## Facts and Fallacies About Digestive Diseases

National Digestive Diseases Information Clearinghouse



National Institute of Diabetes and Digestive and Kidney Diseases

NATIONAL INSTITUTES OF HEALTH Researchers have only recently begun to understand the many, often complex, diseases that affect the digestive system. Accordingly, people are gradually replacing folklore, old wives' tales, and rumors about the causes and treatments of digestive diseases with accurate, up-to-date information. But misunderstandings still exist, and, while some folklore is harmless, some can be dangerous if it keeps a person from correctly preventing or treating an illness. Listed below are some common misconceptions (fallacies), about digestive diseases, followed by the facts as professionals understand them today.

### Spicy food and stress cause stomach ulcers. False.

The truth is, almost all stomach ulcers are caused either by infection with a bacterium called *Helicobacter pylori* (*H. pylori*) or by use of pain medications such as aspirin, ibuprofen, or naproxen, the so-called nonsteroidal anti-inflammatory drugs (NSAIDs). Most *H. pylori*-related ulcers can be cured with antibiotics. NSAID-induced ulcers can be cured with time, stomach-protective medications, antacids, and avoidance of NSAIDs. Spicy food and stress may aggravate ulcer symptoms in some people, but they do not cause ulcers.



### Smoking a cigarette helps relieve heartburn. False.

Actually, cigarette smoking contributes to heartburn. Heartburn occurs when the lower esophageal sphincter (LES) a muscle between the esophagus and stomach—relaxes, allowing the acidic contents of the stomach to splash back into the esophagus. Cigarette smoking causes the LES to relax.

### Celiac disease is a rare childhood disease. False.

Celiac disease affects children and adults. At least 1 in 1,000 people and, in some populations, 1 in 200 people have celiac disease. Most often, celiac disease first causes symptoms during childhood, usually diarrhea, growth failure, and failure to thrive. But the disease can also first cause symptoms in adults. These symptoms may be vague and therefore attributed to other conditions. Symptoms can include bloating, diarrhea, abdominal pain, skin rash, anemia, and thinning of the bones (osteoporosis). Celiac disease may cause such nonspecific symptoms for several years before being correctly diagnosed and treated.

People with celiac disease should not eat any foods containing gluten, a protein in wheat, rye, barley, and possibly oats, regardless of whether or not they have symptoms. In these people, gluten destroys part of the lining of the small intestine, which interferes with the absorption of nutrients. The damage can occur from even a small amount of gluten, and not everyone has symptoms of damage.

### Bowel regularity means a bowel movement every day. False.

The frequency of bowel movements among normal, healthy people varies from three a day to three a week, and perfectly healthy people may fall outside both ends of this range.

### Habitual use of enemas to treat constipation is harmless. False.

The truth is, habitual use of enemas is not harmless. Over time, enemas can impair the natural muscle action of the intestines, leaving them unable to function normally. An ongoing need for enemas is not normal; you should see a doctor if you find yourself relying on them or any other medication to have a bowel movement.

### Irritable bowel syndrome is a disease. False.

Irritable bowel syndrome is not a disease. It is a functional disorder, which means that there is a problem in how the muscles in the intestines work. Irritable bowel syndrome is characterized by gas, abdominal pain, and diarrhea or constipation, or both. Although the syndrome can cause considerable pain and discomfort, it does not damage the digestive tract as diseases do. Also, irritable bowel syndrome does not lead to more serious digestive diseases later.

### Diverticulosis is an uncommon and serious problem. False.

Actually, the majority of Americans over age 60 have diverticulosis, but only a small percentage have symptoms or complications. Diverticulosis is a condition in which little sacs—or out-pouchings—called diverticula, develop in the wall of the colon. These tend to appear and increase in number with age. Most people do not have symptoms and would not know that they had diverticula unless x-ray or intestinal examination were done. Less than 10 percent of people with diverticulosis ever develop complications such as infection (diverticulitis), bleeding, or perforation of the colon.

### Inflammatory bowel disease is caused by psychological problems. False.

Inflammatory bowel disease is the general name for two diseases that cause inflammation in the intestines, Crohn's disease and ulcerative colitis. The cause of the disease is unknown, but researchers speculate that it may be a virus or bacteria interacting with the body's immune system. There is no evidence to support the theory that inflammatory bowel disease is caused by tension, anxiety, or other psychological factors or disorders.

### Cirrhosis is only caused by alcoholism. False.

Alcoholism is just one of many causes of cirrhosis. Cirrhosis is scarring and decreased function of the liver. In the United States, alcohol causes less than one-half of cirrhosis cases. The remaining cases are from other diseases that cause liver damage. For example, in children, cirrhosis may result from cystic fibrosis, alpha-1 antitrypsin deficiency, biliary atresia, glycogen storage disease, and other rare diseases. In adults, cirrhosis may be caused by hepatitis B or C, primary biliary cirrhosis, diseases of abnormal storage of metals like iron or copper in the body, severe reactions to prescription drugs, or injury to the ducts that drain bile from the liver.

### After ostomy surgery, men become impotent and women have impaired sexual function and are unable to become pregnant. False.

Ostomy surgery does not, in general, interfere with a person's sexual or reproductive capabilities. Ostomy surgery is a procedure in which the diseased part of the small or large intestine is removed and the remaining intestine is attached to an opening in the abdomen. Although some men who have had radical ostomy surgery for cancer lose the ability to achieve and sustain an erection, most men do not experience impotence, or, if they do, it is temporary. If impotence does occur, a variety of solutions are available. A urologist, a doctor who specializes in such problems, can help find the best solution. In women, ostomy surgery does not damage sexual or reproductive organs, so it does not directly cause sexual problems or sterility. Factors such as pain and the adjustment to a new body image may create some temporary sexual problems, but they can usually be resolved with time and, in some cases, counseling. Unless a woman has had a hysterectomy to remove her uterus, she can still bear children.

### **Additional Resources**

American Liver Foundation 1425 Pompton Avenue Cedar Grove, NJ 07009 Tel: (800) 465–4837 or (973) 256–2550

Celiac Disease Foundation 13251 Ventura Boulevard Suite 1 Studio City, CA 91604–1838 Tel: (818) 990–2354

Crohn's & Colitis Foundation of America, Inc. 386 Park Avenue South 17th Floor New York, NY 10016–8804 Tel: (800) 932–2423 or (212) 685–3440

Hepatitis Foundation International 30 Sunrise Terrace Cedar Grove, NJ 07009–1423 Tel: (800) 891–0707 or (973) 239–1035

International Foundation for Functional Gastrointestinal Disorders P.O. Box 17864 Milwaukee, WI 53217 Tel: (414) 964–1799

United Ostomy Association 19772 MacArthur Boulevard Suite 200 Irvine, CA 92612–2405 Tel: (800) 826–0826 or (949) 660–8624

### National Digestive Diseases Information Clearinghouse

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The National Digestive Diseases Information Clearinghouse (NDDIC) is a service of the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). NIDDK is part of the National Institutes of Health under the U.S. Department of Health and Human Services. Established in 1980, the clearinghouse provides information about digestive diseases to people with digestive disorders and to their families, health care professionals, and the public. NDDIC answers inquiries; develops, reviews, and distributes publications; and works closely with professional and patient organizations and Government agencies to coordinate resources about digestive diseases.

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# Crohn's Disease

National Digestive Diseases Information Clearinghouse



National Institute of Diabetes and Digestive and Kidney Diseases

NATIONAL INSTITUTES OF HEALTH Crohn's disease causes inflammation in the small intestine. Crohn's disease usually occurs in the lower part of the small intestine, called the ileum, but it can affect any part of the digestive tract, from the mouth to the anus. The inflammation extends deep into the lining of the affected organ. The inflammation can cause pain and can make the intestines empty frequently, resulting in diarrhea.

Crohn's disease is an inflammatory bowel disease (IBD), the general name for diseases that cause inflammation in the intestines. Crohn's disease can be difficult to diagnose because its symptoms are similar to other intestinal disorders such as irritable bowel syndrome and to another type of IBD called ulcerative colitis. Ulcerative colitis causes inflammation and ulcers in the top layer of the lining of the large intestine.

Crohn's disease affects men and women equally and seems to run in some families. About 20 percent of people with Crohn's disease have a blood relative with some form of IBD, most often a brother or sister and sometimes a parent or child.

Crohn's disease may also be called ileitis or enteritis.

### What Causes Crohn's Disease?

Theories about what causes Crohn's disease abound, but none has been proven. The most popular theory is that the body's



immune system reacts to a virus or a bacterium by causing ongoing inflammation in the intestine.

People with Crohn's disease tend to have abnormalities of the immune system, but doctors do not know whether these abnormalities are a cause or result of the disease. Crohn's disease is not caused by emotional distress.

### What Are the Symptoms?

The most common symptoms of Crohn's disease are abdominal pain, often in the lower right area, and diarrhea. Rectal bleeding, weight loss, and fever may also occur. Bleeding may be serious and persistent, leading to anemia. Children with Crohn's disease may suffer delayed development and stunted growth.

### How Is Crohn's Disease Diagnosed?

A thorough physical exam and a series of tests may be required to diagnose Crohn's disease.

Blood tests may be done to check for anemia, which could indicate bleeding in the intestines. Blood tests may also uncover a high white blood cell count, which is a sign of inflammation somewhere in the body. By testing a stool sample, the doctor can tell if there is bleeding or infection in the intestines.

The doctor may do an upper gastrointestinal (GI) series to look at the small intestine. For this test, the patient drinks barium, a chalky solution that coats the lining of the small intestine, before x-rays are taken. The barium shows up white on x-ray film, revealing inflammation or other abnormalities in the intestine.

The doctor may also do a colonoscopy. For this test, the doctor inserts an endoscope—a long, flexible, lighted tube linked to a computer and TV monitor—into the anus to see the inside of the large intestine. The doctor will be able to see any inflammation or bleeding. During the exam, the doctor may do a biopsy, which involves taking a sample of tissue from the lining of the intestine to view with a microscope.

If these tests show Crohn's disease, more x-rays of both the upper and lower digestive tract may be necessary to see how much is affected by the disease.

### What Are the Complications of Crohn's Disease?

The most common complication is blockage of the intestine. Blockage occurs because the disease tends to thicken the intestinal wall with swelling and scar tissue, narrowing the passage. Crohn's disease may also cause sores, or ulcers, that tunnel through the affected area into surrounding tissues such as the bladder, vagina, or skin. The areas around the anus and rectum are often involved. The tunnels, called fistulas, are a common complication and often become infected. Sometimes fistulas can be treated with medicine, but in some cases they may require surgery.

Nutritional complications are common in Crohn's disease. Deficiencies of proteins, calories, and vitamins are well documented in Crohn's disease. These deficiencies may be caused by inadequate dietary intake, intestinal loss of protein, or poor absorption (malabsorption).

Other complications associated with Crohn's disease include arthritis, skin problems, inflammation in the eyes or mouth, kidney stones, gallstones, or other diseases of the liver and biliary system. Some of these problems resolve during treatment for disease in the digestive system, but some must be treated separately.

### What Is the Treatment for Crohn's Disease?

Treatment for Crohn's disease depends on the location and severity of disease, complications, and response to previous treatment. The goals of treatment are to control inflammation, correct nutritional deficiencies, and relieve symptoms like abdominal pain, diarrhea, and rectal bleeding. Treatment may include drugs, nutritional supplements, surgery, or a combination of these options. At this time, treatment can help control the disease, but there is no cure.

Some people have long periods of remission, sometimes years, when they are free of symptoms. However, the disease usually recurs at various times over a person's lifetime. This changing pattern of the disease means one cannot always tell when a treatment has helped. Predicting when a remission may occur or when symptoms will return is not possible.

Someone with Crohn's disease may need medical care for a long time, with regular doctor visits to monitor the condition.

### **Drug Therapy**

Most people are first treated with drugs which are aminosalicylate derivatives, a substance that helps control inflammation. Sulfasalazine is the most commonly used of these drugs. Patients who do not benefit from it or who cannot tolerate it may be put on other aminosalicylate-containing drugs, generally known as 5-ASA agents, such as Asacol, Dipentum, or Pentasa. Possible side effects of mesalamine preparations include nausea, vomiting, heartburn, diarrhea, and headache.

Some patients take corticosteroids to control inflammation. These drugs are the most effective for active Crohn's disease, but they can cause serious side effects, including greater susceptibility to infection.

Drugs that suppress the immune system are also used to treat Crohn's disease. Most commonly prescribed are 6-mercaptopurine and a related drug, azathioprine. Immunosuppressive agents work by blocking the immune reaction that contributes to inflammation. These drugs may cause side effects like nausea, vomiting, and diarrhea and may lower a person's resistance to infection. When patients are treated with a combination of corticosteroids and immunosuppressive drugs, the dose of corticosteriods can eventually be lowered. Some studies suggest that immunosuppressive drugs may enhance the effectiveness of corticosteroids.

The U.S. Food and Drug Administration has approved the drug infliximab (brand

name, Remicade) for the treatment of moderate to severe Crohn's disease that does not respond to standard therapies (aminosalicylate substances, corticosteroids, immunosuppressive agents) and for the treatment of open, draining fistulas. Infliximab, the first treatment approved specifically for Crohn's disease, is an antitumor necrosis factor (TNF) substance. TNF is a protein produced by the immune system that may cause the inflammation associated with Crohn's disease. Anti-TNF removes TNF from the bloodstream before it reaches the intestines, thereby preventing inflammation. Investigators will continue to study patients taking infliximab to determine its long-term safety and efficacy.

Antibiotics are used to treat bacterial overgrowth in the small intestine caused by stricture, fistulas, or prior surgery. For this common problem, the doctor may prescribe one or more of the following antibiotics: ampicillin, sulfonamide, cephalosporin, tetracycline, or metronidazole.

Diarrhea and crampy abdominal pain are often relieved when the inflammation subsides, but additional medication may also be necessary. Several antidiarrheal agents could be used, including diphenoxylate, loperamide, and codeine. Patients who are dehydrated because of diarrhea will be treated with fluids and electrolytes.

### **Nutrition Supplementation**

The doctor may recommend nutritional supplements, especially for children whose growth has been slowed. Special highcalorie liquid formulas are sometimes used for this purpose. A small number of patients may need periods of feeding by vein. This can help patients who need extra nutrition temporarily, those whose intestines need to rest, or those whose intestines cannot absorb enough nutrition from food.

#### Surgery

Surgery to remove part of the intestine can help Crohn's disease but cannot cure it. The inflammation tends to return next to the area of intestine that has been removed. Many patients with Crohn's disease require surgery, either to relieve symptoms that do not respond to medical therapy or to correct complications such as blockage, perforation, abscess, or bleeding in the intestine.

Some people who have Crohn's disease in the large intestine need to have their entire colon removed in an operation called colectomy. A small opening is then made in the front of the abdominal wall, and the tip of the ileum is brought to the skin's surface. This opening, called a stoma, is where waste exits the body. The stoma is about the size of a quarter and is usually located in the right lower part of the abdomen near the beltline. A pouch is worn over the opening to collect waste, and the patient empties the pouch as needed. The majority of colectomy patients go on to live normal, active lives.

Sometimes only the diseased section of intestine is removed and no stoma is needed. In this operation, the intestine is cut above and below the diseased area and reconnected.

Because Crohn's disease often recurs after surgery, people considering it should carefully weigh its benefits and risks compared with other treatments. Surgery may not be appropriate for everyone. People faced with this decision should get as much information as possible from doctors, nurses who work with colon surgery patients (enterostomal therapists), and other patients. Patient advocacy organizations can suggest support groups and other information resources. (See page 5 for the names of such organizations.)

People with Crohn's disease may feel well and be free of symptoms for substantial spans of time when their disease is not active. Despite the need to take medication for long periods of time and occasional hospitalizations, most people with Crohn's disease are able to hold jobs, raise families, and function successfully at home and in society.

### Research

Researchers continue to look for more effective treatments. Examples of investigational treatments include

- Anti-TNF. Research has shown that cells affected by Crohn's disease contain a cytokine, a protein produced by the immune system, called TNF. TNF may be responsible for the inflammation of Crohn's disease. Anti-TNF is a substance that finds TNF in the bloodstream, binds to it, and removes it before it can reach the intestines and cause inflammation. In studies, anti-TNF seems particularly helpful in closing fistulas.
- Interleukin 10. Interleukin 10 (IL–10) is a cytokine that suppresses inflammation. Researchers are now studying the effectiveness of synthetic IL–10 in treating Crohn's disease.
- Antibiotics. Antibiotics are now used to treat the bacterial infections that often accompany Crohn's disease, but some research suggests that they might also be useful as a primary treatment for active Crohn's disease.
- **Budesonide.** Researchers recently identified a new corticosteroid called budesonide that appears to be as effective as other corticosteroids but causes fewer side effects.
- Methotrexate and cyclosporine. These are immunosuppressive drugs that may be useful in treating Crohn's disease. One potential benefit of methotrexate and cyclosporine is that they appear to work faster than traditional immunosuppressive drugs.

• Zinc. Free radicals—molecules produced during fat metabolism, stress, and infection, among other things—may contribute to inflammation in Crohn's disease. Free radicals sometimes cause cell damage when they interact with other molecules in the body. The mineral zinc removes free radicals from the bloodstream. Studies are under way to determine whether zinc supplementation might reduce inflammation.

### Can Diet Control Crohn's Disease?

No special diet has been proven effective for preventing or treating this disease. Some people find their symptoms are made worse by milk, alcohol, hot spices, or fiber. People are encouraged to follow a nutritious diet and avoid any foods that seem to worsen symptoms. But there are no consistent rules.

People should take vitamin supplements only on their doctor's advice.

### Is Pregnancy Safe for Women with Crohn's Disease?

Research has shown that the course of pregnancy and delivery is usually not impaired in women with Crohn's disease. Even so, women with Crohn's disease should discuss the matter with their doctors before pregnancy. Most children born to women with Crohn's disease are unaffected. Children who do get the disease are sometimes more severely affected than adults, with slowed growth and delayed sexual development in some cases.

#### Resources

Crohn's & Colitis Foundation of America, Inc. 386 Park Avenue South, 17th Floor New York, NY 10016–8804 Tel: (800) 932–2423 or (212) 685–3440 E-mail: info@ccfa.org Home page: http://www.ccfa.org

Pediatric Crohn's & Colitis Association, Inc.
P.O. Box 188
Newton, MA 02468
Tel: (617) 489–5854
Home page: http://pcca.hypermart.net

Pull-thru Network 4 Woody Lane Westport, CT 06880 Tel: (203) 221–7530 E-mail: pullthrunw@aol.com Home page: http://members.aol.com/ pullthrunw/Pullthru.html

Reach Out for Youth with Ileitis and Colitis, Inc. 15 Chemung Place Jericho, NY 11753 Tel: (516) 822–8010

United Ostomy Association, Inc. 36 Executive Park, Suite 120 Irvine, CA 92714 Tel: (800) 826–0826 or (714) 660–8624 E-mail: uoa@deltanet.com Home page: http://www.uoa.org

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# Irritable Bowel Syndrome

National Digestive Diseases Information Clearinghouse

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National Institute of Diabetes and Digestive and Kidney Diseases

NATIONAL INSTITUTES OF HEALTH Irritable bowel syndrome (IBS) is a disorder that interferes with the normal functions of the large intestine (colon). It is characterized by a group of symptoms—crampy abdominal pain, bloating, constipation, and diarrhea.

One in five Americans has IBS, making it one of the most common disorders diagnosed by doctors. It occurs more often in women than in men, and it usually begins around age 20.

IBS causes a great deal of discomfort and distress, but it does not permanently harm the intestines and does not lead to intestinal bleeding or to any serious disease such as cancer. Most people can control their symptoms with diet, stress management, and medications prescribed by their physician. But for some people, IBS can be disabling. They may be unable to work, go to social events, or travel even short distances.

### What causes IBS?

What causes one person to have IBS and not another? No one knows. Symptoms cannot be traced to a single organic cause. Research suggests that people with IBS seem to have a colon that is more sensitive and reactive than usual to a variety of things, including certain foods and stress. Some evidence indicates that the immune system, which fights infection, is also involved. IBS symptoms result from the following:



- The normal motility of the colon may not work properly. It can be spasmodic or can even stop temporarily. Spasms are sudden strong muscle contractions that come and go.
- The lining of the colon (epithelium), which is affected by the immune and nervous systems, regulates the passage of fluids in and out of the colon. In IBS, the epithelium appears to work properly. However, fast movement of the colon's contents can overcome the absorptive capacity of the colon. The result is too much fluid in the stool. In other patients, colonic movement is too slow, too much fluid is absorbed, and constipation develops.
- The colon responds strongly to stimuli (for example, foods or stress) that would not bother most people.



U.S. Department of Health and Human Services In people with IBS, stress and emotions can strongly affect the colon. It has many nerves that connect it to the brain. Like the heart and the lungs, the colon is partly con-

### What does the colon do?

The colon, which is about 5 feet long, connects the small intestine with the rectum and anus. The major function of the colon is to absorb water, nutrients, and salts from the partially digested food that enters from the small intestine. Two pints of liquid matter enter the colon from the small intestine each day. Stool volume is a third of a pint. The difference in volume represents what the colon absorbs each day.

Colon motility (the contraction of the colon muscles and the movement of its contents) is controlled by nerves and hormones and by electrical activity in the colon muscle. Contractions move the contents slowly back and forth but mainly toward the rectum. During this passage, water and nutrients are absorbed into the body. What remains is stool. A few times each day, strong muscle contractions move down the colon, pushing the stool ahead of them. Some of these strong contractions result in a bowel movement. The muscles of the pelvis and anal sphincters have to relax at the right time to allow the stool to be expelled. If the muscles of the colon, sphincters, and pelvis do not contract in a coordinated way, the contents do not move smoothly, resulting in abdominal pain, cramps, constipation or diarrhea, and a sense of incomplete stool movement.

trolled by the autonomic nervous system, which has been proven to respond to stress. For example, when you are frightened, your heart beats faster, your blood pressure may go up, or you may gasp. The colon responds to stress also. It may contract too much or too little. It may absorb too much water or too little.

Research has shown that very mild or hidden (occult) celiac disease is present in a smaller group of people with symptoms that mimic IBS. People with celiac disease cannot digest gluten, which is present in wheat, rye, barley, and possibly oats. Foods containing gluten are toxic to these people, and their immune system responds by damaging the small intestine. A blood test can determine whether celiac disease is present. (For information about celiac disease, see the *Celiac Disease* fact sheet from the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK).)

The following have been associated with a worsening of IBS symptoms:

- large meals
- bloating from gas in the colon
- medicines
- wheat, rye, barley, chocolate, milk products, or alcohol
- drinks with caffeine, such as coffee, tea, or colas
- stress, conflict, or emotional upsets

Researchers have also found that women with IBS may have more symptoms during their menstrual periods, suggesting that reproductive hormones can exacerbate IBS problems.

### What are the symptoms of IBS?

Abdominal pain or discomfort in association with bowel dysfunction is the main symptom. Symptoms may vary from person to person. Some people have constipation (hard, difficult-to-pass, or infrequent bowel movements); others have diarrhea (frequent loose stools, often with an urgent need to move the bowels); and still others experience alternating constipation and diarrhea. Some people experience bloating, which is gas building up in the intestines and causing the feeling of pressure inside the abdomen.

IBS affects the motility or movement of stool and gas through the colon and how fluids are absorbed. When stool remains in the colon for a long time, too much water is absorbed from it. Then it becomes hard and difficult to pass. Or spasms push the stool through the colon too fast for the fluid to be absorbed, resulting in diarrhea. In addition, with spasms, gas may get trapped in one area or stool may collect in one place, temporarily unable to move forward.

Sometimes people with IBS have a crampy urge to move their bowels but cannot do so or pass mucus with their bowel movements.

Bleeding, fever, weight loss, and persistent severe pain are not symptoms of IBS and may indicate other problems such as inflammation or rarely cancer.

### How is IBS diagnosed?

If you think you have IBS, seeing your doctor is the first step. IBS is generally diagnosed on the basis of a complete medical history that includes a careful description of symptoms and a physical examination.

No particular test is specific for IBS. However, diagnostic tests may be performed to

### **Criteria for IBS Diagnosis**

- Abdominal pain or discomfort for at least 12 weeks out of the previous 12 months. These 12 weeks do not have to be consecutive.
- The abdominal pain or discomfort has two of the following three features:
  - It is relieved by having a bowel movement.
  - When it starts, there is a change in how often you have a bowel movement.
  - When it starts, there is a change in the form of the stool or the way it looks.

rule out other diseases. These tests may include stool or blood tests, x rays, or endoscopy (viewing the colon through a flexible tube inserted through the anus). If these tests are all negative, the doctor may diagnose IBS based on your symptoms: that is, how often you have had abdominal pain or discomfort during the past year, when the pain starts and stops in relation to bowel function, and how your bowel frequency and stool consistency are altered.

### What is the treatment for IBS?

No cure has been found for IBS, but many options are available to treat the symptoms. Your doctor will give you the best treatments available for your particular symptoms and encourage you to manage stress and make changes to your diet.

Medications are an important part of relieving symptoms. Your doctor may

suggest fiber supplements or occasional laxatives for constipation, as well as medicines to decrease diarrhea, tranquilizers to calm you, or drugs that control colon muscle spasms to reduce abdominal pain. Antidepressants may also relieve some symptoms. Medications available to treat IBS specifically are the following:

- Alosetron hydrochloride (Lotronex) has been re-approved by the U.S. Food and Drug Administration (FDA) for women with severe IBS who have not responded to conventional therapy and whose primary symptom is diarrhea. However, even in these patients, it should be used with caution because it can have serious side effects, such as severe constipation or decreased blood flow to the colon.
- Tegaserod maleate (Zelnorm) has been approved by the FDA for the short-term treatment (usually 4 weeks) of women with IBS whose primary symptom is constipation.

With any medication, even over-thecounter medications such as laxatives and fiber supplements, it is important to follow your doctor's instructions. Laxatives can be habit forming if they are not used carefully or are used too frequently.

It is also important to note that medications affect people differently and that no one medication or combination of medications will work for everyone with IBS. You need to work with your doctor to find the best combination of medicine, diet, counseling, and support to control your symptoms.

### How does stress affect IBS?

Stress—feeling mentally or emotionally tense, troubled, angry, or overwhelmed stimulates colon spasms in people with IBS. The colon has a vast supply of nerves that connect it to the brain. These nerves control the normal rhythmic contractions of the colon and cause abdominal discomfort at stressful times. People often experience cramps or "butterflies" when they are nervous or upset. But with IBS, the colon can be overly responsive to even slight conflict or stress. Stress also makes the mind more tuned to the sensations that arise in the colon and makes the stressed person perceive these sensations as unpleasant.

Some evidence suggests that IBS is affected by the immune system, which fights infection in the body. The immune system is also affected by stress. For all these reasons, stress management is an important part of treatment for IBS. Stress management comprises

- stress reduction (relaxation) training and relaxation therapies, such as meditation
- counseling and support
- regular exercise such as walking or yoga
- changes to the stressful situations in your life
- adequate sleep

### Can changes in diet help IBS?

For many people, careful eating reduces IBS symptoms. Before changing your diet, keep a journal noting the foods that seem to cause distress. Then discuss your findings with your doctor. You may also want to consult a registered dietitian, who can help you make changes to your diet. For instance, if dairy products cause your symptoms to flare up, you can try eating less of those foods. You might be able to tolerate yogurt better than other dairy products because it contains bacteria that supply the enzyme needed to digest lactose, the sugar found in milk products. Dairy products are an important source of calcium and other nutrients. If you need to avoid dairy products, be sure to get adequate nutrients in the foods you substitute or take supplements.

In many cases, dietary fiber may lessen IBS symptoms, particularly constipation. However, it may not help pain or diarrhea. Whole grain breads and cereals, fruits, and vegetables are good sources of fiber. Highfiber diets keep the colon mildly distended, which may help prevent spasms. Some forms of fiber also keep water in the stool, thereby preventing hard stools that are difficult to pass. Doctors usually recommend a diet with enough fiber to produce soft, painless bowel movements. High-fiber diets may cause gas and bloating, but these symptoms often go away within a few weeks as your body adjusts. (For information about diets for people with celiac disease, please see the Celiac Disease fact sheet from NIDDK.)

Drinking six to eight glasses of plain water a day is important, especially if you have diarrhea. But drinking carbonated beverages, such as sodas, may result in gas and cause discomfort. Chewing gum and eating too quickly can lead to swallowing air, which again leads to gas.

Also, large meals can cause cramping and diarrhea, so eating smaller meals more often or eating smaller portions should help IBS symptoms. It may also help if your meals are low in fat and high in carbohydrates, such as pasta, rice, whole-grain breads and cereals (unless you have celiac disease), fruits, and vegetables.

### Is IBS linked to other diseases?

IBS itself is not a disease. As its name indicates, it is a syndrome—a combination of signs and symptoms. But IBS has not been shown to lead to any serious, organic diseases, including cancer. Through the years, IBS has been called by many names, among them colitis, mucous colitis, spastic colon, or spastic bowel. However, no link has been established between IBS and inflammatory bowel diseases such as Crohn's disease or ulcerative colitis.

### **Hope Through Research**

The NIDDK conducts and supports research into many kinds of digestive disorders, including IBS. Researchers are studying gastrointestinal motility and sensitivity to find possible treatments for IBS. These studies include the structure and contraction of gastrointestinal muscles as well as the mechanics of fluid movement through the intestines. Understanding the influence of the nerves, hormones, and inflammation in IBS may lead to new treatments to better control the symptoms.

### **For More Information**

International Foundation for Functional Gastrointestinal Disorders P.O. Box 170864 Milwaukee, WI 53217 Phone: 1–888–964–2001 or 414–964–1799 Fax: 414–964–7176 Email: iffgd@iffgd.org Internet: www.iffgd.org

### **Points to Remember**

- IBS is a disorder that interferes with the normal functions of the colon. The symptoms are crampy abdominal pain, bloating, constipation, and diarrhea.
- IBS is a common disorder found more often in women than in men and usually begins around age 20.
- People with IBS have colons that are more sensitive and react to things that might not bother other people, such as stress, large meals, gas, medicines, certain foods, caffeine, or alcohol.
- IBS is diagnosed by its symptoms and by the absence of other diseases.
- Most people can control their symptoms by taking medicines (laxatives, antidiarrhea medicines, tranquilizers, or antidepressants), reducing stress, and changing their diet.
- IBS does not harm the intestines and does not lead to cancer. It is not related to Crohn's disease or ulcerative colitis.

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### National Digestive Diseases Information Clearinghouse

2 Information Way Bethesda, MD 20892–3570 Phone: 1–800–891–5389 Fax: 703–738–4929 Email: nddic@info.niddk.nih.gov Internet: www.digestive.niddk.nih.gov

The National Digestive Diseases Information Clearinghouse (NDDIC) is a service of the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). The NIDDK is part of the National Institutes of Health under the U.S. Department of Health and Human Services. Established in 1980, the clearinghouse provides information about digestive diseases to people with digestive disorders and to their families, health care professionals, and the public. NDDIC answers inquiries, develops and distributes publications, and works closely with professional and patient organizations and Government agencies to coordinate resources about digestive diseases.

Publications produced by the clearinghouse are carefully reviewed by both NIDDK scientists and outside experts. This fact sheet was reviewed by Michael Camilleri, M.D., Mayo Clinic Rochester.

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES National Institutes of Health

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# Ulcerative Colitis

National Digestive Diseases Information Clearinghouse



National Institute of Diabetes and Digestive and Kidney Diseases

NATIONAL INSTITUTES OF HEALTH Ulcerative colitis is a disease that causes inflammation and sores, called ulcers, in the top layers of the lining of the large intestine. The inflammation usually occurs in the rectum and lower part of the colon, but it may affect the entire colon. Ulcerative colitis rarely affects the small intestine except for the lower section, called the ileum. Ulcerative colitis may also be called colitis, ileitis, or proctitis.

The inflammation makes the colon empty frequently, causing diarrhea. Ulcers form in places where the inflammation has killed colon lining cells; the ulcers bleed and produce pus and mucus.

Ulcerative colitis is an inflammatory bowel disease (IBD), the general name for diseases that cause inflammation in the intestines. Ulcerative colitis can be difficult to diagnose because its symptoms are similar to other intestinal disorders such as irritable bowel syndrome and to another type of IBD called Crohn's disease. Crohn's disease differs from ulcerative colitis because it causes inflammation deeper within the intestinal wall. Crohn's disease usually occurs in the small intestine, but it can also occur in the mouth, esophagus, stomach, duodenum, large intestine, appendix, and anus.

Ulcerative colitis occurs most often in people ages 15 to 40, although children and older people sometimes develop the disease. Ulcerative colitis affects men and women equally and appears to run in some families.



### What Causes Ulcerative Colitis?

Theories about what causes ulcerative colitis abound, but none have been proven. The most popular theory is that the body's immune system reacts to a virus or a bacterium by causing ongoing inflammation in the intestinal wall.

People with ulcerative colitis have abnormalities of the immune system, but doctors do not know whether these abnormalities are a cause or a result of the disease. Ulcerative colitis is not caused by emotional distress or sensitivity to certain foods or food products, but these factors may trigger symptoms in some people.

### What Are the Symptoms of Ulcerative Colitis?

The most common symptoms of ulcerative colitis are abdominal pain and bloody diarrhea. Patients also may experience

- Fatigue.
- Weight loss.
- Loss of appetite.
- Rectal bleeding.
- Loss of body fluids and nutrients.

About half of patients have mild symptoms. Others suffer frequent fever, bloody diarrhea, nausea, and severe abdominal cramps. Ulcerative colitis may also cause problems such as arthritis, inflammation of the eye, liver disease (fatty liver, hepatitis, cirrhosis, and primary sclerosing cholangitis), osteoporosis, skin rashes, anemia, and kidney stones. No one knows for sure why problems occur outside the colon. Scientists think these complications may occur when the immune system triggers inflammation in other parts of the body. These problems are usually mild and go away when the colitis is treated.

### How Is Ulcerative Colitis Diagnosed?

A thorough physical exam and a series of tests may be required to diagnose ulcerative colitis.

Blood tests may be done to check for anemia, which could indicate bleeding in the colon or rectum. Blood tests may also uncover a high white blood cell count, which is a sign of inflammation somewhere in the body. By testing a stool sample, the doctor can tell if there is bleeding or infection in the colon or rectum. The doctor may do a colonoscopy. For this test, the doctor inserts an endoscope—a long, flexible, lighted tube connected to a computer and TV monitor—into the anus to see the inside of the colon and rectum. The doctor will be able to see any inflammation, bleeding, or ulcers on the colon wall. During the exam, the doctor may do a biopsy, which involves taking a sample of tissue from the lining of the colon to view with a microscope. A barium enema x-ray of the colon may also be required. This procedure involves filling the colon with barium, a chalky white solution. The barium shows up white on x-ray film, allowing the doctor a clear view of the colon, including any ulcers or other abnormalities that might be there.

### What Is the Treatment for Ulcerative Colitis?

Treatment for ulcerative colitis depends on the seriousness of the disease. Most people are treated with medication. In severe cases, a patient may need surgery to remove the diseased colon. Surgery is the only cure for ulcerative colitis.

Some people whose symptoms are triggered by certain foods are able to control the symptoms by avoiding foods that upset their intestines, like highly seasoned foods or milk sugar (lactose). Each person may experience ulcerative colitis differently, so treatment is adjusted for each individual. Emotional and psychological support is important.

Some people have remissions—periods when the symptoms go away—that last for months or even years. However, most patients' symptoms eventually return. This changing pattern of the disease means one cannot always tell when a treatment has helped. Someone with ulcerative colitis may need medical care for some time, with regular doctor visits to monitor the condition.

### **Drug Therapy**

Most patients with mild or moderate disease are first treated with 5-ASA agents, a combination of the drugs sulfonamide, sulfapyridine, and salicylate that helps control inflammation. Sulfasalazine is the most commonly used of these drugs. Sulfasalazine can be used for as long as needed and can be given along with other drugs. Patients who do not do well on sulfasalazine may respond to newer 5-ASA agents. Possible side effects of 5-ASA preparations include nausea, vomiting, heartburn, diarrhea, and headache.

People with severe disease and those who do not respond to mesalamine preparations may be treated with corticosteroids. Prednisone and hydrocortisone are two corticosteroids used to reduce inflammation. They can be given orally, intravenously, through an enema, or in a suppository, depending on the location of the inflammation. Corticosteroids can cause side effects such as weight gain, acne, facial hair, hypertension, mood swings, and increased risk of infection, so doctors carefully watch patients taking these drugs.

Other drugs may be given to relax the patient or to relieve pain, diarrhea, or infection.

Occasionally, symptoms are severe enough that the person must be hospitalized. For example, a person may have severe bleeding or severe diarrhea that causes dehydration. In such cases the doctor will try to stop diarrhea and loss of blood, fluids, and mineral salts. The patient may need a special diet, feeding through a vein, medications, or sometimes surgery.

### Surgery

About 25 percent to 40 percent of ulcerative colitis patients must eventually have their colons removed because of massive bleeding, severe illness, rupture of the colon, or risk of cancer. Sometimes the doctor will recommend removing the colon if medical treatment fails or if the side effects of corticosteroids or other drugs threaten the patient's health.

One of several surgeries may be done. The most common surgery is a proctocolectomy with ileostomy, which is done in two stages. In the proctocolectomy, the surgeon removes the colon and rectum. In the ileostomy, the surgeon creates a small opening in the abdomen, called a stoma, and attaches the end of the small intestine, called the ileum, to it. This type of ileostomy is called a Brooke ileostomy. Waste will travel through the small intestine and exit the body through the stoma. The stoma is about the size of a quarter and is usually located in the lower right part of the abdomen near the beltline. A pouch is worn over the opening to collect waste, and the patient empties the pouch as needed.

An alternative to the Brooke ileostomy is the continent ileostomy. In this operation, the surgeon uses the ileum to create a pouch inside the lower abdomen. Waste empties into this pouch, and the patient drains the pouch by inserting a tube into it through a small, leakproof opening in his or her side. The patient must wear an external pouch for only the first few months after the operation. Possible complications of the continent ileostomy include malfunction of the leakproof opening, which requires surgical repair, and inflammation of the pouch (pouchitis), which is treated with antibiotics.

An ileoanal anastomosis, or pull-through operation, allows the patient to have normal bowel movements because it preserves part of the rectum. This procedure is becoming increasingly common for ulcerative colitis. In this operation, the surgeon removes the diseased part of the colon and the inside of the rectum, leaving the outer muscles of the rectum. The surgeon then attaches the ileum to the inside of the rectum and the anus, creating a pouch. Waste is stored in the pouch and passed through the anus in the usual manner. Bowel movements may be more frequent and watery than usual. Pouchitis is a possible complication of this procedure.

Not every operation is appropriate for every person. Which surgery to have depends on the severity of the disease and the patient's needs, expectations, and lifestyle. People faced with this decision should get as much information as possible by talking to their doctors, to nurses who work with colon surgery patients (enterostomal therapists), and to other colon surgery patients. Patient advocacy organizations can direct people to support groups and other information resources. (See page 5 for the names of such organizations.)

Most people with ulcerative colitis will never need to have surgery. If surgery ever does become necessary, however, some people find comfort in knowing that after the surgery, the colitis is cured and most people go on to live normal, active lives.

#### Research

Researchers are always looking for new treatments for ulcerative colitis. Several drugs are being tested to see whether they might be useful in treating the disease:

- **Budesonide.** A corticosteroid called budesonide may be nearly as effective as prednisone in treating mild ulcerative colitis, and it has fewer side effects.
- Cyclosporine. Cyclosporine, a drug that suppresses the immune system, may be a promising treatment for people who do not respond to 5-ASA preparations or corticosteroids.
- Nicotine. In an early study, symptoms improved in some patients who were given nicotine through a patch or an enema. (Using nicotine as treatment is still experimental—the findings do not mean that people should go out and buy nicotine patches or start smoking.)
- Heparin. Researchers overseas are examining whether the anticoagulant heparin can help control colitis by preventing blood clots.

### Is Colon Cancer a Concern?

About 5 percent of people with ulcerative colitis develop colon cancer. The risk of cancer increases with the duration and the extent of involvement of the colon. For example, if only the lower colon and rectum are involved, the risk of cancer is not higher than normal. However, if the entire colon is involved, the risk of cancer may be as great as 32 times the normal rate.

Sometimes precancerous changes occur in the cells lining the colon. These changes are called "dysplasia." People who have dysplasia are more likely to develop cancer than those who do not. (Doctors look for signs of dysplasia when doing a colonoscopy and when examining tissue removed during the test.)

According to 1997 guidelines on screening for colon cancer, people who have had IBD throughout their colon for at least 8 years and those who have had IBD in only the left colon for at least 15 years should have a colonoscopy every 1 to 2 years to check for dysplasia. Such screening has not been proven to reduce the risk of colon cancer, but it may help identify cancer early should it develop. (These guidelines were produced by an independent expert panel and endorsed by numerous organizations, including the American Cancer Society, American College of Gastroenterology, American Society of Colon and Rectal Surgeons, and the Crohn's & Colitis Foundation of America Inc., among others.)

#### Resources

Crohn's & Colitis Foundation of America Inc. 386 Park Avenue South, 17th floor New York, NY 10016–8804 Tel: (800) 932–2423 or (212) 685–3440 E-mail: info@ccfa.org Home page: <a href="http://www.ccfa.org">http://www.ccfa.org</a>

Pediatric Crohn's & Colitis Association Inc. P.O. Box 188 Newton, MA 02168 Tel: (617) 489–5854

Pull-thru Network 4 Woody Lane Westport, CT 06880 Tel: (203) 221–7530 E-mail: pullthrunw@aol.com Home page: <<u>http://members.aol.com/</u> *pullthrunw/Pullthru.html*>

Reach Out for Youth with Ileitis and Colitis Inc.15 Chemung PlaceJericho, NY 11753Tel: (516) 822–8010

United Ostomy Association 36 Executive Park, Suite 120 Irvine, CA 92714 Tel: (800) 826–0826 or (714) 660–8624 E-mail: uoa@deltanet.com Home page: <a href="http://www.uoa.org">http://www.uoa.org</a>

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The National Digestive Diseases Information Clearinghouse (NDDIC) is a service of the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). The NIDDK is part of the National Institutes of Health under the U.S. Department of Health and Human Services. Established in 1980, the clearinghouse provides information about digestive diseases to people with digestive disorders and to their families, health care professionals, and the public. NDDIC answers inquiries; develops, reviews, and distributes publications; and works closely with professional and patient organizations and Government agencies to coordinate resources about digestive diseases.

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES Public Health Service National Institutes of Health

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## Chronic Hepatitis C: Current Disease Management

National Digestive Diseases Information Clearinghouse

National Institute of Diabetes and Digestive and Kidney Diseases

NATIONAL INSTITUTES OF HEALTH The hepatitis C virus (HCV) is one of the most important causes of chronic liver disease in the United States. It accounts for about 15 percent of acute viral hepatitis, 60 to 70 percent of chronic hepatitis, and up to 50 percent of cirrhosis, end-stage liver disease, and liver cancer. Almost 4 million Americans, or 1.8 percent of the U.S. population, have antibody to HCV (anti-HCV), indicating ongoing or previous infection with the virus. Hepatitis C causes an estimated 10,000 to 12,000 deaths annually in the United States.

