Gastrointestinal Block

Pathology lecture

2018

Pathophysiology and mechanisms of diarrhea

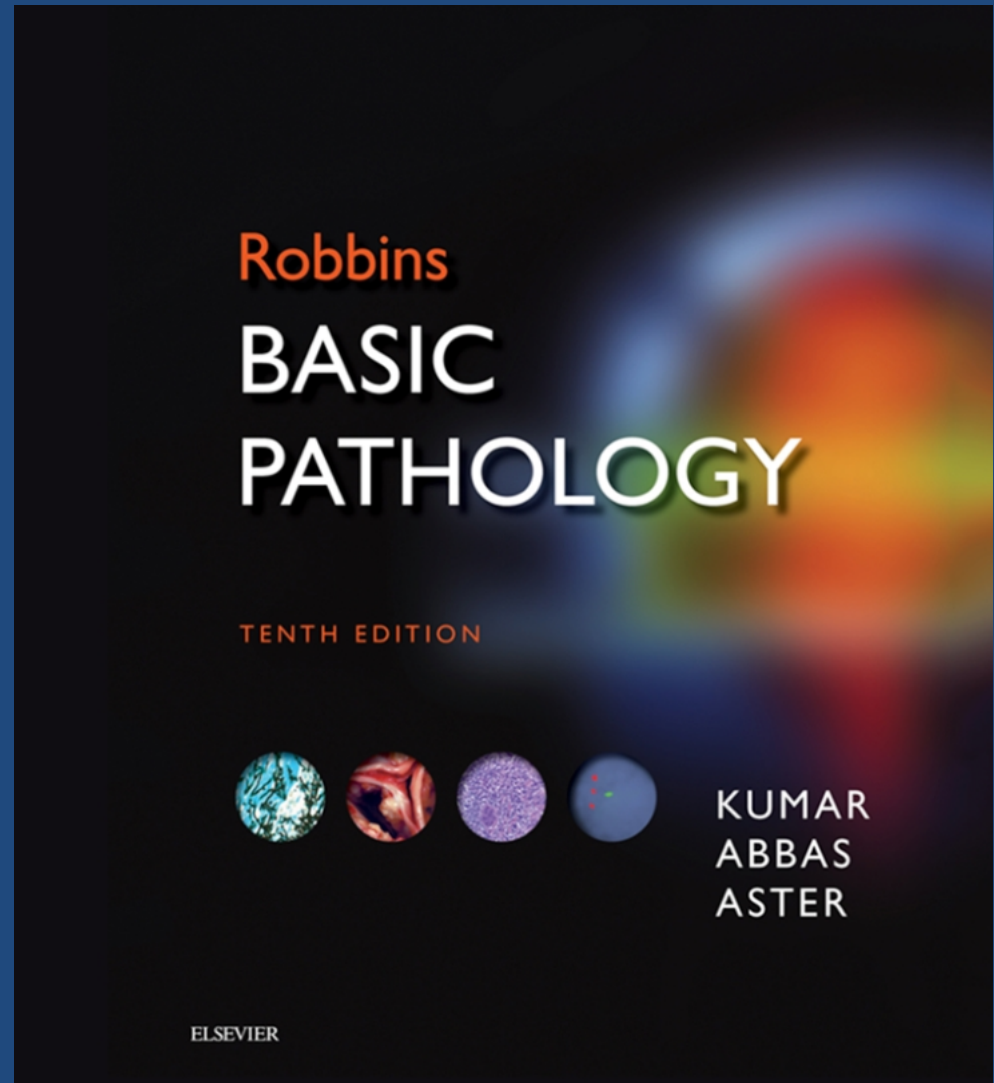Dr. Maha Arafah

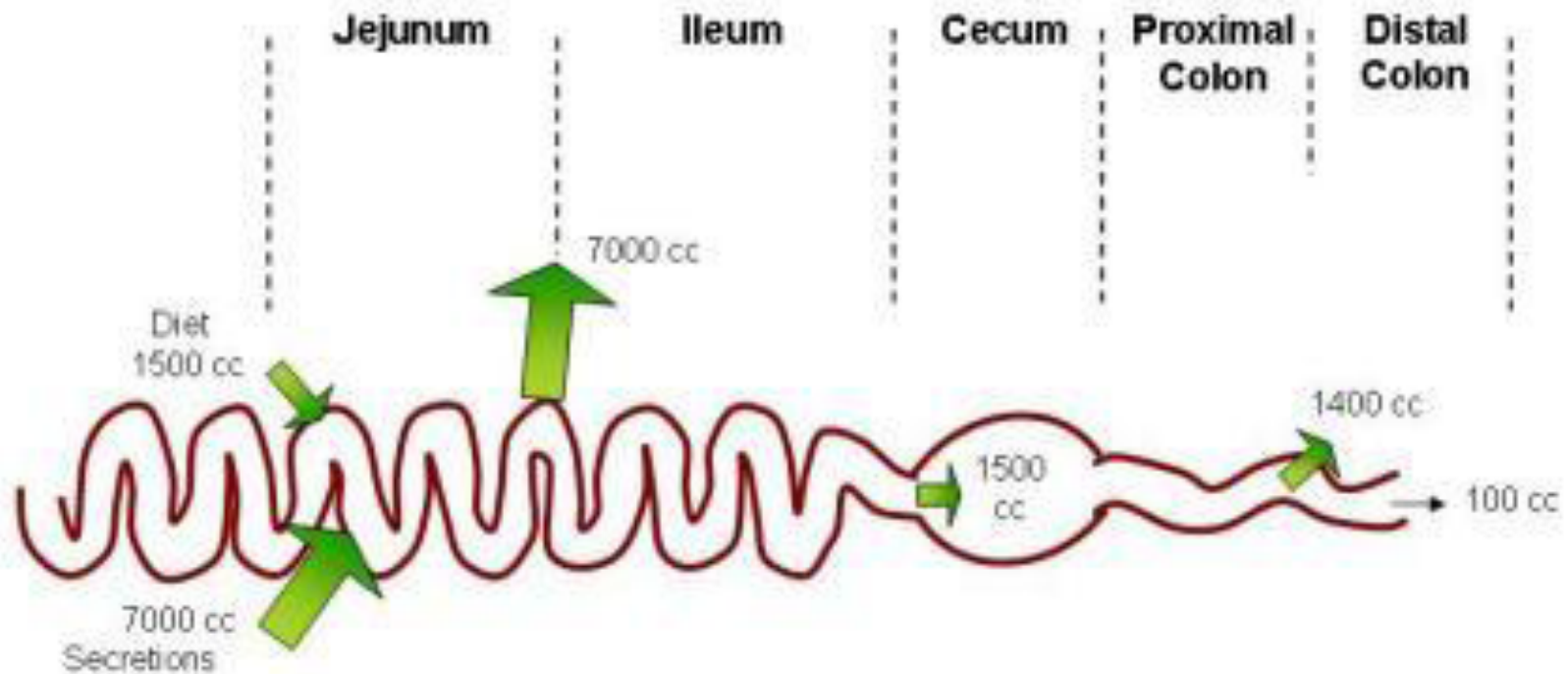Dr. Ahmed Al Humaidi

DIARREAHA
Objectives

1. Define diarrhea

2. Understand the four categories of diarrheal diseases, and list the major causes in each category.

3. List the causes of chronic diarrhea

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Physiology of Fluid and small intestine

DIARREAHA
DEFINITION

- World Health Organization

➢ 3 or more loose or liquid stools per day

- Abnormally high fluid content of stool

  ➢ 200-300 gm/day

  (more than 250 g of stool per day)

Why important?

- The loss of fluids through diarrhea can cause dehydration and electrolyte imbalances
- Easy to treat but if untreated, may lead to death especially in children

Why important?

