GI INFECTIONS

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Diarrhea

- Diarrhea is high volume output of liquid stool.
- Soft stools with urgency reflect proctitis, not diarrhea.
- Gastroenteritis is acute diarrhea without fever
- Viral
- Food poisoning
- Giardia
- Dysentery is diarrhea lasting more than one day and associated with fever and abdominal pain
- Bacterial

Gastroenteritis

- Acute diarrheal illness probably viral:
- Norovirus and Rotavirus present with hyperacute onset
- Vomiting usually present
- <u>Resolves spontaneously in 24-48 hours</u>.
- <u>Constitutional symptoms common with Rotavirus;</u> usually involves children.
- Vibrio infection also presents with acute diarrhea.
 No spontaneous resolution.

Food poisoning

- Common bacterial causes:
- Salmonella (non-typhi species)
- Campylobacter
- Shigella

Food poisoning

- <u>Toxin mediated gastroenteritis has onset 1-8 hours</u> <u>after exposure</u>.
- Food poisoning from Staphylococcus aureus
- OR Bacillus cereus preformed toxins
- <u>Vomiting prominent.</u>
- Resolves spontaneously within 12 hours.
- <u>Toxin mediated gastroenteritis has onset 8-16 hours</u> <u>after exposure.</u>
- Food poisoning from Clostridium perfringens elaborated toxin
- <u>Abdominal cramping prominent</u>.
- Resolves spontaneously within 1-2 days.

Therapy of gastroenteritis

- Reydration with salt containing fluids and the use of anti-diarrheal medications (loperamide) are safe and effective in treating gastroenteritis.
- BRAT (bananas, rice, applesauce, toast) diet.
- Avoid dairy products as lactose intolerance present after diarrhea.

Diarrhea

- Diarrhea in hospitalized patient likely toxin producing strain of Clostridium dificile.
- Diagnose by positive toxin assay (minimum three stools sampled). Positive likelihood ratio, LR+, is 14 for positive toxin assay. (LR-, 0.05).
- Oral metronidazole or oral vancomycin employed.
- No anti-diarrheals.
- Relapse up to 25% of patients.

- If diarrhea for more than one day with fever and abdominal pain, empirical treatment with a fluoroquinolone is instituted.
- Add a macrolide if Campylobacter likely.
- This is not gastroenteritis.
- Stool culture for treatment follow-up.
- No anti-diarrheals are used
- They may prolong the fever
- They may lead to toxic megacolon
- Increase the risk of hemolytic-uremic syndrome (HUS) in patients with Shiga toxin producing Escherichia coli (STEC).

- <u>Tenesmus is a common finding in patients with</u> <u>Shigella dysentery</u>
- <u>Right lower quadrant pain is prominent in patients</u> with STEC or entero-invasive Escherichia coli dysentery.

- Bloody diarrhea
- More likely due to Shigella or Campylobacter
- May also be seen with Salmonella, Yersinia, and entero-hemorrhagic Escherichia coli.
- Salmonella typhi may ulcerate (Peyers patches)
- Entamoeba histolytica
- Bloody diarrhea begins 2-3 days after onset of watery diarrhea.
- Bacteria commonly remain in the stool for 4-5 weeks and re-infection is possible.

- <u>Stool cultures often negative but are necessary.</u>
- If fecal leukocytes present on smear, the positive likelihood ratio (LR+) of having a positive culture is 4.5. LR-, 0.3.
- If high risk for STEC, withhold antibiotics.
- Antibiotics for Salmonella only if typhoid fever.
- May have to divert bowel temporarily

Enterocolitis

- Present with diarrhea, abdominal pain, urgency, perianal discomfort, incontinence, and hemorrhage
- Etiology varies with age, nutrition, and host nutritional status.