A distinct and major characteristic of hepatitis C is its tendency to cause chronic liver disease. At least 75 percent of patients with acute hepatitis C ultimately develop chronic infection, and most of these patients have accompanying chronic liver disease.

Chronic hepatitis C varies greatly in its course and outcome. At one end of the spectrum are patients who have no signs or symptoms of liver disease and completely normal levels of serum liver enzymes. Liver biopsy usually shows some degree of chronic hepatitis, but the degree of injury is usually mild, and the overall prognosis may be good. At the other end of the spectrum are patients with severe hepatitis C who have symptoms, HCV RNA in serum, and elevated serum liver enzymes, and who ultimately develop cirrhosis and end-stage liver disease. In the middle of the spectrum are many patients who have few or no symptoms, mild to moderate elevations in liver enzymes, and an uncertain prognosis.

Chronic hepatitis C can cause cirrhosis, liver failure, and liver cancer. Researchers estimate that at least 20 percent of patients with chronic hepatitis C develop cirrhosis, a process that takes at least 10 to 20 years. After 20 to 40 years, a smaller percentage of patients with chronic disease develop liver cancer. Liver failure from chronic hepatitis C is one of the most common reasons for liver transplants in the United States. Hepatitis C is the cause of about half of cases of primary liver cancer in the developed world. Men, alcoholics, patients with cirrhosis, people over age 40, and those infected for 20 to 40 years are more likely to develop HCV-related liver cancer.

### **Risk Factors and Transmission**

HCV is spread primarily by contact with blood and blood products. Blood transfusions and the use of shared, unsterilized, or poorly sterilized needles and syringes have been the main causes of the spread of HCV in the United States. With the introduction in 1991 of routine blood screening for HCV antibody and improvements in the test in the mid-1992, transfusion-related hepatitis C has virtually disappeared. At present, injection drug use is the most common risk factor for contracting the disease. However, many patients acquire hepatitis C without any known exposure to blood or to drug use.



U.S. Department of Health and Human Services The major high-risk groups for hepatitis C are

- Injection drug users, including those who used drugs briefly many years ago.
- People who had blood transfusions before June 1992, when sensitive tests for anti-HCV were introduced for blood screening.
- People who have frequent exposure to blood products. These include patients with hemophilia, solid-organ transplants, chronic renal failure, or cancer requiring chemotherapy.
- Infants born to HCV-infected mothers.
- Health care workers who suffer needlestick accidents.

Other groups that appear to be at slightly increased risk for hepatitis C are

- people with high-risk sexual behavior, multiple partners, and sexually transmitted diseases
- people who use cocaine, particularly with intranasal administration, using shared equipment

### **Maternal-Infant Transmission**

Maternal-infant transmission is not common. In most studies, only 5 percent of infants born to infected women become infected. The disease in newborns is usually mild and free of symptoms. The risk of maternal-infant spread rises with the amount of virus in the mother's blood and with complications of delivery such as early rupture of membranes and fetal monitoring. Breast-feeding has not been linked to spread of HCV.

### **Sexual Transmission**

Sexual transmission of hepatitis C between monogamous partners appears to be uncommon. Surveys of spouses and monogamous sexual partners of patients with hepatitis C show that less than 5 percent are infected with HCV, and many of these have other risk factors for this infection. Spread of hepatitis C to a spouse or partner in stable, monogamous relationships occurs in less than 1 percent of partners per year. For these reasons, changes in sexual practices are not recommended for monogamous patients. Testing sexual partners for anti-HCV can help with patient counseling. People with multiple sex partners should be advised to follow safe sex practices, which should protect against hepatitis C as well as hepatitis B and HIV.

### **Sporadic Transmission**

Sporadic transmission, when the source of infection is unknown, occurs in about 10 percent of acute hepatitis C cases and in 30 percent of chronic hepatitis C cases. These cases are usually referred to as sporadic or community-acquired infections. These infections may have come from exposure to the virus from cuts, wounds, or medical injections or procedures.

### **Unsafe Injection Practices**

In many areas of the world, unsafe injection practices are an important and common cause of hepatitis C (and hepatitis B as well). Use of inadequately sterilized equipment, lack of disposable needles and syringes, and inadvertent contamination of medical infusions are unfortunately well-documented causes of transmission of hepatitis C. Careful attention to universal precautions and injection techniques should prevent this type of spread. In the United States, multiple-use vials are a frequent culprit in leading to nosocomial spread of hepatitis C.



### The Hepatitis C Virus

HCV is a small (40 to 60 nanometers in diameter), enveloped, single-stranded RNA virus of the family Flaviviridae and genus hepacivirus. Because the virus mutates rapidly, changes in the envelope proteins may help it evade the immune system. There are at least 6 major genotypes and more than 50 subtypes of HCV. The different genotypes have different geographic distributions. Genotypes 1a and 1b are the most common in the United States (about 75 percent of cases). Genotypes 2 and 3 are present in only 10 to 20 percent of patients. There is little difference in the severity of disease or outcome of patients infected with different genotypes. However, patients with genotypes 2 and 3 are more likely to respond to interferon treatment.

### **Clinical Symptoms** and Signs

Many people with chronic hepatitis C have no symptoms of liver disease. If symptoms are present, they are usually mild, nonspecific, and intermittent. They may include

- fatigue
- mild right-upper-quadrant discomfort or tenderness ("liver pain")
- nausea
- poor appetite
- muscle and joint pains

Similarly, the physical exam is likely to be normal or show only mild enlargement of the liver or tenderness. Some patients have vascular spiders or palmar erythema.

### **Clinical Features of Cirrhosis**

Once a patient develops cirrhosis or if the patient has severe disease, symptoms and signs are more prominent. In addition to fatigue, the patient may complain of muscle weakness, poor appetite, nausea, weight loss, itching, dark urine, fluid retention, and abdominal swelling.

Physical findings of cirrhosis may include

- enlarged liver
- enlarged spleen
- jaundice
- muscle wasting
- excoriations
- ascites
- ankle swelling

### **Extrahepatic Manifestations**

Complications that do not involve the liver develop in 1 to 2 percent of people with hepatitis C. The most common is cryoglobulinemia, which is marked by

- skin rashes, such as purpura, vasculitis, or urticaria
- joint and muscle aches
- kidney disease
- neuropathy
- cryoglobulins, rheumatoid factor, and low complement levels in serum

Other complications of chronic hepatitis C are

- glomerulonephritis
- porphyria cutanea tarda

Diseases that are less well documented to be related to hepatitis C are

- seronegative arthritis
- keratoconjunctivitis sicca (Sjögren's syndrome)
- non-Hodgkin's type, B-cell lymphomas
- fibromyalgia
- lichen planus

### **Serologic Tests**

#### **Enzyme Immunoassay**

Anti-HCV is detected by enzyme immunoassay (EIA). The third-generation test (EIA-3) used today is more sensitive and specific than previous ones. However, as with all enzyme immunoassays, falsepositive results are occasionally a problem with the EIA-3. Additional or confirmatory testing is often helpful.

The best approach to confirm the diagnosis of hepatitis C is to test for HCV RNA using a sensitive assay such as polymerase chain reaction (PCR) or transcription mediated amplification (TMA). The presence of HCV RNA in serum indicates an active infection.

Testing for HCV RNA is also helpful in patients in whom EIA tests for anti-HCV are unreliable. For instance, immunocompromised patients may test negative for anti-HCV despite having HCV infection because they may not produce enough antibodies for detection with EIA. Likewise, patients with acute hepatitis may test negative for anti-HCV when first tested. Antibody is present in almost all patients by 1 month after onset of acute illness; thus, patients with acute hepatitis who initially test negative may need followup testing. In these situations, HCV RNA is usually present and confirms the diagnosis.

### **Recombinant Immunoblot Assay**

Immunoblot assays can be used to confirm anti-HCV reactivity as well. These tests are also called "Western blots"; serum is incubated on nitrocellulose strips on which four recombinant viral proteins are blotted. Color changes indicate that antibodies are adhering to the proteins. An immunoblot is considered positive if two or more proteins react and is considered indeterminate if only one positive band is detected. In some clinical situations, confirmatory testing by immunoblotting is helpful, such as for the person with anti-HCV detected by EIA who tests negative for HCV RNA. The EIA anti-HCV reactivity could represent a false-positive reaction, recovery from hepatitis C, or continued virus infection with levels of virus too low to be detected (the last occurs only rarely when sensitive PCR or TMA assays are used). If the immunoblot test for anti-HCV is positive, the patient has most likely recovered from hepatitis C and has persistent antibody. If the immunoblot test is negative, the EIA result was probably a false positive.

Immunoblot tests are routine in blood banks when an anti-HCV-positive sample is found by EIA. Immunoblot assays are highly specific and valuable in verifying anti-HCV reactivity. Indeterminate tests require further followup testing, including attempts to confirm the specificity by repeat testing for HCV RNA.

#### **Direct Assays for HCV RNA**

PCR and TMA amplification can detect low levels of HCV RNA in serum. Testing for HCV RNA is a reliable way of demonstrating that hepatitis C infection is present and is the most specific test for infection. Testing for HCV RNA is particularly useful when aminotransferases are normal or only slightly elevated, when anti-HCV is not present, or when several causes of liver disease are possible. This method also helps diagnose hepatitis C in people who are immunosuppressed, have recently had an organ transplant, or have chronic renal failure. A PCR assay has now been approved by the Food and Drug Administration for general use. This assay will detect HCV RNA in serum down to a lower limit of 50 to 100 copies per milliliter (mL) which is equivalent to 25 to 50 international units (IU). A slightly more sensitive TMA test is currently under evaluation and may soon become available. Almost all patients with chronic hepatitis C will test positive by these assays.

### Quantification of HCV RNA in Serum

Several methods are available for measuring the concentration or level of virus in serum, which is an indirect assessment of viral load. These methods include a quantitative PCR and a branched DNA (bDNA) test. Unfortunately, these assays are not well standardized, and different methods from different laboratories can provide different results on the same specimen. In addition, serum levels of HCV RNA can vary spontaneously by 3- to 10-fold over time. Nevertheless, when performed carefully, quantitative assays provide important insights into the nature of hepatitis C. Most patients with chronic hepatitis C have levels of HCV RNA (viral load) between

### **Biochemical Indicators of Hepatitis C Virus Infection**

- In chronic hepatitis C, increases in the alanine and aspartate aminotransferases range from 0 to 20 times (but usually less than 5 times) the upper limit of normal.
- Alanine aminotransferase (ALT) levels are usually higher than aspartate aminotransferase (AST) levels, but that finding may be reversed in patients who have cirrhosis.
- Alkaline phosphatase and gamma glutamyl transpeptidase are usually normal. If elevated, they may indicate cirrhosis.
- Rheumatoid factor and low platelet and white blood cell counts are frequent in patients with severe fibrosis or cirrhosis, providing clues to the presence of advanced disease.
- The enzymes lactate dehydrogenase and creatine kinase are usually normal.
- Albumin levels and prothrombin time are normal until late-stage disease.
- Iron and ferritin levels may be slightly elevated.

100,000 (10<sup>5</sup>) and 10,000,000 (10<sup>7</sup>) copies per mL. Expressed as IU, these averages are 50,000 to 5 million IU.

Viral levels as measured by HCV RNA do not correlate with the severity of the hepatitis or with a poor prognosis (as in HIV infection); but viral load does correlate with the likelihood of a response to antiviral therapy. Rates of response to a course of alpha interferon and ribavirin are higher in patients with low levels of HCV RNA. There are several definitions of a "low level" of HCV RNA, but the usual definition is below 1 million IU (2 million copies) per mL.

In addition, monitoring HCV RNA levels during the early phases of treatment may provide early information on the likelihood of a response. Yet because of the shortcomings of the current assays for HCV RNA level, these tests are not always reliable guides to therapy.

### Genotyping and Serotyping of HCV

There are 6 known genotypes and more than 50 subtypes of hepatitis C. The genotype of infection is helpful in defining the epidemiology of hepatitis C. More important, knowing the genotype or serotype (genotype-specific antibodies) of HCV is helpful in making recommendations and counseling regarding therapy. Patients with genotypes 2 and 3 are two to three times more likely to respond to interferon-based therapy than patients with genotype 1. Furthermore, when using combination therapy, the recommended dose and duration of treatment depend on the genotype. For patients with genotypes 2 and 3, a 24-week course of combination treatment using interferon and 800 milligrams (mg) of ribavirin daily is adequate, whereas for patients with genotype 1, a 48-week course and full dose of ribavirin (1,000 to 1,200 mg daily) is recommended. For these reasons, testing for HCV genotype is often clinically helpful. Once the genotype is identified, it need not be tested again; genotypes do not change during the course of infection.

#### Normal Serum ALT Levels

Some patients with chronic hepatitis C have normal serum alanine aminotransferase (ALT) levels, even when tested on multiple occasions. In this and other situations in which the diagnosis of chronic hepatitis C may be questioned, the diagnosis should be confirmed by testing for HCV RNA. The presence of HCV RNA indicates that the patient has ongoing viral infection despite normal ALT levels.

### **Liver Biopsy**

Liver biopsy is not necessary for diagnosis but is helpful for grading the severity of disease and staging the degree of fibrosis and permanent architectural damage. Hematoxylin and eosin stains and Masson's trichrome stain are used to grade the amount of necrosis and inflammation and to stage the degree of fibrosis. Specific immunohistochemical stains for HCV have not been developed for routine use. Liver biopsy is also helpful in ruling out other causes of liver disease, such as alcoholic liver injury or iron overload.

HCV causes the following changes in liver tissue:

- Necrosis and inflammation around the portal areas, so-called "piecemeal necrosis" or "interface hepatitis."
- Necrosis of hepatocytes and focal inflammation in the liver parenchyma.
- Inflammatory cells in the portal areas ("portal inflammation").
- Fibrosis, with early stages being confined to the portal tracts, intermediate stages being expansion of the portal tracts and bridging between portal areas or to the central area, and late stages being frank cirrhosis character-

ized by architectural disruption of the liver with fibrosis and regeneration. Several scales are used to stage fibrosis, most commonly a scale from 0 to 4 where 0 indicates none and 4 indicates cirrhosis. Stage 1 and 2 fibrosis is limited to the portal and periportal areas. Stage 3 fibrosis is characterized by bridges of fibrosis bands linking up portal and central areas.

Grading and staging of hepatitis by assigning scores for severity are helpful in managing patients with chronic hepatitis. The degree of inflammation and necrosis can be assessed as none, minimal, mild, moderate, or severe. The degree of fibrosis can be similarly assessed. Scoring systems are particularly helpful in clinical studies on chronic hepatitis.

### Serum Markers of Hepatic Fibrosis

Liver biopsy is an invasive procedure that is expensive and not without complications. At least 20 percent of patients have pain requiring medications after liver biopsy. More uncommon complications include puncture of another organ, infection, and bleeding. Significant bleeding after liver biopsy occurs in 1/100 to 1/1,000 cases, and deaths are reported in 1/5,000 to 1/10,000 cases. Obviously, noninvasive means of grading and staging liver disease would be very helpful.

ALT levels, particularly if tested over an extended period, are reasonably accurate reflections of disease activity. Thus, patients with repeatedly normal ALT levels usually have mild necroinflammatory activity on liver biopsy. Furthermore, patients who maintain ALT levels above 5 times the upper limit of normal usually have marked necroinflammatory activity. But for the majority of patients with mild-to-moderate ALT elevations, the actual level is not very predictive of liver biopsy findings.

More important is a means to stage liver disease short of liver biopsy. Unfortunately, serum tests are not reliable in predicting fibrosis, particularly earlier stages (0, 1, and 2). When patients develop bridging (stage 3) fibrosis and cirrhosis (stage 4), serum tests may be helpful. The "danger signals" that suggest the presence of advanced fibrosis include an aspartate aminotransferase (AST) that is higher than ALT (reversal of the ALT/AST ratio), a high gamma glutamyl transpeptidase or alkaline phosphatase, a low platelet count (which is perhaps the earliest change), rheumatoid factor, elevations in globulins, and, of course, abnormal bilirubin, albumin or prothrombin time. Physical findings of a firm liver, or enlarged spleen or prominent spider angionata or palmar erythema, are also danger signals. While none of these findings are perfect, their presence should raise the suspicion of significant fibrosis and lead to evaluation for treatment earlier rather than later.

### Diagnosis

Hepatitis C is most readily diagnosed when serum aminotransferases are elevated and anti-HCV is present in serum. The diagnosis is confirmed by the finding of HCV RNA in serum.

### Acute Hepatitis C

Acute hepatitis C is diagnosed on the basis of symptoms such as jaundice, fatigue, and nausea, along with marked increases in serum ALT (usually greater than 10-fold elevation), and presence of anti-HCV or de novo development of anti-HCV. Diagnosis of acute disease can be problematic because anti-HCV is not always present when the patient develops symptoms and sees the physician. In 30 to 40 percent of patients, anti-HCV is not detected until 2 to 8 weeks after onset of symptoms. In this situation, testing for HCV RNA is helpful, as this marker is present even before the onset of symptoms and lasts through the acute illness. Another approach to diagnosis of acute hepatitis C is to repeat the anti-HCV testing a month after onset of illness. Of course, a history of an acute exposure is also helpful in establishing the diagnosis.

### **Chronic Hepatitis C**

Chronic hepatitis C is diagnosed when anti-HCV is present and serum aminotransferase levels remain elevated for more than 6 months. Testing for HCV RNA (by PCR) confirms the diagnosis and documents that viremia is present; almost all patients with chronic infection will have the viral genome detectable in serum by PCR.

Diagnosis is problematic in patients who cannot produce anti-HCV because they are immunosuppressed or immunoincompetent. Thus, HCV RNA testing may be required for patients who have a solidorgan transplant, are on dialysis, are taking corticosteroids, or have agammaglobulinemia. Diagnosis is also difficult in patients with anti-HCV who have another form of liver disease that might be responsible for the liver injury, such as alcoholism, iron overload, or autoimmunity. In these situations, the anti-HCV may represent a falsepositive reaction, previous HCV infection, or mild hepatitis C occurring on top of another liver condition. HCV RNA testing in these situations helps confirm that hepatitis C is contributing to the liver problem.

### **Differential Diagnosis**

The major conditions that can be confused clinically with chronic hepatitis C include

- autoimmune hepatitis
- chronic hepatitis B and D
- · alcoholic hepatitis
- nonalcoholic steatohepatitis (fatty liver)
- sclerosing cholangitis
- Wilson's disease
- alpha-1-antitrypsin-deficiency-related liver disease
- drug-induced liver disease

### Treatment

The therapy for chronic hepatitis C has evolved steadily since alpha interferon was first approved for use in this disease more than 10 years ago. At the present time, the optimal regimen appears to be a 24or 48-week course of the combination of pegylated alpha interferon and ribavirin.

Alpha interferon is a host protein that is made in response to viral infections and has natural antiviral activity. Recombinant forms of alpha interferon have been produced, and several formulations (alfa-2a, alfa-2b, consensus interferon) are available as therapy for hepatitis C. These standard forms of interferon, however, are now being replaced by pegylated interferons (peginterferons). Peginterferon is alpha interferon that has been modified chemically by the addition of a large inert molecule of polyethylene glycol. Pegylation changes the uptake, distribution, and excretion of interferon, prolonging its half-life. Peginterferon can be given once weekly and provides a constant level of interferon in the blood, whereas standard interferon must be given several times weekly and provides intermittent and fluctuating levels. In addition, peginterferon is more active than standard interferon in inhibiting HCV and yields higher sustained response rates with similar side effects. Because of its ease of administration and better efficacy, peginterferon has been replacing standard interferon both as monotherapy and as combination therapy for hepatitis C.

Ribavirin is an oral antiviral agent that has activity against a broad range of viruses. By itself, ribavirin has little effect on HCV, but adding it to interferon increases the sustained response rate by two- to threefold. For these reasons, combination therapy is now recommended for hepatitis C, and interferon monotherapy is applied only when there are specific reasons not to use ribavirin.

Two forms of peginterferon have been developed and studied in large clinical trials: peginterferon alfa-2a (Pegasys: Hoffman La Roche: Nutley, NJ) and peginterferon alfa-2b (Pegintron: Schering-Plough Corporation, Kenilworth, NJ). These two products are roughly equivalent in efficacy and safety, but have different dosing regimens. Peginterferon alfa-2a is given subcutaneously in a fixed dose of 180 micrograms (mcg) per week. Peginterferon alfa-2b is given subcutaneously weekly in a weight-based dose of 1.5 mcg per kilogram per week (thus in the range of 75 to 150 mcg per week).

Ribavirin is an oral medication, given twice a day in 200-mg capsules for a total daily dose based upon body weight. The standard dose of ribavirin is 1,000 mg for patients who weigh less than 75 kilograms (165 pounds) and 1,200 mg for those who weigh more than 75 kilograms. In certain situations, an 800-mg dose (400 mg twice daily) is recommended (see below).

Combination therapy leads to rapid improvements in serum ALT levels and disappearance of detectable HCV RNA in up to 70 percent of patients. However, long-term improvement in hepatitis C occurs only if HCV RNA disappears during therapy and stays undetectable once therapy is stopped. Among patients who become HCV RNA negative during treatment, a proportion relapse when therapy is stopped. The relapse rate is lower in patients treated with combination therapy compared with monotherapy. Thus, a 48-week course of combination therapy using peginterferon and ribavirin yields a sustained response rate of approximately 55 percent. A similar course of peginterferon monotherapy yields a sustained response rate of only 35 percent. A response is considered "sustained" if HCV RNA remains undetectable for 6 months or more after stopping therapy.

The optimal duration of treatment varies depending on whether interferon monotherapy or combination therapy is used, as well as by HCV genotype. For patients treated with peginterferon monotherapy, a 48-week course is recommended, regardless of genotype. For patients treated with combination therapy, the optimal duration of treatment depends on viral genotype. Patients with genotypes 2 and 3 have a high rate of response to combination treatment (70 to 80 percent), and a 24-week course of combination therapy yields results equivalent to those of a 48-week course. In contrast, patients with genotype 1 have a lower rate of response to combination therapy (40 to 45 percent), and a 48-week course yields a significantly better sustained

response rate. Again, because of the variable responses to treatment, testing for HCV genotype is clinically useful when using combination therapy.

In addition, the optimal dose of ribavirin appears to vary depending on genotype. For patients with genotypes 2 or 3, a dose of 800 mg daily appears adequate. For patients with genotype 1, the full dose of ribavirin (1,000 or 1,200 mg daily depending on body weight) appears to be needed for an optimal response.

#### Who Should Be Treated?

Patients with anti-HCV. HCV RNA. elevated serum aminotransferase levels, and evidence of chronic hepatitis on liver biopsy, and with no contraindications, should be offered therapy with the combination of alpha interferon and ribavirin. The National Institutes of Health Consensus Development Conference Panel recommended that therapy for hepatitis C be limited to those patients who have histological evidence of progressive disease. Thus, the panel recommended that all patients with fibrosis or moderate to severe degrees of inflammation and necrosis on liver biopsy should be treated and that patients with less severe histological disease be managed on an individual basis. Patient selection should not be based on the presence or absence of symptoms, the mode of acquisition, the genotype of HCV RNA, or serum HCV RNA levels.

Patients with cirrhosis found through liver biopsy can be offered therapy if they do not have signs of decompensation, such as ascites, persistent jaundice, wasting, variceal hemorrhage, or hepatic encephalopathy. However, interferon and combination therapy have not been shown to improve survival or the ultimate outcome in patients with preexisting cirrhosis. Patients older than 60 years also should be managed on an individual basis, since the benefit of treatment in these patients has not been well documented and side effects appear to be worse in older patients. However, even patients in their late seventies have been successfully treated for hepatitis C.

The role of interferon therapy in children with hepatitis C remains uncertain. Ribavirin has yet to be evaluated adequately in children, and pediatric doses and safety have not been established. Thus, if children with hepatitis C are treated, monotherapy is recommended, and ribavirin should not be used outside of controlled clinical trials.

People with both HCV and HIV infection should be offered therapy for hepatitis C as long as there are no contraindications. Indeed, hepatitis C tends to be more rapidly progressive in patients with HIV coinfection, and end-stage liver disease has become an increasingly common cause of death in HIV-positive persons. For these reasons, therapy for hepatitis C should be recommended even in HIV-infected patients with early and mild disease. Once HIV infection becomes advanced, complications of therapy are more difficult and response rates are less. The decision to treat people co-infected with HIV must take into consideration the concurrent medications and medical conditions. The efficacy of peginterferon and ribavirin in HIV-infected people has been tested in only a small number of patients. Ribavirin may still have significant interactions with other antiretroviral drugs.

In many of these indefinite situations, the indications for therapy should be reassessed at regular intervals. In view of the rapid developments in hepatitis C today, better therapies may become available within the next few years, at which point expanded indications for therapy would be appropriate.

Patients with acute hepatitis C are a major challenge to management and therapy. Because such a high proportion of patients with acute infection develop chronic hepatitis C, prevention of chronicity has become a focus of attention. In small studies, 83 to 100 percent of persons treated within 1 to 4 months of onset have had resolution of the infection. What is unclear is what dose, duration, and regimen of treatment to use. A practical regimen is peginterferon monotherapy for 24 weeks. The possible role for ribavirin, for short courses of therapy, and for lower doses of peginterferon are under evaluation.

In patients with clinically significant extrahepatic manifestations, such as cryoglobulinemia and glomerulonephritis, therapy with alpha interferon can result in remission of the clinical symptoms and signs. However, relapse after stopping therapy is common. In some patients, long-term or maintenance alpha interferon therapy can be used despite persistence of HCV RNA in serum if clinical symptoms and signs resolve on therapy.

#### Who Should Not Be Treated?

Therapy is inadvisable outside of controlled trials for patients who have

- clinically decompensated cirrhosis because of hepatitis C
- normal aminotransferase levels
- a kidney, liver, heart, or other solidorgan transplant
- specific contraindications to either monotherapy or combination therapy

Contraindications to alpha interferon therapy include severe depression or other neuropsychiatric syndromes, active substance or alcohol abuse, autoimmune disease (such as rheumatoid arthritis, lupus erythematosus, or psoriasis) that is not well controlled, bone marrow compromise, and inability to practice birth control. Contraindications to ribavirin and thus combination therapy include marked anemia, renal dysfunction, and coronary artery or cerebrovascular disease, and, again, inability to practice birth control.

Alpha interferon has multiple neuropsychiatric effects. Prolonged therapy can cause marked irritability, anxiety, personality changes, depression, and even suicide or acute psychosis. Patients particularly susceptible to these side effects are those with preexisting serious psychiatric conditions and patients with neurological disease.

Strict abstinence from alcohol is recommended during therapy with interferon. Interferon therapy can be associated with relapse in people with a previous history of drug or alcohol abuse. Therefore, alpha interferon should be given with caution to a patient who has only recently stopped alcohol or substance abuse. Typically a 6month abstinence is recommended before starting therapy, but this should be applied only to patients with a history of alcohol abuse, not to social drinkers. Patients with continuing alcohol or substance abuse problems should only be treated in collaboration with alcohol or substance abuse specialists or counselors. Patients can be successfully treated while on methadone or in an active substance abuse program. Indeed, the rigor and regular monitoring that accompany methadone treatment provide a structured format for combination therapy. The dose of methadone may need to be modified during interferon-based therapy for hepatitis.

Alpha interferon therapy can induce autoantibodies, and a 24- to 48-week course triggers an autoimmune condition in about 2 percent of patients, particularly if they have an underlying susceptibility to autoimmunity (high titers of antinuclear or antithyroid antibodies, for instance). Exacerbation of a known autoimmune disease (such as rheumatoid arthritis or psoriasis) occurs commonly during interferon therapy.

Alpha interferon has bone marrow suppressive effects. Therefore, patients with bone marrow compromise or cytopenias, such as low platelet count (< 75,000 cells/mm<sup>3</sup>) or neutropenia (< 1,000 cells/mm<sup>3</sup>) should be treated cautiously and with frequent monitoring of cell counts. These side effects appear to be more common with peginterferon than standard interferon.

Ribavirin causes red cell hemolysis to a variable degree in almost all patients. Therefore, patients with a preexisting hemolysis or anemia (hemoglobin < 11 grams [g] or hematocrit < 33 percent) should not receive ribavirin. Similarly, patients who have significant coronary or cerebral vascular disease should not receive ribavirin, as the anemia caused by treatment can trigger significant ischemia. Fatal myocardial infarctions and strokes have been reported during combination therapy with alpha interferon and ribavirin.

Growth factors such as erythropoietin to raise red blood cell counts or granulocyte stimulating factor to raise neutrophil counts have been used successfully to treat patients with cytopenias during combination therapy. The proper role, dose, and side effects of these adjunctive therapies have yet to be defined.

Ribavirin is excreted largely by the kidneys. Patients with renal disease can develop hemolysis that is severe and even lifethreatening. Patients who have elevations in serum creatinine above 2.0 mg per deciliter (dL) should not be treated with ribavirin.

Finally, ribavirin causes birth defects in animal studies and should not be used in women or men who are not practicing adequate means of birth control. Alpha interferon also should not be used in pregnant women, as it has direct antigrowth and antiproliferative effects.

Combination therapy should therefore be used with caution. Patients should be fully informed of the potential side effects before starting therapy.

#### Side Effects of Treatment

Common side effects of alpha interferon and peginterferon (occurring in more than 10 percent of patients) include

- fatigue
- muscle aches
- headaches
- nausea and vomiting
- skin irritation at the injection site
- low-grade fever
- weight loss
- irritability
- depression
- mild bone marrow suppression
- hair loss (reversible)

Most of these side effects are mild to moderate in severity and can be managed. They are worse during the first few weeks of treatment, especially with the first injection. Thereafter, side effects diminish. Acetaminophen may be helpful for the muscle aches and low-grade fever. Fatigue and depression are occasionally so troublesome that the dose of interferon should be decreased or therapy stopped early. Depression and personality changes can occur on interferon therapy and be quite subtle and not readily admitted by the patient. These side effects need careful monitoring. Patients with depression may benefit from antidepressant therapy using selective serotonin reuptake inhibitors. Generally, the psychiatric side effects resolve within 2 to 4 weeks of stopping combination therapy.

Ribavirin also causes side effects, and the combination is generally less well tolerated than interferon monotherapy. The most common side effects of ribavirin are

- anemia
- fatigue and irritability
- itching
- skin rash
- nasal stuffiness, sinusitis, and cough

Ribavirin causes a dose-related hemolysis of red cells; with combination therapy, hemoglobin usually decreases by 2 to 3 g/dL and the hematocrit by 5 to 10 percent. The amount of decrease in hemoglobin is highly variable. The decrease starts between weeks 1 and 4 of therapy and can be precipitous. Some patients develop symptoms of anemia, including fatigue, shortness of breath, palpitations, and headache.

The sudden drop in hemoglobin can precipitate angina pectoris in susceptible people, and fatalities from acute myocardial infarction and stroke have been reported in patients receiving combination therapy for hepatitis C. For these important reasons, ribavirin should not be used in patients with preexisting anemia or with significant coronary or cerebral vascular disease. If such patients require therapy for hepatitis C, they should receive alpha interferon monotherapy.

Ribavirin has also been found to cause itching and nasal stuffiness. These are histamine-like side effects; they occur in 10 to 20 percent of patients and are usually mild to moderate in severity. In some patients, however, sinusitis, recurrent bronchitis, or asthma-like symptoms become prominent. It is important that these


### **Considerations: Before, During and After Therapy**

#### **Before Starting Therapy**

- Do a liver biopsy to confirm the diagnosis of HCV, assess the grade and stage of disease, and rule out other diagnoses. In situations where a liver biopsy is contraindicated, such as clotting disorders, combination therapy can be given without a pretreatment liver biopsy.
- Test for serum HCV RNA to document that viremia is present.
- Test for HCV genotype (or serotype) to help determine the duration of therapy and dose of ribavirin.
- Measure blood counts and aminotransferases to establish a baseline for these values.
- Counsel the patient about the relative risks and benefits of treatment. Side effects should be thoroughly discussed.

#### **During Therapy**

- Measure blood counts and aminotransferases at weeks 1, 2, and 4 and at 4- to 8-week intervals thereafter.
- Adjust the dose of ribavirin downward (by 200 mg at a time) if significant anemia occurs (hemoglobin less than 10 g/dL or hematocrit < 30 percent) and stop ribavirin if severe anemia occurs (hemoglobin < 8.5 g/dL or hematocrit < 26 percent).
- Adjust the dose of peginterferon downward if there are intolerable side effects such as severe fatigue, depression, or irritability or marked decreases in white blood cell counts (absolute neutrophil count below 500 cells/mm<sup>3</sup>) or platelet counts (decrease below 30,000 cells/mm<sup>3</sup>). When using peginterferon alfa-2a, the dose can be reduced from 180 to 135 and then to 90 mcg per week. When using peginterferon alfa-2b, the dose can be reduced from 1.5 to 1.0 and then to 0.5 mcg per kilogram per week.
- In patients with genotype 1, measure HCV RNA level immediately before therapy and again (by the same method) at week 12. Therapy can be stopped early if HCV RNA levels have not decreased by at least two log<sub>10</sub> units, as studies have shown that genotype 1 patients without this amount of decrease in HCV RNA are unlikely to have a sustained response (likelihood is < 1 percent). In situations where HCV RNA levels are not obtainable, repeat testing for HCV RNA by PCR (or TMA) should be done at 24 weeks and therapy stopped if HCV RNA is still present, as a sustained response is unlikely.</p>
- Reinforce the need to practice strict birth control during therapy and for 6 months thereafter.
- Measure thyroid-stimulating hormone levels every 3 to 6 months during therapy. Patients with genotypes 2 or 3 can stop therapy at 24 weeks. Patients with genotype 1 and a drop in HCV RNA by 12 weeks should continue therapy for 48 weeks.
- At the end of therapy, test HCV RNA by PCR to assess whether there is an end-of-treatment response.

#### **After Therapy**

- Measure aminotransferases every 2 months for 6 months.
- Six months after stopping therapy, test for HCV RNA by PCR. If HCV RNA is still negative, the chance for a long-term "cure" is excellent; relapses have rarely been reported after this point.

symptoms be recognized as attributable to ribavirin, because dose modification (by 200 mg per day) or early discontinuation of treatment may be necessary.

Uncommon side effects of alpha interferon, peginterferon, and combination therapy (occurring in less than 2 percent of patients) include

- autoimmune disease (especially thyroid disease)
- severe bacterial infections
- marked thrombocytopenia
- marked neutropenia
- seizures
- depression and suicidal ideation or attempts
- retinopathy (microhemorrhages)
- hearing loss and tinnitus

Rare side effects include acute congestive heart failure, renal failure, vision loss, pulmonary fibrosis or pneumonitis, and sepsis. Deaths have been reported from acute myocardial infarction, stroke, suicide, and sepsis.

A unique but rare side effect is paradoxical worsening of the disease. This is assumed to be caused by induction of autoimmune hepatitis, but its cause is really unknown. Because of this possibility, aminotransferases should be monitored. If ALT levels rise to greater than twice the baseline values, therapy should be stopped and the patient monitored. Some patients with this complication have required corticosteroid therapy to control the hepatitis.

#### **Options for Patients Who Do Not Respond to Treatment**

Few options exist for patients who either do not respond to therapy or who respond and later relapse. Patients who relapse after a course of interferon monotherapy may respond to a course of combination therapy, particularly if they became and remained HCV RNA negative during the period of monotherapy. The response rates and optimal dose (800 vs. 1,000 mg to 1,200 mg of ribavirin) and duration (24 or 48 weeks) of peginterferon and ribavirin for relapse or previous nonresponder patients have not been defined. The algorithm for treatment given above is for treatment of naive patients.

An experimental approach to treatment of non-responders is the use of long-term or maintenance interferon, which is feasible only if the peginterferon is well tolerated and has a clear-cut effect on serum aminotransferases or liver histology, despite lack of clearance of HCV RNA. This approach is now under evaluation in long-term clinical trials in the United States. New medications and approaches to treatment are needed. Most promising for the future are the use of other cytokines and the development of newer antivirals, such as RNA polymerase, helicase, or protease inhibitors.

## Hope Through Research Basic Research

A major focus of hepatitis C research is developing a tissue culture system that will enable researchers to study HCV outside the human body. Animal models and molecular approaches to the study of HCV are also important. Understanding how the virus replicates and how it injures cells would be helpful in developing a means of controlling it and in screening for new drugs that would block it.

#### **Diagnostic Tests**

More sensitive and less expensive assays for measuring HCV RNA and antigens in the blood and liver are needed. Although current tests for anti-HCV are quite sensitive, a small percentage of patients with hepatitis C test negative for anti-HCV (falsenegative reaction), and a percentage of patients who test positive are not infected (false-positive reaction). Also, there are patients who have resolved the infection but still test positive for anti-HCV. Convenient tests to measure HCV in serum and to detect HCV antigens in liver tissue would be helpful. Clinically, noninvasive tests that would reliably predict liver fibrosis would be a very valuable advance.

#### **New Treatments**

Most critical for the future is the development of new antiviral agents for hepatitis C. Most interesting will be specific inhibitors of HCV-derived enzymes such as protease, helicase, and polymerase inhibitors. Drugs that inhibit other steps in HCV replication may also be helpful in treating this disease, by blocking production of HCV antigens from the RNA (IRES inhibitors), preventing the normal processing of HCV proteins (inhibitors of glycosylation), or blocking entry of HCV into cells (by blocking its receptor). In addition, nonspecific cytoprotective agents might be helpful for hepatitis C by blocking the cell injury caused by the virus infection. Further, molecular approaches to treating hepatitis C are worthy of investigation; these consist of using ribozymes, which are enzymes that break down specific viral RNA molecules, and antisense oligonucleotides, which are small complementary segments of DNA that bind to viral RNA and inhibit viral replication. All of these approaches remain experimental and few have been applied to humans. The serious nature and the frequency of hepatitis C in the population make the search for new therapies of prime importance.

#### Prevention

At present, the only means of preventing new cases of hepatitis C are to screen the blood supply, encourage health professionals to take precautions when handling blood and body fluids, and inform people about high-risk behaviors. Programs to promote needle exchange offer some hope of decreasing the spread of hepatitis C among injection drug users. Furthermore, all drug users should receive instruction in safer injection techniques, simple interventions that can be life-saving. Vaccines and immunoglobulin products do not exist for hepatitis C, and development seems unlikely in the near future because these products would require antibodies to all the genotypes and variants of hepatitis C. Nevertheless, advances in immunology and innovative approaches to immunization make it likely that some form of vaccine for hepatitis C will eventually be developed.

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## **Patient Education Materials**

The National Digestive Diseases Information Clearinghouse (NDDIC) has patient education materials on hepatitis C. To obtain free copies, contact the clearinghouse at

#### NDDIC

2 Information Way Bethesda, MD 20892–3570 Phone: 1–800–891–5389 Fax: 703–738–4929 Email: nddic@info.niddk.nih.gov Internet: www.digestive.niddk.nih.gov

Patient education materials are also available from

#### **American Liver Foundation**

75 Maiden Lane, Suite 603
New York, NY 10038–4810
Phone: 1–800–GO–LIVER (465–4837) or 1–888–443–7222 or 212–668–1000 or 1–800–676–9340
24-hour helpline (7 days/week): 1–800–465–4857 or 1–888–443–7222
Fax: 973–256–3214 or 212–483–8179
Email: info@liverfoundation.org
Internet: www.liverfoundation.org

# Centers for Disease Control and Prevention

1600 Clifton Road NE Mail Stop G37 Atlanta, GA 30333 Phone: 404–371–5900 Fax: 404–371–5488 Internet: www.cdc.gov Viral Hepatitis and Injection Drug Users fact sheet available at www.cdc.gov/idu/ hepatitis/index.htm

#### Hepatitis Foundation International

504 Blick Drive Silver Spring, MD 20904–2901 Phone: 1–800–891–0707 or 301–622–4200 Email: hepfi@hepfi.org Internet: www.hepfi.org

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# Vaccination for Hepatitis A



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## Candidates for Hepatitis A Vaccination

#### **Routine vaccination**

• Children living in areas with high incidence rates of hepatitis A (above the national average). Check with your health department to see if this applies to your area.

#### **High-risk populations**

- rates of hepatitis A, including Mexico.
- Men who have sex with men.
- Users of illegal drugs.
- People who work with hepatitis A virus in research settings.
- Travelers to developing countries with high People who work with infected nonhuman primates.
  - Recipients of clotting factor concentrates.
  - People with chronic liver disease (because of risk of fulminant hepatitis A).

#### Doses and Schedules: Hepatitis A

HAVRIX*					
Age	# of Doses	Schedule	Dose		
Children age 2 to 18 years	2	0 and 6 to 12 months	720 ELISA units (0.5 mL)		
Adults 18 years and older	2	0 and 6 to 12 months	1440 ELISA units (1.0 mL)		

\* Inactivated vaccine. Manufactured by SmithKline Beecham Biologicals.

VAQTA*				
Age	# of Doses	Schedule	Dose	
Children age 2 to 17 years	2	0 and 6 to 18 months	25 units (0.5 mL)	
Adults 17 years and older	2	0 and 6 months	50 units (1.0 mL)	

\* Inactivated vaccine. Manufactured by Merck & Company, Inc.

#### **Postexposure prophylaxis**

Immune globulin is more than 85 percent effective in preventing hepatitis A virus infection when given within 2 weeks of exposure to the hepatitis A virus. The dose is 0.02 mL/kg injected into the gluteal muscle in adults or the anterolateral thigh muscle in children under 2 years. Concurrent hepatitis A vaccination may also be appropriate in people 2 years and older.



U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES National Institutes of Health

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# Vaccination for Hepatitis B

National Digestive Diseases Information Clearinghouse

## Candidates for Hepatitis B Vaccination

#### **Routine vaccination**

• All infants, children, and adolescents.

#### **High-risk populations**

- People with multiple sex partners and those who have been recently diagnosed with a sexually transmitted disease.
- Sex partners and household contacts of HBV carriers.
- Men who have sex with men.
- Household contacts of adoptees from countries with high rates of hepatitis B.
- Doses and Schedules: Hepatitis B

- Injection drug users.
- Travelers to countries with high rates of hepatitis B (staying longer than 6 months).
- People with occupational exposure to blood.
- Clients and staff in institutions for the developmentally disabled.
- Patients with chronic kidney failure (including those on chronic hemodialysis).
- Patients receiving clotting factor concentrates.
- Inmates of long-term correctional facilities.

Recombivax HB*Energix-B**Infants with HBsAg-negative mother30 to 2, 1 to 4, and 6 to 18 months5.0 µg (0.5 mL)10 µg (0.5 mL)Infants with HBsAg-positive mother3Hepatitis B immune globulin (HBIG) and vaccination within 12 hours of birth, then vaccine at 1 to 2 and 6 months5.0 µg (0.5 mL)10 µg (0.5 mL)Children and adolescents age 1 to 19 years30, 1 to 2, and 4 to 6 months5.0 µg (0.5 mL)10 µg (0.5 mL)Adolescents 11 to 15 years20 and 4 to 6 months10 µg (1.0 mL)N/A	AGE	# OF DOSES	ES SCHEDULE D		OSE	
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Adults 20 years and alder $2 = 0.1$ to 2 and 4 to (months $10 \text{ up}(10 \text{ mL}) = 20 \text{ up}(10 \text{ mL})$	Adolescents 11 to 15 years	2	0 and 4 to 6 months	10 µg (1.0 mL)	N/A	
Adults 20 years and older $5$ 0, 1 to 2, and 4 to 6 months $10 \mu\text{g}$ (1.0 mL) $20 \mu\text{g}$ (1.0 mL)	Adults 20 years and older	3	0, 1 to 2, and 4 to 6 months	10 µg (1.0 mL)	20 µg (1.0 mL)	
Immunocompromised adults30, 1, and 6 months40 $\mu$ g (1.0 mL)N/A	Immunocompromised adults	3	0, 1, and 6 months	40 µg (1.0 mL)	N/A	
4 0, 1, 2, and 6 months N/A 40 μg (2.0 mL)		4	0, 1, 2, and 6 months	N/A	40 µg (2.0 mL)	

*Note:* There should be at least 1 month between the first and second doses, at least 2 months between the second and third doses, and at least 4 months between the first and third doses. For infants, the third dose should not be given before 6 months of age.

