Gastrointestinal Infections

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INTRODUCTION

Gastrointestinal infections may not readily spring to mind as a major cause of gastrointestinal disease in the elderly. Nevertheless, a special consideration of gastrointestinal infections in this group is warranted because their response to such infections may be different from that of a younger population. Gastrointestinal infections are important in two contexts. Infection with Helicobacter pylori is implicated in a variety of gastroduodenal diseases. Intestinal and colonic infection by a variety of enteropathogens results in diarrheal disease. This chapter will consider these two major aspects of gastrointestinal infection with special reference to their effect on elderly subjects.

HELOCBACTER PYLORI INFECTION

Introduction

Infection with the organism Helicobacter pylori is the most common infection with any organism worldwide. It is responsible for a large number of gastrointestinal diseases throughout the world. Helicobacter pylori infection causes chronic gastritis and is responsible for most cases of duodenal ulcer and gastric ulcer disease. Strong associations of this infection with gastric cancer and lymphoma have also been noted. Helicobacter helmaniti, previously known as Gastrospirillum hominis, is another helicobacter that infects the gastric mucosa of humans. The prevalence of Helicobacter pylori infection increases with age. A substantial proportion of the population (depending on the area of residence) acquires the infection by age 15, and subsequent rate of acquisition is between 1-3% per year of adult life. Serological studies indicate that 80-90% of persons over the age of sixty in developing countries are infected with this organism. In Western countries, infection is less frequent with about 50% of persons over sixty harbouring H pylori. The rate of acquisition of infection in children may have changed in recent decades, and the resulting birth cohort effect is thought to explain the difference in seropositivity between developing and developed countries.

Infection is acquired either by oral-oral or fecal-oral transmission. The infectious dose of the organism is likely to be small. Humans are the natural host for the organism. Cats harbour H pylori in nature, but do not appear to be a significant zoonotic reservoir for human infection. The exact mode of transmission is not known in most instances. In developed countries oral-oral transmission is likely; in developing countries the fecal-oral route may be more important. Contamination of water sources with the organism has been documented.

Disease Associations

Peptic Ulcer Disease

There is now incontrovertible evidence that H pylori infection is responsible for relapses of duodenal ulcer and probably for many cases of gastric ulcer. Duodenal ulcers do not recur if the organism is successfully eradicated using combination antibiotic therapy. Between 6-20% of H pylori infections may result in
peptic ulceration at some time during life.

Bleeding from duodenal or gastric ulcers is a special problem in elderly patients. If this happens in the absence of the use of non-steroidal anti-inflammatory drugs (NSAIDs), then the eradication of *H. pylori* infection is indicated. Evidence from younger patients suggests that this is likely to prevent ulcer recurrence and late rebleeding. However, ulcer bleeding in the elderly is most often associated with chronic use of NSAIDs for joint and other pains. A link between NSAID-induced ulceration in the elderly and *H. pylori* infection has been explored, but the data are not adequate for firm conclusions. With regard to duodenal ulcers, the data may be interpreted as showing that *H. pylori* is the major causative factor in the development of duodenal ulceration, but the concomitant use of NSAIDs increases risk of bleeding from these ulcers. On the other hand, gastric ulcers appear to be caused independently either by NSAID use alone or by *H. pylori* infection. Gastric ulcers caused by NSAID use appear to be more prone to bleeding than *H. pylori*-induced ulcers.

**Non-ulcer Dyspepsia**

Gastritis associated with *H. pylori* is the commonest finding in elderly patients with dyspepsia. The association of this organism with non-ulcer dyspepsia (i.e. whether *H. pylori* is indeed the cause of dyspepsia) remains controversial. Both *H. pylori* infection and non-ulcer dyspepsia are common conditions, and it is not surprising if the two conditions co-exist in some people. The majority of short-term eradication studies have been disappointing. However, in practice, it is not unusual to find that many patients with dyspepsia who have *H. pylori* infection have been treated for the same.

**Reflux Oesophagitis**

Infection with the organism does not correlate with the presence of reflux oesophagitis in elderly patients. There is, however, a suggestion that patients with reflux oesophagitis should first receive *H. pylori* eradication before commencing long-term acid suppression therapy.

**Gastric Carcinoma**

Carcinoma of the gastric antrum appears to be associated with *H. pylori* infection leading to atrophic gastritis and intestinal metaplasia. Less than 1% of *H. pylori* infections are associated with carcinoma. Infection with the organism is often inactive by the time carcinoma develops, and eradication of *H. pylori* does not currently form part of the management of gastric carcinoma.

**MALT lymphoma of the stomach**

*H. pylori* infection is associated with low-grade gastric MALT lymphoma. Such lymphomas sometimes regress when antibiotic treatment is instituted. This suggests that *H. pylori* provides the antigenic stimulus for lymphoproliferation and the development of low-grade lymphoma.

