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55 CHAPTER

EVALUATION OF ACUTE DIARRHEA

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1. What is the definition of *acute diarrhea?*

Diarrhea is defined as the passage of an increased number of stools of less-than-normal form and consistency. Acute diarrhea refers to acute onset of symptoms of less than 14 to 30 days' duration. Diarrhea lasting longer than 1 month is considered chronic. The severity of acute diarrhea can be defined as *mild,* where no change in daily activities is noted; *moderate,* where a change in daily activities is required but the patient is able to function; and *severe,* where the patient is disabled by the symptoms.

2. What is the impact of acute diarrhea in the United States and worldwide?

American adults average about one episode of acute diarrhea annually. Acute diarrhea is one of the most common medical conditions seen by primary care practitioners. In the United States, approximately 1 million hospital admissions and 6000 deaths per year are attributed to acute diarrhea, and in most, an etiology is not identified. Worldwide, diarrhea-related diseases are among the most common causes of morbidity and mortality and, for children younger than 4 years, the most common cause of death.

3. Who should undergo medical evaluation for acute diarrhea?

Most cases of acute diarrhea are self-limited and require no medical evaluation. Nearly half of the cases last for less than 1 day. Evaluation should be reserved for patients with evidence of systemic toxicity (dehydration, bloody diarrhea, fever, severe abdominal pain), diarrhea of more than 48 hours' duration, and elderly or immunocompromised patients.

4. What are the most common causes of acute bloody diarrhea?

Infectious dysentery, inflammatory bowel disease (ulcerative colitis and Crohn's disease), and ischemic colitis.

5. What is *dysentery?*

Dysentery is a disease process characterized by diarrhea that contains blood and polymorphonuclear cells. Dysentery results when an organism causes an inflammatory reaction, either by direct invasion of the colonic/ileal epithelium or by producing a toxin that causes cellular death and tissue damage. Symptoms associated with dysentery may include abdominal pain and cramping, tenesmus (painful urgency to evacuate stool), fever, and dehydration.

6. Name the common causes of infectious dysentery in the United States

Campylobacter and *Salmonella* spp. are the principal causes of dysentery in the United States. *Shigella* sp. and certain strains of *Escherichia coli* (specifically O157:H7) are less common. Rarer causes include *Yersinia, Entamoeba, Aeromonas*, and *Plesiomonas* spp.

7. What is the significance of stool leukocytes (white blood cells) and how are they detected?

The presence of fecal leukocytes helps to distinguish inflammatory from noninflammatory diarrhea. Normally, leukocytes are not present in stool. Fecal leukocytes are usually found in infectious diarrhea caused by *Campylobacter, Salmonella, Shigella,* and *Yersinia* spp.; *Clostridium difficile;* enterohemorrhagic and enteroinvasive strains of *E. coli*; and *Aeromonas* sp. In cases of ischemic colitis and inflammatory bowel disease, fecal leukocytes are the result of mucosal bleeding. Diarrhea secondary to toxigenic bacteria (e.g., enterotoxigenic *E. coli* [ETEC], *Vibrio cholerae*), viruses, and small bowel protozoa (e.g., *Giardia* sp.) do not contain stool leukocytes. The presence of white blood cells (WBCs) in the stool can be assayed by microscopic examination of the stool or by means of an immunoassay for the neutrophil marker lactoferrin. The sensitivity of fecal lactoferrin and microscopy for fecal WBCs is 92% and 72%, respectively.

8. If 100 random patients with acute diarrhea underwent evaluation with stool cultures, how many would be positive? Which patients with acute diarrhea should be evaluated with a stool culture?

Published studies show the diagnostic yield of stool cultures to be 1.5% to 5.6%. This percentage range can be increased if tested patients are selected carefully. A stool culture should be obtained from patients with dysentery

symptoms, persistent diarrhea (beyond 3 to 5 days) or from patients who are immunocompromised. Patients with dysentery symptoms are much more likely than the other two groups to have a positive stool culture. The rate of positive stool culture in patients hospitalized with dysentery is 40% to 60%.