Table 17-8 Features of Bacterial Enterocolitides

					Affected GI		
Infection Type	Geography	Reservoir	Transmission	Epidemiology	Sites	Symptoms	Complications
Cholera	India, Africa	Shellfish	Fecal-oral, water	Sporadic, endemic, epidemic	Small intestine	Severe watery dianthea	Dehydration, electrolyte imbalances
Campylobacter spp.	Developed countries	Chickens, sheep, pigs, cattle	Poultry, milk, other foods	Sporadic; children, travelers	Colon	Watery or bloody dianthea	Arthritis, Guillain- Barré syndrome
Shigellosis	Worldwide, endemic in developing countries	Humans	Fecal-oral, food, water	Children, migrant workers, travelers,nursing homes	Left colon, ileum	Bloody diarrhea	Reactive arthritis, urethritis, conjunctivitis, hemolytic-uremic syndrome
Salmonellosis	Worldwide	Poultry, farm animals, reptiles	Meat, poultry, eggs, milk	Children, older adults	Colon and small intestine	Watery or bloody dianthea	Sepsis, abscess
Enteric (typhoid) fever	India, Maxico, Philippines	Humans	Fecal-oral, water	Children. adolescents, travelers	Small intestine	Bloody diarrhea, fever	Chronic infection, carrier state, encephalopathy, myocarditis, intestinal perforation
Yersinia spp.	Northern and central Europe	Pigs, cows, puppies, cats	Pork, milk, water	Clustered cases	lleum, appendix, right colon	Abdominal pain, fever, diarrhea.	Reactive arthritis, erythema nodosum
Escherichia coli							
Enterotoxigenic (ETEC)	Developing countries	Unknown	Food or fecal-oral	Infants, adolescents, travelers	Small intestine	Severe watery dianhea	Dehydration, electrolyte imbalances
Enteropathogenic (EPEC)	Worldwide	Humans	Fecal-oral	Infants	Small intestine	Watery diamhea	Dehydration, electrolyte imbalances
Enteropathogenic (EPEC) Enterohemorrhagic (EHEC)	Worldwide Worldwide	Humans Widespread, includes cattle	Fecal-oral Beef, milk, produce	Infants Sporadic and epidemic	Small intestine Colon	Watery diarrhea Bloody diarrhea	Dehydration, electrolyte imbalances Hemolytic-uremic syndrome
Enteropathogenic (EPEC) Enterohemonrhagic (EHEC) Enteroinvasive (EIEC)	Worldwide Worldwide Developing countries	Humans Widespread, includes cattle Unknown	Fecal-oral Beef, milk, produce Cheese, other foods, water	Infants Sporadic and epidemic Young children	Small intestine Colon Colon	Watery diarrhea Bloody diarrhea Bloody diarrhea	Dehydration, electrolyte imbalances Hemolytic-uremic syndrome
Enteropathogenic (EPEC) Enterohemonthagic (EHEC) Enteroinvasive (EEC) Enteroaggregative (EAEC)	Worldwide Worldwide Developing countries Worldwide	Humans Widespread, includes cattle Unknown Unknown	Fecal-oral Beef, milk, produce Cheese, other foods, water Unknown	Infants Sporadic and epidemic Young children Children, adults, travelers	Small intestine Colon Colon Colon	Watery diarrhea Bloody diarrhea Bloody diarrhea Nonbloody diarrhea, afebrile	Dehydration, electrolyte imbalances Hemolytic-uremic syndrome Unknown Poorly defined
Enteropathogenic (EPEC) Enterohemorrhægic (EHEC) Enteroinvæsive (EEC) Enteroæggregative (EAEC) Pseudomembranous colitis (<i>C. difficile</i>)	Worldwide Worldwide Developing countries Worldwide Worldwide	Humans Widespread, includes cattle Unknown Unknown Unknown Humans, hospitals	Fecal-oral Beef, milk, produce Cheese, other foods, water Unknown Antibiotics allow emergence	Infants Sporadic and epidemic Young children Children, adults, travelers Immuncsuppressed, antibiotic-treated	Small intestine Colon Colon Colon	Watery diarrhea Bloody diarrhea Bloody diarrhea Nonbloody diarrhea, afebrile Watery diarrhea, fever	Dehydration, electrolyte imbalances Hemolytic-uremic syndrome Unknown Poorly defined Relapse, toxic megacolon
Enteropathogenic (EPEC) Enterohemorrhægic (EHEC) Enteroinvæsive (EEC) Enteroæggregative (EAEC) Pseudomembranous colitis (<i>C. difficile</i>) Whipple diseæse	Worldwide Worldwide Developing countries Worldwide Worldwide Rural > urban	Humans Widespread, includes cattle Unknown Unknown Humans, hospitals Unknown	Fecal-oral Beef, milk, produce Cheese, other foods, water Unknown Antibiotics allow emergence Unknown	Infants Sporadic and epidemic Young children Children, adults, travelers Immuncsuppressed, antibiotic-treated Rare	Small intestine Colon Colon Colon Colon Small intestine	Watery diarrhea Bloody diarrhea Bloody diarrhea Nonbloody diarrhea, afabrile Watery diarrhea, fever Malabsorption	Dehydration, electrolyte imbalances Hemolytic-uremic syndrome Unknown Poorly defined Relapse, toxic megacolon Arthritis, CNS disease
Enteropathogenic (EPEC) Enteroinvasive (EHEC) Enteroinvasive (EEC) Enteroaggregative (EAEC) Pseudomembranous colitis (<i>C. difficile</i>) Whipple disease Mycobacterial infection	Worldwide Worldwide Developing countries Worldwide Worldwide Rural > urban Worldwide	Humans Widespread, includes cattle Unknown Unknown Humans, hospitals Unknown Unknown	Fecal-oral Beef, milk, produce Cheese, other foods, water Unknown Antibiotics allow emergence Unknown Unknown	Infants Sporadic and epidemic Young children Children, adults, travelers Immuncsuppressed, antibiotic-treated Rare Immuncsuppressed, endemic	Small intestine Colon Colon Colon Colon Colon Small intestine	Watery diarrhea Bloody diarrhea Bloody diarrhea Bloody diarrhea diarrhea, afebrile Watery diarrhea, fever Malabsorption	Dehydration, electrolyte imbalances Hemolytic-uremic syndrome Unknown Poorly defined Relapse, toxic megacolon Arthritis, CNS disease Pneumonia, infection at other sites