More than 70 % of almost 11 million child deaths every year are attributable to 6 causes:

1. Diarrhea
2. Malaria
3. neonatal infection
4. Pneumonia
5. preterm delivery
6. lack of oxygen at birth.

UNICEF

CLASSIFICATION

1. Acute ……………*if* 2 weeks,

2. Persistent ……. *if 2 to 4 weeks,*

3. Chronic ………..*if 4 weeks in* duration.

Pathophysiology
Categories of diarrhea

1. **Secretory**

   Secretory diarrhea: loss of isotonic fluid

2. **Osmotic**

   Osmotic diarrhea: loss of hypotonic fluid

3. **Exudative**

   inflammatory

4. **Motility-related**

Stool osmotic gap: distinguishes secretory from osmotic diarrhea

Fecal osmolarity

- As stool leaves the colon, fecal osmolality is equal to the serum osmolality i.e. 290 mosm/kg

- Under normal circumstances, the major osmoles are Na^+, K^+, Cl^-, and HCO_3^-

- **Stool osmotic gap** =
  Stool osmolality - 2 x (stool Na + stool K)

  Normal fecal fluid values:
  Osmolality: ~290 mOsm/kg
  Na+: ~30 mmol/L
  K+: ~75 mmol/L

Stool osmotic gap

Fecal Osmotic Gap

$$290 \text{ mosm/kg } H_2O - 2\,([Na^+] + [K^+])$$

- is a calculation performed to distinguish among different causes of diarrhea.

- A normal gap is between 50 and 100 mosm/kg

- A low stool osmotic gap (<50 mosm/kg) can imply secretory diarrhea

- A high gap (>125 mosm/kg) can imply osmotic diarrhea

- The reason for this is that secreted sodium and potassium ions make up a greater percentage of the stool osmolality in secretory diarrhea, whereas in osmotic diarrhea, molecules such as unabsorbed carbohydrates are more significant contributors to stool osmolality.

Secretory Diarrhea

- There is an increase in the active secretion of water
- High stool output
- Lack of response to fasting
- Stool osmotic gap   < 100 mOsm/kg
- The most common cause of this type of diarrhea is a bacterial toxin (E. coli , cholera) that stimulates the secretion of anions.
- Other causes:
  - Enteropathogenic virus e.g. rotavirus and norwalk virus
  - Also seen in neuroendocrine tumours (carcinoid tumor, gastrinomas)
  - Rectal villous adenoma

Osmotic Diarrhea

- Excess amount of poorly absorbed substances that exert osmotic effect………water is drawn into the bowels……diarrhea
- Stool output is usually not massive
- Fasting improve the condition
- Stool osmotic gap is high, > 125 mOsm/kg (loss of hypotonic fluid)
- **Can be the result of**
1. Malabsorption in which the nutrients are left in the lumen to pull in water e.g. lactose intolerance, chronic pancreatitis, celiac disease
2. Osmotic laxatives e.g. Lactulose (non-absorbable sugar)
3. Hexitols (poorly absorbed): sorbitol, mannitol, xylitol)

Exudative (inflammatory) Diarrhea

- Results from the outpouring of blood protein, or mucus from an inflamed or ulcerated mucosa

- Presence of blood and pus in the stool.

- Persists on fasting

- Occurs with inflammatory bowel diseases, and invasive infections e.g. *E. coli, Clostridium difficile* and *Shigella*

# Exudative (inflammatory) Diarrhea

- Some bacterial infections cause damage by invasion of the mucosa. Many cause diarrhea with blood and pus in the stool **(bacterial dysentery**)
  - The main organisms of bacterial dysentry are:
    - *Campylobacter* invades mucosa in the jejunum, ileum and colon, causing ulceration and acute inflammation.
    - *Salmonella typhi*, *S. paratyphi A*, *B*, **and *C***
    - *Shigella* infections are mainly seen in young children.
    - **Enteroinvasive and enterohemorrhagic** *E. coli*

Motility-related Diarrhea

- Caused by the rapid movement of food through the intestines (hypermotility).