9. Which patients with acute diarrhea should be evaluated with an endoscopic examination?

Generally, a flexible sigmoidoscopy or colonoscopy is not needed for the evaluation of acute diarrhea. Most cases of acute diarrhea are self-limited, and endoscopic exam findings add usually little information to the history, physical exam, and stool tests. However, patients with prolonged symptoms or those suspected to have pseudomembranous colitis, ischemic colitis, or inflammatory bowel disease should be considered for endoscopic evaluation.

10. By what mechanisms do toxigenic organisms produce diarrhea?

The toxins produced by organisms can be classified into two categories: cytotonic and cytotoxic. Cytotonic toxins cause a watery diarrhea by activation of intracellular enzymes, which cause net fluid secretion into the intestinal lumen. Examples of cytotonic toxins include those produced by *V. cholerae* and enterotoxigenic strains of *E. coli*. Cytotoxic toxins cause structural injury to the intestinal mucosa, which, in turn, causes inflammation and mucosal bleeding. Enterohemorrhagic *E. coli* produces a cytotoxic toxin (*Shiga*-like toxin).

11. Which *Campylobacter* sp. are implicated as causes of dysentery? How is *Campylobacter* transmitted?

C. jejuni accounts for 98% of reported *Campylobacter* isolates and is the most common cause of bacterial gastroenteritis in industrialized nations. The less common isolates are *C. fetus* and *C. fecalis.* Direct contact with fecal matter from infected persons or animals and ingestion of contaminated food or water have been implicated in the transmission of *Campylobacter* infection.

12. Describe the clinical and endoscopic features of *Campylobacter* diarrhea

The incubation period from ingestion until onset of symptoms is 1 to 7 days. Symptoms include diarrhea (often bloody), abdominal pain (can be confused with appendicitis on occasion), malaise, headache, and fever (sometimes high). With or without antibiotic therapy, most patients recover within 5 to 7 days. However, diarrhea can persist for 2 to 3 weeks and relapse may occur. The rectosigmoidoscopic findings of *Campylobacter* diarrhea may be indistinguishable from those of ulcerative colitis or Crohn's disease. The identification of comma-shaped, gram-negative bacteria on stool Gram stain suggests the diagnosis of *Campylobacter* infection. A rare, extraintestinal complication of *Campylobacter* infection is Guillain-Barré syndrome. Up to a third of Guillain-Barré cases in the United States are caused by *Campylobacter* infection.

13. How are *Salmonella* organisms classified?

Salmonella sp. are gram-negative, aerobic, and facultative anaerobic bacteria of the Enterobacteriaceae family. Using O and H antigens, 2500 different serotypes have been identified. The term "nontyphoidal salmonellosis" is used to denote disease caused by serotypes other than *S. typhi. S. enteriditis* and *S. yphimurium* are the serotypes most commonly isolated in the United States.

14. How is *Salmonella* infection acquired?

Infection can be acquired by ingesting food contaminated with *Salmonella* or through contact with infected animals (includes reptiles). Ingestion of raw or poorly cooked animal products such as chicken, beef, and eggs can lead to infection. Cooking a meat thoroughly will kill the bacterium. Recent outbreaks have also been attributed to vegetables and unpasteurized milk. *Salmonella* is the leading cause of mortality from foodborne illness.

15. List the types of illnesses that can be caused by *Salmonella*

- Acute gastroenteritis (The degree of colonic involvement determines the extent of the dysentery-like symptoms. Symptoms of fever, abdominal pain, and diarrhea occur 12 to 72 hours after infection. Illness is generally self-limited and resolves within 5 to 7 days.)
- Bacteremia (with or without gastrointestinal [GI] involvement)
- Localized infection (Bacteremia can result in localized nonintestinal infections—e.g., bone, joints, meninges. Predisposing conditions for localized infection include abdominal aortic aneurysm, prosthetic heart valve, vascular grafts, and orthopedic hardware.)
- Typhoidal or enteric fever
- Asymptomatic carrier states (more common in older age, in women [3:1], and in people with biliary disease)

