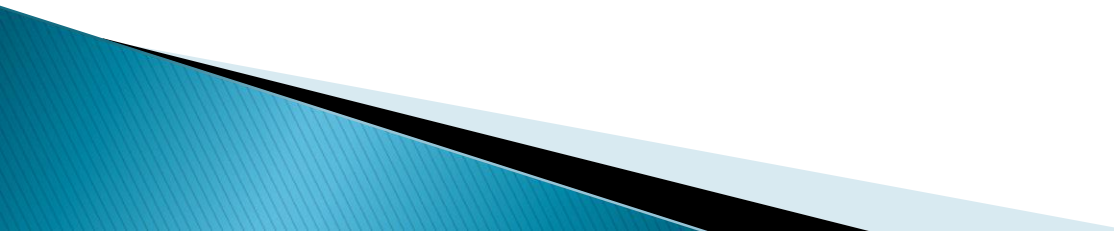


Diarrheal Diseases

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Learning objectives

At the end of the session, the students will be able to

- ▶ Describe terms related to GI infections
 - ▶ Describe etiopathogenesis of diarrheal diseases
 - ▶ Choose appropriate laboratory diagnosis and interpret the results
 - ▶ Outline the treatment for diarrheal diseases
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Diarrheal Diseases

▶ Diarrhea

- Passage of three or more loose or liquid stools per day, in excess than the usual habit for that person
- Caused by microbial infections, or as a result of other gastrointestinal diseases such as inflammatory bowel diseases

▶ Gastroenteritis (infectious diarrhea)

- Inflammation of mucous membrane of stomach and intestine resulting in combination of diarrhea, vomiting and pain abdomen with or without mucus/blood/fever/ dehydration

▶ **Dysentery**

- Diarrhea with increased blood and mucus, often associated with fever, abdominal pain, and tenesmus

▶ **Food Poisoning**

- Illness acquired through consumption of food or drink contaminated either with microorganisms, or their toxins

▶ **Traveler's Diarrhea**

- Most common travel-related infectious illness
- Sudden onset abdominal cramps, anorexia, and watery diarrhea

Infectious agents of acute diarrhea and the underlying mechanism

❖ **Non-inflammatory**

- ▶ **Location:** Proximal small bowel
- ▶ **Illness:** Watery diarrhea
- ▶ **Stool findings:** No fecal leukocytes, Fecal lactoferrin –not increased

Non-inflammatory – pathogens involved

▶ Bacteria:

- ▶ *Vibrio cholerae*
- ▶ *Escherichia coli*: EPEC, ETEC, EAEC
- ▶ *Clostridium perfringens*
- ▶ *Bacillus cereus*
- ▶ *Staphylococcus aureus*
- ▶ *Aeromonas hydrophila*
- ▶ *Plesiomonas shigelloides*

▶ Viruses:

- ▶ Rotavirus, Norovirus
- ▶ Enteric adenoviruses

▶ Parasites:

- ▶ *Giardia lamblia*
- ▶ *Cryptosporidium* species
- ▶ *Cyclospora* species
- ▶ *Cystoisospora* species
- ▶ Microsporidia

Infectious agents of acute diarrhea and the underlying mechanism

❖ Inflammatory Diarrhea

- ▶ **Location:** Colon or distal small bowel
- ▶ **Illness:** Dysentery or Inflammatory diarrhea
- ▶ **Stool findings:**
 - Fecal pus cells (polymorphonuclear leukocytes)—increased
 - Fecal lactoferrin—increased

Inflammatory Diarrhea – pathogens involved

- ▶ Predominantly dysentery:
 - ▶ *Shigella* species
 - ▶ *Campylobacter jejuni*
 - ▶ Enterohemorrhagic *E. coli*
 - ▶ Enteroinvasive *E. coli*
 - ▶ *Vibrio parahaemolyticus*
- ▶ Predominantly inflammatory diarrhea
 - ▶ *Salmonella* species
 - ▶ *Yersinia enterocolitica*
 - ▶ *Listeria monocytogenes*
 - ▶ *Clostridium difficile*
 - ▶ *Aeromonas hydrophila*
 - ▶ *Plesiomonas shigelloides*