- Irritable bowel syndrome (IBS) – a motor disorder that causes abdominal pain and altered bowel habits with diarrhea predominating

- Increased serotonin: carcinoid syndrome
 - Serotonin increases bowel motility
    No inflammation in bowel mucosa

TYPE	CHARACTERISTICS	CAUSES	SCREENING TESTS
Secretory	Loss of isotonic fluid High-volume diarrhea Mechanisms:Laxatives Enterotoxins stimulate Cl^- channels regulated by cAMP and cGMP	Laxatives: melanosis coli with use of phenanthracene laxatives Production of enterotoxins: *Vibrio cholerae* Enterotoxigenic *E. coli*	Stool osmotic gap < 50 mOsm/kg Fecal smear for leukocytes: negative
Osmotic	Osmotically active substance is drawing hypotonic salt solution out of bowel High-volume diarrhea No inflammation in bowel mucosa	Disaccharidase def. pancreatitis Giardiasis, Celiac Dis. Ingestion of poorly absorbable solutes	Fecal smear for leukocytes:negative Stool osmotic gap > 125 mOsm/kg
Invasive Inflammatory	Pathogens invade enterocytes Low-volume diarrhea Diarrhea with blood and leukocytes (i.e., dysentery	*Shigella* spp. *Campylobacter jejuni* Entamoeba histolytica	Fecal smear for leukocytes: positive in most cases Stool culture and for O&P
Motility-related	Rapid movement of food through the Intestines Serotonin increases bowel motility No inflammation in bowel mucosa	Irritable bowel syndrome (IBS) – a motor disorder Increased serotonin: carcinoid syndrome	Increased 5-HIAA