16. What is typhoid fever?

Typhoid fever is a clinical syndrome characterized by marked hectic fever, persistent bacteremia, hepatosplenomegaly, and abdominal pain. The illness can be caused by any serotype of *Salmonella* but results most commonly from *S. typhi* and less commonly from *S. paratyphi*. Because humans are the only known reservoir of *S. typhi*, transmission is primarily by the fecal-oral route. The illness usually lasts for 3 to 5 weeks. Up to 90% of patients experience a *rose*

spot rash on the upper anterior trunk within the first or second week of illness. Although diarrhea is unusual, ulceration of Peyer patches in the intestinal wall may cause hemorrhage or perforation. A number of vaccines are successful against typhoid. Typhoid fever is rare in the United States and, when it occurs, is usually seen in international travelers.

17. How is *Salmonella* infection treated?

Nontyphoid *Salmonella* gastroenteritis is generally self-limited. A *Cochrane Database Systematic Review* showed that antibiotic therapy only increases the carrier rate. Antibiotics are *only* indicated for those at risk for increased morbidity:

- Infants up to 2 months of age
- Elderly persons
- Immunocompromised persons
- Persons with sickle-cell disease
- Persons with prosthetic grafts and valves
- Persons with extraintestinal findings

Treatment for those at-risk patients should last 2 to 5 days or until the patient is afebrile.

Typhoid fever (*S. typhi*) is best treated with antibiotics for 5 to 7 days for uncomplicated cases and up to 10 to 14 days for a severe infection. Unfortunately, antibiotic resistance is rapidly emerging (fluoroquinolones, 42%; trimethoprim-sulfamethoxazole (TMP-SMX), chloramphenicol, ampicillin, streptomycin, and sulfisoxazole, 12% to 13%).

18. Describe the characteristics of *Shigella* infection. How is it treated?

Shigella sp. is a gram-negative rod and member of the family Enterobacteriaceae. Most (90% to 95%) infections are caused by one of four species: *S. sonnei* (most common in the United States), *S. flexneri, S. dysenteriae*, and *S. boydii*. There are no nonhuman hosts for this organism. The organism is highly infectious, having a fecal-oral route of transmission. Infection can occur with the ingestion of as few as 10 to 100 organisms. Intestinal damage results primarily from direct invasion of the organism into the colonic epithelium and, to a lesser extent, from the production of an enterotoxin. The *Shigella* toxin is composed of an A subunit, which is catalytic, and a B subunit, which is responsible for binding. Stool volume is typically low and the diarrhea may be bloody, mucoid, or watery. The endoscopic appearance of shigellosis shows intense involvement of the rectosigmoid with variable proximal involvement. Approximately 15% of cases present with pancolitis. In children, *Shigella* infection has been associated with seizures. Antimicrobial therapy is recommended for all cases of shigellosis: a fluoroquinolone may be used or, if susceptible, trimethoprim-sulfamethoxazole or ampicillin.

19. What diarrheogenic illnesses are caused by *E. coli*?

E. coli belongs to the family Enterobacteriaceae, a facultative anaerobic, gram-negative bacteria. The organisms are common inhabitants of the human GI tract, and most strains do not have the virulence factors necessary to cause disease. The primary pathogenic strains of *E. coli* and the syndromes that they cause are listed next.