Cholera

- Abrupt onset of watery diarrhea 1-5 days post exposure
- Voluminous loss of fluid
- Stools resemble rice water
- Fishy odor.
- Oral rehydration often sufficient therapy
- Comma shaped organisms

Cholera

- <u>Vibrio organisms are noninvasive and remain within</u>
 <u>the intestinal lumen.</u>
- Cholera toxin, encoded by a virulence phage and released by the Vibrio organism, causes disease.
- Flagellar proteins, involved in motility and attachment, are necessary for efficient bacterial colonization.
- Hemagglutinin, a metalloproteinase, is important for bacterial detachment and shedding in the stool.
- Shellfish and plankton may serve as reservoirs for the bacterium.

Cholera

- <u>Cholera toxin stimulates adenylate cyclase</u>
- Increases intracellular cAMP
- Opens <u>CFTR</u>
- Releases chloride ions into the lumen.
- Chloride and sodium absorption are also inhibited by cAMP.
- Chloride, bicarbonate, and sodium assumulate within the lumen
- Massive osmotic diarrhea results
- Mucosal biopsies show only minimal histologic change.



Figure 17-27 Cholera toxin transport and signaling. After retrograde toxin transport to the endoplasmic reticulum (ER), the A subunit is released by the action of protein disulfide isomerase (PDI) and is then able to access the epithelial cell cytoplasm. In concert with an ADP-ribosylation factor (ARF), the A subunit then ADP-ribosylates $G_s\alpha$, which locks it in the active, GTP-bound state. This leads to adenylate cyclase (AC) activation, and the cAMP produced opens CFTR to drive chloride secretion and diarrhea.

Campylobacter jejuni

- Common bacterial enteric pathogen
- Important cause of traveler's diarrhea.
- Flagella allow Campylobacter to be motile.
- This facilitates adherence and colonization, which are necessary for mucosal invasion.
- Cytotoxins that cause epithelial damage and a cholera toxin-like enterotoxin are also released by some isolates.
- Invasive antigen (B) also produced.
- Enteric fever occurs when bacteria proliferate within the lamina propria and mesenteric lymph nodes

Campylobacter

- <u>Campylobacter infection can result in reactive arthritis</u>, primarily in patients with HLA-B27.
- Other extraintestinal complications:
- Erythema nodosum
- Guillain-Barré syndrome
- Campylobacter found in 50% of cases
- Molecular mimicry as cause
- Campylobacter are comma-shaped, flagellated, gram-negative organisms.
- Grow best at 42C at low Oxygen levels
- Mild inflammatory changes noted on intestinal biopsy

Erythema nodosum



Fig. 7-23 Accessed 07/16/2010

Source: Wolff K, Johnson RA: Fitzpatrick's Color Atlas and Synopsis of Clinical Dermatology, 6th Edition: http://www.accessmedicine.com

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- Gram-negative unencapsulated, nonmotile, facultative anaerobes that belong to the Enterobacteriaceae family and are closely related to enteroinvasive E. coli.
- Humans as the only reservoir
- Shigella are resistant to the harsh acidic environment of the stomach
- <u>Once in the intestine, organisms are taken up by</u> <u>specialized epithelial cells, M (microfold).</u>
- M cells are specialized for sampling and presentation of luminal antigens.