\* Recombinant vaccine. Manufactured by Merck & Company, Inc.

\*\* Recombinant vaccine. Manufactured by SmithKline Beecham Biologicals.

#### Postexposure prophylaxis

Prophylactic treatment for exposure to hepatitis B virus involves either hepatitis B immune globulin (HBIG), hepatitis B vaccine, or a combination of both. The HBIG dose equals 0.06 mL/kg. Efficacy ranges from 70 to 95 percent for different types of exposure.

EXPOSURE	TREATMENT
Perinatal	1 dose of HBIG given with the first hepatitis B vaccine dose.
Percutaneous or permucosal	HBIG and vaccination depending on vaccination and exposure status.
Sexual	HBIG with or without vaccination for exposure to acute hepatitis B; vaccination alone for chronic exposure.
Household contact	HBIG with vaccination for acute hepatitis B in infants under age 12 months; vaccination alone for chronic.
NIH Publication No. 00-4245	

# Celiac Disease

National Digestive Diseases Information Clearinghouse



National Institute of Diabetes and Digestive and Kidney Diseases

NATIONAL INSTITUTES OF HEALTH

# What is celiac disease?

Celiac disease is a digestive disease that damages the small intestine and interferes with absorption of nutrients from food. People who have celiac disease cannot tolerate a protein called gluten, found in wheat, rye, and barley. Gluten is found mainly in foods but may also be found in products we use everyday, such as stamp and envelope adhesive, medicines, and vitamins.

When people with celiac disease eat foods or use products containing gluten, their immune system responds by damaging the small intestine. The tiny, fingerlike protrusions lining the small intestine are damaged or destroyed. Called villi, they normally allow nutrients from food to be absorbed into the bloodstream. Without healthy villi, a person becomes malnourished, regardless of the quantity of food eaten.





nutrients.

U.S. Department of Health and Human Services

Because the body's own immune system causes the damage, celiac disease is considered an autoimmune disorder. However, it is also classified as a disease of



The small intestine is shaded above.

malabsorption because nutrients are not absorbed. Celiac disease is also known as celiac sprue, nontropical sprue, and gluten-sensitive enteropathy.

Celiac disease is a genetic disease, meaning it runs in families. Sometimes the disease is triggered—or becomes active for the first time—after surgery, pregnancy, childbirth, viral infection, or severe emotional stress.

# What are the symptoms of celiac disease?

Celiac disease affects people differently. Symptoms may occur in the digestive system, or in other parts of the body. For example, one person might have diarrhea and abdominal pain, while another person may be irritable or depressed. In fact, irritability is one of the most common symptoms in children.

Symptoms of celiac disease may include one or more of the following:

- gas
- recurring abdominal bloating and pain
- chronic diarrhea
- constipation
- pale, foul-smelling, or fatty stool
- weight loss / weight gain
- fatigue
- unexplained anemia (a low count of red blood cells causing fatigue)
- bone or joint pain
- osteoporosis, osteopenia
- behavioral changes
- tingling numbness in the legs (from nerve damage)
- muscle cramps
- seizures
- missed menstrual periods (often because of excessive weight loss)
- infertility, recurrent miscarriage
- delayed growth
- failure to thrive in infants
- pale sores inside the mouth, called aphthous ulcers
- tooth discoloration or loss of enamel
- itchy skin rash called dermatitis herpetiformis

A person with celiac disease may have no symptoms. People without symptoms are still at risk for the complications of celiac disease, including malnutrition. The longer a person goes undiagnosed and untreated, the greater the chance of developing malnutrition and other complications. Anemia, delayed growth, and weight loss are signs of malnutrition: The body is just not getting enough nutrients. Malnutrition is a serious problem for children because they need adequate nutrition to develop properly. (See Complications.)

# Why are celiac disease symptoms so varied?

Researchers are studying the reasons celiac disease affects people differently. Some people develop symptoms as children, others as adults. Some people with celiac disease may not have symptoms, while others may not know that their symptoms are from celiac disease. The undamaged part of their small intestine may not be able to absorb enough nutrients to prevent symptoms.

The length of time a person is breastfed, the age a person started eating glutencontaining foods, and the amount of gluten-containing foods one eats are three factors thought to play a role in when and how celiac disease appears. Some studies have shown, for example, that the longer a person was breastfed, the later the symptoms of celiac disease appear and the more uncommon the symptoms.

# How is celiac disease diagnosed?

Recognizing celiac disease can be difficult because some of its symptoms are similar to those of other diseases. In fact, sometimes celiac disease is confused with irritable bowel syndrome, iron-deficiency anemia caused by menstrual blood loss, Crohn's disease, diverticulitis, intestinal infections, and chronic fatigue syndrome. As a result, celiac disease is commonly under diagnosed or misdiagnosed.

Recently, researchers discovered that people with celiac disease have higher than normal levels of certain autoantibodies in their blood. Antibodies are protective proteins produced by the immune system in response to substances that the body perceives to be threatening. Autoantibodies are proteins that react against the body's own molecules or tissues. To diagnose celiac disease, physicians will usually test blood to measure levels of

- Immunoglobulin A (IgA)
- anti-tissue transglutaminase (tTGA)
- IgA anti-endomysium antibodies (AEA)

Before being tested, one should continue to eat a regular diet that includes foods with gluten, such as breads and pastas. If a person stops eating foods with gluten before being tested, the results may be negative for celiac disease even if celiac disease is actually present. If the tests and symptoms suggest celiac disease, the doctor will perform a small bowel biopsy. During the biopsy, the doctor removes a tiny piece of tissue from the small intestine to check for damage to the villi. To obtain the tissue sample, the doctor eases a long, thin tube called an endoscope through the mouth and stomach into the small intestine. Using instruments passed through the endoscope, the doctor then takes the sample.

#### Screening

Screening for celiac disease involves testing for the presence of antibodies in the blood in people without symptoms. Americans are not routinely screened for celiac disease. Testing for celiac-related antibodies in children less than 5 years old may not be reliable. However, since celiac disease is hereditary, family members, particularly first-degree relatives-meaning parents, siblings, or children of people who have been diagnosed-may wish to be tested for the disease. About 5 to 15 percent of an affected person's first-degree relatives will also have the disease. About 3 to 8 percent of people with type 1 diabetes will have biopsy-confirmed celiac disease and 5 to 10 percent of people with Down syndrome will be diagnosed with celiac disease.

## What is the treatment?

The only treatment for celiac disease is to follow a gluten-free diet. When a person is first diagnosed with celiac disease, the doctor usually will ask the person to work with a dietitian on a gluten-free diet plan. A dietitian is a health care professional who specializes in food and nutrition. Someone with celiac disease can learn from a dietitian how to read ingredient lists and identify foods that contain gluten in order to make informed decisions at the grocery store and when eating out.

For most people, following this diet will stop symptoms, heal existing intestinal damage, and prevent further damage. Improvements begin within days of starting the diet. The small intestine is usually healed in 3 to 6 months in children and younger adults and within 2 years for older adults. Healed means a person now has villi that can absorb nutrients from food into the bloodstream.

In order to stay well, people with celiac disease must avoid gluten for the rest of their lives. Eating any gluten, no matter how small an amount, can damage the small intestine. The damage will occur in anyone with the disease, including people without noticeable symptoms. Depending on a person's age at diagnosis, some problems will not improve, such as delayed growth and tooth discoloration. Some people with celiac disease show no improvement on the gluten-free diet. This condition is called unresponsive celiac disease. The most common reason for poor response is that small amounts of gluten are still present in the diet. Advice from a dietitian who is skilled in educating patients about the gluten-free diet is essential to achieve the best results.

Rarely, the intestinal injury will continue despite a strictly gluten-free diet. People in this situation have severely damaged intestines that cannot heal. Because their intestines are not absorbing enough nutrients, they may need to receive nutrients directly into their bloodstream through a vein (intravenously). People with this condition may need to be evaluated for complications of the disease. Researchers are now evaluating drug treatments for unresponsive celiac disease.

The web contains information about celiac disease, some of which is not accurate. The best people for advice about diagnosing and treating celiac disease are one's doctor and dietitian.

#### **The Gluten-Free Diet**

A gluten-free diet means not eating foods that contain wheat (including spelt, triticale, and kamut), rye, and barley. The foods and products made from these grains are also not allowed. In other words, a person with celiac disease should not eat most grain, pasta, cereal, and many processed foods. Despite these restrictions, people with celiac disease can eat a well-balanced diet with a variety of foods, including gluten-free bread and pasta. For example, people with celiac disease can use potato, rice, soy, amaranth, quinoa, buckwheat, or bean flour instead of wheat flour. They can buy gluten-free bread, pasta, and other products from stores that carry organic foods, or order products from special food companies. Gluten-free products are increasingly available from regular stores.

Checking labels for "gluten free" is important since many corn and rice products are produced in factories that also manufacture wheat products. Hidden sources of gluten include additives such as modified food starch, preservatives, and stabilizers. Wheat and wheat products are often used as thickeners, stabilizers, and texture enhancers in foods.

"Plain" meat, fish, rice, fruits, and vegetables do not contain gluten, so people with celiac disease can eat as much of these foods as they like. Recommending that people with celiac disease avoid oats is controversial because some people have been able to eat oats without having symptoms. Scientists are currently studying whether people with celiac disease can tolerate oats. Until the studies are complete, people with celiac disease should follow their physician's or dietitian's advice about eating oats. Examples of foods that are safe to eat and those that are not are provided in the table on pages 6–7. The gluten-free diet is challenging. It requires a completely new approach to eating that affects a person's entire life. Newly diagnosed people and their families may find support groups to be particularly helpful as they learn to adjust to a new way of life. People with celiac disease have to be extremely careful about what they buy for lunch at school or work, what they purchase at the grocery store, what they eat at restaurants or parties, or what they grab for a snack. Eating out can be a challenge. If a person with celiac disease is in doubt about a menu item, ask the waiter or chef about ingredients and preparation, or if a glutenfree menu is available.

Gluten is also used in some medications. One should check with the pharmacist to learn whether medications used contain gluten. Since gluten is also sometimes used as an additive in unexpected products, it is important to read all labels. If the ingredients are not listed on the product label, the manufacturer of the product should provide the list upon request. With practice, screening for gluten becomes second nature.

# The Gluten-Free Diet: Some Examples

Following are examples of foods that are allowed and those that should be avoided when eating a gluten-free diet. This list is *not* complete, so people with celiac disease should discuss gluten-free food choices with a dietitian or physician who specializes in celiac disease. People with celiac disease should always read food ingredient lists carefully to make sure that the food does not contain gluten.

Food Categories	Foods Allowed or Recommended	Foods to Omit	Tips		
Breads, cereals, rice, and pasta: 6 to 11 servings each day					
Serving size = 1 slice bread, 1 cup ready-to-eat cereal, ½ cup cooked cereal, rice, or pasta; ½ bun, bagel, or English muffin	Bread made from corn, rice, soy, arrowroot corn, or potato starch; pea, potato, or whole-bean flour; or tapioca, sago, rice bran, cornmeal, buckwheat, millet, flax, teff, sorghum, amaranth, quinoa Hot cereals made from soy, hominy, hominy grits, brown rice, white rice, buckwheat groats, millet, cornmeal, quinoa flakes Puffed corn, rice, or millet, other rice and corn made with allowed ingredients Rice, rice noodles, pastas made from allowed ingredients Some rice crackers and cakes, popped corn cakes made from allowed ingredients	Breads or baked products containing wheat, rye, triticale, barley, oats, wheat germ, bran; graham, gluten, or durum flour; wheat starch, oat bran, bulgur, farina, wheat-based semolina, spelt, kamut Cereals made from wheat, rye, triticale, barley, and oats; or made with malt extract, malt flavorings Pastas made from ingredients above Most crackers	Use corn, rice, soy, arrowroot, tapioca, and potato flours or a mixture of them instead of wheat flours in recipes. Experiment with gluten-free products. Look for gluten-free products at the supermarket, health food store, or directly from the manufacturer.		
Food Categories	Foods Recommended	Foods to Omit	Tips		
Vegetables: 3 to 5	Vegetables: 3 to 5 servings each day (includes starchy vegetables)				
Serving size = 1 cup raw leafy, ½ cup cooked or chopped, ¾ cup juice	All plain, fresh, frozen, or canned vegetables made with allowed ingredients	Any creamed or breaded vegetables (unless allowed ingredients are used); canned baked beans Some french fries	Buy plain, frozen, or canned vegetables seasoned with herbs, spices, or sauces made with allowed ingredients.		
Food Categories	Foods Recommended	Foods to Omit	Tips		
Fruits: 2 to 4 serv	Fruits: 2 to 4 servings each day				
Serving size = 1 medium size, ½ cup canned, ¾ cup juice, ¼ cup dried	All fruits and fruit juices	Some commercial fruit pie fillings, dried fruit			

Food Categories	Food Categories   Foods Allowed or Recommended		Tips
Milk, yogurt, and	cheese: 2 to 3 servings each day		
Serving size = 1 cup milk or yogurt, 1½ oz natural cheese, 2 oz processed cheese	All milk and milk products except those made with gluten additives Aged cheese	Malted milk Some milk drinks, flavored or frozen yogurt	Contact the food manufacturer for product information if the ingredients are not listed on the label.
Food Categories	Foods Recommended	Foods to Omit	Tips
Meats, poultry, fis	h, dry beans and peas, eggs, and n	uts: 2 to 3 servings or t	otal of 6 oz daily
Serving size = 2 to 3 oz cooked; count 1 egg, ½ cup cooked beans, 2 Tbsp peanut butter, or ¼ cup nuts as 1 oz of meat	All meat, poultry, fish, shellfish, eggs Dry peas and beans, nuts, peanut butter, soybeans Cold cuts, frankfurters, sausage without fillers	Any prepared with wheat, rye, oats, barley, gluten stabilizers, fillers including some frankfurters, cold cuts, sandwich spreads, sausages, canned meats Self-basting turkey Some egg substitutes	When dining out, select meat, poultry, or fish made without breading, gravies, or sauces.
Food Categories	Foods Recommended	Foods to Omit	Tips
Fats, snacks, swee	ts, condiments, and beverages		
	Butter, margarine, salad dressings, sauces, soups, desserts made with allowed ingredients Sugar, honey, jelly, jam, hard candy, plain chocolate, coconut, molasses, marshmallows, meringues Pure instant or ground coffee, tea, carbonated drinks, wine (made in United States), rum, alcohol distilled from cereals such as gin, vodka, whiskey Most seasonings and flavorings	Commercial salad dressings, prepared soups, condiments, sauces, seasonings prepared with ingredients listed above Hot cocoa mixes, nondairy cream substitutes, flavored instant coffee, herbal tea Beer, ale, malted beverages Licorice	Store all gluten-free products in your refrigerator or freezer because they do not contain preservatives. Avoid sauces, gravies, canned fish, products with hydrolyzed vegetable protein or hydrolyzed plant protein (HVP/HPP) made from wheat protein, and anything with questionable ingredients.

2001, the American Dietetic Association. "Patient Education Materials: Supplement to the Manual of Clinical Dietetics." 3rd ed. Used with permission.

# What are the complications of celiac disease?

Damage to the small intestine and the resulting nutrient absorption problems put a person with celiac disease at risk for malnutrition, anemia, and several other diseases and health problems.

- **Lymphoma and adenocarcinoma** are cancers that can develop in the intestine.
- **Osteoporosis** is a condition in which the bones become weak, brittle, and prone to breaking. Poor calcium absorption contributes to osteoporosis.
- Miscarriage and congenital malformation of the baby, such as neural tube defects, are risks for pregnant women with untreated celiac disease because of nutrient absorption problems.
- Short stature refers to being significantly under-the-average height. Short stature results when childhood celiac disease prevents nutrient absorption during the years when nutrition is critical to a child's normal growth and development. Children who are diagnosed and treated before their growth stops may have a catch-up period.

# How common is celiac disease?

Data on the prevalence of celiac disease is spotty. In Italy about 1 in 250 people, and in Ireland about 1 in 300 people, have celiac disease. Recent studies have shown that it may be more common in Africa, South America, and Asia than previously believed.

Until recently, celiac disease was thought to be uncommon in the United States. However, studies have shown that celiac disease is very common. Recent findings estimate about 2 million people in the United States have celiac disease, or about 1 in 133 people. Among people who have a first-degree relative diagnosed with celiac disease, as many as 1 in 22 people may have the disease.

Celiac disease could be under diagnosed in the United States for a number of reasons including:

- Celiac symptoms can be attributed to other problems.
- Many doctors and health care providers are not knowledgeable about the disease.
- Only a small number of U.S. laboratories are experienced and skilled in testing for celiac disease.

More research is needed to learn the true prevalence of celiac disease among Americans.

# Diseases Linked to Celiac Disease

People with celiac disease tend to have other autoimmune diseases. The connection between celiac disease and these diseases may be genetic. These diseases include

- thyroid disease
- systemic lupus erythematosus
- type 1 diabetes
- liver disease
- collagen vascular disease
- rheumatoid arthritis
- Sjögren's syndrome

## **Dermatitis Herpetiformis**

Dermatitis herpetiformis (DH) is a severe itchy, blistering skin manifestation of celiac disease. Not all people with celiac disease develop dermatitis herpetiformis. The rash usually occurs on the elbows, knees, and buttocks. Unlike other forms of celiac disease, the range of intestinal abnormalities in DH is highly variable, from minimal to severe. Only about 20 percent of people with DH have intestinal symptoms of celiac disease.

To diagnose DH, the doctor will test the person's blood for autoantibodies related to celiac disease and will biopsy the person's skin. If the antibody tests are positive and the skin biopsy has the typical findings of DH, patients do not need to have an intestinal biopsy. Both the skin disease and the intestinal disease respond to a gluten-free diet and recur if gluten is added back into the diet. In addition, the rash symptoms can be controlled with medications such as dapsone (4',4'diaminodiphenylsuphone). However, dapsone does not treat the intestinal condition and people with DH should also maintain a gluten-free diet.

# Hope Through Research

The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) conducts and supports research on celiac disease. NIDDK-supported researchers are studying the genetic and environmental causes of celiac disease. In addition, researchers are studying the substances found in gluten that are believed to be responsible for the destruction of the immune system function, as happens in celiac disease. They are engineering enzymes designed to destroy these immunotoxic peptides. Researchers are also developing educational materials for standardized medical training to raise awareness among healthcare providers. The hope is that increased understanding and awareness will lead to earlier diagnosis and treatment of celiac disease.

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## **Points to Remember**

- People with celiac disease cannot tolerate gluten, a protein in wheat, rye, barley, and possibly oats.
- Untreated celiac disease damages the small intestine and interferes with nutrient absorption.
- Without treatment, people with celiac disease can develop complications like cancer, osteoporosis, anemia, and seizures.
- A person with celiac disease may or may not have symptoms.
- Diagnosis involves blood tests and a biopsy of the small intestine.
- Since celiac disease is hereditary, family members of a person with celiac disease may wish to be tested.
- Celiac disease is treated by eliminating all gluten from the diet. The gluten-free diet is a lifetime requirement.
- A dietitian can teach a person with celiac disease food selection, label reading, and other strategies to help manage the disease.

# **For More Information**

#### **American Dietetic Association**

120 South Riverside Plaza, Suite 2000 Chicago, IL 60606–6995 Phone: 1–800–366–1655 or 1–800–877–1600 Email: hotline@eatright.org Internet: www.eatright.org

#### **Celiac Disease Foundation**

13251 Ventura Boulevard, #1 Studio City, CA 91604 Phone: 818–990–2354 Fax: 818–990–2379 Email: cdf@celiac.org Internet: www.celiac.org



#### Celiac Sprue Association/USA Inc.

P.O. Box 31700 Omaha, NE 68131–0700 Phone: 1–877–272–4272 or 402–558–0600 Fax: 402–558–1347 Email: celiacs@csaceliacs.org Internet: www.csaceliacs.org

#### **Gluten Intolerance Group of North America**

15110 10th Avenue, SW., Suite A Seattle, WA 98166 Phone: 206–246–6652 Fax: 206–246–6531 Email: info@gluten.net Internet: www.gluten.net

#### **National Foundation for Celiac Awareness**

124 South Maple Street Ambler, PA 19002 Phone: 215–325–1306 Email: info@celiacawareness.org Internet: www.celiacawareness.org

#### North American Society for Pediatric Gastroenterology, Hepatology and Nutrition (NASPGHAN)

P.O. Box 6 Flourtown, PA 19031 Phone: 215–233–0808 Fax: 215–233–3918 Email: naspghan@naspghan.org Internet: www.naspghan.org www.cdhnf.org

# National Digestive Diseases Information Clearinghouse

2 Information Way Bethesda, MD 20892–3570 Phone: 1–800–891–5389 Fax: 703–738–4929 Email: nddic@info.niddk.nih.gov Internet: www.digestive.niddk.nih.gov

The National Digestive Diseases Information Clearinghouse (NDDIC) is a service of the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). The NIDDK is part of the National Institutes of Health under the U.S. Department of Health and Human Services. Established in 1980, the Clearinghouse provides information about digestive diseases to people with digestive disorders and to their families, health care professionals, and the public. The NDDIC answers inquiries, develops and distributes publications, and works closely with professional and patient organizations and Government agencies to coordinate resources about digestive diseases.

Publications produced by the Clearinghouse are carefully reviewed by both NIDDK scientists and outside experts. This fact sheet was reviewed by Ciaran Kelly, M.D., Beth Israel Deaconess Medical Center; Mitchell Cohen, M.D., Cincinnati, Children's Hospital Medical Center; Walter Reed Army Medical Center; National Foundation for Celiac Awareness; Celiac Disease Foundation; Celiac Sprue Association/USA Inc.; and Centers for Disease Control and Prevention staff.

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This fact sheet is also available at *www.digestive.niddk.nih.gov.* 



U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES National Institutes of Health

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# Diarrhea

National Digestive Diseases Information Clearinghouse



National Institute of Diabetes and Digestive and Kidney Diseases

NATIONAL INSTITUTES OF HEALTH

# Diarrhea

Diarrhea—loose, watery stools occurring more than three times in one day—is a common problem that usually lasts a day or two and goes away on its own without any special treatment. However, prolonged diarrhea can be a sign of other problems.

Diarrhea can cause dehydration, which means the body lacks enough fluid to function properly. Dehydration is particularly dangerous in children and the elderly, and it must be treated promptly to avoid serious health problems. Dehydration is discussed on page 3.

People of all ages can get diarrhea. The average adult has a bout of diarrhea about four times a year.

# What Causes Diarrhea?

Diarrhea may be caused by a temporary problem, like an infection, or a chronic problem, like an intestinal disease. A few of the more common causes of diarrhea are

- Bacterial infections. Several types of bacteria, consumed through contaminated food or water, can cause diarrhea. Common culprits include *Campylobacter*, *Salmonella*, *Shigella*, and *Escherichia coli*.
- Viral infections. Many viruses cause diarrhea, including rotavirus, Norwalk virus, cytomegalovirus, herpes simplex virus, and viral hepatitis.

- Food intolerances. Some people are unable to digest a component of food, such as lactose, the sugar found in milk.
- Parasites. Parasites can enter the body through food or water and settle in the digestive system. Parasites that cause diarrhea include *Giardia lamblia*, *Entamoeba histolytica*, and *Cryptosporidium*.
- Reaction to medicines, such as antibiotics, blood pressure medications, and antacids containing magnesium.
- Intestinal diseases, like inflammatory bowel disease or celiac disease.
- Functional bowel disorders, such as irritable bowel syndrome, in which the intestines do not work normally.

Some people develop diarrhea after stomach surgery or removal of the gallbladder. The reason may be a change in how quickly food moves through the digestive system after stomach surgery or an increase in bile in the colon that can occur after gallbladder surgery.

In many cases, the cause of diarrhea cannot be found. As long as diarrhea goes away on its own, an extensive search for the cause is not usually necessary.

People who visit foreign countries are at risk for traveler's diarrhea, which is caused by eating food or drinking water contaminated with bacteria, viruses, or, sometimes, parasites. Traveler's diarrhea is a particular problem for people visiting developing countries. Visitors to the United States, Canada, most European countries, Japan, Australia, and New Zealand do not face much risk for traveler's diarrhea.

#### Diarrhea in Children

Children can have acute (short-term) or chronic (long-term) forms of diarrhea. Causes include bacteria, viruses, parasites, medications, functional disorders, and food sensitivities. Infection with the rotavirus is the most common cause of acute childhood diarrhea. Rotavirus diarrhea usually resolves in 5 to 8 days. A vaccine to prevent rotavirus infection is now available for infants under 6 months of age.

Medications to treat diarrhea in adults can be dangerous to children and should be given only under a doctor's guidance.

Diarrhea can be dangerous in newborns and infants. In small children, severe diarrhea lasting just a day or two can lead to dehydration. Because a child can die from dehydration within a few days, the main treatment for diarrhea in children is rehydration. Rehydration is discussed on page 3.

Take your child to the doctor if any of the following symptoms appear:

- Stools containing blood or pus, or black stools.
- Temperature above 101.4 degrees Fahrenheit.
- No improvement after 24 hours.
- Signs of dehydration (see page 3).

## What Are the Symptoms?

Diarrhea may be accompanied by cramping abdominal pain, bloating, nausea, or an urgent need to use the bathroom. Depending on the cause, a person may have a fever or bloody stools.

Diarrhea can be either acute or chronic. The acute form, which lasts less than 3 weeks, is usually related to a bacterial, viral, or parasitic infection. Chronic diarrhea lasts more than 3 weeks and is usually related to functional disorders like irritable bowel syndrome or diseases like celiac disease or inflammatory bowel disease.

### What is Dehydration?

General signs of dehydration include

- Thirst.
- Less frequent urination.
- Dry skin.
- Fatigue.
- Light-headedness.

Signs of dehydration in children include

- Dry mouth and tongue.
- No tears when crying.
- No wet diapers for 3 hours or more.
- Sunken abdomen, eyes, or cheeks.
- High fever.
- · Listlessness or irritability
- Skin that does not flatten when pinched and released.

If you suspect that you or your child is dehydrated, call the doctor immediately. Severe dehydration may require hospitalization.

# When Should a Doctor Be Consulted?

Although usually not harmful, diarrhea can become dangerous or signal a more serious problem. You should see the doctor if

- You have diarrhea for more than 3 days.
- You have severe pain in the abdomen or rectum.
- You have a fever of 102 degrees Fahrenheit or higher.
- You see blood in your stool or have black, tarry stools.
- You have signs of dehydration.

If your child has diarrhea, do not hesitate to call the doctor for advice. Diarrhea can be dangerous in children if too much fluid is lost and not replaced quickly.

# What Tests Might the Doctor Do?

Diagnostic tests to find the cause of diarrhea include the following:

- Medical history and physical examination. The doctor will need to know about your eating habits and medication use and will examine you for signs of illness.
- Stool culture. Lab technicians analyze a sample of stool to check for bacteria, parasites, or other signs of disease or infection.
- Blood tests. Blood tests can be helpful in ruling out certain diseases.
- Fasting tests. To find out if a food intolerance or allergy is causing the diarrhea, the doctor may ask you to avoid lactose (found in milk products), carbohydrates, wheat, or other foods to see whether the diarrhea responds to a change in diet.

- Sigmoidoscopy. For this test, the doctor uses a special instrument to look at the inside of the rectum and lower part of the colon.
- Colonoscopy. This test is similar to sigmoidoscopy, but the doctor looks at the entire colon.

# What Is the Treatment?

In most cases, replacing lost fluid to prevent dehydration is the only treatment necessary. (See "Preventing Dehydration" below.) Medicines that stop diarrhea may be helpful in some cases, but they are not recommended for people whose diarrhea is from a bacterial infection or parasite—stopping the diarrhea traps the organism in the intestines, prolonging the problem. Instead, doctors usually prescribe antibiotics. Viral causes are either treated with medication or left to run their course, depending on the severity and type of the virus.

#### **Preventing Dehydration**

Dehydration occurs when the body has lost too much fluid and electrolytes (the salts potassium and sodium). The fluid and electrolytes lost during diarrhea need to be replaced promptly—the body cannot function properly without them. Dehydration is particularly dangerous for children, who can die from it within a matter of days.

Although water is extremely important in preventing dehydration, it does not contain electrolytes. To maintain electrolyte levels, you should also have chicken or beef broth, which contains sodium, and fruit and cola drinks, which contain potassium.

For children, doctors often recommend a special rehydration solution that contains the nutrients they need. You can buy this

solution in the grocery store without a prescription. Examples include Pedialyte, Ceralyte, and Infalyte.

#### **Tips About Food**

Until diarrhea subsides, try to avoid milk products and foods that are greasy, highfiber, or very sweet. These foods tend to aggravate diarrhea.

As you improve, you can add soft, bland foods to your diet, including bananas, plain rice, boiled potatoes, toast, crackers, cooked carrots, and baked chicken without the skin or fat. For children, the pediatrician may recommend what is called the BRAT diet: bananas, rice, applesauce, and toast.

# Preventing Traveler's Diarrhea

Traveler's diarrhea happens when you consume food or water contaminated with bacteria, viruses, or parasites. You can take the following precautions to prevent traveler's diarrhea when you go abroad:

- Do not drink any tap water, not even when brushing your teeth.
- Do not drink unpasteurized milk or dairy products.
- Do not use ice made from tap water.
- Avoid all raw fruits and vegetables (including lettuce and fruit salad) unless they can be peeled and you peel them yourself.
- Do not eat raw or rare meat and fish.
- Do not eat meat or shellfish that is not hot when served to you.
- Do not eat food from street vendors.

You can safely drink bottled water (if you are the one to break the seal), carbonated soft drinks, and hot drinks like coffee or tea.

Depending on where you are going and how long you are staying, your doctor may recommend that you take antibiotics before leaving to protect you from possible infection.

### **Points to Remember**

- Diarrhea is a common problem that usually resolves on its own.
- Diarrhea is dangerous if a person becomes dehydrated.
- Causes include viral, bacterial, or parasitic infections; food intolerance; reactions to medicine; intestinal diseases; and functional bowel disorders.
- Treatment involves replacing lost fluids and electrolytes. Depending on the cause of the problem, a person might also need medication to stop the diarrhea or treat an infection. Children may need an oral rehydration solution to replace lost fluids and electrolytes.
- Call the doctor if a person with diarrhea has severe pain in the abdomen or rectum, a fever of 102 degrees Fahrenheit or higher, blood in the stool, signs of dehydration, or diarrhea for more than 3 days.

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# National Digestive Diseases Information Clearinghouse

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES National Institutes of Health

NIH Publication No. 99–2749 February 1999

# Gastroparesis and Diabetes

National Digestive Diseases Information Clearinghouse



National Institute of Diabetes and Digestive and Kidney Diseases

NATIONAL INSTITUTES OF HEALTH Gastroparesis is a disorder in which the stomach takes too long to empty its contents. Gastroparesis is most often a complication of type 1 diabetes. At least 20 percent of people with type 1 diabetes develop gastroparesis. It also occurs in people with type 2 diabetes, although less often.

Gastroparesis happens when nerves to the stomach are damaged or stop working. The vagus nerve controls the movement of food through the digestive tract. If the vagus nerve is damaged, the muscles of the stomach and intestines do not work normally, and the movement of food is slowed or stopped.

Diabetes can damage the vagus nerve if blood glucose (sugar) levels remain high over a long period of time. High blood glucose causes chemical changes in nerves and damages the blood vessels that carry oxygen and nutrients to the nerves.

# **Symptoms**

Symptoms of gastroparesis are

- Nausea
- Vomiting
- An early feeling of fullness when eating
- Weight loss
- Abdominal bloating
- Abdominal discomfort.

These symptoms may be mild or severe, depending on the person.



# **Complications of Gastroparesis**

If food lingers too long in the stomach, it can cause problems like bacterial overgrowth from the fermentation of food. Also, the food can harden into solid masses called bezoars that may cause nausea, vomiting, and obstruction in the stomach. Bezoars can be dangerous if they block the passage of food into the small intestine.

Gastroparesis can make diabetes worse by adding to the difficulty of controlling blood glucose. When food that has been delayed in the stomach finally enters the small intestine and is absorbed, blood glucose levels rise. Since gastroparesis makes stomach emptying unpredictable, a person's blood glucose levels can be erratic and difficult to control.

# Major Causes of Gastroparesis

- Diabetes.
- Postviral syndromes.
- Anorexia nervosa.
- Surgery on the stomach or vagus nerve.
- Medications, particularly anticholinergics and narcotics (drugs that slow contractions in the intestine).
- Gastroesophageal reflux disease (rarely).
- Smooth muscle disorders such as amyloidosis and scleroderma.
- Nervous system diseases, including abdominal migraine and Parkinson's disease.
- Metabolic disorders, including hypothyroidism.

# Diagnosis

The diagnosis of gastroparesis is confirmed through one or more of the following tests:

• **Barium x-ray:** After fasting for 12 hours, you will drink a thick liquid called barium, which coats the inside of the stomach, making it show up on the x-ray. Normally, the stomach will be empty of all food after 12 hours of fasting. If the x-ray shows food in the stomach, gastroparesis is likely. If the x-ray shows an empty stomach but the doctor still suspects that you have delayed emptying, you may need to repeat the test another day. On any one day, a person with gastroparesis may digest a meal normally, giving a falsely normal test result. If you have diabetes, your doctor may have special instructions about fasting.

- Barium beefsteak meal: You will eat a meal that contains barium, thus allowing the radiologist to watch your stomach as it digests the meal. The amount of time it takes for the barium meal to be digested and leave the stomach gives the doctor an idea of how well the stomach is working. This test can help detect emptying problems that do not show up on the liquid barium x-ray. In fact, people who have diabetes-related gastroparesis often digest fluid normally, so the barium beefsteak meal can be more useful.
- Radioisotope gastric-emptying scan: You will eat food that contains a radioisotope, a slightly radioactive substance that will show up on the scan. The dose of radiation from the radioisotope is small and not dangerous. After eating, you will lie under a machine that detects the radioisotope and shows an image of the food in the stomach and how quickly it leaves the stomach. Gastroparesis is diagnosed if more than half of the food remains in the stomach after 2 hours.
- Gastric manometry: This test measures electrical and muscular activity in the stomach. The doctor passes a thin tube down the throat into the stomach. The tube contains a wire that takes measurements of the stomach's electrical and muscular activity as it digests liquids and solid food. The measurements show how the stomach is working and whether there is any delay in digestion.
- **Blood tests:** The doctor may also order laboratory tests to check blood counts and to measure chemical and electrolyte levels.

To rule out causes of gastroparesis other than diabetes, the doctor may do an upper endoscopy or an ultrasound.

- Upper endoscopy. After giving you a sedative, the doctor passes a long, thin, tube called an endoscope through the mouth and gently guides it down the esophagus into the stomach. Through the endoscope, the doctor can look at the lining of the stomach to check for any abnormalities.
- Ultrasound. To rule out gallbladder disease or pancreatitis as a source of the problem, you may have an ultrasound test, which uses harmless sound waves to outline and define the shape of the gallbladder and pancreas.

## Treatment

The primary treatment goal for gastroparesis related to diabetes is to regain control of blood glucose levels. Treatments include insulin, oral medications, changes in what and when you eat, and, in severe cases, feeding tubes and intravenous feeding.

It is important to note that in most cases treatment does not cure gastroparesis—it is usually a chronic condition. Treatment helps you manage the condition so that you can be as healthy and comfortable as possible.

# Insulin for blood glucose control in people with diabetes

If you have gastroparesis, your food is being absorbed more slowly and at unpredictable times. To control blood glucose, you may need to

- Take insulin more often.
- Take your insulin after you eat instead of before.
- Check your blood glucose levels frequently after you eat, administering insulin whenever necessary.

Some doctors recommend taking two injections of intermediate insulin every day and as many injections of a fast-acting insulin as needed according to blood glucose monitoring. The newest insulin, lispro insulin (Humalog), is a quick-acting insulin that might be advantageous for people with gastroparesis. It starts working within 5 to 15 minutes after injection and peaks after 1 to 2 hours, lowering blood glucose levels after a meal about twice as fast as the slower-acting regular insulin. Your doctor will give you specific instructions based on your particular needs.

## Medication

Several drugs are used to treat gastroparesis. Your doctor may try different drugs or combinations of drugs to find the most effective treatment.

- Metoclopramide (Reglan). This drug stimulates stomach muscle contractions to help empty food. It also helps reduce nausea and vomiting. Metoclopramide is taken 20 to 30 minutes before meals and at bedtime. Side effects of this drug are fatigue, sleepiness, and sometimes depression, anxiety, and problems with physical movement.
- Cisapride (Propulsid). Cisapride stimulates stomach movement and also causes intestinal contractions, which can be helpful. This drug is generally more potent than metoclopramide, but causes fewer side effects (headache, abdominal cramps, diarrhea). Cisapride is also taken 20 to 30 minutes before meals and at bedtime. Metoclopramide and cisapride are called promotility agents.
- Erythromycin. This antibiotic also improves stomach emptying. It works by increasing the contractions that move food through the stomach. Side effects are nausea, vomiting, and abdominal cramps.

- **Domperidone.** The Food and Drug Administration is reviewing domperidone, which has been used elsewhere in the world to treat gastroparesis. It is a promotility agent like cisapride and metoclopramide. Domperidone also helps with nausea.
- Other medications. Other medications may be used to treat symptoms and problems related to gastroparesis. For example, an antiemetic can help with nausea and vomiting. Antibiotics will clear up a bacterial infection. If you have a bezoar, the doctor may use an endoscope to inject medication that will dissolve it.

#### Meal and food changes

Changing your eating habits can help control gastroparesis. Your doctor or dietitian will give you specific instructions, but you may be asked to eat six small meals a day instead of three large ones. If less food enters the stomach each time you eat, it may not become overly full. Or the doctor or dietitian may suggest that you try several liquid meals a day until your blood glucose levels are stable and the gastroparesis is corrected. Liquid meals provide all the nutrients found in solid foods, but can pass through the stomach more easily and quickly.

The doctor may also recommend that you avoid fatty and high-fiber foods. Fat naturally slows digestion—a problem you do not need if you have gastroparesis—and fiber is difficult to digest. Some high-fiber foods like oranges and broccoli contain material that cannot be digested. Avoid these foods because the indigestible part will remain in the stomach too long and possibly form bezoars.

#### **Feeding tube**

If other approaches do not work, you may need surgery to insert a feeding tube. The tube, called a jejunostomy tube, is inserted through the skin on your abdomen into the small intestine. The feeding tube allows you to put nutrients directly into the small intestine, bypassing the stomach altogether. You will receive special liquid food to use with the tube. A jejunostomy is particularly useful when gastroparesis prevents the nutrients and medication necessary to regulate blood glucose levels from reaching the bloodstream. By avoiding the source of the problem—the stomach—and putting nutrients and medication directly into the small intestine, you ensure that these products are digested and delivered to your bloodstream quickly. A jejunostomy tube can be temporary and is used only if necessary when gastroparesis is severe.

#### **Parenteral nutrition**

Parenteral nutrition refers to delivering nutrients directly into the bloodstream, bypassing the digestive system. The doctor places a thin tube called a catheter in a chest vein, leaving an opening to it outside the skin. For feeding, you attach a bag containing liquid nutrients or medication to the catheter. The fluid enters your bloodstream through the vein. Your doctor will tell you what type of liquid nutrition to use.

This approach is an alternative to the jejunostomy tube and is usually a temporary method to get you through a difficult spell of gastroparesis. Parenteral nutrition is used only when gastroparesis is severe and is not helped by other methods. The U.S. Government does not endorse or favor any specific commercial product or company. Brand names appearing in this publication are used only because they are considered essential in the context of the information reported herein.

#### **Points to Remember**

- Gastroparesis is a common complication of type 1 diabetes.
- Gastroparesis is the result of damage to the vagus nerve, which controls the movement of food through the digestive system. Instead of the food moving through the digestive tract normally, it is retained in the stomach.
- The vagus nerve becomes damaged after years of poor blood glucose control, resulting in gastroparesis. In turn, gastroparesis contributes to poor blood glucose control.
- Symptoms of gastroparesis include early fullness, nausea, vomiting, and weight loss.
- Gastroparesis is diagnosed through tests such as x-rays, manometry, and scanning.
- Treatments include changes in when and what you eat, changes in insulin type and timing of injections, oral medications, a jejunostomy, or parenteral nutrition.

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES National Institutes of Health

NIH Publication No. 99–4348 May 1999

# Hemochromatosis

National Digestive Diseases Information Clearinghouse



National Institute of Diabetes and Digestive and Kidney Diseases

NATIONAL INSTITUTES OF HEALTH Hemochromatosis, the most common form of iron overload disease, is an inherited disorder that causes the body to absorb and store too much iron. The extra iron builds up in organs and damages them. Without treatment, the disease can cause these organs to fail.

Iron is an essential nutrient found in many foods. The greatest amount is found in red meat and iron-fortified bread and cereal. In the body, iron becomes part of hemoglobin, a molecule in the blood that transports oxygen from the lungs to all body tissues.

Healthy people usually absorb about 10 percent of the iron contained in the food they eat to meet the body needs. People with hemochromatosis absorb more than the body needs. The body has no natural way to rid itself of excess iron, so extra iron is stored in body tissues, especially the liver, heart, and pancreas.

# Causes

Genetic or hereditary hemochromatosis is mainly associated with a defect in a gene called *HFE*, which helps regulate the amount of iron absorbed from food. There are two known important mutations in *HFE*, named C282Y and H63D. C282Y is the most important. When C282Y is inherited from both parents, iron is overabsorbed from the diet and hemochromatosis can result. H63D usually causes little increase in iron absorption, but a person



*Excess iron is stored in body tissues, especially the liver, heart, and pancreas.* 

with H63D from one parent and C282Y from the other may rarely develop hemochromatosis.



U.S. Department of Health and Human Services The genetic defect of hemochromatosis is present at birth, but symptoms rarely appear before adulthood. A person who inherits the defective gene from both parents may develop hemochromatosis. A person who inherits the defective gene from only one parent is a carrier for the disease but usually does not develop it. However, carriers might have a slight increase in iron absorption.

Scientists hope that further study of *HFE* will reveal how the body normally metabolizes iron. They also want to learn how iron injures cells and whether it contributes to organ damage in other diseases, such as alcoholic liver disease, hepatitis C, porphyria cutanea tarda, heart disease, reproductive disorders, cancer, autoimmune hepatitis, diabetes, and joint disease.

Juvenile hemochromatosis and neonatal hemochromatosis are two forms of the disease that are not caused by an *HFE* defect. Their cause is unknown. The juvenile form leads to severe iron overload and liver and heart disease in adolescents and young adults between the ages of 15 and 30, and the neonatal form causes the same problems in newborn infants.