- *Enterotoxigenic E. coli* (ETEC) accounts for most cases of travelers' diarrhea but is relatively rare in the United States. Fecal-oral transmission through the ingestion of contaminated food or water is the primary means of spread. Disease is produced by the adherence of ETEC to the mucosa, followed by the production of toxins (heat-labile *cholera-like* toxins). Invasion of the mucosa does not occur. The illness is usually self-limited, lasting 3 to 5 days. Symptoms include watery diarrhea and abdominal cramping. Occasionally associated with this illness is low-grade fever and, rarely, bloody diarrhea.
- *Enteropathogenic E. coli* (EPEC) lacks invasive properties. Disease results from its enteroadherent properties. Illness caused by EPEC affects primarily young children (younger than age 3 years) and must be considered as a probable cause of nursery and pediatric outbreaks of diarrhea. Profuse watery diarrhea, which may become chronic, is the usual presentation. As with ETEC-caused illnesses, those caused by EPEC rarely result in bloody diarrhea.
- *Enteroinvasive E. coli* (EIEC) can invade the intestinal mucosa and cause acute dysentery. EIEC strains share characteristics with *Shigella* sp. and are not commonly found in the United States. Infants under age 1 are most susceptible to EIEC strains in developed countries.
- *Enteroaggregative E. coli* (EAEC) was identified in the 1980s and is responsible for diarrhea in children in developing countries, prolonged diarrhea in HIV infection in developing countries, and travelers' diarrhea.
- *Shiga-toxin E. coli* (STEC; also known as *enterohemorrhagic E. coli* [EHEC]) has a number of serotypes, but *E. coli* O157:H7 is the most important. *E. coli* O157:H7 is acquired primarily from the ingestion of contaminated beef, although outbreaks have also been associated with contaminated water, raw milk, unpasteurized juices, and person-to-person transmission among household members. Drinking water contaminated with farm waste has been implicated in several recent large outbreaks. The typical clinical presentation begins with severe abdominal cramps and watery diarrhea followed by rapid progression to bloody diarrhea. The organism is not invasive but produces a *Shiga*-like toxin, which is cytotoxic to vascular endothelium. The disease can cause hemolytic uremic syndrome and

thrombotic thrombocytopenia purpura (less than 10% of cases). The very young and very old are the most susceptible to fatal complications. The most common cause of acute renal failure in North American children is O157:H7 infection. This is the *only E. coli* species that will be tested when a stool culture is referred to a lab. Typically, the lab does not evaluate for ETEC, EPEC, EIEC, and EAEC.

20. What is the therapy for O157:H7-induced diarrhea?

Antibiotic therapy for O157:H7 should be avoided. Early therapy with antibiotics has been implicated in the development of hemolytic uremia syndrome. Supportive care, correction of fluid and electrolyte disturbances, and hemodialysis for acute renal failure are the mainstays of therapy. Antimotility agents should be avoided.

21. Describe the clinical presentation of infection with *Yersinia enterocolitica.*

The most common presentation includes diarrhea, abdominal pain, and low-grade fever. Microscopic examination of the stool usually shows red and white blood cells. Approximately 25% of the cases are grossly bloody. The clinical presentation of children and young adults may resemble that of appendicitis (right lower quadrant abdominal pain and tenderness, fever, and leukocytosis). Findings at surgery show mesenteric lymphadenitis and terminal ileitis. On rare occasions, a patient may progress to fulminant enterocolitis with intestinal perforation, peritonitis, and hemorrhage. Pharyngitis is common in children with *Y. enterocolitica* infection and is seen in up to 10% of adult cases. Patients with iron overload (hemochromatosis) are more susceptible to yersinial sepsis. Postinfectious manifestations of reactive arthritis, erythema nodosum, Reiter syndrome, thyroiditis, myocarditis, and glomerulonephritis have been reported.

22. Which organisms are associated with seafood-induced diarrhea?

Vibrio parahaemolyticus and *Vibrio vulnificus*, all members of the ***Vibrio*** genus, are halophilic organisms (i.e., it grows only in media containing salt) that have been isolated in fish, crustaceans, and shellfish. The diarrhea is characteristically watery, but bloody diarrhea may be seen in up to 15% of patients. Patients with liver disease have a high rate of mortality if infected with *V. vulnificus.* Other causes of seafood-induced diarrhea include norovirus, *Plesiomonas shigelloides*, *Campylobacter,* scromboid fish poisoning (fish contains high levels of histamine and heat stable amines), and ciguatera fish poisoning (toxin found in reef fish produced from a dinoflagellate).