- Proliferate intracellularly, escape into the lamina propria, and are phagocytosed by macrophages, in which they induce apoptosis.
- The resulting inflammatory process damages surface epithelia and allows Shigella to gain access to the basolateral membranes of colonic epithelial cells
- <u>The preferred domain for invasion</u>.
- All Shigella spp. carry <u>virulence plasmids</u>, some of which encode a type III secretion system capable of directly injecting bacterial proteins into the host cytoplasm.

- S. dysenteriae serotype 1 also release the <u>Shiga</u> <u>toxin (STX)</u>
- Inhibits protein synthesis, resulting in host cell damage and death.
- <u>Shigella infections are most prominent in the left</u> <u>colon</u>, but the ileum may also be involved
- The mucosa is hemorrhagic and ulcerated, and pseudomembranes may be present.
- 1 week incubation period
- 50% develop dysentery (bloody diarrhea)

- <u>Reactive arthritis</u>, urethritis, and conjunctivitis that preferentially affects HLA-B27-positivemen between 20 and 40 years of age is a complication of infection. (<u>Reiter's syndrome</u>)
- <u>Hemolytic-uremic syndrome</u>, which is typically associated with enterohemorrhagic E. coli (EHEC), may also occur after infection with S. dysenteriae serotype 1 that secrete Shiga toxin.

Non-typhoid salmonella

- Possess virulence genes that encode a type III secretion system capable of transferring bacterial proteins into M cells and enterocytes.
- The transferred proteins activate host Rho GTPases, triggering actin rearrangement and bacterial endocytosis.
- Flagellin activates TLR5 on host cells
- Lipopolysaccharide activates TLR4
- Increase inflammatory response

Typhoid fever

- Enteric fever
- The majority of cases in endemic countries are due to S. typhi, while infection by S. paratyphi is more common among travelers
- Humans as only reservoir
- <u>Gallbladder colonization</u> with S. typhi or S. paratyphi may be associated with gallstones and the chronic carrier

Typhoid fever

- Classic features are fever, abdominal pain and hematochezia
- First week of illness:
- Rising ("stepwise") fever associated with chills, although frank rigors are rare
- <u>Second week of illness</u>:
- Abdominal pain develops and "rose spots" (faint salmon- colored macules on the trunk and abdomen) may be seen

Rose spots



Source: J.L. Jameson, A.S. Fauci, D.L. Kasper, S.L. Hauser, D.L. Longo, J. Loscalzo: Harrison's Principles of Internal Medicine, 20th Edition Copyright © McGraw-Hill Education. All rights reserved.

Typhoid fever

- Third week of illness:
- Hepatosplenomegaly, intestinal bleeding and perforation due to ileocecal lymphatic hyperplasia of the Peyer's patches may occur
- Perforation is four times more common in men than women

Ulcerated Peyer's patches



https://www.gastrointestinalatlas.com/english/Typhoid_ulcers.html

Typhoid fever

- Salmonella survive gastric acid and are taken up by M cells in the small intestine.
- There are an abundance of M cells in the dome epithelium over the Peyer patches.
- Infection causes Peyer patches in the terminal ileum to enlarge into sharply delineated, plateau-like elevations.
- Draining mesenteric lymph nodes are also enlarged.

Typhoid fever

- Neutrophils accumulate within the superficial lamina propria, and macrophages containing bacteria, red cells, and nuclear debris mix with lymphocytes and plasma cells in the lamina propria.
- <u>Mucosal damage creates oval ulcers, oriented along</u> the axis of the ileum, that may perforate.



Figura 3a - Histopathology (HE - 100x): Mucosal fragment of terminal ileum, with atrophy of villi (1), a voluminous lymphoid follicle (2), and dense infiltration of mixed inflammatory cells in lamina propria.