**Diagnosis**

The diagnosis of *H. pylori* infection traditionally involves the use of endoscopy to obtain gastric mucosal biopsies, which are then examined either by smear, histology, rapid urease testing or by culture to detect the infection. In developing countries these continue to be the commonly used methods to diagnose active infection. Biopsies or smears can be stained with Giemsa stain to demonstrate the organism, which is also visible in H&E stained sections to the trained eye. The rapid urease test, now widely available commercially, is also used to diagnose the infection using endoscopic biopsies. The need for endoscopy has consider-
ably diminished following the development of sensitive and specific serological tests for screening. Studies in
developed countries demonstrate that currently available serological tests are highly sensitive and specific in
detecting active infection with the organism. This has been separately confirmed in elderly subjects. The
same is not necessarily true of developing countries, where the majority of infected individuals acquire
infection before the age of fifteen. In these regions, a number of individuals (especially those who develop
atrophic gastritis) have probably eliminated the infection by the age of sixty, but may continue to have antibi-
odies detectable by serological testing. Hence serological tests must be used with caution in elderly patients
in developing countries when the intention is to initiate therapy. The 13C-urea breath test, which measures
breath elimination of 13CO₂ after administering urea orally, provides evidence of active infection as well,
giving a quantitative measure of the infective burden. They are now considered the investigations of choice
for confirming eradication of infection, but have not entered into widespread use as yet because of the
expense involved.

**Treatment**

The therapy of *H pylori* infection involves the use of multi-drug regimens. Currently, the treatment
of choice is triple therapy with a proton pump inhibitor and two antibiotics (usually amoxycillin or an imidazole
derivative combined with clarithromycin). Typically, omeprazole (20 mg) or lansoprazole (30 mg) is given
along with amoxycillin (1 gm) and clarithromycin (250-500 mg) twice daily for one week to achieve eradica-
tion rates of around 90%. Side effects include diarrhea and taste disturbances. Eradication rates are signifi-
cantly less when metronidazole is used, due to significant metronidazole resistance in *H pylori*. In early trials,
the use of ranitidine bismuth citrate, in combination with two antibiotics, has been found to be very effective
in eradicating infection.

Eradication therapy should be offered to patients with symptomatic and complicated peptic ulcers.
Patients with low-grade gastric MALT lymphoma may also be given eradication therapy. However, they
require close follow up to ensure that the tumour regresses completely, and that it does not require any other
form of therapy. The current controversy regarding eradication therapy relates to patients with non-ulcer
dyspepsia. In practice, many of these patients receive eradication therapy when infection is detected. Such
treatment may lead to complacency and avoidance of further investigation, which may be particularly inap-
propriate in the elderly, who may have a more serious illness that is responsible for their dyspepsia.

**Prevention**

Global eradication of infection can be achieved only by immunisation, and work is on to develop
vaccines for *H pylori*. This has received a boost from the recent sequencing of the entire genome of the
organism. In the absence of a clear knowledge of the spread of the organism, other preventive measures
cannot be prescribed at present.

**INTESTINAL PATHOGENS CAUSING DIARRHEA**

**General Considerations**

In developed countries, outbreaks of infective gastroenteritis are known to occur among elderly
patients in nursing homes, with considerable mortality. In these countries, infectious diarrhea is the fourth
most common infectious disease in elderly patients confined to chronic care facilities. Prospective studies
report an incidence of approximately 33 cases per 100 patient years. Risk factors for infectious diarrhea in
these countries include residence in nursing homes, recent antibiotic therapy and travel abroad. Outbreaks of
diarrhea confined to elderly individuals are rare in developing countries where the elderly are rarely confined
to nursing homes for chronic care. In such countries, many gastrointestinal infections are endemic in the
community, and people are exposed to these in childhood, with resultant immunity. It is rare to find adults being symptomatic from infection with these pathogens. On the other hand, if a pathogenic agent newly enters the community, adults are affected equally with children. Under such circumstances, the elderly may be more often affected.

The elderly have a predisposition to infectious diarrhea. This predisposition could result from several factors including age-related immune system dysfunction, achlorhydria, altered intestinal or colonic motility and changes in fecal flora. Although gross measures of immune function are normal in the elderly, more sophisticated tests of leukocyte function have identified differences in the immune response of older and younger adults. Hypochlorhydria or achlorhydria may occur in elderly patients secondary to atrophic gastritis or to the use of long-term histamine H₂ antagonists or proton pump inhibitors. Gastric acid is one of the recognised barriers that protects against gastrointestinal infection, and its absence may increase the probability of developing infectious diarrhea. Disturbed intestinal motility due to neuromuscular diseases such as stroke, diabetes or microvascular atherosclerosis is common in the elderly and may predispose to colonisation by enteropathogens.