23. What parasites cause bloody diarrhea?

Entamoeba histolytica, Balantidium coli, Dientamoeba fragilis, and *Schistosoma* spp. The most common cause of parasitic dysentery in the United States is amebiasis (*E. histolytica*). Although parasitic dysentery is uncommon in the United States, it is a significant cause of morbidity and mortality worldwide.

24. Who is at risk for amebiasis? What are the potential complications of amebic dysentery?

Travelers to and immigrants from endemic areas, institutionalized patients, and homosexual men. Complications include liver abscess, toxic megacolon, intestinal perforation, peritonitis, intussusception, obstruction, and ameboma (mass of granulation tissue in the terminal ileum/right colon). Amoebic dysentery should be considered in any patient who has persistent travelers' diarrhea (longer than 2 weeks).

25. Which laboratory studies are useful in the diagnosis of amebic dysentery?

- Microscopic examination of the stool for cysts and/or trophozoites or a colon ulcer biopsy yields positive results in only 50% of cases.
- Monoclonal antibody–based EIA stool assays for *E. histolytica* antigens have a sensitivity of 95%.
- Detection of circulating antibodies to *E. histolytica* by the indirect hemagglutination (IHAA) test. Approximately 80% to 90% of patients with amebic dysentery have a positive IHAA serology. A positive IHAA test in a patient with presumptive inflammatory bowel disease should raise the possibility of amebiasis.

26. Describe the treatment of amebic dysentery. What are the potential side effects?

Acute amebic dysentery is treated with metronidazole, 500 to 750 mg three times a day for 5 to 10 days, followed by an agent to treat intraluminal cysts such as iodoquinol 650 mg three times a day for 20 days. Consumption of alcohol during metronidazole therapy may induce an Antabuse effect (e.g., abdominal cramps, nausea, emesis, headache, flushing). Peripheral neuropathy is a potentially severe and chronic side effect of metronidazole. Other possible symptoms include a metallic taste and GI distress manifested by nausea, flatus, and diarrhea. Metronidazole is teratogenic and should not be taken during the first trimester of pregnancy.

27. Which parasites typically cause nonbloody diarrhea? What are the risks for acquisition?

Giardia, Cryptosporidiosis, and *Cyclospora* spp. typically cause self-limited nonbloody diarrhea. Contaminated water is the primary source for community outbreaks. *Giardia* sp. is a frequent culprit after consumption of water from

mountainous lakes and streams. The lack of secretory IgA correlates with chronic giardiasis. *Cyclospora* sp. should be considered in travelers from Nepal. *Cyclospora* infection has also been implicated from imported fruit. Cryptosporidiosis is a significant cause of HIV-related diarrhea.

28. What is the most common cause of hospital-acquired diarrhea?

The number one cause of hospital-acquired diarrhea is *C. difficile* infection. It is rare that another bacterial agent is the cause of diarrhea in patients, unless part of a foodborne or waterborne outbreak.

Noninfectious causes of hospital-acquired diarrhea include enteral nutrition and hyperosmolar liquid medications (which commonly contain sorbitol). Other medications that can cause diarrhea include antacids, magnesium supplements, antibiotics, antineoplastics, cholinergics, theophylline, and prostaglandins.

For more information on pseudomembranous colitis (PMC), the reader is referred to Chapter 50.

29. List the risk factors and therapy for infectious dysentery

See Table 55-1.

30. The use of empiric antibiotics in the treatment of acute diarrhea is potentially detrimental in what ways?

Antibiotic therapy in patients with O157:H7 can precipitate the hemolytic uremia syndrome and, in patients with *Salmonella,* can prolong the chronic carrier state and increase relapse. Most patients with acute diarrhea do not require antibiotic therapy. Bacterial resistance is a significant problem in treating the bacterial organisms that cause diarrhea. Many of the diarrhea-causative bacterial organisms are resistant to the penicillins, tetracycline, and TMP-SMX. On the average, significant resistance is noted approximately 10 years following the introduction of an antibiotic.