Infectious agents of acute diarrhea and the underlying mechanism

❖ Penetrating

- ▶ Location: Distal small bowel
- ▶ Illness: Enteric fever
- ▶ Stool findings:
 - ▶ Fecal mononuclear leukocytes increased
- ▶ Common pathogens: *Salmonella* Typhi, *Yersinia enterocolitica*

Infectious agents of food

Organism	Symptoms	Common food sources
Incubation period :1-6 h		
<i>Staphylococcus aureus</i>	Nausea, vomiting, diarrhea	Ham, poultry, potato or egg salad, mayonnaise, pastries
<i>Bacillus cereus</i>	Nausea, vomiting, diarrhea	Fried rice
<i>Clostridium botulinum</i>	Nausea, vomiting, diarrhea	Canned food
Incubation period:8-16 h		
<i>Clostridium perfringens</i>	Abdominal cramps, diarrhea (vomiting rare)	Beef, poultry, legumes, gravies
<i>B. cereus</i>		Meats, vegetables, dried beans, cereals

Infectious agents of food

Organism	Symptoms	Common food sources
Incubation period: >16 h		
<i>Vibrio cholerae</i>	Watery diarrhea	Shellfish, water
Enterotoxigenic <i>E. coli</i>	Watery diarrhea	Salads, cheese, meat, water
Enterohemorrhagic <i>E. coli</i>	Bloody diarrhea	Ground beef, salami, raw milk, raw vegetables, apple juice
<i>Salmonella</i> species	Inflammatory diarrhea	Beef, poultry, eggs, dairy products
<i>Campylobacter jejuni</i>	Inflammatory diarrhea	Poultry, raw milk
<i>Shigella</i> species	Dysentery	Potato or egg salad, lettuce, raw vegetables

Agents causing traveler's diarrhea

Etiologic agent	Comments
Bacteria (50–75%)	
Enterotoxigenic <i>E. coli</i> (10–45%)	Single most important agent
Enteroaggregative <i>E. coli</i> (5–35%)	Emerging enteric pathogen with worldwide distribution
<i>Campylobacter jejuni</i> (5–25%)	More common in Asia
<i>Shigella</i>	Major cause of dysentery
<i>Salmonella</i>	Common agent in India
Others	Including <i>Aeromonas</i> , <i>Plesiomonas</i> , and <i>Vibrio cholerae</i>

Agents causing traveler's diarrhea

Etiologic agent	Comments
Viruses (<20%)	
Norovirus (<10%)	Associated with cruise ships
Rotavirus (<5%)	Common among children
	Associated with cruise ships
Parasites (0-10%)	<i>Giardia lamblia</i> , <i>Cryptosporidium</i> , <i>Entamoeba histolytica</i> , <i>Cyclospora</i>

Pathogenic mechanisms of diarrheal agents

Toxins production

Enterotoxins

Cholera toxin

Vibrio

parahaemolyticus

E. coli

- LT and ST of ETEC
- EAST of EAEC
- VT of EHEC

Clostridioides

difficile (toxin A)

Aeromonas

Rotavirus (NSP4)

Campylobacter jejuni

Cytotoxins *Shigella*

dysenteriae type 1

Enterohemorrhagic

E. coli

Clostridioides difficile

(toxin B)

Neurotoxins

Staphylococcus aureus

enterotoxin *Bacillus*

cereus toxin

Clostridium botulinum

toxin

Pathogenic mechanisms of diarrheal agents

Toxins production

Attachment within or close to mucosal cells

E. coli

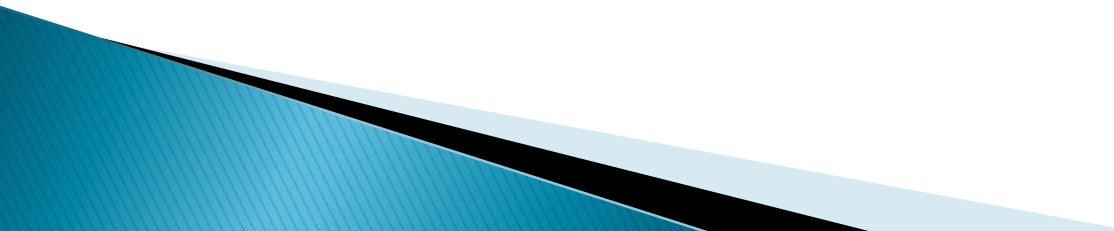
- Enteropathogenic
- Enterohemorrhagic

Cryptosporidium species
Cyclospora species
Cystoisospora species
Rotavirus
Norovirus