Entamoeba histolytica
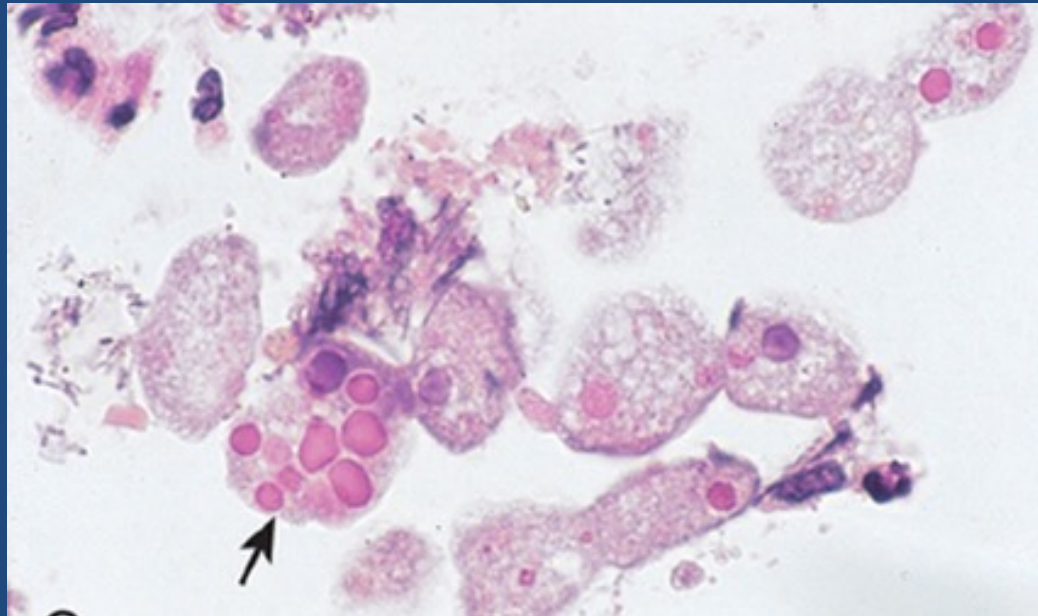
Acute diarrhea

Acute diarrhea

- **Infection:** Approximately 80% of acute diarrheas (viruses, bacteria, helminths, and protozoa).
- Viral gastroenteritis (viral infection of the stomach and the small intestine) is the most common cause of acute diarrhea worldwide.
- Preformed toxin, enterotoxin, cytoxin or invasive
- **Food poisoning**
- **Drugs:** antibiotic, NSAID, antiacid, bronchodilaters, antiarrythmics
- **Others:** occlusive colitis, ischemia, toxin (insecticides)
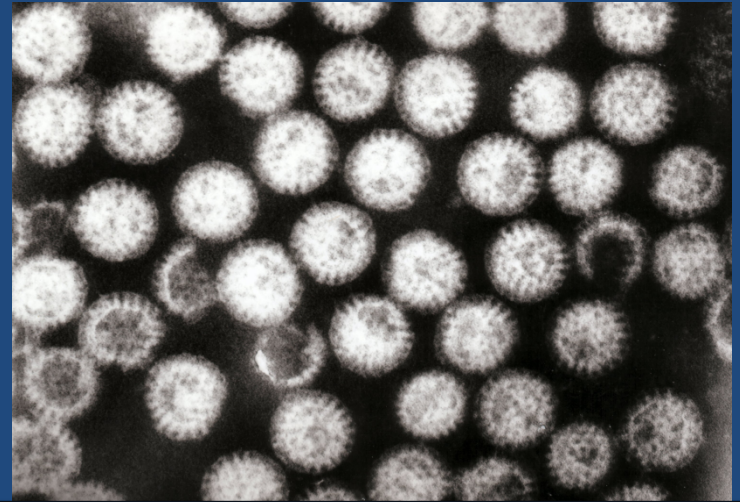
Rotavirus

- The cause of nearly 40% of hospitalizations from diarrhea in children under 5
- Rotaviruses cause 50% in infants

Clinically person become dehydrated with electrolyte disturbance and low bicarbonate in blood

Mild self limited , need rehydration

Antibiotic-Associated Diarrheas

- **Diarrhea occurs in 20% of patients receiving broad-spectrum antibiotics; about 20% of these diarrheas are due to *Clostridium difficile***

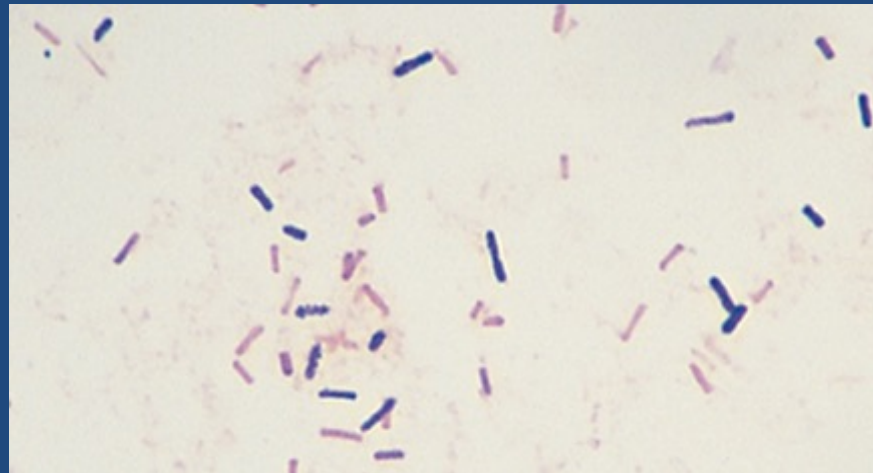- **Leading to pseudomembranous colitis**