The development of diarrheal disease in the elderly carries a particularly high mortality, since dehydration in the patient with atherosclerotic vascular involvement carries the increased risk of precipitating an acute cardiovascular or cerebrovascular episode. While they usually occur within the span of the diarrheal illness, there is an increased risk of cardiovascular and cerebrovascular events even a week or more after the diarrheal illness subsides. In some studies, diarrheal mortality increased up to 400-fold in patients above the age of 75 years when compared to young adults.

As in the very young, gastroenteritis has the potential to worsen the nutritional state in elderly patients. The elderly have a high baseline prevalence of undernutrition. Diarrhea may exacerbate this due to decreased oral intake, fever with its increased metabolic demand, malabsorption and protein-losing enteropathy. These factors should be borne in mind while managing elderly patient with gastrointestinal infection.

Infectious diarrhea in the elderly may be confused with a variety of non-infectious causes of diarrhea (Table 1). Spurious diarrhea secondary to chronic constipation and fecal impaction is a common differential diagnosis, particularly in bedridden patients and those with neurological illnesses. Stool examination for the presence of leukocytes and occult blood is useful in detecting the presence of infection in acute diarrheal conditions in the elderly. Culture and further testing can recover a specific diarrhea-inducing micro-organism or toxin in 40-50% of patients. Proctosigmoidoscopy or colonoscopy are rarely required except when the diagnosis remains unclear.

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Specific Enteric Infections

In developed countries, pathogens isolated from elderly patients with diarrhea include Shigella and Salmonella, while *Campylobacter jejuni*, giardia and rotavirus infection are less frequent. Even in developing countries where infection with these organisms is endemic, common enteropathogens must be considered first in elderly patients with diarrhea.

*Vibrio cholerae*

Cholera is a devastating disease due to the rapidity with which severe dehydration occurs. There were two major biotypes of cholera (classic and El Tor) until recently, when a new biotype, *Vibrio cholerae* O139 emerged to cause epidemics of diarrheal disease in India and Bangladesh. Cholera results from enterotoxin-induced fluid secretion, mainly from the small bowel, in the absence of mucosal damage. Cholera toxin (CT) stimulates adenyly cyclase to inhibit NaCl absorption and stimulate Cl secretion in the small intestinal epithelium. A reflex neural action also appears to be important in CT-induced secretion. Two other enterotoxins, accessory cholera enterotoxin (ACE) and zonula occludens toxin (ZOT), have been recently isolated from *V. cholerae*. *Vibrio O139* possesses the enterotoxins present in classic and El Tor vibrios but has additional virulence attributes. Cholera is transmitted mainly through contaminated water and food. Person-to-person transmission is very uncommon. In epidemics in southern India caused by O139, and in the recent cholera epidemics in the Americas, the elderly were affected disproportionately, with an excess of mortality in this age group. In both situations, an organism was introduced to which the population had not been exposed earlier. The illness presents with vomiting and abdominal distension, followed by frequent purging with large volumes of rice-water stools. Patients present with dehydration and profound hypovolemic shock, leading to renal failure. Diagnosis of cholera vibrios can be made by hanging drop examination of the stool for bacteria with characteristic shape and motility, and can be confirmed by culture. Elderly patients should be treated by intravenous hydration with normal saline or Ringer lactate in the first four to six hours. Rehydration needs to be carefully monitored in those with suspected compromise of myocardial or renal function. Delay in instituting treatment may result in complications such as electrolyte imbalance, renal failure, myocardial infarction and stroke. Doxycycline 300mg, as a single dose, is administered when the patient is able to tolerate it orally. Parenteral rehydration of dehydrated patients is followed by maintenance of oral hydration therapy. Oral hydration using cereal-based oral rehydration solutions is more effective than glucose-based oral rehydration solution in reducing stool output and the duration of diarrhea. The patient is put on a normal diet as early as possible. *Vibrio cholerae* O139 is more invasive than classic or El Tor vibrios, and is occasionally associated with bacteremia. This may particularly be noted in those with depressed immune defenses and may necessitate systemic antibiotic therapy. Cholera inoculation has limited effectiveness in epidemic situations, because the infection is already widespread in the community by the time initial cases are
Escherichia Coli

Escherichia coli are major components of the normal intestinal microflora in human beings and animals. Although the vast majority are relatively harmless in the bowel, some strains possess virulence factors that are responsible for diarrheal disease.