31. Are antimotility agents contraindicated in patients with dysentery?

Historically, treatment of dysentery with antimotility agents, such as diphenoxylate-atropine (Lomotil) and loperamide (Imodium), has been contraindicated. It was believed that reduced intestinal motility would worsen dysentery by slowing pathogen clearance. Recent studies of patients with shigellosis dysentery who were given a combination of loperamide and antibiotic therapy had a shortened duration of diarrhea without adverse effects. Antimotility agents continue to be contraindicated in children with dysentery because of recurrent adverse case reports.

Table 55-1. Risk Factors and Therapy for Infectious Dysentery

ORGANISM	RISK FACTORS/RESERVOIRS	THERAPY
Aeromonas spp.*	Contaminated water Fluoquinolone	TMP/SMX
Campylobacter spp.*	Contaminated food, water, raw milk, infected animals and humans	Erythromycin Fluroquinolone
	Azithromycin	
Salmonella spp.* (nontyphoidal)	Food (milk, eggs, poultry, meats), water, infected humans	Fluroquinolone TMP-SMX, ceftraxone
Shigella spp.*	Food, water, infected humans	Fluroquinolone
	TMP/SMX	
Escherichia coli	Beef, raw milk, untreated water,	Supportive care
Enterohemorrhagic *E. coli**	Contaminated food and water	Rifaximin
Enterotoxigenic *E. coli**	Contaminated food and water	Fluoquinolone
Aeromonas spp.*	Untreated water, shellfish	TMP-SMX
Plesiomonas spp.	Water, seafood, chicken	TMP-SMX
Yersinia spp.*	Food (milk products, tofu), water	TMP-SMX
		Ceftriaxone (severe)
Entamoeba histolytica	Travel to endemic areas (food, water, fruit)	Metronidazole
Clostridium difficile	Antibiotic use, hospitalization, chemotherapy	Metronidazole Vancomycin Cholestyramine

TMP-SMX, trimethroprim-sulfamethoxazole.
*Mild-to-moderate symptoms do not require antibiotic therapy.

32. Several members of a family develop nausea, emesis, and watery diarrhea 2 to 6 hours after a picnic. Food at the picnic included ham, rice, and custard pie. What type of bacteria is likely to be the cause?

Enterotoxin-producing bacteria must be considered because the symptoms began soon after ingestion of the food. Two enterotoxin-producing bacteria that cause symptoms with such a short incubation are *Staphylococcus aureus* and *Bacillus cereus*. Coagulase-positive strains of *S. aureus* are responsible for many cases of food poisoning in the United States. *S. aureus* enterotoxin is heat-stable. The incubation period from ingestion to symptoms (nausea, emesis, abdominal cramping, and diarrhea) is approximately 3 hours (range, 1 to 6 hours). *S. aureus* favors growth in foods with high sugar content (e.g., custard) and high salt intake (e.g., ham). Recovery is generally complete in 24 to 48 hours. *B. cereus* is a spore-forming, gram-positive rod that produces a diarrheogenic, heat-labile enterotoxin. Vomiting can occur within 2 hours of ingestion of contaminated food. Almost all persons with *B. cereus* develop diarrhea. Meat and rice are the most common food vehicles for infection. *Clostridium perfringens* also produces an enterotoxin. However, the time of onset of symptoms is usually 8 to 16 hours after ingestion of contaminated food.

33. What are the common causes and incidence of travelers' diarrhea?

More than 80% of these cases are secondary to a bacterial pathogen. *E. coli* (ETEC and EAEC strains are most common), *Campylobacter, Salmonella*, and *Shigella* spp. account for most cases of travelers' diarrhea. The rate of illness in high-risk areas (Latin America, Southern Asia, and Africa) is 30% to 40%; in intermediate-risk areas (Caribbean islands, Middle East, China, and Russia), 15% to 20%; and in low-risk areas (United States, northern Europe, Australia, and Japan), less than 10%.