Figura 3b - Histopathology (HE - 50x): Mucosal fragment of distal intestine, with crypt atrophy (black arrow), an ulceration area (blue arrow), and a dense infiltration of mixed inflammatory cells in lamina propria.

Figura 3c - Histopathology - (HE 100x): Intense inflammatory reaction, with abscess of the mucosal crypts (inserts 1- HE 400x; 2-HE 400x).

Murinello, A, et al., "Typhoid fever: clinical and endoscopic aspects," J Port Gastrenterol 2008; 15: 76-82

Typhoid fever

- The draining lymph nodes also harbor organisms and are enlarged due to phagocyte accumulation.
- The spleen is enlarged and soft, with uniformly pale red pulp, obliterated follicular markings, and prominent phagocyte hyperplasia.
- The liver shows small, randomly scattered foci of parenchymal necrosis in which hepatocytes are replaced by macrophage aggregates (<u>typhoid</u> <u>nodules</u>)
- Such nodules may also develop in the bone marrow and lymph nodes.

Typhoid fever

- Hematogenous dissemination may lead to encephalopathy, myocarditis, pneumonia, and gallbladder infection.
- <u>Sickle cell patients are at risk for development of</u> <u>osteomyelitis.</u>

Yersinia

- Yersinia invade M cells and use specialized bacterial proteins, called adhesins, to bind to host cell β1integrins.
- A pathogenicity island encodes an iron uptake system that mediates iron capture and transport.
- Enhances virulence and dissemination
- Yersinia infections preferentially involve the ileum, appendix, and right colon.
- The organisms multiply extracellularly in lymphoid tissue, resulting in regional lymph node and Peyer patch hyperplasia as well as bowel wall thickening.

Yersinia

- The mucosa overlying lymphoid tissue may become hemorrhagic, and aphthous-like erosions and ulcers may develop, along with neutrophil infiltrates (Y.enterocolitica)
- If granulomas (Y. paratuberculosis)
- May mimic appendicitis in young persons
- Extraintestinal symptoms of pharyngitis, arthralgia, and erythema nodosum occur frequently.
- Reactive arthritis is also seen.

Enterotoxigenic E. coli

- The principal cause of traveler's diarrhea.
- Produce heat-labile toxin (LT) and heat-stable toxin (ST).
- Both induce chloride and water secretion while inhibiting intestinal fluid absorption.
- The LT toxin is similar to cholera toxin
- Binds to adenylate cyclase
- <u>ST toxin effects on transport are similar to those</u> produced by LT
- Bind to guanylate cyclase.

Enterotoxigenic E. coli

- Produce attaching and effacing (A/E) lesions
- Bacteria attach tightly to the enterocyte apical membranes and cause local loss (effacement) of the microvilli.
- TIR is a product of the ESPE gene which is part of the locus of enterocyte effacement (LEE)
- Inserted into the intestinal epithelial cell plasma membrane.
- Acts as a receptor for the bacterial outer membrane protein intimin
- Is used for molecular detection and diagnosis of EPEC infection.

Enterotoxigenic E. coli

- Also encodes is a type III secretion system that injects bacterial effector proteins into the epithelial cell cytoplasm.
- Minimal histologic abnormalities.

Enterohemorrhagic E. coli

- O157:H7 and non-O157:H7 serotypes
- Cows as reservoirs
- Produce Shiga-like toxins
- Hemolytic-uremic syndrome (HUS) and ischemic colitis as complications
- Children at greater risk for HUS

Enteroinvasive E.coli

- Do not produce toxins
- Invade epithelium and cause limited inflammatory reaction

Enteroaggregative E. coli

- Attach to enterocytes via adherence fimbriae and are aided by dispersin, a bacterial surface protein that neutralizes the negative surface charge of lipopolysaccharide.
- Produce LT toxin and a Shiga-like toxin
- Minimal histologic damage
- Produce non-bloody diarrhea
- Immunocompromised at risk

Pseudomembranous colitis

- <u>Clostridium dificile</u>
- Antibotic related alteration of microbiota
- 30% of hospitalized patients colonized
- Fever, leukocytosis, abdominal pain, cramps, watery diarrhea
- May have red cells in stool, but no bloody diarrhea
- 40% recur
- Toxins released cause the ribosylation of small GTPases (e.g., Rho)
- Disrupt the epithelial cytoskeleton, the tight junction barrier, promote cytokine release, and apoptosis.