Enterotoxigenic Escherichia coli (ETEC)

These organisms are transmitted through contaminated food and water. Although primarily implicated in childhood diarrhea, it is reported that the elderly easily develop clinical illness if infected with these organisms. They colonise the small intestinal epithelium through pili or colonisation factors and produce enterotoxins. Two types of toxin (heat-labile or LT, and heat-stable or ST) are produced that induce fluid secretion in the intestine, acting through cyclic AMP (LT) or through cyclic GMP (ST). LT-producing ETEC induce an illness similar to cholera. ST-producing ETEC are important causes of travelers' diarrhea. Diagnosis is established by testing E coli isolated from stool for toxin production (LT and ST). Treatment includes parenteral and oral hydration. There is little evidence to suggest that antibiotic treatment shortens the disease.

Enterohemorrhagic Escherichia coli (EHEC)

This organism was first recognised as a pathogen in 1982, when it was found responsible for two outbreaks of diarrheal illness in the United States. In developed countries, infection is usually acquired from eating contaminated beef in hamburgers. In developing countries, the organism is widely detected in the environment, particularly in relation to domestic cattle. Transmission is likely to involve contaminated water and food. Some instances of sporadic and epidemic diarrhea in developing countries may well be due to this organism. The very young and the aged are most at risk from developing disease due to this organism. Specific serotypes of E coli (most notably O157:H7) elaborate a cytotoxin belonging to the family of Shiga toxin (hence called Shiga-like toxins or SLT). The infection involves the cecum and right colon and, in its most severe form, produces hemorrhagic colitis. Infection with EHEC can cause a wide range of manifestations, including asymptomatic infection, non-bloody diarrhea, hemorrhagic colitis and hemolytic uremic syndrome (HUS). Severe illness is characterised by cramp-like abdominal pain, marked abdominal distention, and grossly bloody diarrhea, and carries a high fatality rate. Infection in the elderly can be particularly severe and may resemble ischemic colitis. The organism may theoretically cause HUS in patients receiving chemotherapeutic agents, since these agents may induce the production of Shiga-like toxins. The diagnosis can be established by culturing the feces and testing colonies of E coli for cytotoxin production using Vero cell cultures or an enzyme linked immunosorbent assay. DNA hybridization using molecular probes for Shiga-like toxins is an alternative method of making the diagnosis. No clear response to antimicrobial agents is noted, and antidiarrheal agents may aggravate the disease. Patients are however hospitalised to observe, and treat, complications.

Enteroaggregative Escherichia coli (EAEC)

These organisms adhere to cultured intestinal epithelial cells (HEp-2 cell line) with a distinctive "stacked brick" pattern of aggregation. These strains of E coli have been shown to be pathogenic in human volunteers and are implicated as diarrheal pathogens. Epidemiological evidence has implicated them in the causation of persistent diarrhea in childhood. However they may cause sporadic (or epidemic) diarrhea in all age groups, including the elderly. The mechanism of diarrhea produced by these organisms is still poorly understood. Several putative toxins have been isolated from these bacteria, one of which is enteroaggregative.
heat-stable-like enterotoxin (EAST). The diarrheal illness induced by these pathogens is characterised by its prolonged nature, sometimes persisting for over two weeks. Diagnosis of the infection is made by isolating and testing fecal E coli for adherence to HEP-2 cell monolayers in culture. The response of these organisms to antibiotic therapy is not known. In most cases, attention to hydration and nutrition is all that is necessary.

**Enteroinvasive Escherichia coli (EIEC)**

EIEC resemble Shigella biochemically and in terms of disease production. It causes dysenteric illness due to invasion of the colonic mucosa. Little information is available about disease caused by these organisms in the elderly.

**Aeromonas and Plesiomonas**

*Aeromonas hydrophila* and the closely related bacterium *Plesiomonas shigelloides* may both induce diarrhea. A variety of toxins, including heat-labile enterotoxin, and a cytotoxin are produced. Aeromonas diarrhea is usually noted in children, although we have isolated the organism in sporadic adult diarrhea. It may produce mild watery diarrhea or bloody diarrhea mimicking ulcerative colitis. Many cases resolve spontaneously. Therapy is reserved for patients who are immunocompromised or acutely ill, or who have persistent symptoms. Plesiomonas is often associated with consumption of raw oysters or other seafood. It may cause diarrhea characterised by small volume stools that may contain blood. Severe abdominal pain may be present. In about a third of patients, the course may be prolonged, sometimes up to 4 weeks. Treatment with antibiotics does not usually alter the course of gastrointestinal illness. Both Aeromonas and Plesiomonas are sensitive to quinolones, co-trimoxazole, third generation cephalosporins or aminoglycosides.

