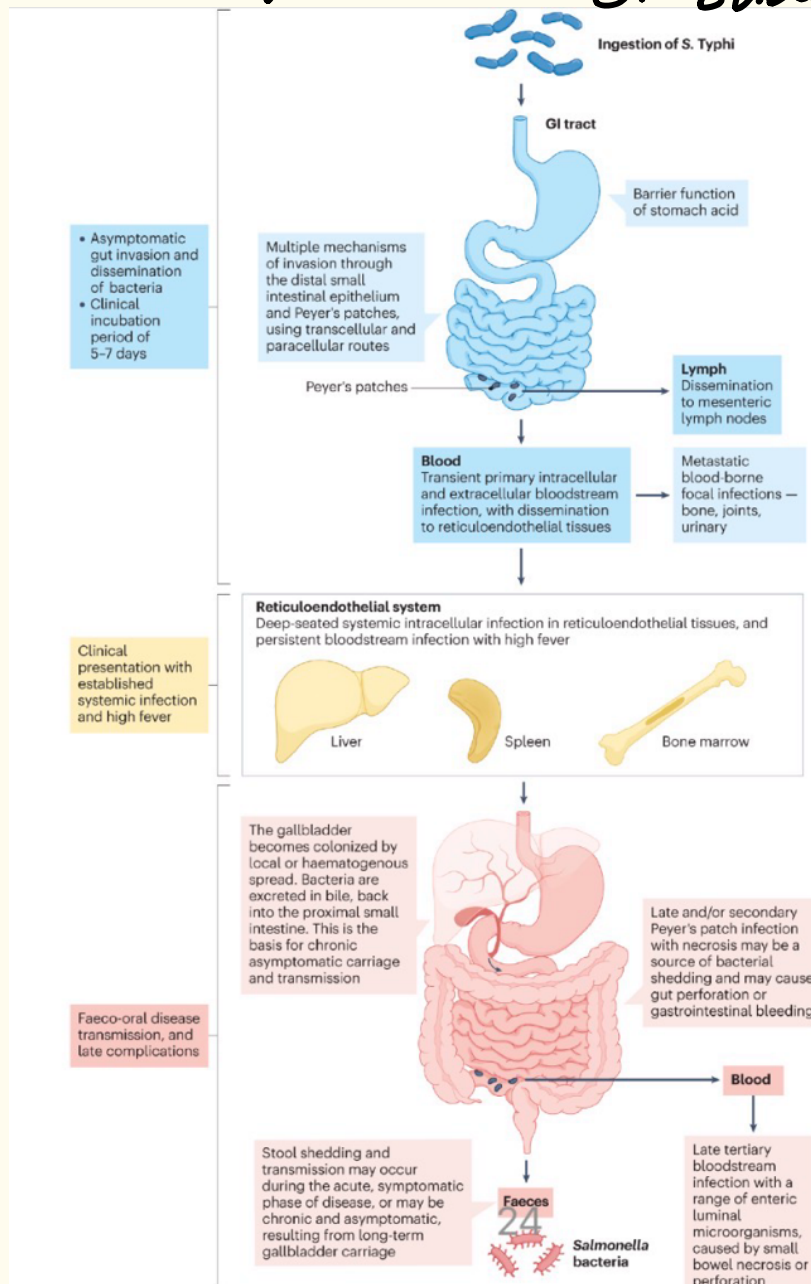
1-Blood culture early

2-Stool culture later

Chronic carrier state

خصوصاً بال **gallbladder**

This pic from Dr. slide



Meiring, J.E., Khanam, F., Basnyat, B. et al. Typhoid fever. Nat Rev Dis Primers 9, 71 (2023). <https://doi.org/10.1038/s41572-023-00480-z>

3-Shigella:

- * Nonmotile
- * very low infectious dose
- * humans are only reservoir

Pathogenesis:

.colonic mucosa يغزو

Cause:

- 1-ulceration
- 2-inflammation

Clinical:

- 1-bloody diarrhea
- 2-mucus
- 3-fever
- 4-tenesmus

Important toxin

Shiga toxin

Important

✗ avoid antimotility drugs

4-Yersinia enterocolitica

Source:

pork products غالبًا

مميز لأنه:

✓ can grow in refrigerator temperatures

Disease:

1-terminal ileitis

2-mesenteric lymphadenitis

Important

appendicitis يشبه

→ pseudoappendicitis

5-Cronobacter sakazakii:

.neonates خطير عند

مرتبط بـ:

powdered infant formula

Causes:

1-sepsis

2-meningitis

3-necrotizing enterocolitis

Summary – Enteric Gram-negative Bacterial Infections of the GI Tract pt.2

*This lecture discusses diarrheagenic *Escherichia coli*, *Salmonella*, and *Shigella* infections, including their diagnosis, laboratory identification, treatment, and prevention.