Pseudomembranous colitis
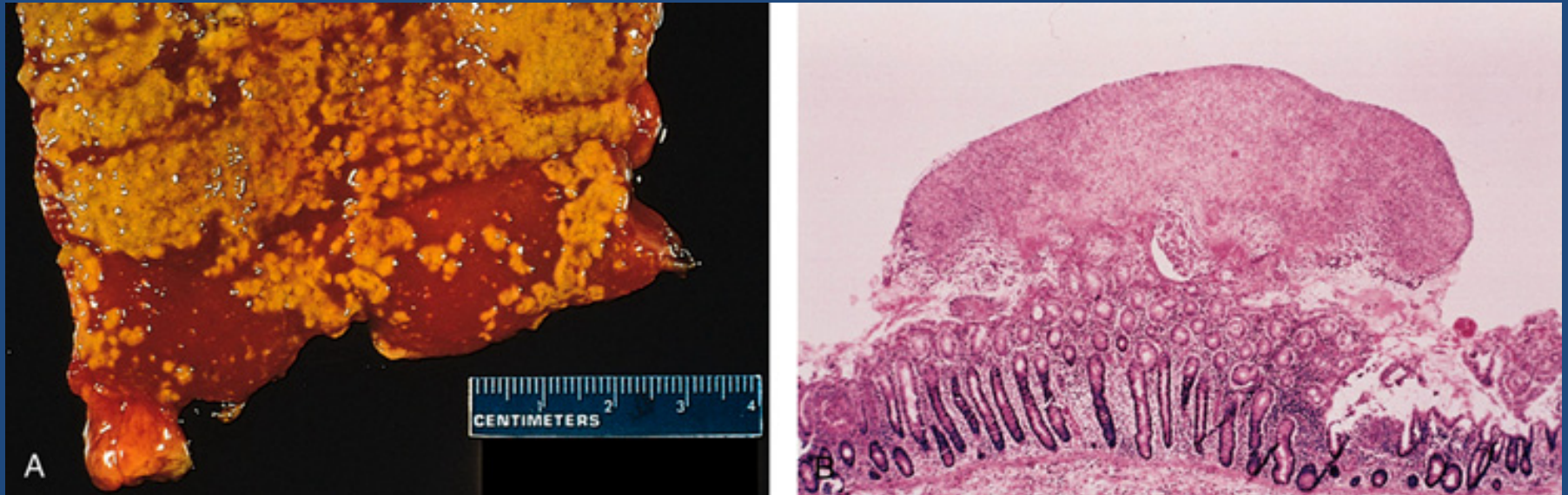
patients received broad-spectrum antibiotics

Caused by *Clostridium difficile*

Clostridium species. Gram-positive rods

Chronic diarrhea

Chronic diarrhea

Aetiology

Most of the causes of chronic diarrhea are noninfectious

1. **Infection** **e.g.** *Giardia lamblia* . AIDS often have chronic infections of their intestines that cause diarrhea.