**Shigella**

Shigella species are commonly isolated from elderly patients with diarrhea in developed countries. Several different subgroups, *S dysenteriae*, *S flexneri*, *S boydii* and *S sonnei* are known. Shigellosis is essentially an infection of the colon, and symptoms are caused by invasion of the mucosa causing inflammation and ulceration. This results in diarrhea with blood and mucus (dysentery). Shiga toxin, an additional pathogenic factor, is produced only by *S dysenteriae* and by limited strains of *S flexneri* and *S sonnei*. Shiga toxin is a cytotoxin, causing cell death due to suppression of protein synthesis and may be responsible for manifestations such as the hemolytic uremic syndrome (HUS) described in children. It appears that some species are more likely to affect the elderly. Thus, *S flexneri* infection is reported more commonly in elderly patients, as compared to *S sonnei*. Elderly patients present usually with watery diarrhea, fever, and abdominal pain. Three to five days after onset, tenesmus (pain on defecation) and small volume bloody stools may commence. Bloody stools are less frequent in the elderly than in children. Shigellosis in the elderly is characterised by a prolonged clinical course, often lasting over a week if untreated. Hemolytic uremic syndrome as a complication of shigellosis has not been reported in the elderly. A reactive arthritis involving large joints asymmetrically may occur occasionally two to three weeks after the onset of acute dysentery. Laboratory abnormalities are often noted in elderly patients and include abnormalities of serum electrolytes and hepatic enzymes. The diagnosis is made by stool examination showing multiple polymorphonuclear leukocytes and red blood cells, and confirmed by culture. In the elderly, attention must be paid mainly to hydration and correction of electrolyte abnormalities. Opiates to control diarrhea should be avoided since they have been associated with the occurrence of toxic megacolon, which may be a fatal complication. Shigella infections, other than those due to *S dysenteriae* I, are often self-limited. Antibiotic therapy is necessary in those with bloody diarrhea, prolonged illness or systemic symptoms. One of the quinolone drugs, such as ciprofloxacin or norfloxacin, is administered.
Salmonella

Salmonellae (non-typhoidal) are a common cause of gastroenteritis in the elderly in developed countries. Transmission is food-borne, and flies, food, fingers, feces and fomites are all implicated. Non-human reservoirs play a major role in transmission of the disease. Infection can cause a variety of clinical syndromes including acute gastroenteritis, bacteremia, focal non-intestinal infections, typhoid and an asymptomatic carrier state. Gastrointestinal symptoms are due both to invasion of the mucosa by the organism, and to net fluid and electrolyte secretion induced by the organism. The elderly are more liable than younger patients to become symptomatic when infected with non-typhoidal Salmonella species. The incubation period varies from 6-48 hours, but is sometimes much longer. Presenting symptoms include watery diarrhea, nausea, vomiting, abdominal cramps and fever. Bacteremia or focal infection should be suspected if there is persistent fever or specific findings on physical examination. The diagnosis is usually made by culture of feces or of blood. Antibiotic therapy can be avoided in those with mild, uncomplicated gastroenteritis caused by Salmonellae. This is advised particularly in order to limit the spread of antibiotic resistance in these organisms. Gastroenteritis due to Salmonella should be treated with antibiotics in patients with underlying disease (e.g. neoplasia) and in those with features of sepsis. Drugs that may be used include quinolones (such as ciprofloxacin), co-trimoxazole or ampicillin. Parenteral quinolones or aminoglycosides may be used when necessary.

Campylobacter Jejuni

Campylobacter jejuni infection is very common in developing countries. The most common route of transmission is from infected animals to human beings, though consumption of contaminated or improperly cooked food is also causal. The organism has also been isolated from water. In developing countries, exposure is common during childhood and adults are unlikely to develop diarrhea due to the organism. However, the elderly appear to be susceptible to development of illness if infected with the organism. The organism may colonise either the small or large bowel and produce diarrhea, which may be either watery or bloody. There is often a prodrome with coryza, headache and malaise. Abdominal pain and fever are common when diarrhea develops. Diarrhea usually resolves without intervention in a week, but may persist or relapse in some cases, causing confusion with inflammatory bowel disease. Stool examination reveals many white and red blood cells. The diagnosis is made by stool culture using a selective isolation medium with antibiotics and special culture conditions. Antibiotics have no effect on the course of illness in most cases, but if given sufficiently early, erythromycin may hasten recovery. Quinolone antibiotics or gentamicin may also be used, particularly for Campylobacter septicaemia.

Yersinia Enterocolitica

Yersinia enterocolitica is a pathogen that is responsible for diarrheal disease primarily in children. The organism is transmitted through contaminated food (particularly milk) and water and many animals are reservoirs for infection. The organism causes disease through invasion of the intestinal mucosa and also produces a heat-stable enterotoxin, which is produced at 25°C. In adults, the organism usually causes acute diarrhea, followed two to three weeks later by joint symptoms and skin rash (erythema nodosum or erythema multiforme). In persons with underlying disease such as malignancy or diabetes, bacteremia can result. Diagnosis is established by stool culture, provided the laboratory is aware of the suspected diagnosis. The organism is susceptible to several antibiotics including quinolones, tetracycline, co-trimoxazole and gentamicin, but antibiotic therapy does not usually change the course of gastrointestinal illness.