1) Diarrheagenic *E. coli*

EPEC (Enteropathogenic *E. coli*):

- * Identified by O antigen typing and sometimes H antigen typing.
 - * Tissue culture assays using HEp-2 or HeLa cells may be used in reference laboratories.
-

ETEC (Enterotoxigenic *E. coli*) :

- *Common cause of traveler's diarrhea.
- *Diagnosed by detecting heat-labile toxin (LT) using:
 - 1-cell culture assays
 - 2-immunologic assays
 - 3-gene detection methods.
- * Plasmids may carry colonization factor antigens (CFAs), which help bacterial attachment to intestinal epithelium.

STEC / EHEC (e.g., O157:H7)

- * Does not ferment sorbitol on Sorbitol MacConkey agar (SMAC).
 - * Negative for β -glucuronidase (MUG test).
 - * Shiga toxins can be detected by:
 - * enzyme immunoassay (EIA)
 - * PCR
 - * Vero cell cytotoxin assay.
-

EIEC (Enteroinvasive E. coli)

- * Similar to Shigella.
- * Nonmotile.
- * Non-lactose fermenter or late lactose fermenter.

EAEC (Enteraggregative E. coli)

- * Requires tissue culture adhesion assays for confirmation.
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Treatment and Prevention of E. coli Infections

1-Antibiotics may shorten the duration of disease in EPEC and ETEC infections.

2-Traveler's diarrhea:

- * short-term treatment is preferred over prophylaxis.
- * ciprofloxacin or trimethoprim-sulfamethoxazole may be used.

* Prevention:

- 1-avoid contaminated food and water.
 - 2-cook ground beef thoroughly.
 - 3-avoid unpasteurized products such as apple cider.
-

2) Salmonella:

Microbiological Features:

- 1-Gram-negative bacilli.
- 2-Facultative anaerobes.
- 3-Usually motile with peritrichous flagella.
- 4-Do not ferment lactose or sucrose.
- 5-Oxidase negative.
- 6-Usually produce H_2S .

Diagnosis of Salmonella:

Specimens

- 1-Stool culture is preferred for non-typhoidal Salmonella.
- 2-In enteric fever:
 - * blood cultures are commonly positive in the first week.
 - * bone marrow culture has the highest sensitivity (80-95%).

Culture Media

- * MacConkey and EMB agar detect non-lactose fermenters.
- * Bismuth sulfite agar produces black colonies due to H₂S production.
- * Selective media include:
 - 1-Hektoen enteric agar
 - 2-XLD agar
 - 3-Salmonella-Shigella agar.

Enrichment Media

- * Selenite F broth
 - * Tetrathionate broth.
-

Widal Test:

- * Detects antibodies against O and H antigens of Salmonella Typhi.
- * Requires two serum samples taken 7-10 days apart.
- * False-positive and false-negative results may occur.
- * Cannot be relied on alone for definitive diagnosis.

Treatment of Salmonella:

Non-typhoidal Salmonella

- * Usually self-limited.
- * Main treatment is fluid and electrolyte replacement.
- * Antibiotics are recommended for:
 - * neonates
 - * immunocompromised patients
 - * elderly patients with vascular disease.

Enteric Fever

- * Uncomplicated cases: oral azithromycin.
 - * Severe cases: third-generation cephalosporins or fluoroquinolones.
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3) Shigella:

Microbiological Features

- 1-Gram-negative rods.
- 2-Nonmotile.
- 3-Ferment glucose.

* Most species do not ferment lactose except *Shigella sonnei*.

* Rarely produce gas.

***Important species:**

1- *Shigella sonnei*

2-*Shigella flexneri*

3-*Shigella dysenteriae*

4-*Shigella boydii*.

Diagnosis of *Shigella*:

Specimens

* Fresh stool

* Rectal swabs

* Mucus flecks.

TSI Agar Findings

* Alkaline slant / acid butt

* No H₂S production

* No gas production.

* Serology is not useful for diagnosis.

Treatment of Shigellosis:

- * Usually self-limited within 5–7 days.
 - * Oral or IV fluid replacement is important.
 - * Antidiarrheal drugs such as loperamide should be avoided.
 - * Severe infections may require:
 - 1- ciprofloxacin
 - 2- ceftriaxone
 - 3- azithromycin for resistant strains.
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Summary: **Vibrio, Aeromonas, Campylobacter, and Helicobacter.**

General Overview

These organisms are **Gram-negative rods** widely distributed in nature.

- * **Vibrio** → found in marine and surface water.
- * **Aeromonas** → found in fresh and brackish water.
- * **Campylobacter** → commonly found in animals, especially poultry.
- * **Helicobacter** → colonizes the gastrointestinal tract of humans and animals.

1) Vibrio

General Characteristics:

- * Comma-shaped curved rods.
- * Facultative anaerobes.
- * Oxidase-positive and catalase-positive.
- * Motile by polar flagella.
- * Prefer alkaline pH and salty environments (halophilic).