2. **Post-infectious** Following acute viral, bacterial or parasitic infections

3. **Malabsorption**

4. **Inflammatory bowel disease (IBD)**

5. **Endocrine diseases:** **e.g. carcinoid, gastrinoma**

6. **Colon cancer**

7. **Irritable bowel syndrome**

Causes of Chronic Diarrhea

Giardia lamblia
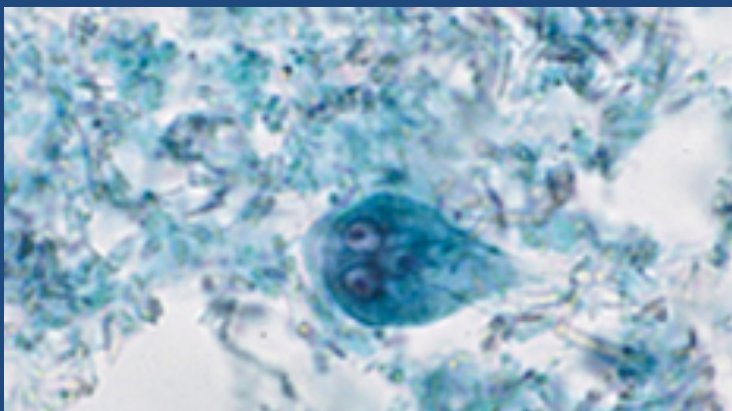
Cryptosporidiosis in AIDS
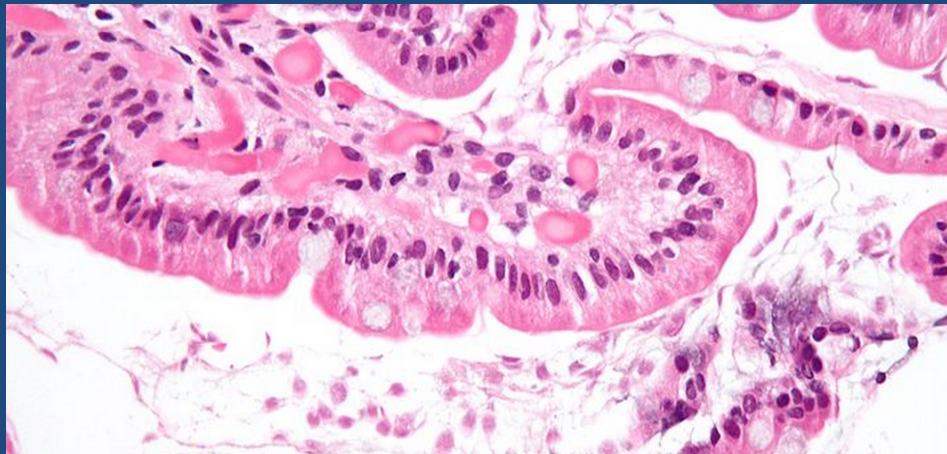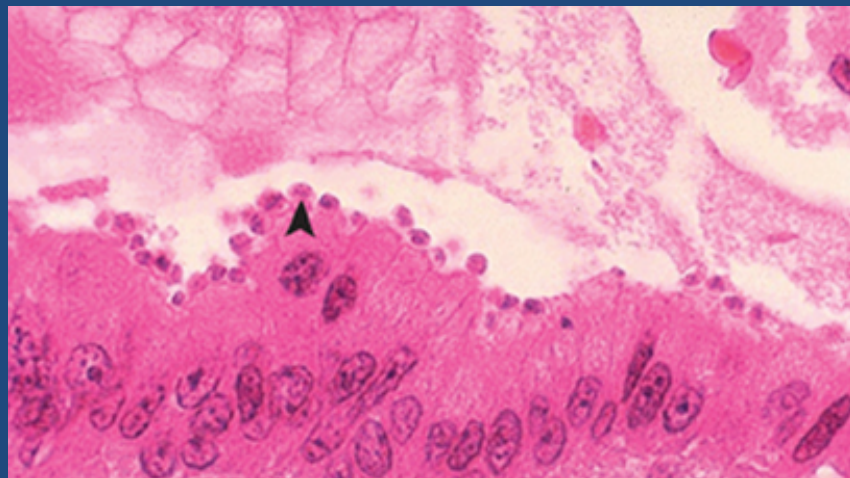
Parasitic and *protozoal* infections affect over half of the world's population on a chronic or recurrent basis.

Complications

1. Fluids ……………….Dehydration
2. Electrolytes ……………. Electrolytes imbalance
3. *Low Sodium bicarbonate in blood…….* Metabolic acidosis
4. If persistent ……Malnutrition

Signs of Dehydration

Early Signs

- Fatigue
- Anxiety
- Irritability
- Depression
- Cravings
- Cramps
- Headaches

Mature Signs

- Heartburn
- Joint Pain
- Back Pain
- Migraines
- Fibromyalgia
- Constipation
- Colitis