Clostridium Perfringens

Clostridium perfringens produces an enterotoxin that is a common cause of food poisoning. Charac-
teristics of this organism that contribute to its ability to cause food-borne illness include the formation of heat-resistant spores that survive normal cooking/heating temperatures, a rapid growth rate in warm food, and the production of enterotoxin (CPE) in the human gut. However, CPE-induced diarrhea has been reported in the absence of a defined food vehicle. These cases typically occur in elderly persons without a history of exposure to contaminated food, and usually occur following a course of antibiotic therapy. Diagnosis is by detecting toxin or the gene by immunoassay or molecular methods, but these are not yet available as commercial kits.

*Clostridium Difficile*

This organism was originally implicated in the causation of antibiotic-associated colitis. The organism elaborates two cytotoxins, which probably induce secretion as well as epithelial cell death. The organism is found primarily in the colon, where it induces inflammation and ulceration with formation of a ‘pseudomembrane’. It is responsible for the colitis seen occasionally following antibiotic therapy. Age is now considered to be a risk factor for infection with the organism. Thus, *Clostridium difficile* has been described as a significant cause of diarrhea in the elderly in developing countries. This occurs even in the absence of antibiotic use and carries a high mortality. In some elderly patients, infection with Clostridium difficile may induce protein-losing enteropathy (secondary to colonic exudation) in the absence of diarrhea. Sigmoidoscopy may reveal evidence of proctosigmoiditis, and the characteristic ‘pseudomembranes’ may be visible. Culturing the organism from stools makes the diagnosis. Either the organism or the stool may be tested for cytotoxins A and B. Mild diarrhea following antibiotics does not need specific therapy. More severe cases are treated usually with either metronidazole or vancomycin.

**Viruses**

Rotaviruses, usually thought of as a cause of gastroenteritis in children, should also be considered as a cause of non-bacterial diarrhea in elderly patients. Rotavirus gastroenteritis has been noted mainly in chronic care and rehabilitation facilities. The virus appears to spread by fecal-oral route and is highly contagious, but appropriate measures can limit its spread. Unlike infection in children, rotavirus infection in adults produces a milder illness. Symptoms may be severe in elderly patients with underlying malnutrition. Stool specimens do not show leukocytes or red blood cells, and bacterial cultures will be negative. ELISA to detect rotavirus antigen in stool using commercially available kits can establish the diagnosis. Electron microscopy of stool is a more cumbersome method to demonstrate the virus. There are no antiviral agents against rotavirus and the mainstay of therapy is oral or intravenous rehydration. As yet, no effective vaccine is available to prevent infection.

Diarrheal outbreaks due to other viruses (Norwalk agent, astrovirus, calicivirus and enteroviruses) are not uncommon in chronic care facilities for the aged. These agents are probably also responsible for sporadic diarrhea in the community. Many of the agents of viral gastroenteritis produce mild diarrhea and mortality does not appear to be obviously increased. Norwalk virus causes epidemics of diarrhea in temperate countries in the winter. It spreads through the fecal-oral route and person-person contact is important. Raw shellfish are a major source of infection. All ages are affected. Symptoms include diarrhea, nausea and vomiting and abdominal cramps. A radioimmunoassay is available for identifying the virus in feces and the antibody in serum.

*Cryptosporidium parvum*

*Cryptosporidium parvum* is a coccidian protozoan parasite that inhabits primarily the microvillus membrane brush border of intestinal epithelial cells. Human infection has been increasingly recognised in the past fifteen years. Infection is common, and usually acquired at an early age in developing countries.
Cell-mediated immunity is required to prevent heavy infection. The clinical manifestations range from asymptomatic infection to chronic diarrhea. In developing countries the primary affected group is children. In immunocompetent adults, infection is usually self-limited. In immunocompromised patients (e.g., those with HIV), infection results in debilitating and life-threatening chronic illness. These patients present with profuse watery diarrhea associated with crampy abdominal pain, anorexia, and nausea and vomiting. Infection of the biliary tree, with abnormal liver function tests, can occur on occasions. Elderly patients with chronic illnesses have recently been recognized to be a group at risk for cryptosporidial infection and diarrhea. Cryptosporidiosis may be acquired in the community, although nosocomial infection in hospital or chronic care facilities is often reported. Cryptosporidium can be detected by examination of the stool using a modified acid-fast stain (such as safranine-methylene blue) or by immunofluorescent techniques. More recently an ELISA has been used for diagnosis. Treatment is usually symptomatic and not satisfactory. Specific therapy with paromomycin (25-35 mg/kg/day in 3 doses) is effective in some patients. Other drugs that have been tried in therapy include spiramycin, azithromycin and clarithromycin. Hyperimmune bovine colostrum has also been used successfully on occasions.