### **Risk Factors**

Hereditary hemochromatosis is one of the most common genetic disorders in the United States. It most often affects Caucasians of Northern European descent, although other ethnic groups are also affected. About 5 people in 1,000 (0.5 percent) of the U.S. Caucasian population carry two copies of the hemochromatosis gene and are susceptible to developing the disease. One person in 8 to 12 is a carrier of the abnormal gene. Hemochromatosis is less common in African Americans, Asian Americans, Hispanic Americans, and American Indians. Although both men and women can inherit the gene defect, men are about five times more likely to be diagnosed with the effects of hereditary hemochromatosis than women. Men also tend to develop problems from the excess iron at a younger age.

# **Symptoms**

Joint pain is the most common complaint of people with hemochromatosis. Other common symptoms include fatigue, lack of energy, abdominal pain, loss of sex drive, and heart problems. Symptoms tend to occur in men between the ages of 30 and 50 and in women over age 50. However, many people have no symptoms when they are diagnosed.

If the disease is not detected early and treated, iron may accumulate in body tissues and may eventually lead to serious problems such as

- arthritis
- liver disease, including an enlarged liver, cirrhosis, cancer, and liver failure
- damage to the pancreas, possibly causing diabetes
- heart abnormalities, such as irregular heart rhythms or congestive heart failure
- impotence
- early menopause
- abnormal pigmentation of the skin, making it look gray or bronze
- thyroid deficiency
- damage to the adrenal gland

2 Hemochromatosis

# Diagnosis

A thorough medical history, physical examination, and routine blood tests help rule out other conditions that could be causing the symptoms. This information often provides helpful clues, such as a family history of arthritis or unexplained liver disease.

Blood tests can determine whether the amount of iron stored in the body is too high. The transferrin saturation test determines how much iron is bound to the protein that carries iron in the blood. The serum ferritin test shows the level of iron in the liver. If either of these tests shows higher than normal levels of iron in the body, doctors can order a special blood test to detect the HFE mutation, which will help confirm the diagnosis. (If the mutation is not present, hereditary hemochromatosis is not the reason for the iron buildup, and the doctor will look for other causes.) A liver biopsy, in which a tiny piece of liver tissue is removed and examined under a microscope, may be needed. It will show how much iron has accumulated in the liver and whether the liver is damaged.

Hemochromatosis is often undiagnosed and untreated. It is considered rare and doctors may not think to test for it. The initial symptoms can be diverse and vague and can mimic the symptoms of many other diseases. Also, doctors may focus on the conditions caused by hemochromatosis arthritis, liver disease, heart disease, or diabetes—rather than on the underlying iron overload. However, if the iron overload caused by hemochromatosis is diagnosed and treated before organ damage has occurred, a person can live a normal, healthy life. Hemochromatosis is usually treated by a specialist in liver disorders (hepatologist), digestive disorders (gastroenterologist), or blood disorders (hematologist). Because of the other problems associated with hemochromatosis, several other specialists may be on the treatment team, such as an endocrinologist, cardiologist, or rheumatologist. Internists or family practitioners can also treat the disease.

#### Treatment

Treatment is simple, inexpensive, and safe. The first step is to rid the body of excess iron. The process is called phlebotomy, which means removing blood. Depending on how severe the iron overload is, a pint of blood will be taken once or twice a week for several months to a year, and occasionally longer. Blood ferritin levels will be tested periodically to monitor iron levels. The goal is to bring blood ferritin levels to the low end of normal and keep them there. Depending on the lab, that means 25 to 50 micrograms of ferritin per liter of serum. Depending on the amount of iron overload at diagnosis, reaching normal levels can take many phlebotomies.

Once iron levels return to normal, maintenance therapy, which involves giving a pint of blood every 2 to 4 months for life, begins. Some people may need it more often. An annual blood ferritin test will help determine how often blood should be removed.

The earlier hemochromatosis is diagnosed and treated in appropriate cases, the better. If treatment begins before any organs are damaged, associated conditions—such as liver disease, heart disease, arthritis, and diabetes—can be prevented. The outlook for people who already have these conditions at diagnosis depends on the degree of organ damage. For example, treating hemochromatosis can stop the progression of liver disease in its early stages, which means a normal life expectancy. However, if cirrhosis has developed, the person's risk of developing liver cancer increases, even if iron stores are reduced to normal levels. Appropriate regular follow-up with a specialist is necessary.

People who have complications of hemochromatosis may want to consider getting treatment from a specialized hemochromatosis center. These centers are located throughout the country. Information is available from the organizations listed on page 5.

People with hemochromatosis should not take iron supplements. Those who have liver damage should not drink alcoholic beverages because they may further damage the liver.

Although treatment cannot cure the conditions associated with established hemochromatosis, it will help most of them. The main exception is arthritis, which does not improve even after excess iron is removed.

## **Tests for Hemochromatosis**

Screening for hemochromatosis (testing people who have no symptoms) is not a routine part of medical care or checkups. However, researchers and public health officials do have some suggestions:

- Brothers and sisters of people who have hemochromatosis should have their blood tested to see if they have the disease or are carriers.
- Parents, children, and other close relatives of people who have the disease should consider testing.
- Doctors should consider testing people who have joint disease, severe and continuing fatigue, heart disease, elevated liver enzymes, impotence, and diabetes, because these conditions may result from hemochromatosis.

Since the genetic defect is common and early detection and treatment are so effective, some researchers and education and advocacy groups have suggested that widespread screening for hemochromatosis would be cost-effective and should be conducted. However, a simple, inexpensive, and accurate test for routine screening does not yet exist, and the available options have limitations. For example, the genetic test provides a definitive diagnosis, but it is expensive. The blood test for transferrin saturation is widely available and relatively inexpensive, but it may have to be done twice with careful handling to confirm a diagnosis and to show that it is the consequence of iron overload.
# Research

Current research in hemochromatosis is concentrated in four areas:

**Genetics.** Scientists are working to understand more about how the *HFE* gene normally regulates iron levels and why not everyone with an abnormal pair of genes develops the disease.

**Pathogenesis.** Scientists are studying how iron injures body cells. Iron is an essential nutrient, but above a certain level it can damage or even kill the cell.

**Epidemiology.** Research is under way to explain why the amounts of iron people normally store in their bodies differ. Research is also being conducted to determine how many people with the defective *HFE* gene go on to develop symptoms, as well as why some people develop symptoms and others do not.

Screening and testing. Scientists are working to determine at what age testing is most effective, which groups should be tested, and what the best tests for widespread screening are.

# **For More Information**

Information about hemochromatosis is available from these organizations:

#### American Hemochromatosis Society, Inc.

777 East Atlantic Avenue
Suite Z-363
Delray Beach, FL 33483–5352
Phone: 1–888–655–IRON (4766) or (561) 266–9037
Fax: (561) 278–0171
Email: ahs@emi.net
Internet: www.americanhs.org

#### **American Liver Foundation**

75 Maiden Lane Suite 603 New York, NY 10038–4810 Phone: 1–800–465–4837 or 1–888–443–7222 Fax: (973) 256–3214 Email: info@liverfoundation.org Internet: www.liverfoundation.org

### The Hemochromatosis Foundation, Inc.

P.O. Box 8569
Albany, NY 12208
(Please send a self-addressed, stamped envelope to receive materials.)
Phone: (518) 489–0972
Fax: (518) 489–0227
Internet: www.hemochromatosis.org

#### National Organization for Rare Disorders, Inc. (NORD)

55 Kenosia Avenue P.O. Box 1968 Danbury, CT 06813–1968 Phone: 1–800–999–6673 or (203) 744–0100 Fax: (203) 798–2291 Email: orphan@rarediseases.org Internet: www.rarediseases.org

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Publications produced by the clearinghouse are carefully reviewed by both NIDDK scientists and outside experts. This fact sheet was reviewed by Bruce R. Bacon, M.D., Saint Louis University School of Medicine, and Anthony Tavill, M.D., Case Western Reserve University School of Medicine.

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES National Institutes of Health

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# Viral Hepatitis A to E and Beyond

National Digestive Diseases Information Clearinghouse



National Institute of Diabetes and Digestive and Kidney Diseases

NATIONAL INSTITUTES OF HEALTH Hepatitis is inflammation of the liver. Several different viruses cause viral hepatitis. They are named the hepatitis A, B, C, D, and E viruses.

All of these viruses cause acute, or shortterm, viral hepatitis. The hepatitis B, C, and D viruses can also cause chronic hepatitis, in which the infection is prolonged, sometimes lifelong.

Other viruses may also cause hepatitis, but they have yet to be discovered and they are obviously rare causes of the disease.

# Symptoms of viral hepatitis

Symptoms include

- jaundice (yellowing of the skin and eyes)
- fatigue
- abdominal pain
- loss of appetite
- nausea
- diarrhea
- vomiting.

However, some people do not have symptoms until the disease is advanced.



Hepatitis is inflammation of the liver.

# **Hepatitis** A

### **Disease Spread**

Primarily through food or water contaminated by feces from an infected person. Rarely, it spreads through contact with infected blood.

### **People at Risk**

International travelers; people living in areas where hepatitis A outbreaks are common; people who live with or have sex with an infected person; and, during outbreaks, day care children and employees, sexually active gay men, and injection drug users.

### Prevention

The hepatitis A vaccine; also, avoiding tap water when traveling internationally and practicing good hygiene and sanitation.

### Treatment

Hepatitis A usually resolves on its own over several weeks.

# Hepatitis **B**

### **Disease Spread**

Through contact with infected blood, through sex with an infected person, and from mother to child during childbirth.

### **People at Risk**

Injection drug users, people who have sex with an infected person, men who have sex with men, children of immigrants from disease-endemic areas, people who live with an infected person, infants born to infected mothers, health care workers, and hemodialysis patients.

### Prevention

The hepatitis B vaccine.

### Treatment

Drug treatment with alpha interferon or lamivudine.

# Hepatitis C

### **Disease Spread**

Primarily through contact with infected blood; less commonly, through sexual contact and childbirth.

### **People at Risk**

Injection drug users, hemodialysis patients, health care workers, people who have sex with an infected person, people who have multiple sex partners, infants born to infected women, and people who received a transfusion of blood or blood products before July 1992 or clotting factors made before 1987.

### Prevention

There is no vaccine for hepatitis C—the only way to prevent the disease is to reduce the risk of exposure to the virus. This means avoiding behaviors like sharing drug needles or sharing personal items like toothbrushes, razors, and nail clippers with an infected person.

### Treatment

Drug treatment with alpha interferon or combination treatment with interferon and the drug ribavirin.

# **Hepatitis D**

### **Disease Spread**

Through contact with infected blood. This disease occurs only in people who are already infected with hepatitis B.

### **People at Risk**

Anyone infected with hepatitis B. Injection drug users who have hepatitis B have the highest risk. People who have hepatitis B are also at risk if they have sex with a person infected with hepatitis D or if they live with an infected person.

### Prevention

Immunization against hepatitis B for those not already infected; also, avoiding exposure to infected blood, contaminated needles, and an infected person's personal items (toothbrush, razor, nail clippers).

### Treatment

Drug treatment with alpha interferon.

# **Hepatitis E**

### **Disease Spread**

Through food or water contaminated by feces from an infected person. This disease is uncommon in the United States.

### **People at Risk**

International travelers; people living in areas where hepatitis E outbreaks are common; and people who live or have sex with an infected person.

### Prevention

There is no vaccine for hepatitis E—the only way to prevent the disease is to reduce the risk of exposure to the virus. This means avoiding tap water when traveling internationally and practicing good hygiene and sanitation.

### Treatment

Hepatitis E usually resolves on its own over several weeks to months.

# Other Causes of Viral Hepatitis

Some cases of viral hepatitis cannot be attributed to the hepatitis A, B, C, D, or E viruses. This is called non A...E hepatitis or hepatitis X. Scientists have identified several candidate viruses, but none have been proven to cause hepatitis. The search for the virus responsible for hepatitis X continues.

# **For More Information**

Information about viral hepatitis is also available from

American Liver Foundation 75 Maiden Lane, Suite 603 New York, NY 10038 Phone: (800) GO-LIVER (465–4837) Internet: www.liverfoundation.org

Centers for Disease Control and Prevention National Center for Infectious Diseases Hepatitis Branch 1600 Clifton Road Atlanta, GA 30333 Phone: (888) 443–7232 Internet: www.cdc.gov/ncidod/ diseases/hepatitis

Hepatitis Foundation International 30 Sunrise Terrace Cedar Grove, NJ 07009–1423 Phone: (800) 891–0707 or (973) 239–1035 Internet: www.hepfi.org

# National Digestive Diseases Information Clearinghouse

2 Information Way Bethesda, MD 20892–3570 Phone: 1–800–891–5389 or (301) 654–3810 Fax: (301) 907–8906 Email: nddic@info.niddk.nih.gov

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Publications produced by the clearinghouse are carefully reviewed by both NIDDK scientists and outside experts. This fact sheet was reviewed by Bruce Bacon, M.D., St. Louis University.

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES National Institutes of Health

NIH Publication No. 02–4762 December 2001

# Bacteria and Foodborne Illness

National Digestive Diseases Information Clearinghouse



National Institute of Diabetes and Digestive and Kidney Diseases

NATIONAL INSTITUTES OF HEALTH Foodborne illness results from eating food contaminated with bacteria (or their toxins) or other pathogens such as parasites or viruses. The illnesses range from upset stomach to more serious symptoms, including diarrhea, fever, vomiting, abdominal cramps, and dehydration. Although most foodborne infections are undiagnosed and unreported, the Centers for Disease Control and Prevention estimates that every year about 76 million people in the United States become ill from pathogens in food. Of these, up to 5,000 die.

# Causes

Harmful bacteria are the most common causes of foodborne illnesses. Some bacteria may be present on foods when you purchase them. Raw foods are not sterile. Raw meat and poultry may become contaminated during slaughter. Seafood may become contaminated during harvest or through processing. One in 20,000 eggs may be contaminated with Salmonella inside the egg shell. Produce such as lettuce, tomatoes, sprouts, and melons can become contaminated with Salmonella, Shigella, or Escherichia coli (E. coli) O157:H7. Contamination can occur during growing, harvesting, processing, storing, shipping, or final preparation. Sources of contamination are varied; however, these items are grown in the soil and therefore may become contaminated during growth or through processing and distribution.

Contamination may also occur during food preparation in the restaurant or in the person's kitchen.

When food is cooked and left out for more than 2 hours at room temperature, bacteria can multiply quickly. Most bacteria grow undetected because they do not produce an "off" odor or change the color or texture of the food. Freezing food slows or stops bacteria's growth but does not destroy the bacteria. The microbes can become reactivated when the food is thawed. Refrigeration may slow the growth of some bacteria, but thorough cooking is needed to destroy the bacteria.

# **Symptoms**

In most cases of foodborne illness, symptoms resemble intestinal flu and may last a few hours or even several days. Symptoms can range from mild to serious and include

- Abdominal cramps
- Nausea
- Vomiting
- Diarrhea
- Fever
- Dehydration

# **Risk Factors**

Some people are at greater risk for bacterial infections because of their age or immune status. Young children, pregnant women and their fetuses, the elderly, and people with lowered immunity are at greatest risk.

# **Complications**

Some micro-organisms, such as *Listeria monocytogenes* and *Clostridium botulinum*, cause far more serious illness than vomiting or diarrhea. They can cause spontaneous abortion or death.

In some people, especially children, hemolytic uremic syndrome (HUS) can result from infection by a particular strain of bacteria, *E. coli* O157:H7, and can lead to kidney failure and death. HUS is a rare disorder that affects primarily young children between the ages of 1 and 10 years and is the leading cause of acute renal failure in previously healthy children. The child may become infected after consuming a contaminated food, such as meat (especially undercooked ground beef), unpasteurized apple cider or apple juice, or raw sprouts.

The most common symptoms of infection are vomiting, abdominal pain, and diarrhea, which may be bloody. In 5 to 10 percent of cases, HUS develops about 2 to 6 days after the onset of illness. This disease may last from 1 to 15 days and is fatal in 3 to 5 percent of cases. Symptoms of HUS include fever, lethargy, irritability, and pallor. In about half the cases, the disease progresses until the kidneys are unable to remove waste products from the blood and excrete them into the urine (acute renal failure). A decrease in circulating red blood cells and blood platelets and reduced blood flow to organs may lead to multiple organ failure. Seizures, heart failure, inflammation of the pancreas, and diabetes can also result. However, most children recover completely.

You need to see a doctor right away if you have any of the following symptoms, with or without gastrointestinal symptoms:

- Signs of shock, such as weak or rapid pulse; shallow breathing; cold, clammy, pale skin; shaking or chills; or chest pain.
- Signs of severe dehydration, such as dry mouth, sticky saliva, decreased urine output, dizziness, fatigue, sunken eyes, low blood pressure, or increased heart rate and breathing.
- Confusion or difficulty reasoning.

# Diagnosis

Your doctor may be able to diagnose foodborne illness from a list of what you've recently eaten and results from the proper laboratory tests. Diagnostic tests for foodborne illness should include examination of the feces. A sample of the suspected food, if available, can also be tested for bacteria and their toxins as well as for viruses and parasites.

### Treatment

Most cases of foodborne illness are mild and can be treated by increasing fluid intake, either orally or intravenously, to replace lost fluids and electrolytes. In cases with gastrointestinal or neurologic symptoms, people should seek medical attention.

In the most severe situations, such as HUS, the patient may need hospitalization in order to receive supportive nutritional and medical therapy. Maintaining adequate fluid and electrolyte balance and controlling blood pressure are important. Doctors will try to minimize the impact of reduced kidney function. Early dialysis is crucial until the kidneys can function normally again, and blood transfusions may be needed.

# Prevention

Most cases of foodborne illness can be prevented through proper cooking or processing of food, which kills bacteria. In addition, because bacteria multiply rapidly between 40°F and 140°F, food must be kept out of this "danger zone."

To prevent harmful bacteria from growing in food, always

- Refrigerate foods promptly. If you let prepared food stand at room temperature for more than 2 hours, it may not be safe to eat. Set your refrigerator at 40°F or lower and your freezer at 0°F.
- Cook food to the appropriate temperature (145°F for roasts, steaks, and chops of beef, veal, and lamb; 160°F for pork, ground veal, and ground beef; 165°F for ground poultry; and 180°F for whole poultry). Use a thermometer to be sure! Foods are properly cooked only when they are heated long enough and at a high enough temperature to kill the harmful bacteria that cause illness.
- Prevent cross-contamination. Bacteria can spread from one food product to another throughout the kitchen and can get onto cutting boards, knives, sponges, and countertops. So keep raw meat, poultry, seafood, and their juices away from other foods that are ready to eat.
- Handle food properly. Always wash your hands before touching food and after using the bathroom, changing diapers, or handling pets, as well as after handling raw meat, poultry, fish, shellfish, or eggs. Clean surfaces well before preparing food on them.
- Keep cold food cold and hot food hot.

- Maintain hot cooked food at 140°F or higher.
- Reheat cooked food to at least 165°F.
- Refrigerate or freeze perishables, prepared food, and leftovers within 2 hours.
- Never defrost food on the kitchen counter. Use the refrigerator, cold running water, or the microwave oven.
- Never let food marinate at room temperature; refrigerate it.
- Divide large amounts of leftovers into small, shallow containers for quick cooling in the refrigerator.
- Remove the stuffing immediately from poultry and other meats and refrigerate it in a separate container.
- Do not pack the refrigerator. Cool air must circulate to keep food safe.

# **Food Irradiation**

Food irradiation is the treatment of food with high energy such as gamma rays, electron beams, or x rays as a means of cold pasteurization, which destroys living bacteria, to control foodborne disease. The United States relies exclusively on the use of gamma rays, which are similar to ultraviolet light and microwaves and pass through the food leaving no residue or "radioactivity." Food irradiation is currently approved for wheat, potatoes, spices, seasonings, pork, poultry, red meats, whole fresh fruits, and dry or dehydrated products. Although irradiation destroys many bacteria, it does not sterilize food. Even if you're using food that has been irradiated by the manufacturer, you must continue to take precautions against foodborne illness, through proper refrigeration and handling, to safeguard against any surviving organisms.

### Links to Other Disorders

Scientists suspect that foodborne pathogens are linked to chronic disorders and can even cause permanent tissue or organ destruction. Research suggests that when some people are infected by foodborne pathogens, the activation of their immune system can trigger an inappropriate autoimmune response, which means the immune system attacks the body's own cells. In some people, an autoimmune response leads to a chronic health condition. Chronic disorders that may be triggered by foodborne pathogens are

- Arthritis
- Inflammatory bowel disease
- Kidney failure
- Guillain-Barré syndrome
- Autoimmune disorders

Further research is needed to explain the link.

# **Common Sources of Foodborne Illness**

Source of illness: Raw and undercooked meat and poultry.Symptoms: Abdominal pain, diarrhea, nausea, and vomiting.Bacteria: *Campylobacter jejuni, E. coli* O157:H7, *L. monocytogenes, Salmonella.* 

**Source of illness:** Raw (unpasteurized) milk and dairy products, such as soft cheeses. **Symptoms:** Nausea and vomiting, fever, abdominal cramps, and diarrhea. **Bacteria:** *L. monocytogenes, Salmonella, Shigella, Staphylococcus aureus, C. jejuni.* 

**Source of illness:** Raw or undercooked eggs. Raw eggs may not be recognized in some foods such as homemade hollandaise sauce, caesar and other salad dressings, tiramisu, homemade ice cream, homemade mayonnaise, cookie dough, and frostings. **Symptoms:** Nausea and vomiting, fever, abdominal cramps, and diarrhea. **Bacteria:** *Salmonella enteriditis.* 

Source of illness: Raw or undercooked shellfish. Symptoms: Chills, fever, and collapse. Bacteria: *Vibrio vulnificus, Vibrio parahaemolyticus.* 

**Source of illness:** Improperly canned goods, and smoked or salted fish. **Symptoms:** Double vision, inability to swallow, difficulty speaking, and inability to breathe. (Seek medical help right away!) **Bacteria:** *C. botulinum*.

Source of illness: Fresh or minimally processed produce.
Symptoms: Diarrhea, nausea, and vomiting.
Bacteria: *E. coli* O157:H7, *L. monocytogenes, Salmonella, Shigella, Yersinia enterocolitica*, viruses, and parasites.

# **Points To Remember**

- Foodborne illness results from eating food that is contaminated with bacteria, viruses, or parasites.
- People at greater risk for foodborne illness include young children, pregnant women and their fetuses, the elderly, and people with lowered immunity.
- Symptoms usually resemble intestinal flu. See a doctor immediately if you have more serious problems, or if you do not seem to be improving as you'd expect.
- Treatment may range from replacement of lost fluids and electrolytes for mild cases of foodborne illness, to hospitalization for severe conditions such as hemolytic uremic syndrome.
- You can prevent foodborne illness by taking the following precautions:
  - Wash your hands with hot, soapy water before preparing food and after using the bathroom or changing diapers.
  - Separate raw meat, poultry, or seafood from other foods to keep these foods and their juices away from ready-to-eat foods.
  - Cook foods properly and at a high enough temperature to kill harmful bacteria.
  - Refrigerate foods within 2 hours or less after cooking because cold temperatures will help keep harmful bacteria from growing and multiplying.
  - Clean surfaces well before using them to prepare foods.

# **For More Information**

U.S. Department of Agriculture 14th & Independence Avenue, SW. Washington, DC 20250 Meat and Poultry Hotline: 1–800–535–4555 Internet: www.usda.gov

U.S. Department of Health and Human Services200 Independence Avenue, SW.Washington, DC 20201Internet: www.os.dhhs.gov

U.S. Environmental Protection Agency (EPA)
401 M Street, SW.
Washington, DC 20460–0003
Phone: (202) 260–2090
Internet: www.epa.gov

U.S. Food and Drug Administration FDA (HFE–88) 5600 Fishers Lane Rockville, MD 20857 Phone: 1–888–INFO–FDA Internet: www.fda.gov

Center for Food Safety & Applied Nutrition Food and Drug Administration 200 C Street, SW. Washington, DC 20204 Food Information Line: 1–800–SAFEFOOD Internet: vm.cfsan.fda.gov/list.html

Centers for Disease Control and Prevention 1600 Clifton Road Atlanta, GA 30333 Phone: (404) 639–3534 or 1–800–311–3435 Internet: www.cdc.gov Gateway to Government Food Safety Information Internet: www.FoodSafety.gov

Partnership for Food Safety Education Internet: www.fightbac.org

American Dietetic Association 216 West Jackson Boulevard Chicago, IL 60606–6995 Consumer Nutrition Hotline: 1–800–366–1655 Internet: www.eatright.org

# National Digestive Diseases Information Clearinghouse

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Publications produced by the clearinghouse are carefully reviewed by both NIDDK scientists and outside experts. This fact sheet was also reviewed by Dr. Howard Trachtman of the Long Island Jewish Medical Center, Dr. Peter McNally of the American College of Gastroenterology, and Howard Setter of the Food and Drug Administration.

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES National Institutes of Health

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# Cyclic Vomiting Syndrome

National Digestive Diseases Information Clearinghouse



National Institute of Diabetes and Digestive and Kidney Diseases

NATIONAL INSTITUTES OF HEALTH In cyclic vomiting syndrome (CVS), people experience bouts or cycles of severe nausea and vomiting that last for hours or even days and alternate with longer periods of no symptoms. CVS occurs mostly in children, but the disorder can affect adults, too.

CVS has no known cause. Each episode is similar to the previous ones. The episodes tend to start at about the same time of day, last the same length of time, and present the same symptoms at the same level of intensity. Although CVS can begin at any age in children and adults, it usually starts between the ages of 3 and 7. In adults, episodes tend to occur less often than they do in children, but they last longer. Furthermore, the events or situations that trigger episodes in adults cannot always be pinpointed as easily as they can in children.

Episodes can be so severe that a person may have to stay in bed for days, unable to go to school or work. No one knows for sure how many people have CVS, but medical researchers believe that more people may have the disorder than is commonly thought (as many as 1 in 50 children in one study). Because other more common diseases and

CVS has no known cause. Each episode tends to start at about the same time of day, last the same length of time, and present the same symptoms with the same level of intensity. disorders also cause cycles of vomiting, many people with CVS are initially misdiagnosed until the other disorders can be ruled out. What *is* known is that CVS can be disruptive and frightening not just to people who have it, but to the entire family as well.

# **The Four Phases of CVS**

CVS has four phases:

- Prodrome
- Episode
- Recovery
- Symptom-free interval

The **prodrome** phase signals that an episode of nausea and vomiting is about to begin. This phase, which is often marked by abdominal pain, can last from just a few minutes to several hours. Sometimes taking medicine early in the prodrome phase can stop an episode in progress. However, sometimes there is no warning: A person may simply wake up in the morning and begin vomiting.

The **episode** phase consists of nausea and vomiting; inability to eat, drink, or take medicines without vomiting; paleness; drowsiness; and exhaustion.

The **recovery** phase begins when the nausea and vomiting stop. Healthy color, appetite, and energy return.

The **symptom-free interval** phase is the period between episodes when no symptoms are present.

# Triggers

Most people can identify a specific condition or event that triggered an episode. The most common trigger is an infection. Another, often found in children, is emotional stress or excitement, often from a birthday or vacation, for example. Colds, allergies, sinus problems, and the flu can also set off episodes in some people.

Other reported triggers include eating certain foods (such as chocolate or cheese), eating too much, or eating just before going to bed. Hot weather, physical exhaustion, menstruation, and motion sickness can also trigger episodes.

# **Symptoms**

The main symptoms of CVS are severe vomiting, nausea, and retching (gagging). Episodes usually begin at night or first thing in the morning and may include vomiting or retching up to five or six times an hour during the worst of the episode. Episodes usually last anywhere from 1 to 4 days, though they can last for up to 10 days.

Other symptoms include pallor, exhaustion, and listlessness. Sometimes the nausea and vomiting are so severe that a person appears to be almost unconscious. Sensitivity to light, headache, fever, dizziness, diarrhea, and abdominal pain may also accompany an episode.

In addition, the vomiting may cause drooling and excessive thirst. Drinking water usually leads to more vomiting, though the water can dilute the acid in the vomit, making the episode a little less painful. Continuous vomiting can lead to dehydration, which means that the body has lost excessive water and salts.

# Diagnosis

CVS is hard to diagnose because no clear tests—such as a blood test or x ray—exist to identify it. A doctor must diagnose CVS by looking at symptoms and medical history and by excluding more common diseases or disorders that can also cause nausea and vomiting. Also, diagnosis takes time because doctors need to identify a pattern or cycle to the vomiting.

# **CVS and Migraine**

The relationship between migraine and CVS is still unclear, but medical researchers believe that the two are related. First, migraine headaches, which cause severe pain in the head; abdominal migraine, which causes stomach pain; and CVS are all marked by severe symptoms that start quickly and end abruptly, followed by longer periods without pain or other symptoms.

Second, many of the situations that trigger CVS also trigger migraines. Those triggers include stress and excitement.

Third, research has shown that many children with CVS either have a family history of migraine or develop migraines as they grow older.

Because of the similarities between migraine and CVS, doctors treat some people with severe CVS with drugs that are also used for migraine headaches. The drugs are designed to prevent episodes, reduce their frequency, or lessen their severity.

# Treatment

CVS cannot be cured. Treatment varies, but people with CVS are generally advised to get plenty of rest; sleep; and take medications that prevent a vomiting episode, stop or alleviate one that has already started, or relieve other symptoms.

Once a vomiting episode begins, treatment is supportive. It helps to stay in bed and sleep in a dark, quiet room. Severe nausea and vomiting may require hospitalization and intravenous fluids to prevent dehydration. Sedatives may help if the nausea continues.

Sometimes, during the prodrome phase, it is possible to stop an episode from happening altogether. For example, people who feel abdominal pain before an episode can ask their doctor about taking ibuprofen (Advil, Motrin) to try to stop it. Other medications that may be helpful are ranitidine (Zantac) or omeprazole (Prilosec), which help calm the stomach by lowering the amount of acid it makes.

During the recovery phase, drinking water and replacing lost electrolytes are very important. Electrolytes are salts that the body needs to function well and stay healthy. Symptoms during the recovery phase can vary: Some people find that their appetites return to normal immediately, while others need to begin by drinking clear liquids and then move slowly to solid food.

People whose episodes are frequent and long-lasting may be treated during the symptom-free intervals in an effort to prevent or ease future episodes. Medications that help people with migraine headaches—propranolol, cyproheptadine, and amitriptyline—are sometimes used during this phase, but they do not work for everyone. Taking the medicine daily for 1 to 2 months may be necessary to see if it helps.

In addition, the symptom-free phase is a good time to eliminate anything known

to trigger an episode. For example, if episodes are brought on by stress or excitement, this period is the time to find ways to reduce stress and stay calm. If sinus problems or allergies cause episodes, those conditions should be treated.

### **Points To Remember**

- People with CVS have severe nausea and vomiting that come in cycles.
- CVS occurs mostly in children, but adults can have it, too.
- CVS has four phases: prodrome, episode, recovery, and symptom-free interval.
- Most people can identify a condition or event that triggers an episode of nausea and vomiting. Infections and emotional stress are two common triggers.
- The main symptoms of CVS are severe vomiting, nausea, and retching. Other symptoms include pallor and exhaustion.
- The only way a doctor can diagnose CVS is by looking at symptoms and medical history to rule out any other possible causes for the nausea and vomiting. Then the doctor must identify a pattern or cycle to the symptoms.
- CVS has no cure. Treatment varies by person, but people with CVS generally need to get plenty of rest and sleep. They may also be given drugs that may prevent an episode, stop one in progress, speed up recovery, or relieve symptoms.
- Complications include dehydration, loss of electrolytes, peptic esophagitis, hematemesis, Mallory-Weiss tear, and tooth decay.

# Complications

The severe vomiting that defines CVS is a risk factor for several complications:

- **Dehydration.** Vomiting causes the body to lose water quickly.
- Electrolyte imbalance. Vomiting also causes the body to lose the important salts it needs to keep working properly.
- **Peptic esophagitis.** The esophagus (the tube that connects the mouth to the stomach) becomes injured from the stomach acid that comes up with the vomit.
- **Hematemesis.** The esophagus becomes irritated and bleeds, so blood mixes with the vomit.
- Mallory-Weiss tear. The lower end of the esophagus may tear open or the stomach may bruise from vomiting or retching.
- **Tooth decay.** The acid in the vomit can hurt the teeth by corroding the tooth enamel.

# **For More Information**

Information about cyclic vomiting syndrome is also available from

Cyclic Vomiting Syndrome Association 3585 Cedar Hill Road, NW. Canal Winchester, OH 43110 Phone: (614) 837–2586 Fax: (614) 837–2586 Email: cvsadwaites@msn.com Internet: www.beaker.iupui.edu/cvsa

National Organization for Rare Disorders Inc. (NORD) P.O. Box 8923 New Fairfield, CT 06812–8923 Phone: 1–800–999–6673 or (203) 746–6518 Fax: (203) 746–6481 Email: orphan@rarediseases.org Internet: www.rarediseases.org

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Publications produced by the clearinghouse are carefully reviewed by both NIDDK scientists and outside experts. This fact sheet was also reviewed by B.U.K. Li, M.D., of Ohio State University, and John Anderson, M.D., of Children's Hospital in Dallas.

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES National Institutes of Health

NIH Publication No. 01–4548 August 2001

# Autoimmune Hepatitis

National Digestive Diseases Information Clearinghouse



National Institute of Diabetes and Digestive and Kidney Diseases

NATIONAL INSTITUTES OF HEALTH Autoimmune hepatitis is a disease in which the body's immune system attacks liver cells. This causes the liver to become inflamed (hepatitis). Researchers think a genetic factor may predispose some people to autoimmune diseases. About 70 percent of those with autoimmune hepatitis are women, most between the ages of 15 and 40.

The disease is usually quite serious and, if not treated, gets worse over time. It's usually chronic, meaning it can last for years, and can lead to cirrhosis (scarring and hardening) of the liver and eventually liver failure.

Autoimmune hepatitis is classified as either type I or II. Type I is the most common form in North America. It occurs at any age and is more common among women than men. About half of those with type I have other autoimmune disorders, such as thyroidosis, Graves' disease, Sjögren's syndrome, autoimmune anemia, and ulcerative colitis. Type II autoimmune hepatitis is less common, typically affecting girls ages 2 to 14, although adults can have it too.



Autoimmune hepatitis affects the liver.

# **Symptoms**

Fatigue is probably the most common symptom of autoimmune hepatitis. Other symptoms include

- enlarged liver
- jaundice
- itching
- skin rashes
- joint pain
- abdominal discomfort

People in advanced stages of the disease are more likely to have symptoms such as fluid in the abdomen (ascites) or mental confusion. Women may stop having menstrual periods.

Symptoms of autoimmune hepatitis range from mild to severe. Because severe viral hepatitis or hepatitis caused by a drug—for example, certain antibiotics—has the same symptoms, tests may be needed for an exact diagnosis. Your doctor should also review and rule out all your medicines before diagnosing autoimmune hepatitis.

# **Autoimmune Disease**

One job of the immune system is to protect the body from viruses, bacteria, and other living organisms. Usually, the immune system does not react against the body's own cells. However, sometimes it mistakenly attacks the cells it is supposed to protect. This response is called autoimmunity. Researchers speculate that certain bacteria, viruses, toxins, and drugs trigger an autoimmune response in people who are genetically susceptible to developing an autoimmune disorder.

# Diagnosis

Your doctor will make a diagnosis based on your symptoms, blood tests, and liver biopsy.

• Blood tests. A routine blood test for liver enzymes can help reveal a pattern typical of hepatitis, but further tests, especially for autoantibodies, are needed to diagnose autoimmune hepatitis. Antibodies are proteins made by the immune system to fight off bacteria and viruses. In autoimmune hepatitis, the immune system makes antinuclear antibodies (ANA), antibodies to smooth muscle cells (SMA), or liver and kidney microsomes (anti-LKM). The pattern and level of these antibodies help define the type of autoimmune hepatitis (type I or type II).

Blood tests also help distinguish autoimmune hepatitis from viral hepatitis (such as hepatitis B or C) or a metabolic disease (such as Wilson's disease).

• Liver biopsy. A tiny sample of your liver tissue, examined under a microscope, can help your doctor accurately diagnose autoimmune hepatitis and tell how serious it is. You will go to a hospital or outpatient surgical facility for this procedure.

# Treatment

Treatment works best when autoimmune hepatitis is diagnosed early. With proper treatment, autoimmune hepatitis can usually be controlled. In fact, recent studies show that sustained response to treatment not only stops the disease from getting worse, but it may actually reverse some of the damage.

The primary treatment is medicine to suppress (slow down) an overactive immune system.

Both types of autoimmune hepatitis are treated with daily doses of a corticosteroid called prednisone. Your doctor may start you on a high dose (20 to 60 mg per day) and lower the dose as the disease is controlled. The goal is to find the lowest possible dose that will control your disease.

Another medicine, azathioprine (Imuran) is also used to treat autoimmune hepatitis. Like prednisone, azathioprine suppresses the immune system, but in a different way. It helps lower the dose of prednisone needed, thereby reducing its side effects. Your doctor may prescribe azathioprine, in addition to prednisone, once your disease is under control.

Most people will need to take prednisone, with or without azathioprine, for years. Some people take it for life. Corticosteroids may slow down the disease, but everyone is different. In about one out of every three people, treatment can eventually be stopped. It is important to carefully monitor your condition and promptly report any new symptoms to your doctor because the disease may return and be even more severe, especially during the first few months after stopping treatment.

In about 7 out of 10 people, the disease goes into remission, with a lessening of severity of symptoms, within 2 years of starting treatment. A portion of persons with a remission will see the disease return within 3 years, so treatment may be necessary on and off for years, if not for life.

### **Side Effects**

Both prednisone and azathioprine have side effects. Because high doses of prednisone are needed to control autoimmune hepatitis, managing side effects is very important. However, most side effects appear only after a long period of time. Some possible side effects of prednisone are

- weight gain
- anxiety and confusion
- thinning of the bones (osteoporosis)
- thinning of the hair and skin
- diabetes
- high blood pressure
- cataracts

Azathioprine can lower your white blood cell count and sometimes causes nausea and poor appetite. Rare side effects are allergic reaction, liver damage, and pancreatitis (inflammation of the pancreas gland with severe stomach pain).

### **Other Treatments**

People who do not respond to standard immune therapy or who have severe side effects may benefit from other immunosuppressive agents like cyclosporine or tacrolimus. People who progress to end stage liver disease (liver failure) may need a liver transplant. Transplantation is a promising alternative, with a 1-year survival rate of 90 percent and a 5-year survival rate of 70 to 80 percent.

# Hope Through Research

Scientists are studying various aspects of autoimmune hepatitis to find out who gets it and why and to discover better ways to treat it. Basic research on the immune system will expand knowledge of autoimmune diseases in general. Epidemiologic research will help doctors understand what triggers autoimmune hepatitis in some people. Research on different steroids, alternatives to steroids, and other immunosuppressants will eventually lead to more effective treatments.

# **Points To Remember**

- Autoimmune hepatitis is a longterm disease in which your body's immune system attacks liver cells.
- The disease is diagnosed using various blood tests and a liver biopsy.
- With proper treatment, autoimmune hepatitis can usually be controlled. The main treatment is medicine that suppresses the body's overactive immune system.

# **Additional Resources**

American Liver Foundation 75 Maiden Lane, Suite 603 New York, NY 10038 Phone: 1–800–GOLIVER (1–800–465–4837) Email: webmail@liverfoundation.org

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# National Digestive Diseases Information Clearinghouse

2 Information Way Bethesda, MD 20892–3570 Phone: 1–800–891–5389 or (301) 654–3810 Fax: (301) 907–8906 Email: nddic@info.niddk.nih.gov

The National Digestive Diseases Information Clearinghouse (NDDIC) is a service of the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). The NIDDK is part of the National Institutes of Health under the U.S. Department of Health and Human Services. Established in 1980, the clearinghouse provides information about digestive diseases to people with digestive disorders and to their families, health care professionals, and the public. NDDIC answers inquiries, develops and distributes publications, and works closely with professional and patient organizations and Government agencies to coordinate resources about digestive diseases.

Publications produced by the clearinghouse are carefully reviewed by both NIDDK scientists and outside experts. This fact sheet was reviewed by Willis Maddrey, M.D., of the University of Texas Southwestern Medical Center at Dallas, and Edward Krawitt, M.D., of the University of Vermont College of Medicine.

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES National Institutes of Health

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# Fecal Incontinence

National Digestive Diseases Information Clearinghouse



National Institute of Diabetes and Digestive and Kidney Diseases

NATIONAL INSTITUTES OF HEALTH Fecal incontinence is the inability to control your bowels. When you feel the urge to have a bowel movement, you may not be able to hold it until you can get to a toilet. Or stool may leak from the rectum unexpectedly.

More than 6.5 million Americans have fecal incontinence. It affects people of all ages children as well as adults. Fecal incontinence is more common in women than in men and more common in older adults than in younger ones. It is not, however, a normal part of aging.

Loss of bowel control can be devastating. People who have fecal incontinence may feel ashamed, embarrassed, or humiliated. Some don't want to leave the house out of fear they might have an accident in public. Most try to hide the problem as long as possible, so they withdraw from friends and family. The social isolation is unfortunate but may be reduced because treatment can improve bowel control and make incontinence easier to manage.

# Causes

Fecal incontinence can have several causes:

- damage to the anal sphincter muscles
- damage to the nerves of the anal sphincter muscles or the rectum
- loss of storage capacity in the rectum
- diarrhea
- pelvic floor dysfunction



Anatomy of the rectum and anus.

# **Muscle Damage**

Fecal incontinence is most often caused by injury to one or both of the ring-like muscles at the end of the rectum called the anal internal and/or external sphincters. The sphincters keep stool inside. When damaged, the muscles aren't strong enough to do their job, and stool can leak out. In women, the damage often happens when giving birth. The risk of injury is greatest if the doctor uses forceps to help deliver the baby or does an episiotomy, which is a cut in the vaginal area to prevent it from tearing during birth. Hemorrhoid surgery can damage the sphincters as well.

### Nerve Damage

Fecal incontinence can also be caused by damage to the nerves that control the anal sphincters or to the nerves that sense stool in the rectum. If the nerves that control the sphincters are injured, the muscle doesn't work properly and incontinence can occur. If the sensory nerves are damaged, they don't sense that stool is in the rectum. You then won't feel the need to use the bathroom until stool has leaked out. Nerve damage can be caused by childbirth, a longterm habit of straining to pass stool, stroke, and diseases that affect the nerves, such as diabetes and multiple sclerosis.

# Loss of Storage Capacity

Normally, the rectum stretches to hold stool until you can get to a bathroom. But rectal surgery, radiation treatment, and inflammatory bowel disease can cause scarring that makes the walls of the rectum stiff and less elastic. The rectum then can't stretch as much and can't hold stool, and fecal incontinence results. Inflammatory bowel disease also can make rectal walls very irritated and thereby unable to contain stool.

### Diarrhea

Diarrhea, or loose stool, is more difficult to control than solid stool that is formed. Even people who don't have fecal incontinence can have an accident when they have diarrhea.