Invasion of intestinal epithelium

Shigella species Enteroinvasive *E. coli*
Campylobacter jejuni *Yersinia enterocolitica*
Plesiomonas shigelloides *Entamoeba histolytica* *Balantidium coli*

LABORATORY DIAGNOSIS

- ▶ **Specimen Collection**
 - ▶ Fecal specimen containing mucus flakes – in a sterile screw capped wide mouthed container
 - ▶ Rectal swab – carriers
 - ▶ Food poisoning outbreaks – vomitus, stool or suspected food materials
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Microscopy

- ▶ **Wet mount:**
 - Saline or iodine – pus cells, RBCs and parasitic forms
- ▶ **Hanging drop preparation:** to demonstrate darting motility of *Vibrio cholerae*;
- ▶ **Gram-stained smear:** Not routinely done because of presence of normal flora in feces. Recommended only in special situations
 - Presence of comma-shaped bacilli: *Vibrio cholerae*
 - Budding oval yeast cells in immunocompromised host or infant—suggestive of *Candida* species

Microscopy

- ▶ **Acid fast staining** – for detection of oocysts of *Cryptosporidium*, *Isospora* and *Cystoisospora*
- ▶ **Electron microscopy** – detection of morphology of specific viruses causing gastroenteritis
 - Rotaviruses appear as spokes grouped around the hub of a wheel
 - Astroviruses have star-like morphology
- ▶ **Coronaviruses** have cup-like depressions on the capsid surface

Stool microscopy findings

Intestinal parasites & Presentation	Stool microscopy detects
<i>Entamoeba histolytica</i> Dysentery	<ul style="list-style-type: none">• Trophozoites and/or quadrinucleated round cyst• Detection of specific antigen (e.g. lectin)/specific genes in stool
<i>Giardia intestinalis</i> Fatty diarrhea	Trophozoites (tear drop-shaped binucleated) with four pairs of flagella and/or Tetra-nucleated oval cyst with a central axoneme
<i>Trichuris</i> Dysentery	Barrel-shaped eggs with mucus plugs at both ends, bile stained

Stool microscopy findings

Intestinal parasites & Presentation	Stool microscopy detects
<i>Enterobius vermicularis</i> Nocturnal anal pruritus	Plano-concave egg containing larva, nonbile stained
<i>Ascaris lumbricoides</i> Malabsorption	Fertilized egg: round-oval, thick albumin coat, floats in saturated saline, bile stained Unfertilized egg: elongated, thin albumin coat, does not float in saturated saline, bile stained

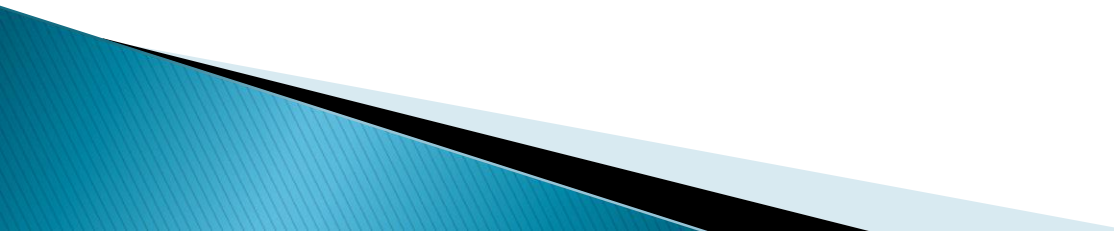
Stool microscopy findings

Intestinal parasites & Presentation	Stool microscopy detects
Hookworm Diarrhea, anemia	Egg: Oval, contains segmented four blastomeres, clear space between blastomeres and egg shell, nonbile stained
<i>Strongyloides</i> Diarrhea	Detection of rhabditiform larva in stool microscopy

Culture

- ▶ **Bacterial Culture** – Inoculated on to
 - Enrichment broth: Selenite F broth and alkaline peptone water
 - Mildly selective medium: MacConkey agar
 - Highly selective medium: DCA(deoxycholate citrate agar), XLD (xylose lysine deoxycholate) agar and TCBS (thiosulfate citrate bile salt sucrose) agar.
 - **Identification:** Appropriate biochemical tests
- ▶ **Antimicrobial susceptibility test**