Important species:

- * *Vibrio cholerae* → causes cholera.
- * *V. parahaemolyticus* → gastroenteritis from seafood.
- * *V. vulnificus* → severe wound infection and septicemia.

1-*Vibrio cholerae*

Morphology & Identification:

- * Curved motile rod.
- * Grows on TCBS agar.
- * Ferments sucrose → produces yellow colonies.
- * Stool samples should be collected early.

Important Serogroups

- * O1 and O139 → epidemic cholera.
- * O1 serotypes:
 - 1-Ogawa
 - 2-Inaba
 - 3-Hikojima

Cholera Toxin

- * Heat-labile enterotoxin with A and B subunits.
- * Increases intracellular cAMP → massive secretion of water and electrolytes.

Pathogenesis:

- * Organism attaches to intestinal epithelium.
- * Produces toxin causing severe watery diarrhea.
- * Infection mainly from contaminated food and water.
- * Patients with low stomach acid need lower infective dose.

Clinical Features:

- * Incubation: 12 hours–3 days.
- * Profuse watery diarrhea (“rice-water stool”).
- * Vomiting and abdominal cramps.
- * Severe dehydration may cause shock and death.

Diagnosis:

- * Stool culture on TCBS agar.
- * Dark-field microscopy shows “shooting-star motility”.
- * Slide agglutination with O1/O139 antisera.

Treatment:

- * Most important: fluid and electrolyte replacement.
- * Antibiotics:
 - 1-doxycycline
 - 2-tetracycline
 - 3-fluoroquinolones
 - 4-azithromycin/erythromycin in children & pregnancy.

Prevention:

- * Sanitation and clean water.
- * Isolation and disinfection.
- * Vaccination for travelers to endemic areas.

2-Non-O1 / Non-O139 *V. cholerae*

- * Cause mild diarrhea, wound infection, or septicemia.
- * Associated with seafood and contaminated water.
- * More severe in patients with comorbidities.

3-*Vibrio parahaemolyticus*

- * Associated with raw or undercooked seafood.
- * Causes watery diarrhea, cramps, nausea, vomiting.
- * Usually self-limited.

4-*Vibrio vulnificus*

- * Associated with oysters and seawater.
- * Causes:
 - * septicemia
 - * cellulitis
 - * necrotizing fasciitis
- * Severe disease in liver disease and immunocompromised patients.

2) *Aeromonas*

Characteristics

- * Found in fresh/brackish water.
- * Oxidase-positive Gram-negative rods.
- * Usually β -hemolytic on blood agar.

Important species:

- * *A. hydrophila*
- * *A. caviae*
- * *A. veronii* biovar *sobria*

Diseases:

Gastroenteritis

- * Watery or dysentery-like diarrhea.
- * Fever, nausea, vomiting.
- * Usually self-limited.

Extraintestinal Disease

- * Wound infections after water exposure.
- * Can cause cellulitis, fasciitis, osteomyelitis, sepsis.

Treatment:

Resistant to:

- * penicillin
- * ampicillin

Sensitive to:

- * fluoroquinolones
 - * carbapenems
 - * 3rd-generation cephalosporins.
-

3) Campylobacter

Characteristics:

- * Require microaerophilic conditions.
- * Best growth at 42°C.
- * *C. jejuni* shows "gull-wing" appearance.
- * Darting motility.
- * Oxidase-positive and catalase-positive.

Diagnosis:

- * Culture on selective media (Skirrow's medium).
- * Hippurate test positive in *C. jejuni*.

Disease:

Transmission:

- * contaminated poultry
- * food and water
- * infected animals

Symptoms:

- * fever
- * abdominal cramps
- * diarrhea (may be bloody).

Complications:

- * Guillain-Barré syndrome
- * reactive arthritis
- * Reiter syndrome.

Treatment:

- * Usually self-limited.
- * Macrolides (erythromycin) may shorten illness.

4) *Helicobacter pylori*

Characteristics:

- * Spiral-shaped Gram-negative rod.
- * Oxidase-positive, catalase-positive, urease-positive.
- * Motile with flagella.

Diseases Associated

- * Chronic gastritis
- * Duodenal ulcers
- * Gastric ulcers
- * Gastric adenocarcinoma
- * MALT lymphoma.

Virulence Factors

- * Urease → neutralizes stomach acid.
- * Flagella → movement through mucus.
- * CagA and VacA toxins → inflammation and tissue damage.

Clinical Findings

- * Epigastric pain
- * nausea
- * vomiting
- * chronic infection may persist lifelong.

Diagnosis:

- * Gastric biopsy.
- * Histology (very sensitive).
- * Rapid urease test.
- * Urea breath test.
- * Stool antigen test for active infection.

Treatment:

Triple Therapy

- * PPI + amoxicillin + clarithromycin.

Quadruple Therapy

- * PPI + metronidazole + tetracycline + bismuth.

*This is a summary of the first three lectures from the micro, I hope you unde to make sense.

Good Luck
Everyone

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