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 diarheal diseases

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		
Staphylococcus aureus	Nausea, vomiting, diarrhea	Ham, poultry, potato or egg salad, mayonnaise, pastries
Bacillus cereus	Nausea, vomiting, diarrhea	Fried rice
Clostridium botulinum	Nausea, vomiting, diarrhea	Canned food
Incubation period:8–16 h		
Clostridium perfringens	Abdominal cramps, diarrhea (vomiting rare)	Beef, poultry, legumes, gravies
B. cereus		Meats, vegetables, dried beans, cereals

Infectious agents of food

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

Agents causing traveler's diarrhea

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

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%)	*Giardia lamblia*, *Cryptosporidium*, *Entamoeba histolytica*, *Cyclospora*

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	**Invasion of intestinal epithelium**
E. coli • Enteropathogenic • Enterohemorrhagic *Cryptosporidium* species *Cyclospora* species *Cystoisospora* species Rotavirus Norovirus	*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

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
Entamoeba histolytica Dysentery	• Trophozoites and/or quadrinucleated round cyst • Detection of specific antigen (e.g. lectin)/specific genes in stool
Giardia intestinalis Fatty diarrhea	Trophozoites (tear drop-shaped binucleated) with four pairs of flagella and/or Tetra-nucleated oval cyst with a central axoneme
Trichuris Dysentery	Barrel-shaped eggs with mucus plugs at both ends, bile stained

Stool microscopy findings

Intestinal parasites & Presentation	Stool microscopy detects
Enterobius vermicularis Nocturnal anal pruritus	Plano-concave egg containing larva, nonbile stained
Ascaris lumbricoides 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
Strongyloides 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**

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

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

Thank you…!