34. How can one avoid travelers' diarrhea?

Safe foods include steaming hot food and beverages, acidic foods such as citrus, dry foods, foods with high sugar content such as syrups and jellies, and carbonated drinks. Bottled, uncarbonated water is not always safe. Avoid uncooked vegetables and unpeeled fruits. Also consume only safe foods on airplanes that are departing from high-risk areas. Chemoprophylaxis with bismuth salicylate (2 tablets with meals and at bedtime) or with the poorly absorbed (less than 0.4%) antibiotic rifaximin (200 mg twice a day) is effective in reducing diarrhea. Probiotics have also been shown to be efficacious although less so than bismuth or rifaximin. Chemoprophylaxis should be given to persons with prior gastric surgery, those taking acid-blocking medicines (H_2 blockers and proton pump inhibitors), or those who are debilitated and immunosuppressed. Travelers who cannot risk or afford a short illness while traveling may opt for chemoprophylaxis.

35. Describe the treatment of travelers' diarrhea

Fluid replacement is the initial and primary therapy for any diarrhea. Bismuth subsalicylate is effective for mild diarrhea although large doses are required. Rifaximin (200 mg three times daily) is effective for treatment of moderate to severe illness. Ciprofloxacin and azithromycin are also effective in reducing symptoms. Ciprofloxacin-resistant strains of *Campylobacter* are common in parts of the developing world**.** Antimotility drugs can be used alone or with antibiotic therapy in adults but should be avoided in children.

36. What is cholera?

Cholera is a severe diarrheal disorder caused by *V. cholerae*, a gram-negative, comma-shaped bacteria. The illness is characterized by massive watery stool output, at times in excess of 1 L/hr. Dehydration, hypovolemic shock, and death occur rapidly if fluid replacement is not provided. The cholera organisms colonize the upper small bowel and release an enterotoxin that binds to and activates mucosal cyclic adenosine monophosphate (cAMP), which, in turn, activates chloride channels in mucosal crypts and leads to the massive secretory diarrhea. A second toxin, called the zonula occludens toxin (ZOT), increases intestinal permeability. The intestinal mucosa is not altered by the organism.

37. How is cholera treated?

Fluid replacement with either intravenous fluids or oral rehydration solution is the mainstay of therapy. A 2-day course of tetracycline is also beneficial.

38. What is oral rehydration solution? How does it work?

Oral rehydration solution (ORS) is composed primarily of water, salt, and glucose (1 L of purified water combined with 20 g of glucose, 3.5 g of sodium chloride, 2.5 g of sodium bicarbonate, and 1.5 g of potassium chloride). Glucose enhances sodium and water absorption across the small bowel villi, even in the presence of cholera enterotoxin. Rice starch can be substituted for glucose.

39. What is a BRAT diet?

BRAT stands for bananas, rice, applesauce, and toast. This diet, with its avoidance of dairy products, because a transient lactase deficiency may occur, is often recommended to patients with gastroenteritis and diarrhea.

40. What viruses cause acute diarrhea?

Acute viral gastroenteritis can be caused by caliciviruses (norovirus, Sapporo viruses), rotaviruses, enteric adenoviruses, coronavirus, and astrovirus. Rotavirus is a common cause of acute diarrhea in patients younger than 2 years. Norovirus (formally Norwalk-like virus) can cause widespread community outbreaks that affect persons of all ages. Fecal-oral transmission has been implicated as the transmission route for viral gastroenteritis. Raw shellfish has been implicated in outbreaks of Norovirus infection. Norovirus is likely the most common cause of foodborne illness.

41. What are the clinical features of rotavirus gastroenteritis? What tests are available for diagnosis?

The clinical presentation of rotavirus can range from an asymptomatic carrier state to severe dehydration that can lead to death. Children under the age of 2 are at greatest risk for infection. Following a 1- to 3-day incubation period, the rotavirus illness is characterized by vomiting and diarrhea for 5 to 7 days. Rotavirus accounts for 25% of cases of acute diarrhea among U.S. children. Rotavirus is more prevalent during cooler months. Adults can develop mild infection with rotavirus. Commercial immunoassays are available to detect rotavirus in the stool.