**Other Parasites**

*Giardia intestinalis*, *Entamoeba histolytica* and *Strongyloides stercoralis* must all be considered as causes of diarrheal disease in the elderly, although no special predilection is reported. Giardiasis causes diarrhea in children, but is not usually considered as a cause of adult diarrhea. However, in the elderly, with depressed intestinal immune function, it is quite possible that it may cause diarrheal illness. Strongyloidiasis leads to chronic diarrhea and malabsorption. Diagnosis of these infections is made by stool microscopy. Both giardiasis and amebiasis can be successfully treated by any of the imidazole drugs including metronidazole or tinidazole. Strongyloidiasis responds to treatment with thiabendazole or albendazole.

**Candida Albicans**

Overgrowth of the bowel with *Candida albicans* is occasionally a cause of diarrhea in elderly, malnourished and critically ill patients. These patients are often hospitalised for other illnesses, with prolonged hospital stays, and may have been treated with multiple antibiotics or chemotherapeutic agents. The diarrhea is characterised by frequent watery stools, usually without blood, mucus, tenesmus, or abdominal pain. Dehydration, prerenal azotemia, hyperchloremic metabolic acidosis and electrolyte imbalance may occur. Colonoscopy is usually normal. The diagnosis is made on the basis of stool culture, which shows the organism in association with suppressed normal flora. Care must be taken to exclude other causes of diarrhea. Diarrhea due to this organism usually responds dramatically to a short course of oral nystatin. Ketoconazole or fluconazole can be used alternatively.

**Small Bowel Bacterial Overgrowth**

Small intestinal bacterial overgrowth has been described in elderly patients even without predisposing structural abnormalities of the small intestine (such as stricture or blind loops). Bacterial overgrowth occurs in these patients probably because of altered motility secondary to ageing. Fasting hypochlorhydria, or changes in mucosal immunity related to age, do not appear to be major contributory factors. The syndrome is reported in patients aged 75 years or more, who present with chronic diarrhea, anorexia, or nausea. Features of vitamin B₁₂ insufficiency may be present. Bacterial overgrowth may also be seen in patients with small intestinal diverticulosis, in whom the incidence of small bowel bacterial overgrowth increases with age. Tests of absorption (fecal fat, xylose absorption and B₁₂ absorption) may reveal abnormalities. Barium meal examination of the small bowel should be done to exclude structural abnormalities such as stricture, blind loops and diverticulosis. The diagnosis can be established by culture of the jejunal luminal fluid, which will reveal colonic-type bacterial flora (*Enterobacteriaceae*). Therapy of these patients will include nutritional
supplementation, vitamin B₁₂, injections and antibiotics. Antbiotic treatment is not well defined in this group of patients with bacterial overgrowth, but can include tetracycline and possibly quinolones. Therapy may need to be intermittent or prolonged.

EVALUATION OF THE ELDERLY PATIENT WITH INFECTIOUS DIARRHEA

Most infectious causes of diarrhea in the elderly are self-limiting, and very often the only measure required is to ensure that treatment begins before detectable dehydration develops. Initial evaluation should eliminate likely non-infectious causes of diarrhea quickly through history taking. This should include identification of new medications that the patient may have been prescribed, including laxatives and magnesium-containing antacids. Constipation leading to fecal impaction with ‘spurious’ diarrhea should be excluded in bedridden or demented patients, or in those taking large doses of opiates. Inflammatory bowel disease and irritable bowel syndrome can also occur in the elderly and should be considered in the history taking.

At initial examination, an assessment will need to be made about the need to hospitalise the patient for intravenous hydration. Elderly patients with abdominal pain, vomiting or fever may not tolerate ORT and require hospitalisation. Signs of dehydration used in younger adults and in children are not reliable in the elderly. Skin elasticity or turgor is reduced in the elderly, and mouth breathing may result in a chronically dry tongue. Pulse rate is usually slow in the elderly, and postural changes in pulse and blood pressure will not occur until 10% of blood volume is lost.

The abdomen should be examined to detect distension, tenderness and rebound tenderness. Acute surgical conditions will need to be excluded in patients with marked tenderness or rebound tenderness. Bowel sounds should be evaluated. Rectal examination is useful to diagnose fecal impaction. It can also provide stool for testing for occult blood. Laboratory tests may offer a clue to dehydration, particularly blood urea and the urea to creatinine ratio. Routine stool cultures are often negative, because many of the pathogens that can cause diarrhea (any of the pathogenic variants of E.coli, most viruses, etc.) will not be detected using methods that are standard in most laboratories. Stool cultures are useful in those with high fever or sepsis, or where a bacterial cause of diarrhea (such as Shigella, Salmonella or V cholerae) is suspected. Other special tests involving feces are not useful in managing sporadic diarrhea, but may be ordered if there is an outbreak of diarrhea, necessitating identification of the causative organism for public health safety reasons.