Laboratory Diagnosis

- ▶ **Tissue Culture**
 - ▶ For detection of enteric viruses
 - ▶ Deetection of toxins of E.coli
 - ▶ **Antigen Detection**
 - ▶ ELISA and rapid tests – rotavirus, *Entamoeba histolytica*, *Giardia* and *Cryptosporidium* in stool
 - ▶ **Molecular methods – PCR**
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Vibrio cholerae – Identification

- ▶ Darting motility
- ▶ Coma-shaped gram-negative bacilli in culture smear Catalase and oxidase positive
- ▶ TCBS agar: sucrose fermenting yellow colored colonies
- ▶ ICUT tests: I+ C-/- U- TSI (acidic slant/acidic butt, gas-, H₂S-)
- ▶ Agglutinates with *Vibrio cholerae* O1 antisera and ogawa antisera (this is the most common pattern; though other serotypes are also present)

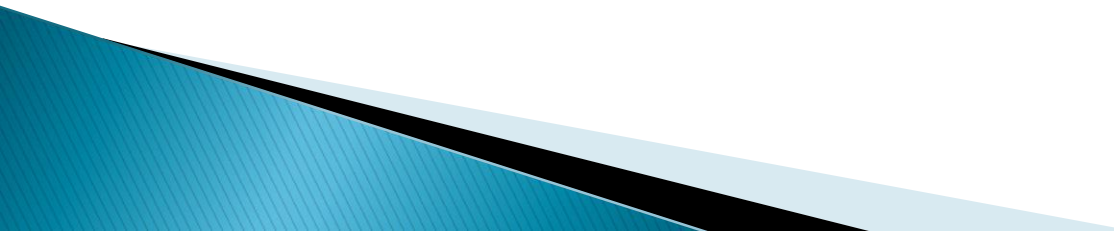
Shigella – Identification

- ▶ **Gram-negative bacilli**, motile Catalase positive, oxidase negative
- ▶ **MAC or DCA**: non-lactose fermenting translucent colonies XLD: red colonies without black center
- ▶ **ICUT tests**: I– C– U– TSI (alkaline slant/acidic butt, gas–, H₂S–)
- ▶ Agglutinates with *Shigella* polyvalent antisera and specific monovalent antisera

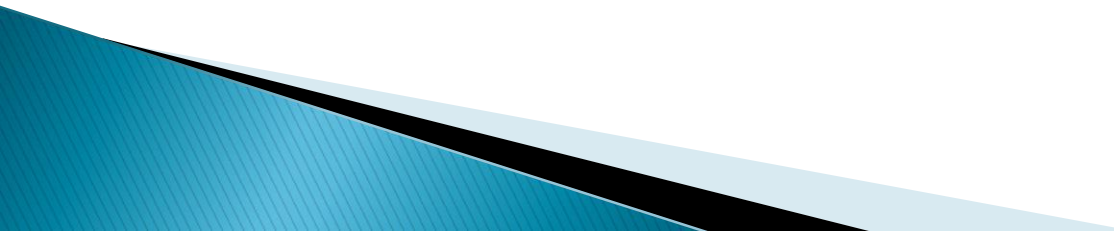
Group B *Salmonella* – Identification

- ▶ **Gram-negative bacilli**, motile Catalase positive, oxidase negative
- ▶ **MAC**: non-lactose fermenting translucent colonies
- ▶ **DCA**: non-lactose fermenting colonies with black center **XLD**: red colonies with black center
- ▶ **ICUT tests**: I- C+ U- TSI (alkaline slant/acidic butt, gas+, H₂S+)
- ▶ Agglutinates with *Salmonella* poly-O antisera and serotype (O4) specific antisera

Viral agents – Identification

- ▶ Agents: Rotavirus, Norovirus, Adenovirus 40, 41, etc.
 - ▶ Detection of viral particles in stool specimen by electron microscopy
 - ▶ Detection of viral antigen by ELISA or
 - ▶ Detection of nucleic acid (RNA or DNA) by PCR in stool specimen
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TREATMENT

- ▶ Treatment depends up on severity.
 - ▶ Fluid therapy is the main stay of treatment
 - ▶ Anti-motility agents and adsorbents may be considered in moderate-to-severe diarrhea
 - ▶ Empiric antibiotic therapy is required only for severe diarrhea
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Thank you...!