42. You are on your honeymoon cruise, and 25% (300 people) of the ship's occupants are afflicted with acute gastroenteritis. What is the most likely causative agent?

The most likely agent is a norovirus. Noroviruses are single-stranded RNA viruses in the family Caliciviridae. Most nonbacterial gastroenteritis illnesses are caused by norovirus.

43. A 42-year-old woman is experiencing lower abdominal cramping, bloating, and intermittent diarrhea 6 months following an episode of dysentery that she experienced during a trip to Mexico. What are the possible mechanisms of her illness?

Her diagnosis is most likely postinfectious irritable bowel syndrome (PI-IBS). Up to 30% of patients with IBS had the onset of their symptoms following an acute diarrheal illness. It has been estimated that 4% to 10% of patients with travelers' diarrhea experience PI-IBS. This disorder occurs more frequently in women. The differential diagnosis also includes parasitic infection, unmasking of celiac disease, and new-onset inflammatory bowel disease.

44. What is Reiter's syndrome? Which enteric infections are associated with its development?

Reiter syndrome is a triad of arthritis, urethritis, and conjunctivitis. Infections with *Salmonella* spp., *Shigella* spp., *C. jejuni*, and *Y. enterocolitica* have been associated with this syndrome. Approximately 80% of patients affected by Reiter syndrome are *HLA-B27* antigen–positive. The male-to-female ratio is 9:1.

45. What is toxic megacolon? What are its risk factors?

Toxic megacolon is a complication of colitis manifested by acute dilatation of the colon, with associated fever, tachycardia, leukocytosis, anemia, and postural hypotension. Transmural inflammation interferes with colonic motility, leading to colonic dilation and risk for perforation. Severe idiopathic panulcerative colitis carries the highest risk for toxic megacolon, but it may occur with any severe colitis (e.g., amebiasis, shigellosis, STEC, *C. difficile*, and *Campylobacter* spp.). Performance of barium enema or colonoscopy or the administration of antimotility agents (loperamide, diphenoxylate, anticholinergics, or opiates) in patients with severe colitis may precipitate toxic megacolon.

46. How does one differentiate between acute infectious dysentery and acute onset of inflammatory bowel disease as the cause of bloody diarrhea?

The clinical symptoms and endoscopic findings of the colon are often similar in the two diagnoses. When evaluating a patient with bloody diarrhea, the clinician must use historic data, assess the patient's potential risk factors (e.g., travel and antibiotic use history) and associated symptoms, and evaluate endoscopic appearance, radiologic findings, and laboratory data to narrow the differential. Many of the infectious dysentery illnesses are self-limited in nature. Dysenteric illnesses that do not spontaneously resolve and are culture-negative should undergo investigation for inflammatory bowel disease. Inflammatory bowel disease should be considered in patients with any additional findings, such as oral apthous ulcers, sacroileitis, spinal or peripheral arthropathy, perianal or cutaneous fistulas, a palpable abdominal mass, erythema nodosum, or pyoderma gangrenosum.

47. How is acute bacterial dysentery differentiated from acute onset of ischemic colitis?

The degree of bloody diarrhea is variable in patients with ischemic colitis, and it may be difficult to distinguish between the two diseases. Clinically, the patient with ischemic colitis complains of sudden-onset abdominal pain, and an acute abdominal series may show *thumbprinting* of the colonic mucosa.

Flexible sigmoidoscopy is the mainstay of diagnosis for ischemic colitis. The rectum is usually spared because of its collateral blood flow. Above the rectum, the mucosa becomes friable and edematous, and there may be hemorrhagic areas and ulcerations resembling those of Crohn's disease. Angiography is not generally helpful in the evaluation of ischemic colitis; ischemic colitis is a small-vessel disease (nonocclusive) compared with mesenteric midgut ischemia of the small bowel, which involves thrombosis or embolism in the superior mesenteric artery (occlusive). A barium enema is contraindicated in patients with suspected ischemic colitis, because colonic expansion during barium instillation may promote further ischemia.

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