### **Pelvic Floor Dysfunction**

Abnormalities of the pelvic floor can lead to fecal incontinence. Examples of some abnormalities are decreased perception of rectal sensation, decreased anal canal pressures, decreased squeeze pressure of the anal canal, impaired anal sensation, a dropping down of the rectum (rectal prolapse), protrusion of the rectum through the vagina (rectocele), and/or generalized weakness and sagging of the pelvic floor. Often the cause of pelvic floor dysfunction is childbirth, and incontinence doesn't show up until the midforties or later.

# Diagnosis

The doctor will ask health-related questions and do a physical exam and possibly other medical tests.

- Anal manometry checks the tightness of the anal sphincter and its ability to respond to signals, as well as the sensitivity and function of the rectum.
- Anorectal ultrasonography evaluates the structure of the anal sphincters.
- Proctography, also known as defecography, shows how much stool the rectum can hold, how well the rectum holds it, and how well the rectum can evacuate the stool.
- Proctosigmoidoscopy allows doctors to look inside the rectum for signs of disease or other problems that could cause fecal incontinence, such as inflammation, tumors, or scar tissue.
- Anal electromyography tests for nerve damage, which is often associated with obstetric injury.

# Treatment

Treatment depends on the cause and severity of fecal incontinence; it may include dietary changes, medication, bowel training, or surgery. More than one treatment may be necessary for successful control since continence is a complicated chain of events.

# **Dietary Changes**

Food affects the consistency of stool and how quickly it passes through the digestive system. One way to help control fecal incontinence in some persons is to eat foods that add bulk to stool, making it less watery and easier to control. Also, avoid foods that contribute to the problem. They include foods and drinks containing caffeine, like coffee, tea, and chocolate, which relax the internal anal sphincter muscle. Another approach is to eat foods low in fiber to decrease the work of the anal sphincters. Fruit can act as a natural laxative and should be eaten sparingly.

You can adjust what and how you eat to help manage fecal incontinence.

- Keep a food diary. List what you eat, how much you eat, and when you have an incontinent episode. After a few days, you may begin to see a pattern between certain foods and incontinence. After you identify foods that seem to cause problems, cut back on them and see whether incontinence improves. Foods that typically cause diarrhea, and so should probably be avoided, include
  - caffeine
  - cured or smoked meat like sausage, ham, or turkey
  - spicy foods
  - alcohol

- dairy products like milk, cheese, and ice cream
- fruits like apples, peaches, or pears
- fatty and greasy foods
- sweeteners, like sorbitol, xylitol, mannitol, and fructose, which are found in diet drinks, sugarless gum and candy, chocolate, and fruit juices
- Eat smaller meals more frequently. In some people, large meals cause bowel contractions that lead to diarrhea. You can still eat the same amount of food in a day, but space it out by eating several small meals.
- Eat and drink at different times. Liquid helps move food through the digestive system. So if you want to slow things down, drink something half an hour before or after meals, but not with the meals.
- Eat more fiber. Fiber makes stool soft, formed, and easier to control. Fiber is found in fruits, vegetables, and grains, like those listed in the box on page 4. You'll need to eat 20 to 30 grams of fiber a day, but add it to your diet slowly so your body can adjust. Too much fiber all at once can cause bloating, gas, or even diarrhea. Also, too much insoluble, or undigestible, fiber can contribute to diarrhea. So if you find that eating more fiber makes your diarrhea worse, try cutting back to two servings each of fruits and vegetables and removing skins and seeds from your food.
- Eat foods that make stool bulkier. Foods that contain soluble, or digestible, fiber slow the emptying of the bowels. Examples are bananas, rice, tapioca, bread, potatoes, apple-

# What Foods Have Fiber?

Examples of foods that have fiber include

Breads, cereals, and beans	fiber
<sup>1</sup> / <sub>2</sub> cup of black-eyed peas,	4 grams
cooked	U
<sup>1</sup> / <sub>2</sub> cup of kidney beans,	5.5 grams
cooked	-
$\frac{1}{2}$ cup of lima beans,	4.5 grams
cooked	-
Whole-grain cereal, cold	
• <sup>1</sup> / <sub>2</sub> cup of All-Bran	10 grams
• <sup>3</sup> / <sub>4</sub> cup of Total	3 grams
• <sup>3</sup> / <sub>4</sub> cup of Post Bran	5 grams
Flakes	
1 packet of whole-grain	3 grams
cereal, hot (oatmeal,	
Wheatena)	
1 slice of whole-wheat or	3 grams
multigrain bread	
Fruits	
1 medium apple	4 grams
1 medium peach	2 grams
<sup>1</sup> / <sub>2</sub> cup of raspberries	4 grams
1 medium tangerine	3 grams
Vegetables	
1 cup of acorn squash, raw	2 grams
1 medium stalk of broccoli,	4 grams
raw	U
5 brussels sprouts, raw	3 grams
1 cup of cabbage, raw	2 grams
1 medium carrot, raw	2 grams
1 cup of cauliflower, raw	2 grams
1 cup of spinach, cooked	2 grams
1 cup of zucchini, raw	2 grams

Source: USDA/ARS Nutrient Data Laboratory

sauce, cheese, smooth peanut butter, yogurt, pasta, and oatmeal.

• Get plenty to drink. You need to drink eight 8-ounce glasses of liquid a day to help prevent dehydration and to keep stool soft and formed. Water is a good choice, but avoid drinks with caffeine, alcohol, milk, or carbonation if you find that they trigger diarrhea.

Over time, diarrhea can rob you of vitamins and minerals. Ask your doctor if you need a vitamin supplement.

# Medication

If diarrhea is causing the incontinence, medication may help. Sometimes doctors recommend using bulk laxatives to help people develop a more regular bowel pattern. Or the doctor may prescribe antidiarrheal medicines such as loperamide or diphenoxylate to slow down the bowel and help control the problem.

# **Bowel Training**

Bowel training helps some people relearn how to control their bowels. In some cases, it involves strengthening muscles; in others, it means training the bowels to empty at a specific time of day.

• Use biofeedback. Biofeedback is a way to strengthen and coordinate the muscles and has helped some people. Special computer equipment measures muscle contractions as you do exercises—called Kegel exercises—to strengthen the rectum. These exercises work muscles in the pelvic floor, including those involved in controlling stool. Computer feedback about how the muscles are working shows whether you're doing the exercises correctly and whether the muscles are getting stronger. Whether biofeedback will work for you depends on the cause of your fecal incontinence, how severe the muscle damage is, and your ability to do the exercises.

• Develop a regular pattern of bowel movements. Some people—particularly those whose fecal incontinence is caused by constipation—achieve bowel control by training themselves to have bowel movements at specific times during the day, such as after every meal. The key to this approach is persistence—it may take a while to develop a regular pattern. Try not to get frustrated or give up if it doesn't work right away.

### Surgery

Surgery may be an option for people whose fecal incontinence is caused by injury to the pelvic floor, anal canal, or anal sphincter. Various procedures can be done, from simple ones like repairing damaged areas, to complex ones like attaching an artificial anal sphincter or replacing anal muscle with muscle from the leg or forearm. People who have severe fecal incontinence that doesn't respond to other treatments may decide to have a colostomy, which involves removing a portion of the bowel. The remaining part is then either attached to the anus if it still works properly, or to a hole in the abdomen called a stoma, through which stool leaves the body and is collected in a pouch.

# What To Do About Anal Discomfort

The skin around the anus is delicate and sensitive. Constipation and diarrhea or contact between skin and stool can cause pain or itching. Here's what you can do to relieve discomfort:

- Wash the area with water, but not soap, after a bowel movement. Soap can dry out the skin, making discomfort worse. If possible, wash in the shower with lukewarm water or use a sitz bath. Or try a no-rinse skin cleanser. Try not to use toilet paper to clean up—rubbing with dry toilet paper will only irritate the skin more. Premoistened, alcohol-free towelettes are a better choice.
- Let the area air dry after washing. If you don't have time, gently pat yourself dry with a lint-free cloth.
- Use a moisture barrier cream, which is a protective cream to help prevent skin irritation from direct contact with stool. However, talk to your

health care professional before you try anal ointments and creams because some have ingredients that can be irritating. Also, you should clean the area well first to avoid trapping bacteria that could cause further problems. Your health care professional can recommend an appropriate cream or ointment.

- Try using nonmedicated talcum powder or corn starch to relieve anal discomfort.
- Wear cotton underwear and loose clothes that "breathe." Tight clothes that block air can worsen anal problems. Change soiled underwear as soon as possible.
- If you use pads or diapers, make sure they have an absorbent wicking layer on top. Products with a wicking layer protect the skin by pulling stool and moisture away from the skin and into the pad.

# **Everyday Practical Tips**

- Take a backpack or tote bag containing cleanup supplies and a change of clothing with you everywhere.
- Locate public restrooms before you need them so you know where to go.
- Use the toilet before heading out.
- If you think an episode is likely, wear disposable undergarments or sanitary pads.
- If episodes are frequent, use oral fecal deodorants to add to your comfort level.

# **Emotional Considerations**

Because fecal incontinence can cause distress in the form of embarrassment, fear, and loneliness, taking steps to deal with it is important. Treatment can help improve your life and help you feel better about yourself. If you haven't been to a doctor yet, make an appointment. Also, consider contacting the organizations listed on page 7. Such groups can help you find information and support and, in some cases, referrals to doctors who specialize in treating fecal incontinence.

# Fecal Incontinence in Children

If your child has fecal incontinence, you need to see a doctor to determine the cause and treatment. Fecal incontinence can occur in children because of a birth defect or disease, but in most cases it's because of chronic constipation.

Potty-trained children often get constipated simply because they refuse to go to the bathroom. The problem might stem from embarrassment over using a public toilet or unwillingness to stop playing and go to the bathroom. But if the child continues to hold in stool, the feces will accumulate and harden in the rectum. The child might have a stomachache and not eat much, despite being hungry. And when he or she eventually does pass the stool, it can be painful, which can lead to fear of having a bowel movement.

A child who is constipated may soil his or her underpants. Soiling happens when liquid stool from farther up in the bowel seeps past the hard stool in the rectum and leaks out. Soiling is a sign of fecal incontinence. Try to remember that your child did not do this on purpose. He or she cannot control the liquid stool and may not even know it has passed.

The first step in treating the problem is passing the built-up stool. The doctor may prescribe one or more enemas or a drink that helps clean out the bowel, like magnesium citrate, mineral oil, or polyethylene glycol.

The next step is preventing future constipation. You will play a big role in this part of your child's treatment. You may need to teach your child bowel habits, which means training your child to have regular bowel movements. Experts recommend that parents of children with poor bowel habits encourage their child to sit on the toilet four times each day (after meals and at bedtime) for 5 minutes. Give rewards for bowel movements and remember that it is important not to punish your child for incontinent episodes.

Some changes in eating habits may be necessary too. Your child should eat more high-fiber foods to soften stool, avoid dairy products if they cause constipation, and drink plenty of fluids every day, including water and juices like prune, grape, or apricot, which help prevent constipation. If necessary, the doctor may prescribe laxatives.

It may take several months to break the pattern of withholding stool and constipation. And episodes may occur again in the future. The key is to pay close attention to your child's bowel habits. Some warning signs to watch for include

- pain with bowel movements
- hard stool
- constipation
- refusal to go to the bathroom
- soiled underpants
- signs of holding back a bowel movement, like squatting, crossing the legs, or rocking back and forth

# Why Children Get Constipated

- They were potty-trained too early.
- They refuse to have a bowel movement (because of painful ones in the past, embarrassment, stubbornness, or even a dislike of public bathrooms).
- They are in an unfamiliar place.
- They are reacting to family stress like a new sibling or their parents' divorce.
- They can't get to a bathroom when they need to go so they hold it. As the rectum fills with stool, the child may lose the urge to go and become constipated as the stool dries and hardens.

# **Hope Through Research**

The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) conducts and supports research into many kinds of digestive disorders, including fecal incontinence. In addition, researchers throughout the country are working hard to find possible solutions to the problem of fecal incontinence. Some studies address fecal incontinence due to anal sphincter damage and combine surgical procedures with electrical stimulation.

# **For More Information**

You can get information about fecal incontinence, as well as support, from

#### **American Academy of Family Physicians**

11400 Tomahawk Creek Parkway Leawood, KS 66211–2672 Phone: (913) 906–6000 Email: fp@aafp.org Internet: www.aafp.org

# International Foundation for Functional Gastrointestinal Disorders

P.O. Box 17864 Milwaukee, WI 53217 Phone: 1–888–964–2001 or (414) 964–1799 Fax: (414) 964–7176 Email: iffgd@iffgd.org Internet: www.iffgd.org

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# El aparato digestivo y su funcionamiento

National Digestive Diseases Information Clearinghouse



National Institute of Diabetes and Digestive and Kidney Diseases

NATIONAL INSTITUTES OF HEALTH El aparato digestivo es una serie de órganos huecos que forman un largo y tortuoso tubo que va de la boca al ano (ver figura). El interior del tubo está revestido por una membrana llamada mucosa. La mucosa de la boca, el estómago y el intestino delgado contiene glándulas diminutas que producen jugos que contribuyen a la digestión de los alimentos.

Hay otros dos órganos digestivos compactos, el hígado y el páncreas, que producen jugos que llegan al intestino a través de pequeños tubos. Además, algunos componentes de otros aparatos y sistemas (por ejemplo, los nervios y la sangre) juegan un papel importante en el aparato digestivo.

# ¿Por qué es importante la digestión?

Cuando comemos alimentos como pan, carne y verduras, estos no están en una forma que el cuerpo pueda aprovechar para nutrirse. Los alimentos y bebidas que consumimos deben transformarse en moléculas más pequeñas de nutrientes antes de ser absorbidos hacia la sangre y transportados a las células de todo el cuerpo. La digestión es el proceso mediante el cual los alimentos y bebidas se descomponen en sus partes más pequeñas para que el cuerpo pueda usarlos como fuente de energía, y para formar y alimentar las células.



# ¿Cómo se digieren los alimentos?

La digestión comprende la mezcla de los alimentos, su paso a través del tracto digestivo y la descomposición química de las moléculas grandes en moléculas más pequeñas. Comienza en la boca, cuando masticamos y comemos, y termina en el intestino delgado. El proceso químico varía un poco dependiendo de la clase de alimento.

# Paso de los alimentos a través del aparato digestivo

Los órganos grandes y huecos del aparato digestivo poseen músculos que permiten que sus paredes se muevan. El movimiento de estas paredes puede impulsar los alimentos y los líquidos, y mezclar el contenido de cada órgano. El movimiento típico del esófago, el estómago y los intestinos se llama peristaltismo. La acción del peristaltismo se parece a la de una ola del mar moviéndose por el músculo. Comenzando desde la parte superior y moviéndose lentamente hacia la parte inferior del órgano, el músculo comienza a contraerse y relajarse. Estas ondas alternadas de contracciones y relajaciones empujan la comida y los líquidos a través de cada órgano.

El primer movimiento muscular importante ocurre cuando ingerimos alimentos o líquidos. Aunque esta parte del proceso es voluntaria, en cuanto empieza se vuelve involuntaria y pasa a estar bajo el control de los nervios.

La comida que acabamos de ingerir pasa al siguiente órgano que es el esófago, y que conecta la garganta con el estómago. En la unión del esófago y el estómago hay una válvula en forma de anillo que cierra el paso entre los dos órganos. Sin embargo, a medida que los alimentos se acercan al anillo cerrado, los músculos que lo rodean se relajan y permiten el paso. Los alimentos entran entonces al estómago, que debe realizar tres tareas mecánicas. Primero, debe almacenar la comida y los líquidos ingeridos. Para ello, el músculo de la parte superior del estómago debe relajarse y aceptar volúmenes grandes de material ingerido. La segunda tarea es mezclar los alimentos, los líquidos y el jugo digestivo producido por el estómago. La acción muscular de la parte inferior del estómago se encarga de esto. La tercera tarea del estómago es vaciar su contenido lentamente en el intestino delgado.

Esto último recibe la influencia de varios factores, como la naturaleza de los alimentos (especialmente su contenido de grasas y proteínas) y el grado de actividad muscular del estómago y del intestino delgado. A medida que los alimentos se digieren en el intestino delgado y se disuelven en los jugos del páncreas, el hígado y el intestino, el contenido intestinal se va mezclando y avanzando para facilitar la digestión adicional.

Finalmente, todos los nutrientes digeridos se absorben a través de las paredes intestinales. Los productos de desecho de este proceso comprenden partes no digeridas de los alimentos, conocidas como fibra, y células viejas que se han desprendido de la mucosa. Estos materiales son impulsados hacia el colon, en el cual permanecen generalmente durante uno o dos días, hasta cuando se expulsa la materia fecal durante la deposición.

# La producción de los jugos digestivos

Las glándulas del sistema digestivo son de primordial importancia en el proceso de la digestión, porque producen tanto los jugos que descomponen los alimentos como las hormonas que controlan el proceso.

Las que actúan primero son las glándulas salivares de la boca. La saliva que producen contiene una enzima que comienza a digerir el almidón de los alimentos y lo transforma en moléculas más pequeñas.

El siguiente grupo de glándulas digestivas está en la membrana que tapiza el estómago. Estas producen ácido y una enzima que digiere las proteínas. Uno de los misterios del sistema digestivo es la razón de por qué el jugo ácido del estómago no disuelve el propio tejido estomacal. En la mayoría de las personas, la mucosa estomacal puede resistir el jugo, a diferencia de los alimentos y de otros tejidos del cuerpo.

Después de que el estómago vierte los alimentos y su jugo en el intestino delgado, los jugos de otros dos órganos se mezclan con ellos para continuar el proceso. Uno de esos órganos es el páncreas, cuyo jugo contiene un gran número de enzimas que descomponen los hidratos de carbono, las grasas y las proteínas de los alimentos. Otras enzimas que participan en el proceso provienen de glándulas de la pared intestinal o forman parte de ella.

El hígado produce la bilis, otro jugo digestivo, que se almacena en la vesícula biliar. Cuando comemos, la bilis sale de la vesícula por las vías biliares al intestino y se mezcla con las grasas de los alimentos. Los ácidos biliares disuelven las grasas en el contenido acuoso del intestino, como los detergentes disuelven la grasa de una sartén. Después de que las grasas se disuelven, las enzimas del páncreas y de la mucosa intestinal las digieren.

# Absorción y transporte de los nutrientes

Las moléculas digeridas de los alimentos, y el agua y minerales provenientes de la dieta se absorben en la parte superior del intestino delgado. Los materiales absorbidos atraviesan la mucosa y pasan a la sangre, que los distribuye a otras partes del cuerpo para almacenarlos o para que pasen por otras modificaciones químicas. Como dijimos antes, esta parte del proceso varía dependiendo de los diferentes tipos de nutrientes.

*Hidratos de carbono*—Un adulto estadounidense promedio consume cerca de media libra de hidratos de carbono al día. Algunas de nuestras comidas más corrientes, como el pan, las papas, los pasteles, los dulces, el arroz, los espaguetis, las frutas y las verduras, contienen principalmente hidratos de carbono. Muchas de ellas contienen al mismo tiempo almidón, que es digerible, y fibra, que no lo es.

Los hidratos de carbono digeribles se descomponen en moléculas más sencillas por la acción de las enzimas de la saliva, del jugo pancreático y de la mucosa intestinal. El almidón se digiere en dos etapas: primero, una enzima de la saliva y del jugo pancreático lo descompone en moléculas de maltosa; luego, la maltasa, una enzima de la mucosa del intestino delgado, divide la maltosa en moléculas de glucosa que pueden absorberse en la sangre. La glucosa va por el torrente sanguíneo al hígado, en donde se almacena o se utiliza como fuente de energía para las funciones del cuerpo. El azúcar común es otro hidrato de carbono que se debe digerir para que sea útil. Una enzima de la mucosa del intestino delgado digiere el azúcar común y lo convierte en glucosa y fructosa, cada una de las cuales puede absorberse en el intestino y pasar a la sangre. La leche contiene lactosa, otro tipo de azúcar que se transforma en moléculas fáciles de absorber mediante la acción de una enzima llamada lactasa, que se encuentra en la mucosa intestinal.

*Proteínas*—Los alimentos como carne, huevos y frijoles están formados por moléculas enormes de proteínas que deben ser digeridas por enzimas antes de que se puedan utilizar para fabricar y reparar los tejidos del cuerpo. Una enzima del jugo gástrico comienza la digestión de las proteínas que comemos. El proceso termina en el intestino delgado. Allí, varias enzimas del jugo pancreático y de la mucosa intestinal descomponen las enormes moléculas en unas mucho más pequeñas, llamadas aminoácidos. Estos pueden absorberse en el intestino delgado y pasar a la sangre, que los lleva a todas partes del cuerpo para fabricar las paredes celulares y otros componentes de las células.

*Grasas*—Las moléculas de grasas son una importante fuente de energía para el cuerpo. El primer paso en la digestión de una grasa como la mantequilla es disolverla en el contenido acuoso del intestino. Los ácidos biliares producidos por el hígado actúan como detergentes naturales que disuelven las grasas en agua y permiten que las enzimas descompongan sus grandes moléculas en moléculas más pequeñas, algunas de las cuales son los ácidos grasos y el colesterol. Los ácidos biliares se unen a los ácidos grasos y al colesterol y les ayudan a pasar al interior de las células de la mucosa. En ellas, las moléculas pequeñas vuelven a formar moléculas grandes, la mayoría de las cuales pasan a los vasos linfáticos cercanos al intestino. Estos vasos llevan las grasas modificadas a las venas del tórax y la sangre las transporta hacia los lugares de depósito en distintas partes del cuerpo.

#### Vitaminas—Otros integrantes

fundamentales de nuestra comida que se absorben en el intestino delgado, son las vitaminas. Estas sustancias químicas se agrupan en dos clases, según el líquido en el que se disuelven: hidrosolubles (todas las vitaminas del complejo B y la vitamina C) y liposolubles (las vitaminas A, D y K).

*Agua y sal*—La mayoría del material que se absorbe del intestino delgado es agua, en la que hay sal disuelta. El agua y la sal vienen de los alimentos y líquidos que consumimos y de los jugos que las glándulas digestivas secretan. En el intestino de un adulto sano se absorbe más de un galón de agua con más de una onza de sal cada 24 horas.

# ¿Cómo se regula la digestión?

### **Reguladores hormonales**

Una característica fascinante del aparato digestivo es que contiene sus propios reguladores. Las principales hormonas que controlan las funciones del aparato digestivo se producen y liberan a partir de células de la mucosa del estómago y del intestino delgado. Estas hormonas pasan a la sangre que riega el aparato digestivo, van hasta el corazón, circulan por las arterias y regresan al aparato digestivo, en donde estimulan la producción de los jugos digestivos y provocan el movimiento de los órganos. Las hormonas que controlan la digestión son la gastrina, la secretina y la colecistocinina.

- La gastrina hace que el estómago produzca un ácido que disuelve y digiere algunos alimentos. Es necesaria también para el crecimiento normal de la mucosa del estómago, el intestino delgado y el colon.
- La secretina hace que el páncreas secrete un jugo digestivo rico en bicarbonato. Estimula al estómago para que produzca pepsina, una enzima que digiere las proteínas, y al hígado para que produzca bilis.
- La colecistocinina hace que el páncreas crezca y produzca las enzimas del jugo pancreático, y hace que la vesícula biliar se vacíe.

### **Reguladores nerviosos**

Dos clases de nervios ayudan a controlar el trabajo del aparato digestivo. Los nervios extrínsecos (de afuera) llegan a los órganos digestivos desde el cerebro o desde la médula espinal y provocan la liberación de dos sustancias químicas: la acetilcolina y la adrenalina. La acetilcolina hace que los músculos de los órganos digestivos se contraigan con más fuerza y empujen mejor los alimentos y líquidos a través del tracto digestivo. También hace que el estómago y el páncreas produzcan más jugos. La adrenalina relaja el músculo del estómago y de los intestinos y disminuye el flujo de sangre que llega a estos órganos.

Los nervios intrínsecos (de adentro), que forman una red densa incrustada en las paredes del esófago, el estómago, el intestino delgado y el colon, son aún más importantes. La acción de estos nervios se desencadena cuando las paredes de los órganos huecos se estiran con la presencia de los alimentos. Liberan muchas sustancias diferentes que aceleran o retrasan el movimiento de los alimentos y la producción de jugos en los órganos

# National Digestive Diseases Information Clearinghouse

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El National Digestive Diseases Information Clearinghouse (NDDIC) es el Centro Coordinador Nacional de Información sobre Enfermedades Digestivas y un servicio del Instituto Nacional de la Diabetes y las Enfermedades Digestivas y de los Riñones (NIDDK). El NIDDK es parte de los Institutos Nacionales de Salud, que a su vez dependen del Departamento de Salud y Servicios Humanos de EE.UU. Fundado en 1980, el NDDIC ofrece información sobre las enfermedades digestivas a las personas que padecen de estas enfermedades y a sus familiares, a los profesionales sanitarios y al público en general. El NDDIC responde a preguntas, produce y distribuye publicaciones, y colabora estrechamente con organizaciones profesionales, gubernamentales y de pacientes para coordinar los recursos sobre las enfermedades digestivas.

Publicaciones producidas del centro coordinador de información son revisadas cuidadosamente de científicos del NIDDK y de expertos fuera de la organización.

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES National Institutes of Health

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# Viral Gastroenteritis

National Digestive Diseases Information Clearinghouse



National Institute of Diabetes and Digestive and Kidney Diseases

NATIONAL INSTITUTES OF HEALTH Viral gastroenteritis is an intestinal infection caused by several different viruses. Highly contagious, viral gastroenteritis is the second most common illness in the United States. It causes millions of cases of diarrhea each year.

Anyone can get viral gastroenteritis and most people recover without any complications. However, viral gastroenteritis can be serious when people cannot drink enough fluids to replace what is lost through vomiting and diarrhea—especially infants, young children, the elderly, and people with weak immune systems.

# **Symptoms**

The main symptoms of viral gastroenteritis are watery diarrhea and vomiting. Other symptoms are headache, fever, chills, and abdominal pain. Symptoms usually appear within 4 to 48 hours after exposure to the virus and last for 1 to 2 days, though symptoms can last as long as 10 days.

# Causes

The viruses that cause viral gastroenteritis damage the cells in the lining of the small intestine. As a result, fluids leak from the cells into the intestine and produce watery diarrhea. Four types of viruses cause most viral gastroenteritis.

 Rotavirus is the leading cause among children 3 to 15 months old and the most common cause of diarrhea in children under the age of 5 years.
 Symptoms of rotavirus infection appear 1 to 2 days after exposure.
 Rotavirus typically causes vomiting and watery diarrhea for 3 to 8 days,



The digestive system.

along with fever and abdominal pain. Rotavirus can also infect adults who are in close contact with infected children, but the symptoms in adults are milder. In the United States, rotavirus infections are most common from November to April.



U.S. Department of Health and Human Services

- Adenovirus occurs mainly in children under the age of 2 years. Of the 49 types of adenoviruses, one strain affects the gastrointestinal tract causing vomiting and diarrhea. Symptoms typically appear 1 week after exposure. Adenovirus infections occur year round.
- Caliciviruses cause infection in people of all ages. This family of viruses is divided into 4 types, the noroviruses being the most common and most responsible for infecting people. The noroviruses are usually responsible for epidemics of viral gastroenteritis and occur more frequently from October to April. Infected people experience vomiting and diarrhea, fatigue, headache, and sometimes muscle aches. The symptoms appear within 1 to 3 days of exposure.
- Astrovirus also infects primarily infants, young children, and the elderly. This virus is most active during the winter months. Vomiting and diarrhea appear within 1 to 3 days of exposure.

# Transmission

Viral gastroenteritis is highly contagious. The viruses are commonly transmitted by people with unwashed hands. People can get the viruses through close contact with infected individuals by sharing their food, drink, or eating utensils, or by eating food or drinking beverages that are

Viral gastroenteritis is often mistakenly called "stomach flu," but it is not caused by the influenza virus and it does not infect the stomach. Also, viral gastroenteritis is not caused by bacteria or parasites. For information about bacterial infections, please see the *Bacteria and Foodborne Illness* fact sheet from the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). contaminated with the virus. Noroviruses in particular, are typically spread to other people by contact with stool or vomit of infected people and through contaminated water or food—especially oysters from contaminated waters.

People who no longer have symptoms may still be contagious, since the virus can be found in their stool for up to 2 weeks after they recover from their illness. Also, people can become infected without having symptoms and they can still spread the infection.

Outbreaks of viral gastroenteritis can occur in households, child care settings, schools, nursing homes, cruise ships, camps, dormitories, restaurants, and other places where people gather in groups. If you suspect that you were exposed to a virus in one of these settings or by foods prepared on the premise of places such as a restaurant, deli, or bakery, you may want to contact your local health department, which tracks outbreaks.

# Diagnosis

If you think you have viral gastroenteritis, you may want to see your doctor. Doctors generally diagnose viral gastroenteritis based on the symptoms and a physical examination. Your doctor may ask for a stool sample to test for rotavirus or to rule out bacteria or parasites as the cause of your symptoms. No routine tests are currently available for the other types of viruses.

# Treatment

Most cases of viral gastroenteritis resolve over time without specific treatment. Antibiotics are not effective against viral infections. The primary goal of treatment is to reduce the symptoms, and prompt treatment may be needed to prevent dehydration.

Your body needs fluids to function. Dehydration is the loss of fluids from the body. Important salts or minerals, known as electrolytes, can also be lost with the fluids.
Dehydration can be caused by diarrhea, vomiting, excessive urination, excessive sweating, or by not drinking enough fluids because of nausea, difficulty swallowing, or loss of appetite.

In viral gastroenteritis, the combination of diarrhea and vomiting can cause dehydration. The symptoms of dehydration are

- excessive thirst
- dry mouth
- little or no urine or dark yellow urine
- decreased tears
- severe weakness or lethargy
- · dizziness or lightheadedness

If you notice any of these symptoms, you should talk to your doctor. Mild dehydration can be treated by drinking liquids. Severe dehydration may require intravenous fluids and hospitalization. Untreated severe dehydration can be life threatening.

Children present special concerns. Because of their smaller body size, infants and children are at greater risk of dehydration from diarrhea and vomiting. Oral rehydration solutions such as Pedialyte can replace lost fluids, minerals, and salts.

The following steps may help relieve the symptoms of viral gastroenteritis.

- Allow your gastrointestinal tract to settle by not eating for a few hours.
- Sip small amounts of clear liquids or suck on ice chips if vomiting is still a problem.
- Give infants and children oral rehydration solutions to replace fluids and lost electrolytes.
- Gradually reintroduce food, starting with bland, easy-to-digest food, like toast, broth, apples, bananas, and rice.
- Avoid dairy products, caffeine, and alcohol until recovery is complete.
- Get plenty of rest.

### **Points to Remember**

- Viral gastroenteritis is a highly contagious infection of the intestines caused by one of several viruses.
- Although sometimes called "stomach flu," viral gastroenteritis is not caused by the influenza virus and does not affect the stomach.
- The main symptoms are watery diarrhea and vomiting.
- Anyone can get viral gastroenteritis through unwashed hands, close contact with an infected person, or food and beverages that contain the virus.
- Diagnosis is based on the symptoms and a physical examination. Currently only rotavirus can be rapidly detected in a stool test.
- Viral gastroenteritis has no specific treatment; antibiotics are not effective against viruses. Treatment focuses on reducing the symptoms and preventing dehydration.
- The symptoms of dehydration are excessive thirst, dry mouth, dark yellow urine or little or no urine, decreased tears, severe weakness or lethargy, and dizziness or lightheadedness.
- Infants, young children, the elderly, and people with weak immune systems have a higher risk of developing dehydration due to vomiting and diarrhea.
- People with viral gastroenteritis should rest, drink clear liquids, and eat easy-to-digest foods.
- For infants and young children, oral rehydration solutions can replace lost fluids, minerals, and salts.
- Avoid viral gastroenteritis by washing hands thoroughly after using the bathroom or changing diapers, disinfecting contaminated surfaces, and avoiding foods or liquids that might be contaminated.

### Prevention

Prevention is the only way to avoid viral gastroenteritis. No vaccine is available. You can avoid infection by

- washing your hands thoroughly for 20 seconds after using the bathroom or changing diapers
- washing your hands thoroughly for 20 seconds before eating
- disinfecting contaminated surfaces such as counters and baby changing stations
- not eating or drinking foods or liquids that might be contaminated

### Hope Through Research

The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), through its Division of Digestive Diseases, supports basic and clinical research into gastrointestinal diseases, including epithelial cell injury in the gastrointestinal tract. New vaccines under development may decrease the risk of infection, especially among infants and young children.

### **For More Information**

Internet: www.cdc.gov

**Centers for Disease Control and Prevention** 1600 Clifton Road Atlanta, GA 30333 Phone: 1–800–311–3435 or 404–639–3534

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The National Digestive Diseases Information Clearinghouse (NDDIC) is a service of the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). The NIDDK is part of the National Institutes of Health under the U.S. Department of Health and Human Services. Established in 1980, the Clearinghouse provides information about digestive diseases to people with digestive disorders and to their families, health care professionals, and the public. The NDDIC answers inquiries, develops and distributes publications, and works closely with professional and patient organizations and Government agencies to coordinate resources about digestive diseases.

Publications produced by the Clearinghouse are carefully reviewed by both NIDDK scientists and outside experts. This fact sheet was reviewed by Mary K. Estes, Ph.D., and Robert Atmar, M.D., Baylor College of Medicine.

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES National Institutes of Health

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# Virtual Colonoscopy

National Digestive Diseases Information Clearinghouse



National Institute of Diabetes and Digestive and Kidney Diseases

NATIONAL INSTITUTES OF HEALTH Virtual colonoscopy (VC) uses x rays and computers to produce two- and threedimensional images of the colon (large intestine) from the lowest part, the rectum, all the way to the lower end of the small intestine and display them on a screen. The procedure is used to diagnose colon and bowel disease, including polyps, diverticulosis, and cancer. VC can be performed with computed tomography (CT), sometimes called a CAT scan, or with magnetic resonance imaging (MRI).

### **VC Procedure**

While preparations for VC vary, you will usually be asked to take laxatives or other oral agents at home the day before the procedure to clear stool from your colon. You may also be asked to use a suppository to cleanse your rectum of any remaining fecal matter.

VC takes place in the radiology department of a hospital or medical center. The examination takes about 10 minutes and does not require sedatives. During the procedure,

- The doctor will ask you to lie on your back on a table.
- A thin tube will be inserted into your rectum, and air will be pumped through the tube to inflate the colon for better viewing.
- The table moves through the scanner to produce a series of two-dimensional cross-sections along the length of the colon. A computer program puts these images together to create a three-dimensional picture that can be viewed on the video screen.

- You will be asked to hold your breath during the scan to avoid distortion on the images.
- The scanning procedure is then repeated with you lying on your stomach.

After the examination, the information from the scanner must be processed to create the computer picture or image of your colon. A radiologist evaluates the results to identify any abnormalities.

You may resume normal activity after the procedure, although your doctor may

### **Conventional Colonoscopy**

In a conventional colonoscopy, the doctor inserts a colonoscope—a long, flexible, lighted tube—into the patient's rectum and slowly guides it up through the colon. Pain medication and a mild sedative help the patient stay relaxed and comfortable during the 30- to 60minute procedure. A tiny camera in the scope transmits an image of the lining of the colon, so the doctor can examine it on a video monitor. If an abnormality is detected, the doctor can remove it or take tissue samples using tiny instruments passed through the scope.

For more information about conventional colonoscopy, please see the *Colonoscopy* fact sheet from the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK).



U.S. Department of Health and Human Services

ask you to wait while the test results are analyzed. If abnormalities are found and you need conventional colonoscopy, it may be performed the same day.

### **Advantages of VC**

VC is more comfortable than conventional colonoscopy for some people because it does not use a colonoscope. As a result, no sedation is needed, and you can return to your usual activities or go home after the procedure without the aid of another person. VC provides clearer, more detailed images than a conventional x ray using a barium enema, sometimes called a lower gastrointestinal (GI) series. It also takes less time than either a conventional colonoscopy or a lower GI series.

### **Disadvantages of VC**

The doctor cannot take tissue samples or remove polyps during VC, so a conventional colonoscopy must be performed if abnormalities are found. Also, VC does not show as much detail as a conventional colonoscopy, so polyps smaller than 10 millimeters in diameter may not show up on the images.

### For More Information

### American College of Gastroenterology (ACG)

4900–B South 31st Street Arlington, VA 22206–1656 Phone: 703–820–7400 Fax: 703–931–4520 Internet: www.acg.gi.org

### International Foundation for Functional Gastrointestinal Disorders (IFFGD)

P.O. Box 170864 Milwaukee, WI 53217 Phone: 1–888–964–2001 or 414–964–1799 Fax: 414–964–7176 Email: iffgd@iffgd.org Internet: www.iffgd.org

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# Nonalcoholic Steatohepatitis

National Digestive Diseases Information Clearinghouse



National Institute of Diabetes and Digestive and Kidney Diseases

NATIONAL INSTITUTES OF HEALTH Nonalcoholic steatohepatitis or NASH is a common, often "silent" liver disease. It resembles alcoholic liver disease, but occurs in people who drink little or no alcohol. The major feature in NASH is fat in the liver, along with inflammation and damage. Most people with NASH feel well and are not aware that they have a liver problem. Nevertheless, NASH can be severe and can lead to cirrhosis, in which the liver is permanently damaged and scarred and no longer able to work properly.

NASH affects 2 to 5 percent of Americans. An additional 10 to 20 percent of Americans have fat in their liver, but no inflammation or liver damage, a condition called "fatty liver." Although having fat in the liver is not normal, by itself it probably causes little harm or permanent damage. If fat is suspected based on blood test results or scans of the liver, this problem is called nonalcoholic fatty liver disease (NAFLD). If a liver biopsy is performed in this case, it will show that some people have NASH while others have simple fatty liver.

Both NASH and NAFLD are becoming more common, possibly because of the greater number of Americans with obesity. In the past 10 years, the rate of obesity has doubled in adults and tripled in children. Obesity also contributes to diabetes and high blood cholesterol, which can further complicate the health of someone with NASH. Diabetes and high blood cholesterol are also becoming more common among Americans.





U.S. Department of Health and Human Services

Biliary system

### Diagnosis

NASH is usually first suspected in a person who is found to have elevations in liver tests that are included in routine blood test panels, such as alanine aminotransferase (ALT) or aspartate aminotransferase (AST). When further evaluation shows no apparent reason for liver disease (such as medications, viral hepatitis, or excessive use of alcohol) and when x rays or imaging studies of the liver show fat, NASH is suspected. The only means of proving a diagnosis of NASH and separating it from simple fatty liver is a liver biopsy. For a liver biopsy, a needle is inserted through the skin to remove a small piece of the liver. NASH is diagnosed when examination of the tissue under the microscope shows fat along with inflammation and damage to liver cells. If there is fat without inflammation and damage, simple fatty

liver or NAFLD is diagnosed. An important piece of information learned from the biopsy is whether scar tissue has developed in the liver. Currently, no blood tests or scans can reliably provide this information.

### **Symptoms**

NASH is usually a silent disease with few or no symptoms. Patients generally feel well in the early stages and only begin to have symptoms—such as fatigue, weight loss, and weakness—once the disease is more advanced or cirrhosis develops. The progression of NASH can take years, even decades. The process can stop and, in some cases, reverse on its own without specific therapy. Or NASH can slowly worsen, causing scarring or "fibrosis" to appear and accumulate in the liver. As fibrosis worsens, cirrhosis develops; the



Liver biopsy



Stages of liver damage

liver becomes seriously scarred, hardened, and unable to function normally. Not every person with NASH develops cirrhosis, but once serious scarring or cirrhosis is present, few treatments can halt the progression. A person with cirrhosis experiences fluid retention, muscle wasting, bleeding from the intestines, and liver failure. Liver transplantation is the only treatment for advanced cirrhosis with liver failure, and transplantation is increasingly performed in people with NASH. NASH ranks as one of the major causes of cirrhosis in America, behind hepatitis C and alcoholic liver disease.

### Causes

Although NASH has become more common, its underlying cause is still not clear. It most often occurs in persons who are middle-aged and overweight or obese. Many patients with NASH have elevated blood lipids, such as cholesterol and triglycerides, and many have diabetes or pre-diabetes, but not every obese person or every patient with diabetes has NASH. Furthermore, some patients with NASH are not obese, do not have diabetes, and have normal blood cholesterol and lipids. NASH can occur without any apparent risk factor and can even occur in children. Thus, NASH is not simply obesity that affects the liver.

While the underlying reason for the liver injury that causes NASH is not known, several factors are possible candidates:

- insulin resistance
- release of toxic inflammatory proteins by fat cells (cytokines)
- oxidative stress (deterioration of cells) inside liver cells

### Treatment

It is important to stress that there are currently no specific therapies for NASH. The most important recommendations given to persons with this disease are to

- reduce their weight (if obese or overweight)
- follow a balanced and healthy diet
- increase physical activity
- avoid alcohol
- · avoid unnecessary medications

These are standard recommendations, but they can make a difference. They are also helpful for other conditions, such as heart disease, diabetes, and high cholesterol.

A major attempt should be made to lower body weight into the healthy range. Weight loss can improve liver tests in patients with NASH and may reverse the disease to some extent. Research at present is focusing on how much weight loss improves the liver in patients with NASH and whether this improvement lasts over a period of time.

People with NASH often have other medical conditions, such as diabetes, high blood pressure, or elevated cholesterol. These conditions should be treated with medication and adequately controlled; having NASH or elevated liver enzymes should not lead people to avoid treating these other conditions.

Experimental approaches under evaluation in patients with NASH include antioxidants, such as vitamin E, selenium, and betaine. These medications act by reducing the oxidative stress that appears to increase inside the liver in patients with NASH. Whether these substances actually help treat the disease is not known, but the results of clinical trials should become available in the next few years. Another experimental approach to treating NASH is the use of newer antidiabetic medications-even in persons without diabetes. Most patients with NASH have insulin resistance, meaning that the insulin normally present in the bloodstream is less effective for them in controlling blood glucose and fatty acids in the blood than it is for people who do not have NASH. The newer antidiabetic medications make the body more sensitive to insulin and may help reduce liver injury in patients with NASH. Studies of these medications-including metformin, rosiglitazone, and pioglitazone—are being sponsored by the National Institutes of Health and should answer the question of whether these medications are beneficial in NASH.

### Hope Through Research

What is most needed in the management of NASH is more research to better understand the liver injury found in this disease. When the pathways that lead to the injury are fully known, safe and effective means can be developed to reverse these pathways and help patients with NASH. Recent breakthroughs in mapping the human genome and uncovering the individual steps by which insulin and other hormones regulate blood glucose and fat could provide the necessary clues.

The National Institute of Diabetes and Digestive and Kidney Diseases funds the **NASH Clinical Research Network,** which comprises eight clinical centers located throughout the United States and a coordinating center at Johns Hopkins University. The NASH network researches the nature and underlying cause of NASH and conducts clinical studies on prevention and treatment. More information on the NASH Clinical Research Network and the locations of the clinical centers are available at *www.nashcrn.com*.

### **Points to Remember**

- Nonalcoholic steatohepatitis (NASH) is fat in the liver, with inflammation and damage.
- NASH occurs in people who drink little or no alcohol and affects 2 to 5 percent of Americans, especially people who are middle-aged and overweight or obese.
- Nash can occur in children.
- People who have NASH may feel well and may not know that they have a liver disease.
- NASH can lead to cirrhosis, a condition in which the liver is permanently damaged and cannot work properly.
- Fatigue can occur at any stage of NASH.
- Weight loss and weakness may begin once the disease is advanced or cirrhosis is present.
- NASH may be suspected if blood tests show high levels of liver enzymes or if scans show fatty liver.
- NASH is diagnosed by examining a small piece of the liver taken through a needle, a procedure called biopsy.
- People who have NASH should reduce their weight, eat a balanced diet, engage in physical activity, and avoid alcohol and unnecessary medications.
- There are no specific therapies for NASH. Experimental therapies being studied include antioxidants and antidiabetes medications.