Pseudomembranous colitis

- The surface epithelium is denuded, and the superficial lamina propria contains a dense infiltrate of neutrophils and occasional fibrin thrombi within capillaries.
- Superficially damaged crypts are distended by a mucopurulent exudate that forms an eruption reminiscent of a volcano (pathognomonic).
- An adherent layer of inflammatory cells and debris at sites of colonic mucosal injury forms.



Figure 17-29 *Clostridium difficile* colitis. **A**, The colon is coated by tan pseudomembranes composed of neutrophils, dead epithelial cells, and inflammatory debris (endoscopic view). **B**, Pseudomembranes are easily appreciated on gross examination. **C**, Typical pattern of neutrophils emanating from a crypt is reminiscent of a volcanic eruption.

Giardia

- <u>Giardia lambia is associated with well-water</u> <u>consumption as well as day-care settings.</u>
- Diarrhea, weight loss, abdominal cramps.
- Belching, flatulence, foul-smelling stools
- <u>No fever.</u>
- Definitive diagnosis with parasite identification in at least one of three stools examined. Antigen assays also sensitive.
- Oral metronidazole as therapy.

Giardia

- If Giardia not identified in stool, consider:
- Cryptosporidium
- OR Isospora belli
- Acid-fast organisms that are often found in the immuno-compromised patient.

Rotavirus

- Highly contagious
- <u>The most common cause of diarrhea in infants and</u> <u>children</u>
- Nausea, vomiting, watery diarrhea, and abdominal pain.
- Common in day care settings
- Biopsy morphology is nonspecific.
- Rotavirus vaccine associated with increased risk of intussusception

Norovirus

- <u>Most common cause of acute gastroenteritis in</u> <u>adults</u>
- Second only to rotavirus in children
- Nausea, vomiting, watery diarrhea, and abdominal pain.
- Biopsy morphology is nonspecific.
- Immunocompromised at risk (may persist)
- Single stranded RNA virus

Adenovirus

- A common cause of pediatric diarrhea
- Also affects immunocompromised patients.
- 7 day incubation
- Small intestinal biopsy specimens can show epithelial degeneration but more often exhibit nonspecific villous atrophy and compensatory crypt hyperplasia.
- Viral nuclear inclusions are uncommon.
- DNA virus



Figure 17-31 Infectious enteritis. **A**, Histologic features of viral enteritis include increased numbers of intraepithelial and lamina propria lymphocytes and crypt hypertrophy. **B**, Diffuse eosinophilic infiltrates in parasitic infection. This case was caused by *Ascaris* (upper inset), but a similar tissue reaction could be caused by *Strongyloides* (lower inset). **C**, Schistosomiasis can induce an inflammatory reaction to eggs trapped within the lamina propria. **D**, *Entamoeba histolytica* in a colon biopsy specimen. Note some organisms ingesting red blood cells (*arrow*). **E**, *Giardia lamblia*, which are present in the luminal space over nearly normal-appearing villi, are easily overlooked. **F**, *Cryptosporidia* organisms are seen as small blue spheres that appear to lie on top of the brush border but are actually enveloped by a thin layer of host cell cytoplasm.

Nematodes

- Ingested eggs hatch in the intestine and larvae penetrate the intestinal mucosa.
- Larvae then migrate from splanchnic to systemic circulation and, finally, enter the lungs to grow within the alveoli.
- Coughed up, they re-enter the intestine and mature into adult worms.
- Marked eosinophilic reaction
- May form hepatic masses
- Require ova stage outside the human (<u>Ascaris</u> <u>lumbricoides</u>)
- Do not require a stage outside the human (Strongyloides stercoralis)

Necator duodenale and Ancylostoma duodenale

- Hookworms
- Infection is initiated by larval penetration through the skin
- After further development in the lungs the larvae migrate up the trachea and are swallowed.
- Once in the duodenum the worms attach to the mucosa, suck blood, and reproduce.
- Multiple superficial erosions, focal hemorrhage, and inflammatory infiltrates

Enterobius vermicularis

- Not invasive
- Live in the intestine.
- Adult <u>pinworms</u> living in the intestine migrate to the anal orifice at night, where the female deposits eggs on the perirectal mucosa.
- The eggs cause intense irritation. Rectal and perineal pruritus ensues.
- The intense itching leads to contamination of the fingers, which promotes human-to-human transmission.
- Both eggs and adult pinworms remain viable outside the body, and repeat infection is common.