TREATMENT

Replacement of fluid is imperative in the elderly patient with diarrhea, since atherosclerosis increases the likelihood of serious sequelae. In the dehydrated patient, this is probably best accomplished by intravenous hydration (using normal saline or Ringer lactate) with care to avoid fluid overload. Oral hydration is the primary form of therapy in patients with mild diarrhea, and in patients with severe diarrhea who have already been rehydrated. Any of the commercially available oral rehydration solutions can be used. Rice-based or other cereal-based oral rehydration solutions have an advantage over glucose ORS in cholera and cholera-like severe watery diarrhea. They reduce fecal losses and duration of diarrhea in these conditions. ORT can be taken by mouth by patients who can drink, or delivered through a nasogastric tube in others. Except in cholera, initial hydration may involve the delivery of 1 to 2 litres of fluid (either intravenously or as ORT) in the first four to six hours. Ongoing fluid losses should then be replaced with an additional 1 to 2 litres per day. The above is adequate for a person with mild infective diarrhea. In more severe diarrhea, particularly cholera, close attention should be paid to stool volume, and adequate fluid replacement ordered. Fluid overload should be avoided in persons with poor myocardial or renal function. These patients require close monitoring.

Anti-motility agents (such as the opiates) are best avoided in those with infective diarrhea. They can
worsen cases of inflammatory diarrhea and precipitate toxic megacolon. Bismuth subsalicylate (30 ml after each loose stool, hourly if necessary up to 8 doses in a day) can be used if symptomatic control of diarrhea is considered necessary. A guide to antimicrobial susceptibility and use is given in Table 2. Except for a few specific infections, antimicrobial therapy does not change the course of infectious gastroenteritis, and is not indicated in the majority of patients. However, such therapy may be required in immunocompromised patients, and in those with prolonged illness, or systemic or extraintestinal involvement.

Table 2. Antimicrobial Therapy For Common Enteropathogens

<table>
<thead>
<tr>
<th>ORGANISM</th>
<th>ANTIMICROBIAL</th>
<th>DOSE &amp; DURATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>V. cholerae</td>
<td>Doxycycline</td>
<td>300 mg stat</td>
</tr>
<tr>
<td>Shigella</td>
<td>Norfloxacin</td>
<td>400 mg BD for 5-7 days</td>
</tr>
<tr>
<td></td>
<td>Ciprofloxacin</td>
<td>500 mg BD for 5-7 days</td>
</tr>
<tr>
<td>C. difficile</td>
<td>Metronidazole</td>
<td>500 mg TDS for 7 days</td>
</tr>
<tr>
<td></td>
<td>Vancomycin</td>
<td>500 mg Q6H for 7 days</td>
</tr>
<tr>
<td>C. albicans</td>
<td>Nystatin</td>
<td>500,000 u QID for 5-7 days</td>
</tr>
<tr>
<td>S. stercoralis</td>
<td>Albendazole</td>
<td>400 mg BD for 3 days</td>
</tr>
<tr>
<td></td>
<td>Ivermectin</td>
<td>150-200ug/kg stat</td>
</tr>
<tr>
<td>E. coli (ETEC)</td>
<td>Doxycycline</td>
<td>100 mg BD</td>
</tr>
<tr>
<td>(Travelers' diarrhea)</td>
<td>Norfloxacin</td>
<td>400 mg BD</td>
</tr>
<tr>
<td></td>
<td>Ciprofloxacin</td>
<td>500 mg BD</td>
</tr>
</tbody>
</table>

Recommended only Under Certain Circumstances

(e.g. prolonged or severe illness, bacteremia, complications)

<table>
<thead>
<tr>
<th>ORGANISM</th>
<th>ANTIMICROBIAL</th>
<th>DOSE &amp; DURATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salmonella (non-typhoidal)</td>
<td>Ciprofloxacin</td>
<td>500 mg BD for 5-7 days</td>
</tr>
<tr>
<td>C. jejuni</td>
<td>Erythromycin</td>
<td>500 mg QID for 7 days</td>
</tr>
<tr>
<td>Y. enterocolitica</td>
<td>Tetracycline</td>
<td>500 mg QID for 5-7 days</td>
</tr>
<tr>
<td>A. hydrophila</td>
<td>Co-trimoxazole</td>
<td>160/800 BD for 5-7 days</td>
</tr>
<tr>
<td>P. shigeloides</td>
<td>Ciprofloxacin</td>
<td>500 mg BD for 7 days</td>
</tr>
<tr>
<td></td>
<td>Co-trimoxazole</td>
<td>160/800 BD for 7-14 days</td>
</tr>
</tbody>
</table>

References:--