Tests useful in the evaluation of diarrhea

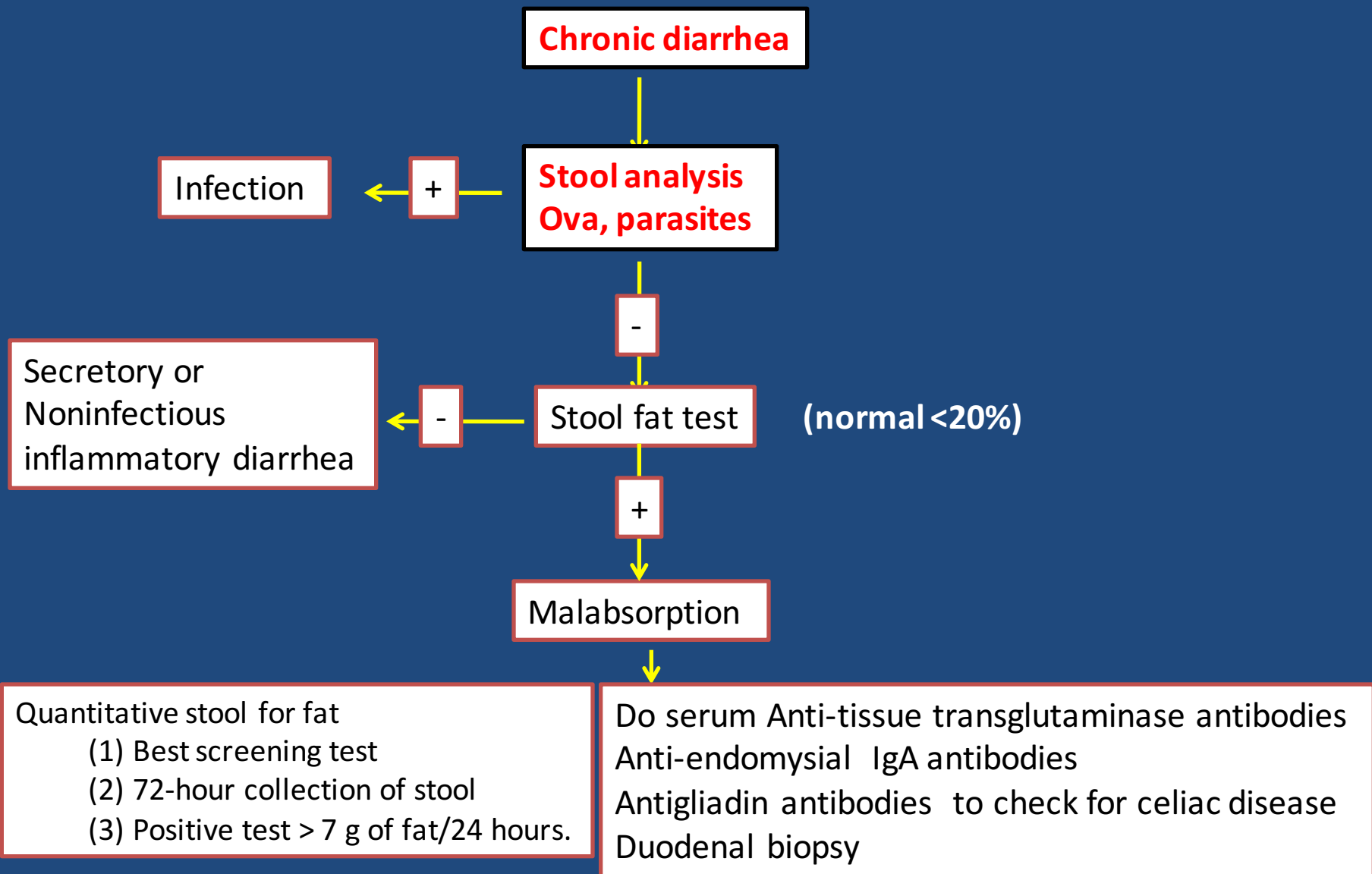**Acute diarrhea**

Fecal leukocytes

not present

present

Noninflammatory Diarrhea

Inflammatory Diarrhea

Suggests a small bowel source
Or colon but without mucosal injury

Suggests colonic mucosa damage caused by invasion

➢ shigellosis, salmonellosis, *Campylobacter* or *Yersinia* infection, amebiasis)
➢ toxin (*C difficile, E coli* O157:H7).
➢ Inflammatory bowel diseases

Chronic diarrhea

Stool analysis Ova, parasites → + → Infection

(−)

Stool fat test → − → Secretory or Noninfectious inflammatory diarrhea

(normal <20%)

+

Malabsorption

Quantitative stool for fat
    (1) Best screening test
    (2) 72-hour collection of stool
    (3) Positive test > 7 g of fat/24 hours.

Do serum Anti-tissue transglutaminase antibodies
Anti-endomysial IgA antibodies
Antigliadin antibodies to check for celiac disease
Duodenal biopsy

A	B
1. Fasting improve the condition	a) Secretory
2. inflammatory bowel diseases	b) Osmotic
3. High stool output	c) Exudative (inflammatory)
4. Presence of WBC in stool	d) Motility-related
5. Irritable bowel syndrome	
6. bacterial toxin	
7. Malabsorption	
8. High fecal osmotic gap	

A	B
1. Irritable bowel syndrome	a) **Acute diarrhea**
2. Giardia lamblia	b) **Chronic diarrhea**
3. Viral gastroenteritis	
4. Inflammatory bowel disease	
5. Food poisoning	
6. Antibiotic-Associated Diarrheas	
7. Malabsorption	