### **For More Information**

### **American Liver Foundation**

75 Maiden Lane, Suite 603 New York, NY 10038–4810 24-hour helpline (7 days/week): 1–800–465–4837 or 1–888–443–7222 Phone: 1–800–676–9340 or 212–668–1000 Fax: 212–483–8179 Email: info@liverfoundation.org Internet: www.liverfoundation.org

### 5 Nonalcoholic Steatohepatitis

### National Digestive Diseases Information Clearinghouse

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The National Digestive Diseases Information Clearinghouse (NDDIC) is a service of the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). The NIDDK is part of the National Institutes of Health under the U.S. Department of Health and Human Services. Established in 1980, the clearinghouse provides information about digestive diseases to people with digestive disorders and to their families, health care professionals, and the public. NDDIC answers inquiries, develops and distributes publications, and works closely with professional and patient organizations and Government agencies to coordinate resources about digestive diseases.

Publications produced by the clearinghouse are carefully reviewed by both NIDDK scientists and outside experts. This fact sheet was reviewed by Anna Mae Diehl, M.D., Johns Hopkins University; and Brent Tetre, M.D., St. Louis University.

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES National Institutes of Health

NIH Publication No. 04–4921 January 2004

# Appendicitis

National Digestive Diseases Information Clearinghouse



National Institute of Diabetes and Digestive and Kidney Diseases

NATIONAL INSTITUTES OF HEALTH The appendix is a small, tube-like structure attached to the first part of the large intestine, also called the colon. The appendix is located in the lower right portion of the abdomen. It has no known function. Removal of the appendix appears to cause no change in digestive function.

Appendicitis is an inflammation of the appendix. Once it starts, there is no effective medical therapy, so appendicitis is considered a medical emergency. When treated promptly, most patients recover without difficulty. If treatment is delayed, the appendix can burst, causing infection and even death. Appendicitis is the most common acute surgical emergency of the abdomen. Anyone can get appendicitis, but it occurs most often between the ages of 10 and 30.

### Causes

The cause of appendicitis relates to blockage of the inside of the appendix, known as the lumen. The blockage leads to increased pressure, impaired blood flow, and inflammation. If the blockage is not treated, gangrene and rupture (breaking or tearing) of the appendix can result.

Most commonly, feces blocks the inside of the appendix. Also, bacterial or viral infections in the digestive tract can lead to





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The appendix is a small, tube-like structure attached to the first part of the large intestine, also called the colon. The appendix is located in the lower right portion of the abdomen, near where the small intestine attaches to the large intestine.

swelling of lymph nodes, which squeeze the appendix and cause obstruction. This swelling of lymph nodes is known as lymphoid hyperplasia. Traumatic injury to the abdomen may lead to appendicitis in a small number of people. Genetics may be a factor in others. For example, appendicitis that runs in families may result from a genetic variant that predisposes a person to obstruction of the appendiceal lumen.

### **Symptoms**

Symptoms of appendicitis may include

- pain in the abdomen, first around the belly button, then moving to the lower right area
- loss of appetite
- nausea
- vomiting
- constipation or diarrhea
- inability to pass gas
- low fever that begins after other symptoms
- abdominal swelling

Not everyone with appendicitis has all the symptoms. The pain intensifies and worsens when moving, taking deep breaths, coughing, or sneezing. The area becomes very tender. People may have a sensation called "downward urge," also known as "tenesmus," which is the feeling that a bowel movement will relieve their discomfort. Laxatives and pain medications should not be taken in this situation. Anyone with these symptoms needs to see a qualified physician immediately.

### **People With Special Concerns**

Patients with special conditions may not have the set of symptoms above and may simply experience a general feeling of being unwell. Patients with these conditions include

- people who use immunosuppressive therapy such as steroids
- people who have received a transplanted organ
- people infected with the HIV virus
- people with diabetes
- people who have cancer or who are receiving chemotherapy
- obese people

Pregnant women, infants and young children, and the elderly have particular issues.

Abdominal pain, nausea, and vomiting are more common during pregnancy and may or may not be the signs of appendicitis. Many women who develop appendicitis during pregnancy do not experience the classic symptoms. Pregnant women who experience pain on the right side of the abdomen need to contact a doctor. Women in their third trimester are most at risk.

Infants and young children cannot communicate their pain history to parents or doctors. Without a clear history, doctors must rely on a physical exam and less specific symptoms, such as vomiting and fatigue. Toddlers with appendicitis sometimes have trouble eating and may seem unusually sleepy. Children may have constipation, but may also have small stools that contain mucus. Symptoms vary widely among children. If you think your child has appendicitis, contact a doctor immediately. Older patients tend to have more medical problems than young patients. The elderly often experience less fever and less severe abdominal pain than other patients do. Many older adults do not know that they have a serious problem until the appendix is close to rupturing. A slight fever and abdominal pain on one's right side are reasons to call a doctor right away.

All patients with special concerns and their families need to be particularly alert to a change in normal functioning and patients should see their doctors sooner, rather than later, when a change occurs.

### Diagnosis

## Medical History and Physical Examination

Asking questions to learn the history of symptoms and a careful physical examination are key in the diagnosis of appendicitis. The doctor will ask many questions—much like a reporter—trying to understand the nature, timing, location, pattern, and severity of pain and symptoms. Any previous medical conditions and surgeries, family history, medications, and allergies are important information to the doctor. Use of alcohol, tobacco, and any other drugs should also be mentioned. This information is considered confidential and cannot be shared without the permission of the patient.

Before beginning a physical examination, a nurse or doctor will usually measure vital signs: temperature, pulse rate, breathing rate, and blood pressure. Usually the physical examination proceeds from head to toe. Many conditions such as pneumonia or heart disease can cause abdominal pain. Generalized symptoms such as fever, rash, or swelling of the lymph nodes may point to diseases that wouldn't require surgery. Examination of the abdomen helps narrow the diagnosis. Location of the pain and tenderness is important. Pain is a symptom described by a patient; tenderness is the response to being touched. Two signs, called peritoneal signs, suggest that the lining of the abdomen is inflamed and surgery may be needed: rebound tenderness and guarding. Rebound tenderness is when the doctor presses on a part of the abdomen and the patient feels more tenderness when the pressure is released than when it is applied. Guarding refers to the tensing of muscles in response to touch. The doctor may also move the patient's legs to test for pain on flexion of the hip (psoas sign), pain on internal rotation of the hip (obturator sign), or pain on the right side when pressing on the left (Rovsing's sign). These are valuable indicators of inflammation but not all patients have them.

### Laboratory Tests

Blood tests are used to check for signs of infection, such as a high white blood cell count. Blood chemistries may also show dehydration or fluid and electrolyte disorders. Urinalysis is used to rule out a urinary tract infection. Doctors may also order a pregnancy test for women of childbearing age (those who have regular periods).

### **Imaging Tests**

X rays, ultrasound, and computed tomography (CT) scans can produce images of the abdomen. Plain x rays can show signs of obstruction, perforation (a hole), foreign bodies, and in rare cases, an appendicolith, which is hardened stool in the appendix. Ultrasound may show appendiceal inflammation and can diagnose gall bladder disease and pregnancy. By far the most common test used, however, is the CT scan. This test provides a series of cross-sectional images of the body and can identify many abdominal conditions and facilitate diagnosis when the clinical impression is in doubt. All women of childbearing age should have a pregnancy test before undergoing any testing with x rays.

In selected cases, particularly in women when the cause of the symptoms may be either the appendix or an inflamed ovary or fallopian tube, laparoscopy may be necessary. This procedure avoids radiation, but requires general anesthesia. A laparoscope is a thin tube with a camera attached that is inserted into the body through a small cut, allowing doctors to see the internal organs. Surgery can then be performed laparoscopically if the condition present requires it.

### Treatment

### Surgery

Acute appendicitis is treated by surgery to remove the appendix. The operation may be performed through a standard small incision in the right lower part of the abdomen, or it may be performed using a laparoscope, which requires three to four smaller incisions. If other conditions are suspected in addition to appendicitis, they may be identified using laparoscopy. In some patients, laparoscopy is preferable to open surgery because the incision is smaller, recovery time is quicker, and less pain medication is required. The appendix is almost always removed, even if it is found to be normal. With complete removal, any later episodes of pain will not be attributed to appendicitis.

Recovery from appendectomy takes a few weeks. Doctors usually prescribe pain medication and ask patients to limit physical activity. Recovery from laparoscopic appendectomy is generally faster, but limiting strenuous activity may still be necessary for 4 to 6 weeks after surgery. Most people treated for appendicitis recover excellently and rarely need to make any changes in their diet, exercise, or lifestyle.

### Antibiotics and Other Treatments

If the diagnosis is uncertain, people may be watched and sometimes treated with antibiotics. This approach is taken when the doctor suspects that the patient's symptoms may have a nonsurgical or medically treatable cause. If the cause of the pain is infectious, symptoms resolve with intravenous antibiotics and intravenous fluids. In general, however, appendicitis cannot be treated with antibiotics alone and will require surgery.

Occasionally the body is able to control an appendiceal perforation by forming an abscess. An abscess occurs when an infection is walled off in one part of the body. The doctor may choose to drain the abscess and leave the drain in the abscess cavity for several weeks. An appendectomy may be scheduled after the abscess is drained.

### **Complications**

The most serious complication of appendicitis is rupture. The appendix bursts or tears if appendicitis is not diagnosed quickly and goes untreated. Infants, young children, and older adults are at highest risk. A ruptured appendix can lead to peritonitis and abscess. Peritonitis is a dangerous infection that happens when bacteria and other contents of the torn appendix leak into the abdomen. In people with appendicitis, an abscess usually takes the form of a swollen mass filled with fluid and bacteria. In a few patients, complications of appendicitis can lead to organ failure and death.

### Hope Through Research

The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) conducts and supports research into many kinds of digestive disorders, including some related to appendicitis.

### **Points to Remember**

- The appendix is a small, tube-like structure attached to the first part of the colon. Appendicitis is an inflammation of the appendix.
- Appendicitis is considered a medical emergency.
- Symptoms of appendicitis include pain in the abdomen, loss of appetite, nausea, vomiting, constipation or diarrhea, inability to pass gas, low-grade fever, and abdominal swelling. Not everyone with appendicitis has all the symptoms.
- Physical examination, laboratory tests, and imaging tests are used to diagnose appendicitis.
- Acute appendicitis is treated by surgery to remove the appendix.
- The most serious complication of appendicitis is rupture, which can lead to peritonitis and abscess.

### **For More Information**

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### American College of Surgeons

633 North Saint Clair Street Chicago, IL 60611–3211 Phone: (312) 202–5000 Fax: (312) 202–5001 Email: postmaster@facs.org Internet: www.facs.org

### American Society of Colon and Rectal Surgeons (ASCRS)

85 West Algonquin Road Suite 550 Arlington Heights, IL 60005 Phone: (847) 290–9184 Fax: (847) 290–9203 Email: ascrs@fascrs.org Internet: www.fascrs.org

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# Anatomic Problems of the Colon

National Digestive Diseases Information Clearinghouse



National Institute of Diabetes and Digestive and Kidney Diseases

NATIONAL INSTITUTES OF HEALTH The colon, or large intestine, is part of the digestive system, which is a series of organs from the mouth to the anus. When the shape of the colon or the way it connects to other organs is abnormal, digestive problems result. Some of these anatomic problems can occur during embryonic development of the fetus in the womb and are known as congenital abnormalities. Other problems develop with age.

Knowing how the colon develops and how it works provides a basis for understanding the specific anatomic problems that follow:

- Malrotation
- Small bowel and colonic intussusception
- Fistulas
- Colonic atresia
- Volvulus
- Imperforate anus

## **Colon Anatomy and Development**

The adult colon is about 5 feet long. It connects to the small bowel, which is also known as the small intestine. The major functions of the colon are to absorb water and salts from partially digested food that enters from the small bowel and then send waste out of the body through the anus. What remains after absorption is stool, which passes from the colon into the rectum and out through the anus when a person has a bowel movement.

The colon comprises several segments:

- the cecum, the portion just after the small bowel
- the ascending colon
- the transverse colon
- the descending colon





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Anatomic Problems of the Colon

- the sigmoid colon, an S-shaped portion near the end of the colon
- the rectum, where stool is stored until evacuation

The colon is formed during the first 3 months of embryonic development. As the bowel lengthens, part of it passes into the umbilical cord, which connects the fetus to the mother. As the fetus grows and the abdominal cavity enlarges, the bowel returns to the abdomen and turns, or rotates, counterclockwise to its final position. The small bowel and colon are held in position by tissue known as the mesentery. The ascending colon and descending colon are fixed in place in the abdominal cavity. The cecum, transverse colon, and sigmoid colon are suspended from the back of the abdominal wall by the mesentery.

### **Malrotation and Volvulus**

If the bowel does not rotate completely during embryonic development, problems can occur. This condition is called malrota-

Mesentery

The colon is held in place by the mesentery.

tion. Normally, the cecum is located in the lower right part of the abdomen. If the cecum is not positioned correctly, the bands of thin tissue that normally hold it in place may cross over and block part of the small bowel.

Also, if the small bowel and colon have not rotated properly, the mesentery may be only narrowly attached to the back of the abdominal cavity. This narrow attachment can lead to a mobile or floppy bowel that is prone to twisting, a disorder called volvulus. (See the section on volvulus, page 5.)

Malrotation is also associated with other gastrointestinal (GI) conditions, including Hirschsprung's disease and bowel atresia.

Malrotation is usually identified in infants. About 60 percent of these cases are found in the first month of life. Malrotation affects both boys and girls, although boys are more often diagnosed in infancy.



In malrotation, the cecum is not positioned correctly. The tissue that normally holds it in place may cross over and block part of the small bowel.

In infants, the main symptom of malrotation is vomiting bile. Bile is a greenishyellow digestive fluid made by the liver and stored in the gallbladder. Symptoms of malrotation with volvulus in older children include vomiting (but not necessarily vomiting bile), abdominal pain, diarrhea, constipation, bloody stools, rectal bleeding, or failure to thrive.

Various imaging studies are used to diagnose malrotation:

- x rays to determine whether there is a blockage. In malrotation, abdominal x rays commonly show that air, which normally passes through the entire digestive tract, has become trapped. The trapped air creates an enlarged, air-filled stomach and upper small bowel, with little or no air in the rest of the small bowel or the colon.
- upper GI series to locate the point of intestinal obstruction. With this test, the patient swallows barium to coat the stomach and small bowel before x rays are taken. Barium makes the organs visible on x ray and indicates the point of the obstruction. This test cannot be done if the patient is vomiting.
- lower GI series to determine the position of the colon. For this test, a barium enema is given while x rays are taken. The barium makes the colon visible so the position of the cecum can be determined.
- computed tomography (CT) scan to help determine and locate the intestinal obstruction.

Malrotation in infants is a medical emergency that usually requires immediate surgery. Surgery may involve

- untwisting the colon
- dividing the bands of tissue that obstruct the small bowel

- repositioning the small bowel and colon
- removing the appendix

Surgery to relieve the blockage of the small bowel is usually successful and allows the digestive system to function normally.

### **Small Bowel and Colonic Intussusception**

Intussusception is a condition in which one section of the bowel tunnels into an adjoining section, like a collapsible telescope. Intussusception can occur in the colon, the small bowel, or between the small bowel and colon. The result is a blocked small bowel or colon.

Intussusception is rare in adults. Causes include

- benign or malignant growths
- adhesions (scarlike tissue)
- surgical scars in the small bowel or colon
- motility disorders (problems with the movement of food through the digestive tract)
- long-term diarrhea

Some cases of intussusception have been associated with viral infections and in patients living with AIDS. It can also occur without any known cause (idiopathic).

In infants and children, intussusception involving the small bowel alone, or the small bowel and the colon, is one of the most common causes of intestinal obstruction. Malrotation is a risk factor. Intussusception affects boys more often than girls, with most cases happening at 5 months and at 3 years of age. Most cases in children have no known cause, but viral infections or a growth in the small bowel or colon may trigger the condition. In the past, cases of intussusception appeared to be associated with a childhood vaccine for rotavirus, a common cause of gastroenteritis (intestinal infection). That vaccine is no longer given.

In adults with intussusception, symptoms can last a long time (chronic symptoms) or they can come and go (intermittent symptoms). The symptoms will depend on the location of the intussusception. They may include

- changes in bowel habits
- urgency—needing to have a bowel movement immediately
- · rectal bleeding
- chronic or intermittent crampy abdominal pain
- pain in a specific area of the abdomen
- abdominal distention
- nausea and vomiting

Children with intussusception may experience

- intermittent abdominal pain
- bowel movements that are mixed with blood and mucus
- abdominal distention or a lump in the abdomen
- vomiting bile
- diarrhea
- fever
- dehydration
- lethargy
- shock (low blood pressure, increased heart rate requiring immediate attention)

If intussusception is not diagnosed promptly, especially in children, it can cause serious damage to the portion of the bowel that is unable to get its normal blood supply. A range of diagnostic tests may be required. X rays of the abdomen may suggest a bowel obstruction (blockage). Upper and lower GI series will locate the intussusception and show the telescoping. CT scans can also help with the diagnosis. When intussusception is suspected, an air or barium enema can often help correct the problem by pushing the telescoped section of bowel into its proper position.

Both adults and children may require surgery to straighten or remove the involved section of bowel. The outcome of this surgery depends on the stage of the intussusception at diagnosis and the underlying cause. With early treatment, the outcome is generally excellent. In some cases, usually in children, intussusception may be temporary and reverse on its own. If no underlying cause is found in these cases, no specific treatment is required.

### **Fistulas**

A fistula is an abnormal passageway between two areas of the digestive tract. An internal fistula occurs between two areas of intestine or an area of intestine and another organ. An external fistula occurs between the intestine and the outside of the body. Both internal and external fistulas may be characterized by abdominal pain and swelling. External fistulas may discharge pus or intestinal contents. Internal fistulas can be associated with diarrhea.

The most common types of fistulas develop around the anus, colon, and small bowel. These types are

- ileosigmoid—occurs between the sigmoid colon and the end of the small bowel, which is also called the ileum
- ileocecal—occurs between the ileum and cecum
- anorectal—occurs between the anal canal and the skin around the anus
- anovaginal—occurs between the rectum and vagina

### 4 Anatomic Problems of the Colon

- colovesical—occurs between the colon and bladder
- cutaneous—occurs between the colon or small bowel and the outside of the body

Fistulas can occur at any age. Some fistulas are congenital, which means they occur during the development of a baby. They are seen in infants and are more common in boys. Other fistulas develop suddenly due to diseases or after trauma, surgery, or local infection. A fistula can form when diseased or damaged tissue comes into contact with other damaged or nondamaged tissue, as seen in Crohn's disease (intestinal inflammation) and diverticulitis. Childbirth can lead to fistulas between the rectum and vagina in women.

External fistulas are found during a physical examination. Internal fistulas can be seen by colonoscopy, upper and lower GI series, or CT scan.

Fistulas may be treated by surgery to remove the portion of the intestine causing the fistula, along with antibiotics to treat any associated infection.

### **Colonic Atresia**

Colonic atresia is a condition that occurs during embryonic development in which the normal tubular shape of the colon in the fetus is unexpectedly closed. This congenital abnormality may be caused by incomplete development of the colon or the loss of blood flow during its development. Colonic atresia is rare and may occur with the more common small bowel atresia.

Infants with colonic atresia have no bowel movements, increasing abdominal distention, and vomiting. X rays will show a dilated colon above the obstruction, which can then be located using a barium enema. Surgery is necessary to open or remove the closed area and re-connect the normal sections of the colon.

### Volvulus

Volvulus refers to the twisting of a portion of the intestine around itself or a stalk of mesentery tissue to cause an obstruction. Volvulus occurs most frequently in the colon, although the stomach and small bowel can also twist. The part of the digestive system above the volvulus continues to function and may swell as it fills with digested food, fluid, and gas. A condition called strangulation develops if the mesentery of the bowel is twisted so tightly that blood flow is cut off and the tissue dies. This condition is called gangrene. Volvulus is a surgical emergency because gangrene can develop quickly, cause a hole in the wall of the bowel (perforation), and become lifethreatening.

In the colon, volvulus most often involves the cecum and sigmoid segment. Sigmoid volvulus is more common than cecal volvulus.

### **Sigmoid Volvulus**

The sigmoid is the last section of the colon. Two anatomic differences can increase the risk of sigmoid volvulus. One is an elongated or movable sigmoid colon that is unattached to the left sidewall of the abdomen. Another is a narrow mesentery that allows twisting at its base. Sigmoid volvulus, however, can occur even without an anatomic abnormality.

Risk factors that can make a person more likely to have sigmoid volvulus are Hirschsprung's disease, intestinal pseudoobstructions, and megacolon (an enlarged colon). Adults, children, and infants can all have sigmoid volvulus. It is more common in men than in women, possibly because men have longer sigmoid colons. It is also more common in people over age 60, in African Americans, and in institutionalized individuals who are on medications for psychiatric disorders. In addition, children with malrotation are more likely to get sigmoid volvulus.

The symptoms can be acute (occur suddenly) and severe. They include a bowel obstruction (commonly seen in infants), nausea, vomiting, bloody stools, abdominal pain, constipation, and shock. Other symptoms can develop more slowly but increase over time, such as severe constipation, lack of passing gas, crampy abdominal pain, and abdominal distention. A doctor may also hear increased or decreased bowel sounds.

Several tests are used to diagnose sigmoid volvulus. X rays show a dilated colon above the volvulus. Upper and lower GI series help locate the point of obstruction and show whether malrotation of the rest of the colon is present. A CT scan may be used to show the degree of twisting and malrotation, and whether perforation has occurred.

In most instances, a sigmoidoscope, a tube used to look into the sigmoid colon and rectum, can be used to reach the site, untwist the colon, and release the obstruction. However, if the colon is found to be twisted very tightly or is twisted so tightly that blood flow is cut off and the tissue is dead, immediate surgery will be needed to correct the problem and, if possible, restore the blood supply. Dead tissue will be removed during surgery, and a portion of the colon may be removed as well-a procedure called a resection. Sigmoid volvulus can recur after untwisting with the sigmoidoscope, but resection eliminates the chance of recurrence. Prompt diagnosis of sigmoid volvulus and appropriate treatment generally lead to a good outcome.

### **Cecal Volvulus**

Cecal volvulus is the twisting of the cecum and ascending segment of the colon. Normally, the cecum and ascending colon are fixed to the internal abdominal wall. If not, they can move and become twisted. The main symptoms of cecal volvulus are crampy abdominal pain and swelling that are sometimes associated with nausea and vomiting.

In testing, x rays will show the cecum out of its normal place and inflated with trapped air. The appendix may be filled with gas, but little or no gas is seen in other parts of the colon. Upper and lower GI series will locate the volvulus and the position of the colon. A CT scan may show how tightly the volvulus is twisted. A colonoscopy, which uses a small, flexible tube with a light and a lens on the end to see the inside of the colon, can sometimes be used to untwist the volvulus. If the cecum becomes gangrenous or holes develop in it, surgery will be needed.



*In volvulus, a portion of the intestine twists around itself.* 

### Imperforate Anus (Anal Atresia)

Imperforate anus or anal atresia is a congenital abnormality in which the anorectal region is abnormal or incompletely developed. In some cases, the rectum may end and not connect with the anus, or it may connect in the wrong spot. For example, it may connect to the urethra, bladder, or vagina. (See the section on fistulas, page 4). In other cases, the anus may be very narrow or missing altogether. The result is that stool cannot pass out of the colon. Imperforate anus occurs in about 1 in 5,000 infants.

Another malformation that results in absence of a functioning anus is congenital cloaca. In patients with this abnormality, the anal muscles and vagina fail to form and the result is a large, ill-defined opening that represents the rectum as well as the vagina and bladder, depending on the extent of the defect. Cloaca deformity of the anus usually requires a colostomy but may be correctable with a surgical procedure that transfers a muscle from another part of the body to create a functioning sphincter at the anus.

Symptoms of imperforate anus include

- no bowel movement within 24 to 48 hours after birth
- a missing or misplaced anal opening
- stool that comes out of the vagina or urethra
- abdominal swelling (distention)

Imperforate anus is usually found when the infant is first examined after birth. Imperforate anus is categorized on the basis of the location of the end of the rectum in relation to the muscles that support the rectum and other organs in the pelvis, called the levator ani muscles. These location categories are

- high: the rectum ends above the muscles
- intermediate: the rectum ends at the level of the muscles
- low: the rectum ends below the muscles

In all cases of imperforate anus, surgery is necessary to reconstruct the anus. Low imperforate anus is corrected through a minor procedure just after birth. High imperforate anus may require surgery to separate the rectum from the other organs if the rectum is connected with them. The outcome is usually very good, but some infants may not develop good bowel control after surgery because the anal muscles may not form. A child with high imperforate anus often has other GI problems, such as malrotation and intestinal atresia.

Factors that affect the outcome of treatment include the location of the abnormality, the patient's sex, and the age at which the surgery is done. Surgery to correct low imperforate anus in boys usually has an excellent outcome. Correcting cloaca in girls requires a more difficult procedure and is more prone to complications.

### **Hope Through Research**

The National Institute of Diabetes and Digestive and Kidney Diseases, through its Division of Digestive Diseases and Nutrition, supports basic and clinical research into GI diseases, including GI structure; the growth of GI cells in normal and disease states; tissue injury, repair, and regeneration; and Crohn's disease. Research includes new methods that will help physicians and researchers see inside the body, thereby increasing the detection rate for anatomic problems of the colon.

### **Points to Remember**

- Anatomic problems of the colon are caused by changes in the shape of the colon or the way it connects to other organs.
- Anatomic problems may be congenital or develop with age.
- Anatomic problems can block the passage of food through the digestive system. Some problems can become life-threatening.
- Symptoms of anatomic problems include abdominal pain, abdominal distension, vomiting, and diarrhea or constipation.
- Some anatomic problems may resolve over time; others may need to be corrected with surgery.

### For More Information

### **Crohn's & Colitis Foundation of America** (CCFA)

386 Park Avenue South, 17th Floor New York, NY 10016–8804 Phone: 1–800–932–2423 or 212–685–3440 Fax: 212–779–4098 Email: info@ccfa.org Internet: www.ccfa.org

### International Foundation for Functional Gastrointestinal Disorders (IFFGD)

P.O. Box 170864 Milwaukee, WI 53217–8076 Phone: 1–888–964–2001 or 414–964–1799 Fax: 414–964–7176 Email: iffgd@iffgd.org Internet: www.iffgd.org

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Publications produced by the clearinghouse are carefully reviewed by both NIDDK scientists and outside experts. This fact sheet was reviewed by Robert Beart, M.D., University of Southern California; James W. Fleshman, M.D., Washington University and Barnes-Jewish Hospital; Kevan Jacobson, M.B.B.Ch, B.C.'s [British Columbia, Canada's] Children's Hospital; Joseph Levy, M.D., Children's Hospital of New York-Presbyterian; and John H. Pemberton, M.D., Mayo Clinic.

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES National Institutes of Health

NIH Publication No. 05–5120 February 2005

# Diverticulosis and Diverticulitis

National Digestive Diseases Information Clearinghouse



National Institute of Diabetes and Digestive and Kidney Diseases

NATIONAL INSTITUTES OF HEALTH

# What are diverticulosis and diverticulitis?

Many people have small pouches in their colons that bulge outward through weak spots, like an inner tube that pokes through weak places in a tire. Each pouch is called a diverticulum. Pouches (plural) are called diverticula. The condition of having diverticula is called diverticulosis. About 10 percent of Americans over the age of 40 have diverticulosis. The condition becomes more common as people age. About half of all people over the age of 60 have diverticulosis.

When the pouches become infected or inflamed, the condition is called diverticulitis. This happens in 10 to 25 percent of people with diverticulosis. Diverticulosis and diverticulitis are also called *diverticular disease*.

### What are the symptoms?

### **Diverticulosis**

Most people with diverticulosis do not have any discomfort or symptoms. However, symptoms may include mild cramps, bloating, and constipation. Other diseases such as irritable bowel syndrome (IBS) and stomach ulcers cause similar problems, so these symptoms do not always mean a person has diverticulosis. You should visit your doctor if you have these troubling symptoms.



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### **Diverticulitis**

The most common symptom of diverticulitis is abdominal pain. The most common sign is tenderness around the left side of the lower abdomen. If infection is the cause, fever, nausea, vomiting, chills, cramping, and



constipation may occur as well. The severity of symptoms depends on the extent of the infection and complications.

### What are the complications?

Diverticulitis can lead to bleeding, infections, perforations or tears, or blockages. These complications always require treatment to prevent them from progressing and causing serious illness.

### Bleeding

Bleeding from diverticula is a rare complication. When diverticula bleed, blood may appear in the toilet or in your stool. Bleeding can be severe, but it may stop by itself and not require treatment. Doctors believe bleeding diverticula are caused by a small blood vessel in a diverticulum that weakens and finally bursts. If you have bleeding from the rectum, you should see your doctor. If the bleeding does not stop, surgery may be necessary.

### Abscess, Perforation, and Peritonitis

The infection causing diverticulitis often clears up after a few days of treatment with antibiotics. If the condition gets worse, an abscess may form in the colon.

An abscess is an infected area with pus that may cause swelling and destroy tissue. Sometimes the infected diverticula may develop small holes, called perforations. These perforations allow pus to leak out of the colon into the abdominal area. If the abscess is small and remains in the colon, it may clear up after treatment with antibiotics. If the abscess does not clear up with antibiotics, the doctor may need to drain it.

To drain the abscess, the doctor uses a needle and a small tube called a catheter. The doctor inserts the needle through the skin and drains the fluid through the catheter. This procedure is called percutaneous catheter drainage. Sometimes surgery is needed to clean the abscess and, if necessary, remove part of the colon.

A large abscess can become a serious problem if the infection leaks out and contaminates areas outside the colon. Infection that spreads into the abdominal cavity is called peritonitis. Peritonitis requires immediate surgery to clean the abdominal cavity and remove the damaged part of the colon. Without surgery, peritonitis can be fatal.

### Fistula

A fistula is an abnormal connection of tissue between two organs or between an organ and the skin. When damaged tissues come into contact with each other during infection, they sometimes stick together. If they heal that way, a fistula forms. When diverticulitisrelated infection spreads outside the colon, the colon's tissue may stick to nearby tissues. The organs usually involved are the bladder, small intestine, and skin. The most common type of fistula occurs between the bladder and the colon. It affects men more than women. This type of fistula can result in a severe, long-lasting infection of the urinary tract. The problem can be corrected with surgery to remove the fistula and the affected part of the colon.

### **Intestinal Obstruction**

The scarring caused by infection may cause partial or total blockage of the large intestine. When this happens, the colon is unable to move bowel contents normally. When the obstruction totally blocks the intestine, emergency surgery is necessary. Partial blockage is not an emergency, so the surgery to correct it can be planned.

## What causes diverticular disease?

Although not proven, the dominant theory is that a low-fiber diet is the main cause of diverticular disease. The disease was first noticed in the United States in the early 1900s. At about the same time, processed foods were introduced into the American diet. Many processed foods contain refined, low-fiber flour. Unlike whole-wheat flour, refined flour has no wheat bran.

Diverticular disease is common in developed or industrialized countries—particularly the United States, England, and Australia where low-fiber diets are common. The disease is rare in countries of Asia and Africa, where people eat high-fiber vegetable diets.

Fiber is the part of fruits, vegetables, and grains that the body cannot digest. Some fiber dissolves easily in water (soluble fiber). It takes on a soft, jelly-like texture in the intestines. Some fiber passes almost unchanged through the intestines (insoluble fiber). Both kinds of fiber help make stools soft and easy to pass. Fiber also prevents constipation.

Constipation makes the muscles strain to move stool that is too hard. It is the main cause of increased pressure in the colon. This excess pressure might cause the weak spots in the colon to bulge out and become diverticula. Diverticulitis occurs when diverticula become infected or inflamed. Doctors are not certain what causes the infection. It may begin when stool or bacteria are caught in the diverticula. An attack of diverticulitis can develop suddenly and without warning.

### How does the doctor diagnose diverticular disease?

To diagnose diverticular disease, the doctor asks about medical history, does a physical exam, and may perform one or more diagnostic tests. Because most people do not have symptoms, diverticulosis is often found through tests ordered for another ailment.



The doctor will ask about medical history.

When taking a medical history, the doctor may ask about bowel habits, symptoms, pain, diet, and medications. The physical exam usually involves a digital rectal exam. To perform this test, the doctor inserts a gloved, lubricated finger into the rectum to detect tenderness, blockage, or blood. The doctor may check stool for signs of bleeding and test blood for signs of infection. The doctor may also order x rays or other tests.

## What is the treatment for diverticular disease?

A high-fiber diet and, occasionally, mild pain medications will help relieve symptoms in most cases. Sometimes an attack of diverticulitis is serious enough to require a hospital stay and possibly surgery.

### Diverticulosis

Increasing the amount of fiber in the diet may reduce symptoms of diverticulosis and prevent complications such as diverticulitis. Fiber keeps stool soft and lowers pressure inside the colon so that bowel contents can move through easily. The American Dietetic Association recommends 20 to 35 grams of fiber each day. The table shows the amount of fiber in some foods that you can easily add to your diet.

The doctor may also recommend taking a fiber product such as Citrucel or Metamucil once a day. These products are mixed with water and provide about 2 to 3.5 grams of fiber per tablespoon, mixed with 8 ounces of water.

Until recently, many doctors suggested avoiding foods with small seeds such as tomatoes or strawberries because they believed that particles could lodge in the diverticula and cause inflammation. However, it is now generally accepted that only foods that may irritate or get caught in the diverticula cause problems. Foods such as nuts, popcorn hulls, and sunflower, pumpkin, caraway, and sesame seeds should be avoided. The seeds in tomatoes, zucchini, cucumbers, strawberries, and raspberries, as well as poppy seeds, are generally considered harmless. People differ in the amounts and types of foods they can eat. Decisions about diet should be made based on what works best for each person. Keeping a food diary may help identify individual items in one's diet.

If cramps, bloating, and constipation are problems, the doctor may prescribe a short course of pain medication. However, many medications affect emptying of the colon, an undesirable side effect for people with diverticulosis.

### **Amount of Fiber in Some Foods**

### Fruits



Apple, raw, with skin Peach raw	1 medium	=	3.3 grams
Pear, raw	1 medium	=	5.1 grams
langerine, raw	1 medium	=	1.9 grams

### **Vegetables**

Asparagus, fresh, cooked Broccoli, fresh, cooked Brussels sprouts, fresh, cooked Cabbage, fresh, cooked Carrot, fresh, cooked Cauliflower, fresh, cooked Romaine lettuce Spinach, fresh, cooked Summer squash, cooked Tomato, raw Winter squash, cooked

4 spears	=	1.2 grams
1/2 cup	=	2.6 grams
1/2 cup	=	2 grams
1/2 cup	=	1.5 grams
1/2 cup	=	2.3 grams
1/2 cup	=	1.7 grams
1 cup	=	1.2 grams
1/2 cup	=	2.2 grams
1 cup	=	2.5 grams
1	=	1 gram
1 cup	=	5.7 grams

#### **Starchy Vegetables**

Baked beans, canned, plain Kidney beans, fresh, cooked Lima beans, fresh, cooked Potato, fresh, cooked

### Grains

Bread, whole-wheat Brown rice, cooked Cereal, bran flake Oatmeal, plain, cooked White rice, cooked



1

)	=	5.7 grams
)	=	6.6 grams
	=	2.3 grams

1 slice	=	1.9 grams
1 cup	=	3.5 grams
3/4 cup	=	5.3 grams
3/4 cup	=	3 grams
1 cup	=	0.6



Source: United States Department of Agriculture (USDA). USDA Nutrient Database for Standard Reference Release 15. Available at www.nal.usda.gov/fnic/cgi-bin/ nut search.pl. Accessed April 5, 2004.



### **Diverticulitis**

Treatment for diverticulitis focuses on clearing up the infection and inflammation, resting the colon, and preventing or minimizing complications. An attack of diverticulitis without complications may respond to antibiotics within a few days if treated early.

To help the colon rest, the doctor may recommend bed rest and a liquid diet, along with a pain reliever.

An acute attack with severe pain or severe infection may require a hospital stay. Most acute cases of diverticulitis are treated with antibiotics and a liquid diet. The antibiotics are given by injection into a vein. In some cases, however, surgery may be necessary.

### When is surgery necessary?

If attacks are severe or frequent, the doctor may advise surgery. The surgeon removes the affected part of the colon and joins the remaining sections. This type of surgery, called colon resection, aims to keep attacks from coming back and to prevent complications. The doctor may also recommend surgery for complications of a fistula or intestinal obstruction.

If antibiotics do not correct an attack, emergency surgery may be required. Other reasons for emergency surgery include a large abscess, perforation, peritonitis, or continued bleeding.

Emergency surgery usually involves two operations. The first surgery will clear the infected abdominal cavity and remove part of the colon. Because of infection and sometimes obstruction, it is not safe to rejoin the colon during the first operation. Instead, the surgeon creates a temporary hole, or stoma, in the abdomen. The end of the colon is connected to the hole, a procedure called a colostomy, to allow normal eating and bowel

### **Points to Remember**

- Diverticulosis occurs when small pouches, called diverticula, bulge outward through weak spots in the colon (large intestine).
- The pouches form when pressure inside the colon builds, usually because of constipation.
- Most people with diverticulosis never have any discomfort or symptoms.
- The most likely cause of diverticulosis is a low-fiber diet because it increases constipation and pressure inside the colon.
- For most people with diverticulosis, eating a high-fiber diet is the only treatment needed.
- You can increase your fiber intake by eating these foods: whole grain breads and cereals; fruit like apples and peaches; vegetables like broccoli, cabbage, spinach, carrots, asparagus, and squash; and starchy vegetables like kidney beans and lima beans.
- Diverticulitis occurs when the pouches become infected or inflamed and cause pain and tenderness around the left side of the lower abdomen.

movements. The stool goes into a bag attached to the opening in the abdomen. In the second operation, the surgeon rejoins the ends of the colon.

### **Additional Readings**

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Marcello PW. Understanding diverticular disease. *Ostomy Quarterly*. 2002;39(2): 56-57.

### **For More Information**

### International Foundation for Functional Gastrointestinal Disorders

P.O. Box 170864 Milwaukee, WI 53217–8076 Phone: 1–888–964–2001 or 414–964–1799 Fax: 414–964–7176 Email: iffgd@iffgd.org Internet: www.iffgd.org

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES National Institutes of Health

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# Gas in the Digestive Tract

National Digestive Diseases Information Clearinghouse



National Institute of Diabetes and Digestive and Kidney Diseases

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Everyone has gas and eliminates it by burping or passing it through the rectum. However, many people think they have too much gas when they really have normal amounts. Most people produce about 1 to 4 pints a day and pass gas about 14 times a day.

Gas is made primarily of odorless vapors carbon dioxide, oxygen, nitrogen, hydrogen, and sometimes methane. The unpleasant odor of flatulence comes from bacteria in the large intestine that release small amounts of gases that contain sulfur.

Although having gas is common, it can be uncomfortable and embarrassing. Understanding causes, ways to reduce symptoms, and treatment will help most people find relief.

### What causes gas?

Gas in the digestive tract (that is, the esophagus, stomach, small intestine, and large intestine) comes from two sources:

- swallowed air
- normal breakdown of certain undigested foods by harmless bacteria naturally present in the large intestine (colon)

### Swallowed Air

Air swallowing (aerophagia) is a common cause of gas in the stomach. Everyone swallows small amounts of air when eating and drinking. However, eating or drinking rapidly, chewing gum, smoking, or wearing loose dentures can cause some people to take in more air.



The digestive tract

Burping, or belching, is the way most swallowed air—which contains nitrogen, oxygen, and carbon dioxide—leaves the stomach. The remaining gas moves into the small intestine, where it is partially absorbed. A small amount travels into the large intestine for release through the rectum. (The stomach also releases carbon dioxide when stomach acid and bicarbonate mix, but most of this gas is absorbed into the bloodstream and does not enter the large intestine.)

### **Breakdown of Undigested Foods**

The body does not digest and absorb some carbohydrates (the sugar, starches, and fiber found in many foods) in the small



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intestine because of a shortage or absence of certain enzymes.

This undigested food then passes from the small intestine into the large intestine, where normal, harmless bacteria break down the food, producing hydrogen, carbon dioxide, and, in about one-third of all people, methane. Eventually these gases exit through the rectum.

People who make methane do not necessarily pass more gas or have unique symptoms. A person who produces methane will have stools that consistently float in water. Research has not shown why some people produce methane and others do not.

Foods that produce gas in one person may not cause gas in another. Some common bacteria in the large intestine can destroy the hydrogen that other bacteria produce. The balance of the two types of bacteria may explain why some people have more gas than others.

### Which foods cause gas?

Most foods that contain carbohydrates can cause gas. By contrast, fats and proteins cause little gas.

### Sugars

The sugars that cause gas are raffinose, lactose, fructose, and sorbitol.

**Raffinose.** Beans contain large amounts of this complex sugar. Smaller amounts are found in cabbage, brussels sprouts, broccoli, asparagus, other vegetables, and whole grains.

Lactose. Lactose is the natural sugar in milk. It is also found in milk products, such as cheese and ice cream, and processed

foods, such as bread, cereal, and salad dressing. Many people, particularly those of African, Native American, or Asian background, normally have low levels of the enzyme lactase needed to digest lactose after childhood. Also, as people age, their enzyme levels decrease. As a result, over time people may experience increasing amounts of gas after eating food containing lactose.

**Fructose.** Fructose is naturally present in onions, artichokes, pears, and wheat. It is also used as a sweetener in some soft drinks and fruit drinks.

**Sorbitol.** Sorbitol is a sugar found naturally in fruits, including apples, pears, peaches, and prunes. It is also used as an artificial sweetener in many dietetic foods and sugar-free candies and gums.

### **Starches**

Most starches, including potatoes, corn, noodles, and wheat, produce gas as they are broken down in the large intestine. Rice is the only starch that does not cause gas.

### Fiber

Many foods contain soluble and insoluble fiber. Soluble fiber dissolves easily in water and takes on a soft, gel-like texture in the intestines. Found in oat bran, beans, peas, and most fruits, soluble fiber is not broken down until it reaches the large intestine, where digestion causes gas.

Insoluble fiber, on the other hand, passes essentially unchanged through the intestines and produces little gas. Wheat bran and some vegetables contain this kind of fiber.

## What are some symptoms and problems of gas?

The most common symptoms of gas are flatulence, abdominal bloating, abdominal pain, and belching. However, not everyone experiences these symptoms. The determining factors probably are how much gas the body produces, how many fatty acids the body absorbs, and a person's sensitivity to gas in the large intestine.

### **Belching**

An occasional belch during or after meals is normal and releases gas when the stomach is full of food. However, people who belch frequently may be swallowing too much air and releasing it before the air enters the stomach.

Sometimes a person with chronic belching may have an upper GI disorder, such as peptic ulcer disease, gastroesophageal reflux disease (GERD), or gastroparesis.