Trichuris trichuria

- Not invasive
- A heavy infestation of <u>whipworm</u> may lead to rectal prolapse and bloody diarrhea.

Schistosoma

- Symptoms of intestinal schistosomiasis are caused by trapping of eggs within the mucosa and submucosa.
- Adult worms reside within the mesenteric veins.
- The resulting immune reaction is often granulomatous

Cestodes

- Diphyllobothrium latum, fish tapeworms
- Taenia solium, pork tapeworms
- Hymenolepis nana, dwarf tapeworms.
- Lives within the intestinal lumen
- The worm derives its nutrients from the food stream and enlarges by formation of egg-filled segments (proglottids).
- Humans are usually infected by a single worm
- Not invasive (no eosinophilia)
- Often asymptomatic

Entamoeba histolytica

- Present with abdominal pain, bloody diarrhea, weight loss.
- Cysts have a chitin wall and four nuclei
- Resistant to gastric acid
- Cysts colonize the epithelial surface of the colon and release trophozoites (ameboid forms) that reproduce under anaerobic conditions.
- Cecum and ascending colon most often affected

Entamoeba histolytica

- Amoeba attach to the colonic epithelium, induce apoptosis, invade crypts, and burrow laterally into the lamina propria.
- This recruits neutrophils, causes tissue damage, and creates a flask-shaped ulcer with a narrow neck and broad base.
- Parasites may penetrate splanchnic vessels and embolize to the liver to produce abscesses in about 40% of patients.
- Hematogenous spread
- Obligate anaerobe

Giardia lamblia

- Flagellated protozoans that cause decreased expression of brush-border enzymes, including lactase.
- Also cause microvillous damage and apoptosis of small intestinal epithelial cells
- Secretory IgA and mucosal IL-6 important for clearing infection.
- Pear shaped torphozoites with two nuclei
- Resistant to chlorine
- Assocciated with day care centers, well water

Cryptosporidium

- Cysts resistant to chlorine
- Cysts killed by freezing
- Concentrated in ileum and terminal colon
- An entire life cycle, with asexual and sexual reproductive phases, transpires in a single host.
- Watery diarrhea
- Minimal histologic change generally

Cryptosporidium

- The ingested encysted oocyte releases sporozoites following activation of proteases by gastric acid.
- The sporozoites are motile and have a specialized organelle that attaches to the brush border and causes changes in the enterocyte cytoskeleton.
- These changes induce the enterocyte to engulf the parasite, which takes up residence in an endocytic vacuole within the microvilli.
- The presence of the parasite leads to sodium malabsorption, chloride secretion, and increased tight junction permeability

Diarrhea work-up

- Has there been extensive ileal resection?
- If there is a history of extensive bowel resection, consider small bowel overgrowth as cause.
- If there is hypoproteinemia and peripheral edema, consider intestinal lymphangiectasis or eosinophilic gastroenteritis as causes.
- Fever and abdominal pain are not seen with malabsorption.
- Examine the stool.
- Stools may appear normal in malabsorption although laden with excess fat.

Diarrhea work-up

- Ova and parasite exam on three loose stools.
- Bacterial culture of stool.
- Clostridium dificile toxin search in stool.
- Examine stool for presence of fat globules and undigested food
- Meat or fibers
- Examine stool for presence of blood and white cells.
- Flexible sigmoidoscopy.



Fig. 15-1

Accessed

03/03/2010

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Fig. 15-2 Accessed 03/03/2010

Diarrhea (immunocompromised)

- If AIDS patient with CD4 count >200 /uL, and on medications, diarrhea is likely medication related.
- If the CD4 count is <200 /uL, and the stool is of large volume
- Cryptosporidium
- Microsporidia
- Mycobacterium avium intercellulare
- Giardia

Diarrhea (immunocompromised)

- If the CD4 count is <200 /uL, and the stool is of small volume
- AND if the stool contains leukocytes
- Salmonella
- Shigella
- Clostridium dificile
- CMV
- Entamoeba histolytica
- Kaposi's sarcoma and lymphoma are less likely causes