Occasionally, some people believe that swallowing air and releasing it will relieve the discomfort of these disorders, and this person may intentionally or unintentionally develop a habit of belching to relieve discomfort.

Gas-bloat syndrome may occur after fundoplication surgery to correct GERD. The surgery creates a one-way valve between the esophagus and stomach that allows food and gas to enter the stomach but often prevents normal belching and the ability to vomit. It occurs in about 10 percent of people who have this surgery but may improve with time.

### Flatulence

Another common complaint is passage of too much gas through the rectum (flatulence). However, most people do not realize that passing gas 14 to 23 times a day is normal. Too much gas may be the result of carbohydrate malabsorption.

### **Abdominal Bloating**

Many people believe that too much gas causes abdominal bloating. However, people who complain of bloating from gas often have normal amounts and distribution of gas. They actually may be unusually aware of gas in the digestive tract.

Doctors believe that bloating is usually the result of an intestinal disorder, such as irritable bowel syndrome (IBS). The cause of IBS is unknown, but may involve abnormal movements and contractions of intestinal muscles and increased pain sensitivity in the intestine. These disorders may give a sensation of bloating because of increased sensitivity to gas.

Any disease that causes intestinal obstruction, such as Crohn's disease or colon cancer, may also cause abdominal bloating. In addition, people who have had many operations, adhesions (scar tissue), or internal hernias may experience bloating or pain. Finally, eating a lot of fatty food can delay stomach emptying and cause bloating and discomfort, but not necessarily too much gas.

### **Abdominal Pain and Discomfort**

Some people have pain when gas is present in the intestine. When gas collects on the left side of the colon, the pain can be confused with heart disease. When the pain is on the right side of the colon, it may mimic gallstones or appendicitis.

## What diagnostic tests are used?

Because gas symptoms may be caused by a serious disorder, those causes should be ruled out. The doctor usually begins with a review of dietary habits and symptoms. The doctor may ask the patient to keep a diary of foods and beverages consumed for a specific time period.

If lactase deficiency is the suspected cause of gas, the doctor may suggest avoiding milk products for a period of time. A blood or breath test may be used to diagnose lactose intolerance.

In addition, to determine if someone produces too much gas in the colon or is unusually sensitive to the passage of normal gas volumes, the doctor may ask patients to count the number of times they pass gas during the day and include this information in a diary.

Careful review of diet and the amount of gas passed may help relate specific foods to symptoms and determine the severity of the problem.

Because the symptoms that people may have are so variable, the physician may order other types of diagnostic tests in addition to a physical exam, depending on the patient's symptoms and other factors.

### How is gas treated?

Experience has shown that the most common ways to reduce the discomfort of gas are changing diet, taking medicines, and reducing the amount of air swallowed.

### Diet

Doctors may tell people to eat fewer foods that cause gas. However, for some people this may mean cutting out healthy foods, such as fruits and vegetables, whole grains, and milk products.

Doctors may also suggest limiting high-fat foods to reduce bloating and discomfort. This helps the stomach empty faster, allowing gases to move into the small intestine.

Unfortunately, the amount of gas caused by certain foods varies from person to person. Effective dietary changes depend on learning through trial and error how much of the offending foods one can handle.

### **Nonprescription Medicines**

Many nonprescription, over-the-counter medicines are available to help reduce symptoms, including antacids with simethicone. Digestive enzymes, such as lactase supplements, actually help digest carbohydrates and may allow people to eat foods that normally cause gas.

Antacids, such as Mylanta II, Maalox II, and Di-Gel, contain simethicone, a foaming agent that joins gas bubbles in the stomach so that gas is more easily belched away. However, these medicines have no effect on intestinal gas. Dosage varies depending on the form of medication and the patient's age.

The enzyme lactase, which aids with lactose digestion, is available in caplet and chewable tablet form without a prescription (Lactaid and Lactrase). Chewing lactase tablets just before eating helps digest foods that contain lactose. Also, lactose-reduced milk and other products are available at many grocery stores (Lactaid and Dairy Ease).

Beano, an over-the-counter digestive aid, contains the sugar-digesting enzyme that the body lacks to digest the sugar in beans and many vegetables. The enzyme comes in liquid and tablet form. Five drops are added per serving or one tablet is swallowed just before eating to break down the gas-producing sugars. Beano has no effect on gas caused by lactose or fiber.

### **Prescription Medicines**

Doctors may prescribe medicines to help reduce symptoms, especially for people with a disorder such as IBS.

### **Reducing Swallowed Air**

For those who have chronic belching, doctors may suggest ways to reduce the amount of air swallowed. Recommendations are to avoid chewing gum and to avoid eating hard candy. Eating at a slow pace and checking with a dentist to make sure dentures fit properly should also help.

### Conclusion

Although gas may be uncomfortable and embarrassing, it is not life-threatening. Understanding causes, ways to reduce symptoms, and treatment will help most people find some relief.

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### **Points to Remember**

- Everyone has gas in the digestive tract.
- People often believe normal passage of gas to be excessive.
- Gas comes from two main sources: swallowed air and normal breakdown of certain foods by harmless bacteria naturally present in the large intestine.
- Many foods with carbohydrates can cause gas. Fats and proteins cause little gas.
- Foods that may cause gas include
  - beans
  - vegetables, such as broccoli, cabbage, brussels sprouts, onions, artichokes, and asparagus
  - fruits, such as pears, apples, and peaches
  - whole grains, such as whole wheat and bran
  - soft drinks and fruit drinks

- milk and milk products, such as cheese and ice cream, and packaged foods prepared with lactose, such as bread, cereal, and salad dressing
- foods containing sorbitol, such as dietetic foods and sugarfree candies and gums
- The most common symptoms of gas are belching, flatulence, bloating, and abdominal pain. However, some of these symptoms are often caused by an intestinal disorder, such as irritable bowel syndrome, rather than too much gas.
- The most common ways to reduce the discomfort of gas are changing diet, taking nonprescription medicines, and reducing the amount of air swallowed.
- Digestive enzymes, such as lactase supplements, actually help digest carbohydrates and may allow people to eat foods that normally cause gas.

### National Digestive Diseases Information Clearinghouse

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES National Institutes of Health

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# Constipation

National Digestive Diseases Information Clearinghouse



National Institute of Diabetes and Digestive and Kidney Diseases

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Constipation is passage of small amounts of hard, dry bowel movements, usually fewer than three times a week. People who are constipated may find it difficult and painful to have a bowel movement. Other symptoms of constipation include feeling bloated, uncomfortable, and sluggish.

Many people think they are constipated when, in fact, their bowel movements are regular. For example, some people believe they are constipated, or irregular, if they do not have a bowel movement every day. However, there is no right number of daily or weekly bowel movements. Normal may be three times a day or three times a week depending on the person. Also, some people naturally have firmer stools than others.

At one time or another, almost everyone gets constipated. Poor diet and lack of exercise are usually the causes. In most cases, constipation is temporary and not serious. Understanding its causes, prevention, and treatment will help most people find relief.

### Who gets constipated?

According to the 1996 National Health Interview Survey, about 3 million people in the United States have frequent constipation. Those reporting constipation most often are women and adults age 65 and over. Pregnant women may also have constipation, and it is a common problem following childbirth or surgery.



U.S. Department of Health and Human Services

Constipation is one of the most common gastrointestinal complaints in the United States, resulting in about 2 million doctor



Lower digestive system

visits annually. However, most people treat themselves without seeking medical help, as is evident from the millions of dollars Americans spend on laxatives each year.

### What causes constipation?

To understand constipation, it helps to know how the colon (large intestine) works. As food moves through the colon, it absorbs water while forming waste products, or stool. Muscle contractions in the colon push the stool toward the rectum. By the time stool reaches the rectum, it is solid because most of the water has been absorbed.

The hard and dry stools of constipation occur when the colon absorbs too much water or if the colon's muscle contractions are slow or sluggish, causing the stool to move through the colon too slowly. Common causes of constipation are

- not enough fiber in the diet
- not enough liquids
- lack of exercise
- medications
- irritable bowel syndrome
- changes in life or routine such as pregnancy, older age, and travel
- abuse of laxatives
- ignoring the urge to have a bowel movement
- specific diseases such as stroke (by far the most common)
- problems with the colon and rectum
- problems with intestinal function (chronic idiopathic constipation)

### Not Enough Fiber in the Diet

The most common cause of constipation is a diet low in fiber found in vegetables, fruits, and whole grains and high in fats found in cheese, eggs, and meats. People who eat plenty of high-fiber foods are less likely to become constipated.

Fiber—both soluble and insoluble—is the part of fruits, vegetables, and grains that the body cannot digest. Soluble fiber dissolves easily in water and takes on a soft, gel-like texture in the intestines. Insoluble fiber passes through the intestines almost unchanged. The bulk and soft texture of fiber help prevent hard, dry stools that are difficult to pass.

According to the National Center for Health Statistics, Americans eat an average of 5 to 14 grams of fiber daily,\* short of the 20 to 35 grams recommended by the American Dietetic Association. Both children and adults eat too many refined and processed foods from which the natural fiber has been removed. A low-fiber diet also plays a key role in constipation among older adults, who may lose interest in eating and choose convenience foods low in fiber. In addition, difficulties with chewing or swallowing may force older people to eat soft foods that are processed and low in fiber.

### **Not Enough Liquids**

Liquids like water and juice add fluid to the colon and bulk to stools, making bowel movements softer and easier to pass. People who have problems with constipation should drink enough of these liquids every day, about eight 8-ounce glasses. Liquids that contain caffeine, like coffee and cola drinks, and alcohol have a dehydrating effect.

### Lack of Exercise

Lack of exercise can lead to constipation, although doctors do not know precisely why. For example, constipation often occurs after an accident or during an illness when one must stay in bed and cannot exercise or move around.

### **Medications**

Some medications can cause constipation. They include

- pain medications (especially narcotics)
- antacids that contain aluminum and calcium
- blood pressure medications (calcium channel blockers)
- antiparkinson drugs
- antispasmodics
- antidepressants
- iron supplements
- diuretics
- anticonvulsants

### Irritable Bowel Syndrome (IBS)

Some people with IBS, also known as spastic colon, have spasms in the colon that affect bowel movements. Constipation and diar-

<sup>\*</sup>National Center for Health Statistics. Dietary Intake of Macronutrients, Micronutrients, and Other Dietary Constituents: United States, 1988–94. Vital and Health Statistics, Series 11, number 245. July 2002.

rhea often alternate, and abdominal cramping, gassiness, and bloating are other common complaints. Although IBS can produce lifelong symptoms, it is not a life-threatening condition. It often worsens with stress, but there is no specific cause or anything unusual that the doctor can see in the colon.

### **Changes in Life or Routine**

During pregnancy, women may be constipated because of hormonal changes or because the heavy uterus compresses the intestine. Aging may also affect bowel regularity because a slower metabolism results in less intestinal activity and muscle tone. In addition, people often become constipated when traveling because their normal diet and daily routines are disrupted.

### **Abuse of Laxatives**

Myths about constipation have led to a serious abuse of laxatives. This is common among people who are preoccupied with having a daily bowel movement.

Laxatives usually are not necessary and can be habit-forming. The colon begins to rely on laxatives to bring on bowel movements. Over time, laxatives can damage nerve cells in the colon and interfere with the colon's natural ability to contract. For the same reason, regular use of enemas can also lead to a loss of normal bowel function.

## Ignoring the Urge to Have a Bowel Movement

People who ignore the urge to have a bowel movement may eventually stop feeling the urge, which can lead to constipation. Some people delay having a bowel movement because they do not want to use toilets outside the home. Others ignore the urge because of emotional stress or because they are too busy. Children may postpone having a bowel movement because of stressful toilet training or because they do not want to interrupt their play.

### **Specific Diseases**

Diseases that cause constipation include neurological disorders, metabolic and endocrine disorders, and systemic conditions that affect organ systems. These disorders can slow the movement of stool through the colon, rectum, or anus.

Several kinds of diseases can cause constipation:

- neurological disorders
  - multiple sclerosis
  - Parkinson's disease
  - chronic idiopathic intestinal pseudo-obstruction
  - stroke
  - spinal cord injuries
- metabolic and endocrine conditions
  - diabetes
  - underactive or overactive thyroid gland
  - uremia
  - hypercalcemia
- systemic disorders
  - amyloidosis
  - lupus
  - scleroderma

## **Problems With the Colon and Rectum**

Intestinal obstruction, scar tissue (adhesions), diverticulosis, tumors, colorectal stricture, Hirschsprung's disease, or cancer can compress, squeeze, or narrow the intestine and rectum and cause constipation.

### **Problems With Intestinal Function (Chronic Idiopathic Constipation)**

Some people have chronic constipation that does not respond to standard treatment. This rare condition, known as idiopathic (of unknown origin) chronic constipation, may be related to problems with intestinal function such as problems with hormonal control or with nerves and muscles in the colon, rectum, or anus. Functional constipation occurs in both children and adults and is most common in women.

Colonic inertia and delayed transit are two types of functional constipation caused by decreased muscle activity in the colon. These syndromes may affect the entire colon or may be confined to the lower or sigmoid colon.

Functional constipation that stems from abnormalities in the structure of the anus and rectum is known as anorectal dysfunction, or anismus. These abnormalities result in an inability to relax the rectal and anal muscles that allow stool to exit.

## What diagnostic tests are used?

Most people with constipation do not need extensive testing and can be treated with changes in diet and exercise. For example, in young people with mild symptoms, a medical history and physical examination may be all the doctor needs to suggest successful treatment. The tests the doctor performs depend on the duration and severity of the constipation, the person's age, and whether blood in stools, recent changes in bowel movements, or weight loss have occurred.

### **Medical History**

The doctor may ask a patient to describe his or her constipation, including duration of symptoms, frequency of bowel movements, consistency of stools, presence of blood in the stool, and toilet habits (how often and where one has bowel movements). A record of eating habits, medication, and level of physical activity or exercise will also help the doctor determine the cause of constipation. The clinical definition of constipation is any two of the following symptoms for at least 12 weeks (not necessarily consecutive) in the previous 12 months:

- straining during bowel movements
- lumpy or hard stool
- sensation of incomplete evacuation
- sensation of anorectal blockage or obstruction
- fewer than three bowel movements per week

### **Physical Examination**

A physical exam may include a rectal exam with a gloved, lubricated finger to evaluate the tone of the muscle that closes off the anus (anal sphincter) and to detect tenderness, obstruction, or blood. In some cases, blood and thyroid tests may be necessary to look for thyroid disease and serum calcium or to rule out inflammatory, neoplastic, metabolic, and other systemic disorders.

Extensive testing usually is reserved for people with severe symptoms, for those with sudden changes in number and consistency of bowel movements or blood in the stool, and for older adults. Additional tests that may be used to evaluate constipation include

- colorectal transit study
- anorectal function tests

Because of an increased risk of colorectal cancer in older adults, the doctor may use tests to rule out a diagnosis of cancer, including

- barium enema x ray
- sigmoidoscopy or colonoscopy

**Colorectal transit study.** This test, reserved for those with chronic constipation, shows how well food moves through the colon. The patient swallows capsules containing small markers that are visible on an x ray. The movement of the markers through the colon is monitored with abdominal x rays taken several times 3 to 7 days after the

capsule is swallowed. The patient follows a high-fiber diet during the course of this test.

Anorectal function tests. These tests diagnose constipation caused by abnormal functioning of the anus or rectum (anorectal function). Anorectal manometry evaluates anal sphincter muscle function. For this test, a catheter or air-filled balloon inserted into the anus is slowly pulled back through the sphincter muscle to measure muscle tone and contractions.

Defecography is an x ray of the anorectal area that evaluates completeness of stool elimination, identifies anorectal abnormalities, and evaluates rectal muscle contractions and relaxation. During the exam, the doctor fills the rectum with a soft paste that is the same consistency as stool. The patient sits on a toilet positioned inside an x ray machine and then relaxes and squeezes the anus to expel the paste. The doctor studies the x rays for anorectal problems that occurred as the paste was expelled.

**Barium enema x ray.** This exam involves viewing the rectum, colon, and lower part of the small intestine to locate any problems. This part of the digestive tract is known as the bowel. This test may show intestinal obstruction and Hirschsprung's disease, a lack of nerves within the colon.

The night before the test, bowel cleansing, also called bowel prep, is necessary to clear the lower digestive tract. The patient drinks a special liquid to flush out the bowel. A clean bowel is important, because even a small amount of stool in the colon can hide details and result in an incomplete exam.

Because the colon does not show up well on x rays, the doctor fills it with barium, a chalky liquid that makes the area visible. Once the mixture coats the inside of the colon and rectum, x rays are taken that reveal their shape and condition. The patient may feel some abdominal cramping when the barium fills the colon, but usually feels little discomfort after the procedure. Stools may be a whitish color for a few days after the exam. **Sigmoidoscopy or colonoscopy.** An examination of the rectum and lower (sigmoid) colon is called a sigmoidoscopy. An examination of the rectum and entire colon is called a colonoscopy.

The patient usually has a liquid dinner the night before a sigmoidoscopy and takes an enema early the next morning. A light breakfast and a cleansing enema an hour before the test may also be necessary.

To perform a sigmoidoscopy, the doctor uses a long, flexible tube with a light on the end called a sigmoidoscope to view the rectum and lower colon. First, the doctor examines the rectum with a gloved, lubricated finger. Then, the sigmoidoscope is inserted through the anus into the rectum and lower colon. The procedure may cause a mild sensation of wanting to move the bowels and abdominal pressure. Sometimes the doctor fills the colon with air to get a better view. The air may cause mild cramping.

To perform a colonoscopy, the doctor uses a flexible tube with a light on the end called a colonoscope to view the entire colon. This tube is longer than a sigmoidoscope. The same bowel cleansing used for the barium x ray is needed to clear the bowel of waste. The patient is lightly sedated before the exam. During the exam, the patient lies on his or her side and the doctor inserts the tube through the anus and rectum into the colon. If an abnormality is seen, the doctor can use the colonoscope to remove a small piece of tissue for examination (biopsy). The patient may feel gassy and bloated after the procedure.

### How is constipation treated?

Although treatment depends on the cause, severity, and duration, in most cases dietary and lifestyle changes will help relieve symptoms of constipation and help prevent it.

### Diet

A diet with enough fiber (20 to 35 grams each day) helps form soft, bulky stool. A doctor or dietitian can help plan an appropriate diet. High-fiber foods include beans, whole grains and bran cereals, fresh fruits, and vegetables such as asparagus, brussels sprouts, cabbage, and carrots. For people prone to constipation, limiting foods that have little or no fiber, such as ice cream, cheese, meat, and processed foods, is also important.

### Lifestyle Changes

Other changes that can help treat and prevent constipation include drinking enough water and other liquids such as fruit and vegetable juices and clear soups, engaging in daily exercise, and reserving enough time to have a bowel movement. In addition, the urge to have a bowel movement should not be ignored.

### Laxatives

Most people who are mildly constipated do not need laxatives. However, for those who have made diet and lifestyle changes and are still constipated, doctors may recommend laxatives or enemas for a limited time. These treatments can help retrain a chronically sluggish bowel. For children, shortterm treatment with laxatives, along with retraining to establish regular bowel habits, also helps prevent constipation.

A doctor should determine when a patient needs a laxative and which form is best. Laxatives taken by mouth are available in liquid, tablet, gum, powder, and granule forms. They work in various ways:

• Bulk-forming laxatives generally are considered the safest but can interfere with absorption of some medicines. These laxatives, also known as fiber supplements, are taken with water. They absorb water in the intestine and make the stool softer. Brand names include Metamucil, Citrucel, Konsyl, and Serutan.

- Stimulants cause rhythmic muscle contractions in the intestines. Brand names include Correctol, Dulcolax, Purge, and Senokot. Studies suggest that phenolphthalein, an ingredient in some stimulant laxatives, might increase a person's risk for cancer. The Food and Drug Administration has proposed a ban on all over-the-counter products containing phenolphthalein. Most laxative makers have replaced or plan to replace phenolphthalein with a safer ingredient.
- Stool softeners provide moisture to the stool and prevent dehydration. These laxatives are often recommended after childbirth or surgery. Products include Colace and Surfak.
- Lubricants grease the stool, enabling it to move through the intestine more easily. Mineral oil is the most common example.
- Saline laxatives act like a sponge to draw water into the colon for easier passage of stool. Laxatives in this group include Milk of Magnesia and Haley's M-O.

People who are dependent on laxatives need to slowly stop using them. A doctor can assist in this process. In most people, this restores the colon's natural ability to contract.

### **Other Treatments**

Treatment may be directed at a specific cause. For example, the doctor may recommend discontinuing medication or performing surgery to correct an anorectal problem such as rectal prolapse.

People with chronic constipation caused by anorectal dysfunction can use biofeedback to retrain the muscles that control release of bowel movements. Biofeedback involves using a sensor to monitor muscle activity that at the same time can be displayed on a computer screen, allowing for an accurate assessment of body functions. A health care professional uses this information to help the patient learn how to use these muscles.

Surgical removal of the colon may be an option for people with severe symptoms caused by colonic inertia. However, the benefits of this surgery must be weighed against possible complications, which include abdominal pain and diarrhea.

### Can constipation be serious?

Sometimes constipation can lead to complications. These complications include hemorrhoids caused by straining to have a bowel movement or anal fissures (tears in the skin around the anus) caused when hard stool stretches the sphincter muscle. As a result, rectal bleeding may occur, appearing as bright red streaks on the surface of the stool. Treatment for hemorrhoids may include warm tub baths, ice packs, and application of a special cream to the affected area. Treatment for anal fissure may include stretching the sphincter muscle or surgical removal of tissue or skin in the affected area.

Sometimes straining causes a small amount of intestinal lining to push out from the anal opening. This condition, known as rectal prolapse, may lead to secretion of mucus from the anus. Usually eliminating the cause of the prolapse, such as straining or coughing, is the only treatment necessary. Severe or chronic prolapse requires surgery to strengthen and tighten the anal sphincter muscle or to repair the prolapsed lining.

Constipation may also cause hard stool to pack the intestine and rectum so tightly that the normal pushing action of the colon is not enough to expel the stool. This condition, called fecal impaction, occurs most often in children and older adults. An impaction can be softened with mineral oil taken by mouth and by an enema. After softening the impaction, the doctor may break up and remove part of the hardened stool by inserting one or two fingers into the anus.

### Hope Through Research

NIDDK's Division of Digestive Diseases and Nutrition supports basic and clinical research into gastrointestinal conditions, including constipation. Among other areas, researchers are studying the anatomical and physiological characteristics of rectoanal motility and the use of new medications and behavioral techniques, such as biofeedback, to treat constipation.

### **Points to Remember**

- Constipation affects almost everyone at one time or another.
- Many people think they are constipated when, in fact, their bowel movements are regular.
- The most common causes of constipation are poor diet and lack of exercise.
- Additional causes of constipation include medications, irritable bowel syndrome, abuse of laxatives, and specific diseases.
- A medical history and physical examination may be the only diagnostic tests needed before the doctor suggests treatment.
- In most cases, following these simple tips will help relieve symptoms and prevent recurrence of constipation:
  - Eat a well-balanced, high-fiber diet that includes beans, bran, whole grains, fresh fruits, and vegetables.
  - Drink plenty of liquids.
  - Exercise regularly.
  - Set aside time after breakfast or dinner for undisturbed visits to the toilet.
  - Do not ignore the urge to have a bowel movement.

- Understand that normal bowel habits vary.
- Whenever a significant or prolonged change in bowel habits occurs, check with a doctor.
- Most people with mild constipation do not need laxatives. However, doctors may recommend laxatives for a limited time for people with chronic constipation.

### **For More Information**

### **International Foundation for Functional Gastrointestinal Disorders Inc.**

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### American Gastroenterological Association

National Office 4930 Del Ray Avenue Bethesda, MD 20814 Phone: 301–654–2055 Fax: 301–652–3890 Email: webinfo@gastro.org Internet: www.gastro.org

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES National Institutes of Health

NIH Publication No. 04–2754 October 2003

## Lactose Intolerance

National Digestive Diseases Information Clearinghouse



National Institute of Diabetes and Digestive and Kidney Diseases NATIONAL INSTITUTES OF HEALTH

### What is lactose intolerance?

Lactose intolerance is the inability to digest significant amounts of lactose, the predominant sugar of milk. This inability results from a shortage of the enzyme lactase, which is normally produced by the cells that line the small intestine. Lactase breaks down milk sugar into simpler forms that can then be absorbed into the bloodstream. When there is not enough lactase to digest the amount of lactose consumed, the results, although not usually dangerous, may be very distressing. While not all persons deficient in lactase have symptoms, those who do are considered to be lactose intolerant.

Common symptoms include nausea, cramps, bloating, gas, and diarrhea, which begin about 30 minutes to 2 hours after eating or drinking foods containing lactose. The severity of symptoms varies depending on the amount of lactose each individual can tolerate.

Some causes of lactose intolerance are well known. For instance, certain digestive diseases and injuries to the small intestine can reduce the amount of enzymes produced. In rare cases, children are born without the ability to produce lactase. For most people, though, lactase deficiency is a condition that develops naturally over time. After about the age of 2 years, the body begins to produce less lactase. However, many people may not experience symptoms until they are much older. Between 30 and 50 million Americans are lactose intolerant. Certain ethnic and racial populations are more widely affected than others. As many as 75 percent of all African Americans and American Indians and 90 percent of Asian Americans are lactose intolerant. The condition is least common among persons of northern European descent.

Researchers have identified a genetic variation associated with lactose intolerance; this discovery may be useful in developing a diagnostic test to identify people with this condition.



The digestive tract



U.S. Department of Health and Human Services

## How is lactose intolerance diagnosed?

The most common tests used to measure the absorption of lactose in the digestive system are the lactose tolerance test, the hydrogen breath test, and the stool acidity test. These tests are performed on an outpatient basis at a hospital, clinic, or doctor's office.

The lactose tolerance test begins with the individual fasting (not eating) before the test and then drinking a liquid that contains lactose. Several blood samples are taken over a 2-hour period to measure the person's blood glucose (blood sugar) level, which indicates how well the body is able to digest lactose.

Normally, when lactose reaches the digestive system, the lactase enzyme breaks it down into glucose and galactose. The liver then changes the galactose into glucose, which enters the bloodstream and raises the person's blood glucose level. If lactose is incompletely broken down, the blood glucose level does not rise and a diagnosis of lactose intolerance is confirmed.

The hydrogen breath test measures the amount of hydrogen in a person's breath. Normally, very little hydrogen is detectable. However, undigested lactose in the colon is fermented by bacteria, and various gases, including hydrogen, are produced. The hydrogen is absorbed from the intestines, carried through the bloodstream to the lungs, and exhaled. In the test, the patient drinks a lactose-loaded beverage, and the breath is analyzed at regular intervals. Raised levels of hydrogen in the breath indicate improper digestion of lactose. Certain foods, medications, and cigarettes can affect the accuracy of the test and should be avoided before taking it. This test is available for children and adults.

The lactose tolerance and hydrogen breath tests are not given to infants and very young children who are suspected of having lactose intolerance. A large lactose load may be dangerous for the very young because they are more prone to the dehydration that can result from diarrhea caused by the lactose. If a baby or young child is experiencing symptoms of lactose intolerance, many pediatricians simply recommend changing from cow's milk to soy formula and waiting for symptoms to abate.

If necessary, a stool acidity test, which measures the amount of acid in the stool, may be given to infants and young children. Undigested lactose fermented by bacteria in the colon creates lactic acid and other short-chain fatty acids that can be detected in a stool sample. In addition, glucose may be present in the sample as a result of unabsorbed lactose in the colon.

## How is lactose intolerance treated?

Fortunately, lactose intolerance is relatively easy to treat. No treatment can improve the body's ability to produce lactase, but symptoms can be controlled through diet.

Young children with lactase deficiency should not eat any foods containing lactose. Most older children and adults need not avoid lactose completely, but people differ in the amounts and types of foods they can handle. For example, one person may have symptoms after drinking a small glass of milk, while another can drink one glass but not two. Others may be able to manage ice cream and aged cheeses, such as cheddar and Swiss, but not other dairy products. Dietary control of lactose intolerance depends on people learning through trial and error how much lactose they can handle. For those who react to very small amounts of lactose or have trouble limiting their intake of foods that contain it, lactase enzymes are available without a prescription to help people digest foods that contain lactose. The tablets are taken with the first bite of dairy food. Lactase enzyme is also available as a liquid. Adding a few drops of the enzyme will convert the lactose in milk or cream, making it more digestible for people with lactose intolerance.

Lactose-reduced milk and other products are available at most supermarkets. The milk contains all of the nutrients found in regular milk and remains fresh for about the same length of time, or longer if it is super-pasteurized.

### How is nutrition balanced?

Milk and other dairy products are a major source of nutrients in the American diet. The most important of these nutrients is calcium. Calcium is essential for the growth and repair of bones throughout life. In the middle and later years, a shortage of calcium may lead to thin, fragile bones that break easily, a condition called osteoporosis. A concern, then, for both children and adults with lactose intolerance, is getting enough calcium in a diet that includes little or no milk.

In 1997, the Institute of Medicine released a report recommending new requirements for daily calcium intake. How much calcium a person needs to maintain good health varies by age group. Recommendations from the report are shown in the following table.

Age group	Amount of calcium to consume daily, in milligrams (mg)	
0–6 months	210 mg	
7–12 months	270 mg	
1–3 years	500 mg	
4–8 years	800 mg	
9–18 years	1,300 mg	
19–50 years	1,000 mg	
51–70+ years	1,200 mg	

Also, pregnant and nursing women under 19 need 1,300 mg daily, while pregnant and nursing women over 19 need 1,000 mg.

In planning meals, making sure that each day's diet includes enough calcium is important, even if the diet does not contain dairy products. Many nondairy foods are high in calcium. Green vegetables, such as broccoli and kale, and fish with soft, edible bones, such as salmon and sardines, are excellent sources of calcium. To help in planning a high-calcium and low-lactose diet, the table on the next page lists some common foods that are good sources of dietary calcium and shows how much lactose they contain.

Recent research shows that yogurt with active cultures may be a good source of calcium for many people with lactose intolerance, even though it is fairly high in lactose. Evidence shows that the bacterial cultures used to make yogurt produce some of the lactase enzyme required for proper digestion.

Vegetables	<b>Calcium Content</b>	Lactose Content
Calcium-fortified orange juice, 1 cup	308–344 mg	0
Sardines, with edible bones, 3 oz.	270 mg	0
Salmon, canned, with edible bones, 3 oz.	205 mg	0
Soymilk, fortified, 1 cup	200 mg	0
Broccoli (raw), 1 cup	90 mg	0
Orange, 1 medium	50 mg	0
Pinto beans, 1/2 cup	40 mg	0
Tuna, canned, 3 oz.	10 mg	0
Lettuce greens, 1/2 cup	10 mg	0
Dairy Products		
Yogurt, plain, low-fat, 1 cup	415 mg	5 g
Milk, reduced fat, 1 cup	295 mg	11 g
Swiss cheese, 1 oz.	270 mg	1 g
Ice cream, 1/2 cup	85 mg	6 g
Cottage cheese, 1/2 cup	75 mg	2–3 g

### **Calcium and Lactose in Common Foods**

Adapted from *Manual of Clinical Dietetics*. 6th ed. American Dietetic Association, 2000; and Soy Dairy Alternatives. Available at: *www.soyfoods.org*. Accessed March 5, 2002.

Clearly, many foods can provide the calcium and other nutrients the body needs, even when intake of milk and dairy products is limited. However, factors other than calcium and lactose content should be kept in mind when planning a diet. Some vegetables that are high in calcium (Swiss chard, spinach, and rhubarb, for instance) are not listed in the chart because the body cannot use the calcium they contain. They also contain substances called oxalates, which stop calcium absorption. Calcium is absorbed and used only when there is enough vitamin D in the body. A balanced diet should provide an adequate supply of vitamin D. Sources of vitamin D include

eggs and liver. However, sunlight helps the body naturally absorb or synthesize vitamin D, and with enough exposure to the sun, food sources may not be necessary.

Some people with lactose intolerance may think they are not getting enough calcium and vitamin D in their diet. Consultation with a doctor or dietitian may be helpful in deciding whether any dietary supplements are needed. Taking vitamins or minerals of the wrong kind or in the wrong amounts can be harmful. A dietitian can help in planning meals that will provide the most nutrients with the least chance of causing discomfort.

### What is hidden lactose?

Although milk and foods made from milk are the only natural sources, lactose is often added to prepared foods. People with very low tolerance for lactose should know about the many food products that may contain even small amounts of lactose, such as

- bread and other baked goods
- processed breakfast cereals
- instant potatoes, soups, and breakfast drinks
- margarine
- lunch meats (other than kosher)
- salad dressings
- candies and other snacks
- mixes for pancakes, biscuits, and cookies
- powdered meal-replacement supplements

Some products labeled nondairy, such as powdered coffee creamer and whipped toppings, may also include ingredients that are derived from milk and therefore contain lactose.

Smart shoppers learn to read food labels with care, looking not only for milk and lactose among the contents, but also for such words as whey, curds, milk by-products, dry milk solids, and nonfat dry milk powder. If any of these are listed on a label, the product contains lactose.

In addition, lactose is used as the base for more than 20 percent of prescription drugs and about 6 percent of over-the-counter medicines. Many types of birth control pills, for example, contain lactose, as do some tablets for stomach acid and gas. However, these products typically affect only people with severe lactose intolerance.

### **Summary**

Even though lactose intolerance is widespread, it need not pose a serious threat to good health. People who have trouble digesting lactose can learn which dairy products and other foods they can eat without discomfort and which ones they should avoid. Many will be able to enjoy milk, ice cream, and other such products if they take them in small amounts or eat other food at the same time. Others can use lactase liquid or tablets to help digest the lactose. Even older women at risk for osteoporosis and growing children who must avoid milk and foods made with milk can meet most of their special dietary needs by eating greens, fish, and other calcium-rich foods that are free of lactose. A carefully chosen diet, with calcium supplements if the doctor or dietitian recommends them, is the key to reducing symptoms and protecting future health.

### **For More Information**

### American Dietetic Association (ADA)

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES National Institutes of Health

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# Smoking and Your Digestive System

National Digestive Diseases Information Clearinghouse



National Institute of Diabetes and Digestive and Kidney Diseases

NATIONAL INSTITUTES OF HEALTH Cigarette smoking causes a variety of lifethreatening diseases, including lung cancer, emphysema, and heart disease. An estimated 400,000 deaths each year are caused directly by cigarette smoking. Smoking is responsible for changes in all parts of the body, including the digestive system. This fact can have serious consequences because it is the digestive system that converts foods into the nutrients the body needs to live.

Current estimates indicate that about onefourth of all adults smoke. And, while adult men seem to be smoking less, women and teenagers of both sexes seem to be smoking more. How does smoking affect the digestive system of all these people?

### Harmful Effects of Smoking on the Digestive System

Smoking has been shown to have harmful effects on all parts of the digestive system, contributing to such common disorders as heartburn and peptic ulcers. It also increases the risk of Crohn's disease and possibly gallstones. Smoking seems to affect the liver, too, by changing the way it handles drugs and alcohol. In fact, there seems to be enough evidence to stop smoking solely on the basis of digestive distress.

### Heartburn

Heartburn is common among Americans. More than 60 million Americans have heartburn at least once a month, and about 15 million have it daily.

Heartburn happens when acidic juices from the stomach splash into the esophagus. Normally, a muscular valve at the lower end of the esophagus, the lower esophageal sphincter (LES), keeps the acid solution in the stomach and out of the esophagus. Smoking decreases the strength of the esophageal valve, thereby allowing stomach juice to reflux, or flow backward into the esophagus.

Smoking also seems to promote the movement of bile salts from the intestine to the stomach, which makes the stomach juice more harmful. Finally, smoking may directly injure the esophagus, making it less able to resist further damage from refluxed material.

### **Peptic Ulcer**

A peptic ulcer is an open sore in the lining of the stomach or duodenum, the first part of the small intestine. The exact cause of ulcers is not known. A *relationship* between smoking cigarettes and ulcers, especially duodenal ulcers, does exist. The 1989 Surgeon General's report stated that ulcers are more likely to occur, less likely to heal, and more likely to cause death in smokers than in nonsmokers.

Why is this so? Doctors are not really sure, but smoking does seem to be one of several factors that work together to promote the formation of ulcers.

For example, some research suggests that smoking might increase a person's risk of infection with the bacterium *Helicobacter pylori* (*H. pylori*). Most peptic ulcers are caused by this bacterium.

Stomach acid is also important in producing ulcers. Normally, most of this acid is buffered by the food we eat. Most of the unbuffered acid that enters the duodenum is quickly neutralized by sodium bicarbonate, a naturally occurring alkali produced by the pancreas. Some studies show that smoking reduces the bicarbonate produced by the pancreas, interfering with the neutralization of acid in the duodenum. Other studies suggest that chronic cigarette smoking may increase the amount of acid secreted by the stomach.

Whatever causes the link between smoking and ulcers, two points have been repeatedly demonstrated: People who smoke are more likely to develop an ulcer, especially a duodenal ulcer, and ulcers are less likely to heal quickly among smokers in response to otherwise effective treatment. This research tracing the relationship between smoking and ulcers strongly suggests that a person with an ulcer should stop smoking.

### **Liver Disease**

The liver is an important organ that has many tasks. Among other things, the liver is responsible for processing drugs, alcohol, and other toxins to remove them from the body. There is evidence that smoking alters the ability of the liver to handle these substances. In some cases, this may influence the dose of medication necessary to treat an illness. Some research also suggests that smoking can aggravate the course of liver disease caused by excessive alcohol intake.

### **Crohn's Disease**

Crohn's disease causes inflammation deep in the lining of the intestine. The disease, which causes pain and diarrhea, usually affects the small intestine, but it can occur anywhere in the digestive tract. Research shows that current and former smokers have a higher risk of developing Crohn's disease than nonsmokers do. Among people with the disease, smoking is associated with a higher rate of relapse, repeat surgery, and immunosuppressive treatment. In all areas, the risk for women, whether current or former smokers, is slightly higher than for men. Why smoking increases the risk of Crohn's disease is unknown, but some theories suggest that smoking might lower the intestine's defenses, decrease blood flow to the intestines, or cause immune system changes that result in inflammation.

### Gallstones

Several studies suggest that smoking may increase the risk of developing gallstones and that the risk may be higher for women. However, research results on this topic are not consistent, and more study is needed.

## Can the Damage to the Digestive System Be Reversed?

Some of the effects of smoking on the digestive system appear to be of short duration. For example, the effect of smoking on bicarbonate production by the pancreas does not appear to last. Within a half-hour after smoking, the production of bicarbonate returns to normal. The effects of smoking on how the liver handles drugs also disappear when a person stops smoking. However, people who no longer smoke still remain at risk for Crohn's disease. Clearly, this question needs more study.

### **For More Information**

Information about smoking and health is available from

### Office on Smoking and Health, Public Information Branch

4770 Buford Highway NE. Mail Stop K50 Atlanta, GA 30341–3724 Tel: (404) 488–5705

### National Digestive Diseases Information Clearinghouse

2 Information Way Bethesda, MD 20892–3570 Tel: (301) 654–3810 Fax: (301) 907–8906 E-mail: nddic@info.niddk.nih.gov

The National Digestive Diseases Information Clearinghouse (NDDIC) is a service of the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). NIDDK is part of the National Institutes of Health under the U.S. Department of Health and Human Services. Established in 1980, the clearinghouse provides information about digestive diseases to people with digestive disorders and to their families, health care professionals, and the public. NDDIC answers inquiries; develops, reviews, and distributes publications; and works closely with professional and patient organizations and Government agencies to coordinate resources about digestive diseases.

Publications produced by the clearinghouse are carefully reviewed for scientific accuracy, content, and readability.

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES National Institutes of Health

NIH Publication No. 99–949 January 1999

# Hemorrhoids

National Digestive Diseases Information Clearinghouse



National Institute of Diabetes and Digestive and Kidney Diseases

NATIONAL INSTITUTES OF HEALTH

### What Are Hemorrhoids?

Hemorrhoids are swollen but normally present blood vessels in and around the anus and lower rectum that stretch under pressure, similar to varicose veins in the legs.

The increased pressure and swelling may result from straining to move the bowel. Other contributing factors include pregnancy, heredity, aging, and chronic constipation or diarrhea.

Hemorrhoids are either inside the anus (internal) or under the skin around the anus (external). (See figure on page 2.)

## What Are the Symptoms of Hemorrhoids?

Many anorectal problems, including fissures, fistulae, abscesses, or irritation and itching (pruritus ani), have similar symptoms and are incorrectly referred to as hemorrhoids.

Hemorrhoids usually are not dangerous or life threatening. In most cases, hemorrhoidal symptoms will go away within a few days.

Although many people have hemorrhoids, not all experience symptoms. The most common symptom of internal hemorrhoids is bright red blood covering the stool, on toilet paper, or in the toilet bowl. However, an internal hemorrhoid may protrude through the anus outside the body, becoming irritated and painful. This is known as a protruding hemorrhoid.

Symptoms of external hemorrhoids may include painful swelling or a hard lump around the anus that results when a blood clot forms. This condition is known as a thrombosed external hemorrhoid.

In addition, excessive straining, rubbing, or cleaning around the anus may cause irritation with bleeding and/or itching, which may produce a vicious cycle of symptoms. Draining mucus may also cause itching.

## How Common Are Hemorrhoids?

Hemorrhoids are very common in men and women. About half of the population have hemorrhoids by age 50. Hemorrhoids are also common among pregnant women. The pressure of the fetus in the abdomen, as well as hormonal changes, cause the hemorrhoidal vessels to enlarge. These vessels are also placed under severe pressure during childbirth. For most women, however, hemorrhoids caused by pregnancy are a temporary problem.

## How Are Hemorrhoids Diagnosed?

A thorough evaluation and proper diagnosis by the doctor is important any time bleeding from the rectum or blood in the stool lasts more than a couple of days. Bleeding may also be a symptom of other digestive diseases, including colorectal cancer.

The doctor will examine the anus and rectum to look for swollen blood vessels that indicate hemorrhoids and will also perform a digital rectal exam with a gloved, lubricated finger to feel for abnormalities.

Closer evaluation of the rectum for hemorrhoids requires an exam with an anoscope, a hollow, lighted tube useful for viewing internal hemorrhoids, or a proctoscope, useful for more completely examining the entire rectum.

To rule out other causes of gastrointestinal bleeding, the doctor may examine the rectum and lower colon (sigmoid) with sigmoidoscopy or the entire colon with colonoscopy. Sigmoidoscopy and colonoscopy are diagnostic procedures that also involve the use of lighted, flexible tubes inserted through the rectum.

### What Is the Treatment?

Medical treatment of hemorrhoids initially is aimed at relieving symptoms. Measures to reduce symptoms include:

- Warm tub or sitz baths several times a day in plain, warm water for about 10 minutes.
- Ice packs to help reduce swelling.
- Application of a hemorroidal cream or suppository to the affected area for a limited time.

Prevention of the recurrence of hemorrhoids is aimed at changing conditions associated with the pressure and straining of constipation. Doctors will often recommend increasing fiber and fluids in the diet. Eating the right amount of fiber and drinking six to eight glasses of fluid (not alcohol) result in softer, bulkier stools. A softer stool makes emptying the bowels easier and lessens the pressure on hemorrhoids caused by straining. Eliminating straining also helps prevent the hemorrhoids from protruding.



Illustration reprinted with permission from the American Society of Colon and Rectal Surgeons. Artist: Russell K. Pearl, M.D.

Good sources of fiber are fruits, vegetables, and whole grains. In addition, doctors may suggest a bulk stool softener or a fiber supplement such as psyllium (Metamucil<sup>®</sup>) or methylcellulose (Citrucel<sup>®</sup>).

In some cases, hemorrhoids must be treated surgically. These methods are used to shrink and destroy the hemorrhoidal tissue and are performed under anesthesia. The doctor will preform the surgery during an office or hospital visit. A number of surgical methods may be used to remove or reduce the size of internal hemorrhoids. These techniques include:

- Rubber band ligation A rubber band is placed around the base of the hemorrhoid inside the rectum. The band cuts off circulation, and the hemorrhoid withers away within a few days.
- Sclerotherapy A chemical solution is injected around the blood vessel to shrink the hemorrhoid.

Techniques used to treat both internal and external hemorrhoids include:

- Electrical or laser heat (laser coagulation) or infrared light (infrared photo coagulation) — Both techniques use special devices to burn hemorrhoidal tissue.
- Hemorrhoidectomy Occasionally, extensive or severe internal or external hemorrhoids may require removal by surgery known as hemorrhoidectomy. This is the best method for permanent removal of hemorrhoids.

### How Are Hemorrhoids Prevented?

The best way to prevent hemorrhoids is to keep stools soft so they pass easily, thus decreasing pressure and straining, and to empty bowels as soon as possible after the urge occurs. Exercise, including walking, and increased fiber in the diet help reduce constipation and straining by producing stools that are softer and easier to pass. In addition, a person should not sit on the toilet for a long period of time.

### **Additional Readings**

Bleeding in the Digestive Tract. 1992. Fact sheet discusses many common causes of bleeding in the digestive tract and related diagnostic procedures and treatment. Available from the National Digestive Diseases Information Clearinghouse, Box NDDIC, 9000 Rockville Pike, Bethesda, Maryland 20892.

Cocchiara, J.L. Hemorrhoids: A practical approach to an aggravating problem.

*Postgraduate Medicine* 1991; 89(1): 149-152. Article for health care professionals discusses causes, symptoms, and treatments.

Sohn, N. Hemorrhoids: Etiology, pathogenesis, classification, and medical therapy. *Practical Gastroenterology* 1991; XV(9): 21-24. General article for physicians.

Stehlin, D. No strain no pain: The bottom line in treating hemorrhoids. *FDA Consumer* 1992; 26(2): 31-33. General information article for patients and the public.

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2 Information Way Bethesda, MD 20892–3570 Tel: (301) 654–3810 Fax: (301) 907–8906 E-mail: nddic@aerie.com

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES Public Health Service National Institutes of Health

NIH Publication No. 97–3021 May 1994

## Pancreatitis

#### National Digestive Diseases Information Clearinghouse



National Institute of Diabetes and Digestive and Kidney Diseases

NATIONAL INSTITUTES OF HEALTH Pancreatitis is an inflammation of the pancreas. The pancreas is a large gland behind the stomach and close to the duodenum. The duodenum is the upper part of the small intestine. The pancreas secretes digestive enzymes into the small intestine through a tube called the pancreatic duct. These enzymes help digest fats, proteins, and carbohydrates in food. The pancreas also releases the hormones insulin and glucagon into the bloodstream. These hormones help the body use the glucose it derives from food for energy.

Normally, digestive enzymes do not become active until they reach the small intestine, where they begin digesting food. But if these enzymes become active inside the pancreas, they start "digesting" it.

Acute pancreatitis occurs suddenly and lasts for a short period of time and usually resolves. Chronic pancreatitis does not resolve itself and results in a slow destruction of the pancreas. Either form can cause serious complications. In severe cases, bleeding, tissue damage, and infection may occur. Cysts, which are fluid-filled sacs of tissue, may also develop. And enzymes and toxins may enter the bloodstream, injuring the heart, lungs, and kidneys, or other organs.

### **Acute Pancreatitis**

Some people have more than one attack and recover completely after each, but acute pancreatitis can be a severe, life-



threatening illness with many complications. About 80,000 cases occur in the United States each year; some 20 percent of them are severe.

Acute pancreatitis is usually caused by drinking too much alcohol or by gallstones. A gallstone can block the pancreatic duct, trapping digestive enzymes in the pancreas and causing pancreatitis. Some prescription drugs, pancreatic or intestinal abnormalities, abdominal trauma, or surgery can also cause pancreatitis. In some cases, recurrent pancreatitis is hereditary and caused by mutations in genes. In rare cases, the disease may result from infections, such as mumps, and in about 15 percent of the cases, the cause is unknown.

### **Symptoms**

Acute pancreatitis usually begins with pain in the upper abdomen that may last for a few days. The pain may be severe and may become constant—just in the abdomen—or it may reach to the back and other areas. It may be sudden and intense or begin as a mild pain that gets worse when food is eaten. Someone with acute pancreatitis often looks and feels very sick. Other symptoms may include

- swollen and tender abdomen
- nausea
- vomiting
- fever
- rapid pulse

Severe cases may cause dehydration and low blood pressure. The heart, lungs, or kidneys may fail. If bleeding occurs in the pancreas, shock and sometimes even death follow.

### Diagnosis

Besides asking about a person's medical history and doing a physical exam, a doctor will order a blood test to diagnose acute pancreatitis. During acute attacks, the blood contains at least three times more amylase and lipase than usual. Amylase and lipase are digestive enzymes formed in the pancreas. Changes may also occur in blood levels of glucose, calcium, magnesium, sodium, potassium, and bicarbonate. After the pancreas improves, these levels usually return to normal.

A doctor may also order an abdominal ultrasound to look for gallstones and a CAT (computerized axial tomography) scan to look for inflammation or destruction of the pancreas. CAT scans are also useful in locating pseudocysts. (See the section on chronic pancreatitis.)

### Treatment

Treatment depends on how bad the attack is. If no complications in the form of kidney failure or lung problems occur, acute pancreatitis usually improves on its own. Treatment is designed to support vital functions and prevent complications. A hospital stay will be necessary so that fluids can be replenished intravenously.

Acute pancreatitis can also cause breathing problems. Many people develop hypoxia, which means that cells and tissues are not receiving enough oxygen. Doctors treat hypoxia by giving oxygen through a face mask. Despite treatment, some people still experience lung failure and require a ventilator.

If pancreatic cysts occur and are considered large enough to interfere with the pancreas's healing, your doctor may drain or surgically remove the cysts.

Sometimes a person cannot stop vomiting and needs to have a tube placed in the stomach to remove fluid and air. In mild cases, a person may not eat for 3 or 4 days and instead may receive fluids and pain relievers through an IV (intravenous) line.

Unless the pancreatic duct or bile duct is blocked by gallstones, an acute attack usually lasts only a few days. In severe cases, a person may be fed intravenously for 3 to 6 weeks while the pancreas slowly heals. This process is called total parenteral nutrition. However, for mild cases of the disease, total parenteral nutrition offers no benefit. If an infection develops, the doctor may prescribe antibiotics. Surgery may be needed for extensive infections. Surgery may also be necessary to find the source of bleeding, to rule out problems that resemble pancreatitis, or to remove severely damaged pancreatic tissue.

Before leaving the hospital, a person will be advised not to drink alcohol and not to eat large meals. After all signs of acute pancreatitis are gone, the doctor will try to decide what caused it in order to prevent future attacks. In some people, the cause of the attack is clear, but in others, more tests are needed.

### Gallstones and Pancreatitis

Gallstones can cause pancreatitis and they usually require surgical removal. Ultrasound or a CAT scan can detect gallstones and can sometimes give an idea of the severity of the pancreatitis. When gallstone surgery can be scheduled depends on how severe the pancreatitis is. If the pancreatitis is mild, gallstone surgery may proceed within about a week. More severe cases may mean gallstone surgery is delayed for a month or more.

After the gallstones are removed and inflammation goes away, the pancreas usually returns to normal.

### **Chronic Pancreatitis**

If injury to the pancreas continues, from drinking alcohol, for example, chronic pancreatitis may develop. Chronic pancreatitis occurs when digestive enzymes attack and destroy the pancreas and nearby tissues, causing scarring and pain. The usual cause of chronic pancreatitis is many years of alcohol abuse, but the chronic form may also be triggered by only one acute attack, especially if the pancreatic ducts are damaged. The damaged ducts cause the pancreas to become inflamed, tissue to be destroyed, and scar tissue to develop.

Damage from alcohol abuse may not appear for many years, and then a person may have a sudden attack of pancreatitis. In 70 to 80 percent of adult patients, chronic pancreatitis appears to be caused by alcoholism. This form is more common in men than in women and often develops between the ages of 30 and 40.

Chronic pancreatitis may also occur when the pancreatic duct is blocked or narrowed because of trauma or because pseudocysts have formed. Pseudocysts are cyst-like buildups of pancreatic fluid in the duct.

Some drugs can cause chronic pancreatitis too. In many cases, however, the cause is unknown. People with chronic pancreatitis may have one or even all three of the following problems: pain, diabetes, or malabsorption of food leading to weight loss.

In some cases, chronic pancreatitis is inherited. Hereditary pancreatitis usually begins in childhood but may not be diagnosed for several years. A person with hereditary pancreatitis usually has the typical symptoms that come and go over time. Episodes last from 2 days to 2 weeks. A determining factor in the diagnosis of hereditary pancreatitis is two or more family members with pancreatitis in more than one generation. Treatment for individual attacks is usually the same as it is for acute pancreatitis. Any pain or nutrition problems are treated just as they are for chronic pancreatitis. Surgery can often ease pain and help manage complications.

### Symptoms

Some people have no pain, but most do. Pain in the back and abdomen may be constant and disabling. In certain cases, abdominal pain goes away as the condition advances, probably because the pancreas is no longer making digestive enzymes.

People with chronic disease often lose weight, even when their appetite and eating habits are normal. The weight loss occurs because the body does not secrete enough pancreatic enzymes to break down food, so nutrients are not absorbed normally. Poor digestion leads to excretion of fat, protein, and sugar into the stool. If the insulinproducing cells of the pancreas (islet cells) have been damaged, diabetes may also develop at this stage.

### Diagnosis

Diagnosis may be difficult, but new techniques can help. Pancreatic function tests help a doctor decide whether the pancreas is still making enough digestive enzymes. Using ultrasonic imaging, endoscopic retrograde cholangiopancreatography (ERCP), and CAT scans, a doctor can see problems indicating chronic pancreatitis. Such problems include calcification of the pancreas, in which tissue hardens from deposits of insoluble calcium salts. In more advanced stages of the disease, when diabetes and malabsorption occur, a doctor can use a number of blood, urine, and stool tests to help diagnose chronic pancreatitis and to monitor its progression.

### Treatment

Relieving pain is the first step in treating chronic pancreatitis. The next step is to plan a diet that is high in carbohydrates and low in fat.

A doctor may prescribe pancreatic enzymes to take with meals if the pancreas does not secrete enough of its own. The enzymes should be taken with every meal to help the body digest food and regain some weight. Sometimes insulin or other drugs are needed to control blood glucose.

In some cases, surgery is needed to relieve pain. The surgery may involve draining an enlarged pancreatic duct or removing part of the pancreas.

For fewer and milder attacks, people with pancreatitis must stop drinking alcohol, stick to their prescribed diet, and take the proper medications.

### **Pancreatitis in Children**

Chronic pancreatitis is rare in children. Trauma to the pancreas and hereditary pancreatitis are two known causes of childhood pancreatitis. Children with cystic fibrosis, a progressive, disabling, and incurable lung disease, may also have pancreatitis. But more often the cause is not known.

### **Points To Remember**

- Pancreatitis begins when the digestive enzymes become active inside the pancreas and start "digesting" it.
- Pancreatitis has two forms: acute and chronic.
- Pancreatitis is often caused by gallstones or by alcohol abuse.
- Symptoms of acute pancreatitis include pain in the abdomen, nausea, vomiting, fever, and a rapid pulse.
- Treatment for acute pancreatitis can include intravenous fluids, oxygen, antibiotics, or surgery.
- Acute pancreatitis becomes chronic when pancreatic tissue is destroyed and scarring develops.
- Treatment for chronic pancreatitis includes easing the pain; eating a high-carbohydrate, low-fat diet; and taking enzyme supplements. Surgery is sometimes needed

### **For More Information**

Information about pancreatitis is also available from

### American Gastroenterological Association

7910 Woodmont Avenue, Suite 700 Bethesda, MD 20814 Phone: (301) 654–2055 Fax: (301) 654–5920 Email: member@gastro.org Internet: www.gastro.org

### National Digestive Diseases Information Clearinghouse

2 Information Way Bethesda, MD 20892–3570 Phone: 1–800–891–5389 or (301) 654–3810 Fax: (301) 907–8906 Email: nddic@info.niddk.nih.gov

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NIH Publication No. 02–1596 November 2001

# Cirrhosis of the Liver

National Digestive Diseases Information Clearinghouse



National Institute of Diabetes and Digestive and Kidney Diseases

NATIONAL INSTITUTES OF HEALTH The liver, the largest organ in the body, is essential in keeping the body functioning properly. It removes or neutralizes poisons from the blood, produces immune agents to control infection, and removes germs and bacteria from the blood. It makes proteins that regulate blood clotting and produces bile to help absorb fats and fat-soluble vitamins. You cannot live without a functioning liver.

In cirrhosis of the liver, scar tissue replaces normal, healthy tissue, blocking the flow of blood through the organ and preventing it from working as it should. Cirrhosis is the eighth leading cause of death by disease, killing about 25,000 people each year. Also, the cost of cirrhosis in terms of human suffering, hospital costs, and lost productivity is high.

### Causes

Cirrhosis has many causes. In the United States, chronic alcoholism and hepatitis C are the most common causes.

Alcoholic liver disease. To many people, cirrhosis of the liver is synonymous with chronic alcoholism, but in fact, alcoholism is only one of the causes. Alcoholic cirrhosis usually develops after more than a decade of heavy drinking. The amount of alcohol that can injure the liver varies greatly from person to person. In women, as few as two to three drinks per day have been linked with cirrhosis and in men, as few as three to four drinks per day. Alcohol seems to injure the liver by blocking the normal metabolism of protein, fats, and carbohydrates. *Chronic hepatitis C*. The hepatitis C virus ranks with alcohol as the major cause of chronic liver disease and cirrhosis in the United States. Infection with this virus causes inflammation of and low grade damage to the liver that over several decades can lead to cirrhosis.

*Chronic hepatitis B and D.* The hepatitis B virus is probably the most common cause of cirrhosis worldwide, but in the United States and Western world it is less common. Hepatitis B, like hepatitis C, causes liver inflammation and injury that over several decades can lead to cirrhosis. The hepatitis D virus is another virus that infects the liver, but only in people who already have hepatitis B.

Autoimmune hepatitis. This type of hepatitis is caused by a problem with the immune system.

*Inherited diseases.* Alpha-1 antitrypsin deficiency, hemochromatosis, Wilson's disease, galactosemia, and glycogen storage diseases are among the inherited diseases that interfere with the way the liver produces, processes, and stores enzymes, proteins, metals, and other substances the body needs to function properly.

*Nonalcoholic steatohepatitis (NASH).* In NASH, fat builds up in the liver and eventually causes scar tissue. This type of hepatitis appears to be associated with diabetes, protein malnutrition, obesity, coronary artery disease, and corticosteroid treatment.

*Blocked bile ducts.* When the ducts that carry bile out of the liver are blocked, bile backs up and damages liver tissue. In babies, blocked bile ducts are most commonly caused by biliary atresia, a disease in which the bile ducts are absent or injured. In adults, the most common cause is primary biliary cirrhosis, a disease in which the ducts become inflamed, blocked, and scarred. Secondary biliary cirrhosis can happen after gallbladder surgery, if the ducts are inadvertently tied off or injured.

*Drugs, toxins, and infections.* Severe reactions to prescription drugs, prolonged exposure to environmental toxins, the parasitic infection schistosomiasis, and repeated bouts of heart failure with liver congestion can each lead to cirrhosis.

### **Symptoms**

Many people with cirrhosis have no symptoms in the early stages of the disease. However, as scar tissue replaces healthy cells, liver function starts to fail and a person may experience the following symptoms:

- Exhaustion
- Fatigue
- Loss of appetite
- Nausea
- Weakness
- Weight loss.

As the disease progresses, complications may develop. In some people, these may be the first signs of the disease.

### **Complications of Cirrhosis**

Loss of liver function affects the body in many ways. Following are common problems, or complications, caused by cirrhosis. *Edema and ascites.* When the liver loses its ability to make the protein albumin, water accumulates in the leg (edema) and abdomen (ascites).

*Bruising and bleeding.* When the liver slows or stops production of the proteins needed for blood clotting, a person will bruise or bleed easily.

*Jaundice*. Jaundice is a yellowing of the skin and eyes that occurs when the diseased liver does not absorb enough bilirubin.

*Itching.* Bile products deposited in the skin may cause intense itching.

*Gallstones.* If cirrhosis prevents bile from reaching the gallbladder, a person may develop gallstones.

Toxins in the blood or brain. A damaged liver cannot remove toxins from the blood, causing them to accumulate in the blood and eventually the brain. There, toxins can dull mental functioning and cause personality changes, coma, and even death. Signs of the buildup of toxins in the brain include neglect of personal appearance, unresponsiveness, forgetfulness, trouble concentrating, or changes in sleep habits.

Sensitivity to medication. Cirrhosis slows the liver's ability to filter medications from the blood. Because the liver does not remove drugs from the blood at the usual rate, they act longer than expected and build up in the body. This causes a person to be more sensitive to medications and their side effects.

*Portal hypertension.* Normally, blood from the intestines and spleen is carried to the liver through the portal vein. But cirrhosis slows the normal flow of blood through the portal vein, which increases the pressure inside it. This condition is called portal hypertension.

*Varices.* When blood flow through the portal vein slows, blood from the intestines and spleen backs up into blood vessels in the stomach and esophagus. These blood vessels may become enlarged because they are not meant to carry this much blood. The enlarged blood vessels, called varices, have thin walls and carry high pressure, and thus are more likely to burst. If they do burst, the result is a serious bleeding problem in the upper stomach or esophagus that requires immediate medical attention.

*Problems in other organs*. Cirrhosis can cause immune system dysfunction, leading to infection. Ascites (fluid) in the abdomen may become infected with bacteria normally present in the intestines, and cirrhosis can also lead to kidney dysfunction and failure.

### Diagnosis

The doctor may diagnose cirrhosis on the basis of symptoms, laboratory tests, the patient's medical history, and a physical examination. For example, during a physical examination, the doctor may notice that the liver feels harder or larger than usual and order blood tests that can show whether liver disease is present.

If looking at the liver is necessary to check for signs of disease, the doctor might order a computerized axial tomography (CAT) scan, ultrasound, or a scan of the liver using a radioisotope (a harmless radioactive substance that highlights the liver). Or the doctor might look at the liver using a laparoscope, an instrument inserted through the abdomen that relays pictures back to a computer screen.

A liver biopsy will confirm the diagnosis. For a biopsy, the doctor uses a needle to take a small sample of tissue from the liver, then examines it for scarring or other signs of disease.

### Treatment

Liver damage from cirrhosis cannot be reversed, but treatment can stop or delay further progression and reduce complications. Treatment depends on the cause of cirrhosis and any complications a person is experiencing. For example, cirrhosis caused by alcohol abuse is treated by abstaining from alcohol. Treatment for hepatitis-related cirrhosis involves medications used to treat the different types of hepatitis, such as interferon for viral hepatitis and corticosteroids for autoimmune hepatitis. Cirrhosis caused by Wilson's disease, in which copper builds up in organs, is treated with medications to remove the copper. These are just a few examples—treatment for cirrhosis resulting from other diseases will depend on the underlying cause. In all cases, regardless of the cause, following a healthy diet and avoiding alcohol are essential because the body needs all the nutrients it can get, and alcohol will only lead to more liver damage.

Treatment will also include remedies for complications. For example, for ascites and edema, the doctor may recommend a lowsodium diet or the use of diuretics, which are drugs that remove fluid from the body. Antibiotics will be prescribed for infections, and various medications can help with itching. Protein causes toxins to form in the digestive tract, so eating less protein will help decrease the buildup of toxins in the blood and brain. The doctor may also prescribe laxatives to help absorb the toxins and remove them from the intestines.

For portal hypertension, the doctor may prescribe blood pressure medication such as a beta-blocker. If varices bleed, the doctor may either inject them with a clotting agent or perform a rubber-band ligation, which uses a special device to compress the varices and stop the bleeding. When complications cannot be controlled or when the liver becomes so damaged from scarring that it completely stops functioning, a liver transplant is necessary. In liver transplantation surgery, a diseased liver is removed and replaced with a healthy one from an organ donor. About 80 to 90 percent of people survive liver transplantation. Survival rates have improved over the past several years because of drugs such as cyclosporine and tacrolimus, which suppress the immune system and keep it from attacking and damaging the new liver.

### **For More Information**

Information about cirrhosis is also available from

American Liver Foundation 1425 Pompton Avenue Cedar Grove, NJ 07009 Tel: (800) 465–4837 or (888) 443–7222 Fax: (201) 256–3214 Internet: www.liverfoundation.org

Hepatitis Foundation International 30 Sunrise Terrace Cedar Grove, NJ 07009–1423 Tel: (800) 891–0707 Fax: (973) 857–5044 Internet: www.hepfi.org

United Network for Organ Sharing (UNOS) P.O. Box 13770 Richmond, VA 23225–8770 Tel: 1–888–894–6361 or (804) 330–8500 Internet: www.unos.org

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES National Institutes of Health

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# Gallstones

National Digestive Diseases Information Clearinghouse



National Institute of Diabetes and Digestive and Kidney Diseases

NATIONAL INSTITUTES OF HEALTH Gallstones form when liquid stored in the gallbladder hardens into pieces of stonelike material. The liquid, called bile, is used to help the body digest fats. Bile is made in the liver, then stored in the gallbladder until the body needs to digest fat. At that time, the gallbladder contracts and pushes the bile into a tube—called a duct that carries it to the small intestine, where it helps with digestion.

Bile contains water, cholesterol, fats, bile salts, and bilirubin. Bile salts break up fat, and bilirubin gives bile and stool a brownish color. If the liquid bile contains too much cholesterol, bile salts, or bilirubin, it can harden into stones.

The two types of gallstones are cholesterol stones and pigment stones. Cholesterol stones are usually yellow-green and are made primarily of hardened cholesterol. They account for about 80 percent of gallstones. Pigment stones are small, dark stones made of bilirubin. Gallstones can be as small as a grain of sand or as large as a golf ball. The gallbladder can develop just one large stone, hundreds of tiny stones, or almost any combination.

Gallstones can block the normal flow of bile if they lodge in any of the ducts that carry bile from the liver to the small intestine. That includes the hepatic ducts, which carry bile out of the liver; the cystic duct, which takes bile to and from the gallbladder; and the common bile duct, which takes bile from



the cystic and hepatic ducts to the small intestine. Bile trapped in these ducts can cause inflammation in the gallbladder, the ducts, or, rarely, the liver. Other ducts open into the common bile duct, including the pancreatic duct, which carries digestive enzymes out of the pancreas. If a gallstone blocks the opening to that duct, digestive enzymes can become trapped in the pancreas and cause an extremely painful inflammation called pancreatitis.

The gallbladder and the ducts that carry bile and other digestive enzymes from the liver, gallbladder, and pancreas to the small intestine are called the biliary system. If any of these ducts remain blocked for a significant period of time, severe—possibly fatal—damage can occur, affecting the gallbladder, liver, or pancreas. Warning signs of a serious problem are fever, jaundice, and persistent pain.

### What Causes Gallstones?

### **Cholesterol Stones**

Scientists believe cholesterol stones form when bile contains too much cholesterol, too much bilirubin, or not enough bile salts, or when the gallbladder does not empty as it should for some other reason.

### **Pigment Stones**

The cause of pigment stones is uncertain. They tend to develop in people who have cirrhosis, biliary tract infections, and hereditary blood disorders such as sickle cell anemia.

### **Other Factors**

It is believed that the mere presence of gallstones may cause more gallstones to develop. However, other factors that contribute to gallstones have been identified, especially for cholesterol stones.

- **Obesity.** Obesity is a major risk factor for gallstones, especially in women. A large clinical study showed that being even moderately overweight increases one's risk for developing gallstones. The most likely reason is that obesity tends to reduce the amount of bile salts in bile, resulting in more cholesterol. Obesity also decreases gallbladder emptying.
- Estrogen. Excess estrogen from pregnancy, hormone replacement therapy,

or birth control pills appears to increase cholesterol levels in bile and decrease gallbladder movement, both of which can lead to gallstones.

- Ethnicity. Native Americans have a genetic predisposition to secrete high levels of cholesterol in bile. In fact, they have the highest rates of gallstones in the United States. A majority of Native American men have gallstones by age 60. Among the Pima Indians of Arizona, 70 percent of women have gallstones by age 30. Mexican-American men and women of all ages also have high rates of gallstones.
- Gender. Women between 20 and 60 years of age are twice as likely to develop gallstones as men.
- Age. People over age 60 are more likely to develop gallstones than younger people.
- Cholesterol-lowering drugs. Drugs that lower cholesterol levels in blood actually increase the amount of cholesterol secreted in bile. This in turn can increase the risk of gallstones.
- **Diabetes.** People with diabetes generally have high levels of fatty acids called triglycerides. These fatty acids increase the risk of gallstones.
- **Rapid weight loss.** As the body metabolizes fat during rapid weight loss, it causes the liver to secrete extra cholesterol into bile, which can cause gallstones.
- **Fasting.** Fasting decreases gallbladder movement, causing the bile to become overconcentrated with cholesterol, which can lead to gallstones.

### What Are the Symptoms?

Symptoms of gallstones are often called a gallstone "attack" because they occur suddenly. A typical attack can cause

- Steady, severe pain in the upper abdomen that increases rapidly and lasts from 30 minutes to several hours.
- Pain in the back between the shoulder blades.
- Pain under the right shoulder.
- Nausea or vomiting.

Gallstone attacks often follow fatty meals, and they may occur during the night. Other gallstone symptoms include

- Abdominal bloating.
- Recurring intolerance of fatty foods.
- Colic.
- Belching.
- Gas.
- Indigestion.

People who also have the following symptoms should see a doctor right away:

- Sweating.
- Chills.
- Low-grade fever.
- Yellowish color of the skin or whites of the eyes.
- Clay-colored stools.

Many people with gallstones have no symptoms. These patients are said to be asymptomatic, and these stones are called "silent stones." They do not interfere in gallbladder, liver, or pancreas function and do not need treatment.

## Who Is at Risk for Gallstones?

- Women.
- People over age 60.
- Native Americans.
- Mexican-Americans.
- Overweight men and women.
- People who fast or lose a lot of weight quickly.
- Pregnant women, women on hormone therapy, and women who use birth control pills.

## How Are Gallstones Diagnosed?

Many gallstones, especially silent stones, are discovered by accident during tests for other problems. But when gallstones are suspected to be the cause of symptoms, the doctor is likely to do an ultrasound exam. Ultrasound uses sound waves to create images of organs. Sound waves are sent toward the gallbladder through a handheld device that a technician glides over the abdomen. The sound waves bounce off the gallbladder, liver, and other organs, and their echoes make electrical impulses that create a picture of the organ on a video monitor. If stones are present, the sound waves will bounce off them, too, showing their location.

Other tests used in diagnosis include

- Cholecystogram or cholescintigraphy. The patient is injected with a special iodine dye, and x-rays are taken of the gallbladder over a period of time. (Some people swallow iodine pills the night before the x-ray.) The test shows the movement of the gallbladder and any obstruction of the cystic duct.
- Endoscopic retrograde cholangiopancreatography (ERCP). The patient swallows an endoscope—a long, flexible, lighted tube connected to a computer and TV monitor. The doctor guides the endoscope through the stomach and into the small intestine. The doctor then injects a special dye that temporarily stains the ducts in the biliary system. ERCP is used to locate stones in the ducts.
- **Blood tests.** Blood tests may be used to look for signs of infection, obstruction, pancreatitis, or jaundice.

Gallstone symptoms are similar to those of heart attack, appendicitis, ulcers, irritable bowel syndrome, hiatal hernia, pancreatitis, and hepatitis. So accurate diagnosis is important.

### What Is the Treatment?

### Surgery

Surgery to remove the gallbladder is the most common way to treat symptomatic gallstones. (Asymptomatic gallstones usually do not need treatment.) Each year more than 500,000 Americans have gallbladder surgery. The surgery is called cholecystectomy. The standard surgery is called laparoscopic cholecystectomy. For this operation, the surgeon makes several tiny incisions in the abdomen and inserts surgical instruments and a miniature video camera into the abdomen. The camera sends a magnified image from inside the body to a video monitor, giving the surgeon a closeup view of the organs and tissues. While watching the monitor, the surgeon uses the instruments to carefully separate the gallbladder from the liver, ducts, and other structures. Then the cystic duct is cut and the gallbladder removed through one of the small incisions.

Because the abdominal muscles are not cut during laparoscopic surgery, patients have less pain and fewer complications than they would have had after surgery using a large incision across the abdomen. Recovery usually involves only one night in the hospital, followed by several days of restricted activity at home.

If the surgeon discovers any obstacles to the laparoscopic procedure, such as infection or scarring from other operations, the operating team may have to switch to open surgery. In some cases the obstacles are known before surgery, and an open surgery is planned. It is called "open" surgery because the surgeon has to make a 5- to 8-inch incision in the abdomen to remove the gallbladder. This is a major surgery and may require about a 2- to 7-day stay in the hospital and several more weeks at home to recover. Open surgery is required in about 5 percent of gallbladder operations.

The most common complication in gallbladder surgery is injury to the bile ducts. An injured common bile duct can leak bile and cause a painful and potentially dangerous infection. Mild injuries can sometimes be treated nonsurgically. Major injury, however, is more serious and requires additional surgery.
# Don't People Need Their Gallbladders?

Fortunately, the gallbladder is an organ that people can live without. Losing it won't even require a change in diet. Once the gallbladder is removed, bile flows out of the liver through the hepatic ducts into the common bile duct and goes directly into the small intestine, instead of being stored in the gallbladder. However, because the bile isn't stored in the gallbladder, it flows into the small intestine more frequently, causing diarrhea in some people. Also, some studies suggest that removing the gallbladder may cause higher blood cholesterol levels, so occasional cholesterol tests may be necessary.

If gallstones are in the bile ducts, the surgeon may use ERCP in removing them before or during the gallbladder surgery. Once the endoscope is in the small intestine, the surgeon locates the affected bile duct. An instrument on the endoscope is used to cut the duct, and the stone is captured in a tiny basket and removed with the endoscope. This two-step procedure is called ERCP with endoscopic sphincterotomy.

Occasionally, a person who has had a cholecystectomy is diagnosed with a gallstone in the bile ducts weeks, months, or even years after the surgery. The two-step ERCP procedure is usually successful in removing the stone.

#### **Nonsurgical Treatment**

Nonsurgical approaches are used only in special situations—such as when a patient's condition prevents using an anesthetic—and only for cholesterol stones. Stones recur after nonsurgical treatment about half the time.

- Oral dissolution therapy. Drugs made from bile acid are used to dissolve the stones. The drugs, ursodiol (Actigall) and chenodiol (Chenix), work best for small cholesterol stones. Months or years of treatment may be necessary before all the stones dissolve. Both drugs cause mild diarrhea, and chenodiol may temporarily raise levels of blood cholesterol and the liver enzyme transaminase.
- Contact dissolution therapy. This experimental procedure involves injecting a drug directly into the gallbladder to dissolve stones. The drug methyl tert butyl—can dissolve some stones in 1 to 3 days, but it must be used very carefully because it is a flammable anesthetic that can be toxic. The procedure is being tested in patients with symptomatic, noncalcified cholesterol stones.
- Extracorporeal shockwave lithotripsy (ESWL). This treatment uses shock waves to break up stones into tiny pieces that can pass through the bile ducts without causing blockages. Attacks of biliary colic (intense pain) are common after treatment, and ESWL's success rate is not very high. Remaining stones can sometimes be dissolved with medication.

### **Points To Remember**

- Gallstones form when substances in the bile harden.
- Gallstones are common among women, Native Americans, Mexican-Americans, and people who are overweight.
- Gallstone attacks often occur after eating a fatty meal.
- Symptoms can mimic those of other problems, including heart attack, so accurate diagnosis is important.
- Gallstones can cause serious problems if they become trapped in the bile ducts.
- Laparoscopic surgery to remove the gallbladder is the most common treatment.

## National Digestive Diseases Information Clearinghouse

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES National Institutes of Health

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# Your Digestive System and How It Works

National Digestive Diseases Information Clearinghouse



National Institute of Diabetes and Digestive and Kidney Diseases

NATIONAL INSTITUTES OF HEALTH The digestive system is a series of hollow organs joined in a long, twisting tube from the mouth to the anus (see figure). Inside this tube is a lining called the mucosa. In the mouth, stomach, and small intestine, the mucosa contains tiny glands that produce juices to help digest food.

Two solid organs, the liver and the pancreas, produce digestive juices that reach the intestine through small tubes. In addition, parts of other organ systems (for instance, nerves and blood) play a major role in the digestive system.

# Why is digestion important?

When we eat such things as bread, meat, and vegetables, they are not in a form that the body can use as nourishment. Our food and drink must be changed into smaller molecules of nutrients before they can be absorbed into the blood and carried to cells throughout the body. Digestion is the process by which food and drink are broken down into their smallest parts so that the body can use them to build and nourish cells and to provide energy.

# How is food digested?

Digestion involves the mixing of food, its movement through the digestive tract, and chemical breakdown of the large molecules of food into smaller molecules. Digestion begins in the mouth, when we



chew and swallow, and is completed in the small intestine. The chemical process varies somewhat for different kinds of food.



U.S. Department of Health and Human Services

#### Movement of Food Through the System

The large, hollow organs of the digestive system contain muscle that enables their walls to move. The movement of organ walls can propel food and liquid and also can mix the contents within each organ. Typical movement of the esophagus, stomach, and intestine is called peristalsis. The action of peristalsis looks like an ocean wave moving through the muscle. The muscle of the organ produces a narrowing and then propels the narrowed portion slowly down the length of the organ. These waves of narrowing push the food and fluid in front of them through each hollow organ.

The first major muscle movement occurs when food or liquid is swallowed. Although we are able to start swallowing by choice, once the swallow begins, it becomes involuntary and proceeds under the control of the nerves.

The esophagus is the organ into which the swallowed food is pushed. It connects the throat above with the stomach below. At the junction of the esophagus and stomach, there is a ringlike valve closing the passage between the two organs. However, as the food approaches the closed ring, the surrounding muscles relax and allow the food to pass.

The food then enters the stomach, which has three mechanical tasks to do. First, the stomach must store the swallowed food and liquid. This requires the muscle of the upper part of the stomach to relax and accept large volumes of swallowed material. The second job is to mix up the food, liquid, and digestive juice produced by the stomach. The lower part of the stomach mixes these materials by its muscle action. The third task of the stomach is to empty its contents slowly into the small intestine.

Several factors affect emptying of the stomach, including the nature of the food (mainly its fat and protein content) and the degree of muscle action of the emptying stomach and the next organ to receive the contents (the small intestine). As the food is digested in the small intestine and dissolved into the juices from the pancreas, liver, and intestine, the contents of the intestine are mixed and pushed forward to allow further digestion.

Finally, all of the digested nutrients are absorbed through the intestinal walls. The waste products of this process include undigested parts of the food, known as fiber, and older cells that have been shed from the mucosa. These materials are propelled into the colon, where they remain, usually for a day or two, until the feces are expelled by a bowel movement.

#### **Production of Digestive Juices**

The glands that act first are in the mouth the salivary glands. Saliva produced by these glands contains an enzyme that begins to digest the starch from food into smaller molecules.

The next set of digestive glands is in the stomach lining. They produce stomach acid and an enzyme that digests protein. One of the unsolved puzzles of the digestive system is why the acid juice of the stomach does not dissolve the tissue of the stomach itself. In most people, the stomach mucosa is able to resist the juice, although food and other tissues of the body cannot. After the stomach empties the food and juice mixture into the small intestine, the juices of two other digestive organs mix with the food to continue the process of digestion. One of these organs is the pancreas. It produces a juice that contains a wide array of enzymes to break down the carbohydrates, fat, and protein in food. Other enzymes that are active in the process come from glands in the wall of the intestine or even a part of that wall.

The liver produces yet another digestive juice—bile. The bile is stored between meals in the gallbladder. At mealtime, it is squeezed out of the gallbladder into the bile ducts to reach the intestine and mix with the fat in our food. The bile acids dissolve the fat into the watery contents of the intestine, much like detergents that dissolve grease from a frying pan. After the fat is dissolved, it is digested by enzymes from the pancreas and the lining of the intestine.

#### Absorption and Transport of Nutrients

Digested molecules of food, as well as water and minerals from the diet, are absorbed from the cavity of the upper small intestine. Most absorbed materials cross the mucosa into the blood and are carried off in the bloodstream to other parts of the body for storage or further chemical change. As already noted, this part of the process varies with different types of nutrients.

*Carbohydrates.* It is recommended that about 55 to 60 percent of total daily calories be from carbohydrates. Some of our most common foods contain mostly carbohydrates. Examples are bread, potatoes, legumes, rice, spaghetti, fruits, and vegetables. Many of these foods contain both starch and fiber.

The digestible carbohydrates are broken into simpler molecules by enzymes in the saliva, in juice produced by the pancreas, and in the lining of the small intestine. Starch is digested in two steps: First, an enzyme in the saliva and pancreatic juice breaks the starch into molecules called maltose; then an enzyme in the lining of the small intestine (maltase) splits the maltose into glucose molecules that can be absorbed into the blood. Glucose is carried through the bloodstream to the liver, where it is stored or used to provide energy for the work of the body.

Table sugar is another carbohydrate that must be digested to be useful. An enzyme in the lining of the small intestine digests table sugar into glucose and fructose, each of which can be absorbed from the intestinal cavity into the blood. Milk contains yet another type of sugar, lactose, which is changed into absorbable molecules by an enzyme called lactase, also found in the intestinal lining.

Protein. Foods such as meat, eggs, and beans consist of giant molecules of protein that must be digested by enzymes before they can be used to build and repair body tissues. An enzyme in the juice of the stomach starts the digestion of swallowed protein. Further digestion of the protein is completed in the small intestine. Here, several enzymes from the pancreatic juice and the lining of the intestine carry out the breakdown of huge protein molecules into small molecules called amino acids. These small molecules can be absorbed from the hollow of the small intestine into the blood and then be carried to all parts of the body to build the walls and other parts of cells.

*Fats.* Fat molecules are a rich source of energy for the body. The first step in digestion of a fat such as butter is to dissolve it into the watery content of the intestinal cavity. The bile acids produced by the liver act as natural detergents to dissolve fat in water and allow the enzymes to break the large fat molecules into smaller molecules, some of which are fatty acids and cholesterol. The bile acids combine with the fatty acids and cholesterol and help these molecules to move into the cells of the mucosa. In these cells the small molecules are formed back into large molecules, most of which pass into vessels (called lymphatics) near the intestine. These small vessels carry the reformed fat to the veins of the chest, and the blood carries the fat to storage depots in different parts of the body.

*Vitamins.* Another vital part of our food that is absorbed from the small intestine is the class of chemicals we call vitamins. The two different types of vitamins are classified by the fluid in which they can be dissolved: water-soluble vitamins (all the B vitamins and vitamin C) and fat-soluble vitamins (vitamins A, D, and K).

*Water and Salt.* Most of the material absorbed from the cavity of the small intestine is water in which salt is dissolved. The salt and water come from the food and liquid we swallow and the juices secreted by the many digestive glands.

# How is the digestive process controlled?

#### **Hormone Regulators**

A fascinating feature of the digestive system is that it contains its own regulators. The major hormones that control the functions of the digestive system are produced and released by cells in the mucosa of the stomach and small intestine. These hormones are released into the blood of the digestive tract, travel back to the heart and through the arteries, and return to the digestive system, where they stimulate digestive juices and cause organ movement.

The hormones that control digestion are gastrin, secretin, and cholecystokinin (CCK):

- **Gastrin** causes the stomach to produce an acid for dissolving and digesting some foods. It is also necessary for the normal growth of the lining of the stomach, small intestine, and colon.
- Secretin causes the pancreas to send out a digestive juice that is rich in bicarbonate. It stimulates the stomach to produce pepsin, an enzyme that digests protein, and it also stimulates the liver to produce bile.
- CCK causes the pancreas to grow and to produce the enzymes of pancreatic juice, and it causes the gallbladder to empty.

Additional hormones in the digestive system regulate appetite:

- **Ghrelin** is produced in the stomach and upper intestine in the absence of food in the digestive system and stimulates appetite.
- **Peptide YY** is produced in the GI tract in response to a meal in the system and inhibits appetite.

Both of these hormones work on the brain to help regulate the intake of food for energy.

#### **Nerve Regulators**

Two types of nerves help to control the action of the digestive system. Extrinsic (outside) nerves come to the digestive organs from the unconscious part of the brain or from the spinal cord. They release a chemical called acetylcholine and another called adrenaline. Acetylcholine causes the muscle of the digestive organs to squeeze with more force and increase the "push" of food and juice through the digestive tract. Acetylcholine also causes the stomach and pancreas to produce more digestive juice. Adrenaline relaxes the muscle of the stomach and intestine and decreases the flow of blood to these organs.

Even more important, though, are the intrinsic (inside) nerves, which make up a very dense network embedded in the walls of the esophagus, stomach, small intestine, and colon. The intrinsic nerves are triggered to act when the walls of the hollow organs are stretched by food. They release many different substances that speed up or delay the movement of food and the production of juices by the digestive organs.

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*Fats.* Fat molecules are a rich source of energy for the body. The first step in digestion of a fat such as butter is to dissolve it into the watery content of the intestinal cavity. The bile acids produced by the liver act as natural detergents to dissolve fat in water and allow the enzymes to break the large fat molecules into smaller molecules, some of which are fatty acids and cholesterol. The bile acids combine with the fatty acids and cholesterol and help these molecules to move into the cells of the mucosa. In these cells the small molecules are formed back into large molecules, most of which pass into vessels (called lymphatics) near the intestine. These small vessels carry the reformed fat to the veins of the chest, and the blood carries the fat to storage depots in different parts of the body.

*Vitamins.* Another vital part of our food that is absorbed from the small intestine is the class of chemicals we call vitamins. The two different types of vitamins are classified by the fluid in which they can be dissolved: water-soluble vitamins (all the B vitamins and vitamin C) and fat-soluble vitamins (vitamins A, D, and K).

*Water and Salt.* Most of the material absorbed from the cavity of the small intestine is water in which salt is dissolved. The salt and water come from the food and liquid we swallow and the juices secreted by the many digestive glands.

# How is the digestive process controlled?

#### **Hormone Regulators**

A fascinating feature of the digestive system is that it contains its own regulators. The major hormones that control the functions of the digestive system are produced and released by cells in the mucosa of the stomach and small intestine. These hormones are released into the blood of the digestive tract, travel back to the heart and through the arteries, and return to the digestive system, where they stimulate digestive juices and cause organ movement.

The hormones that control digestion are gastrin, secretin, and cholecystokinin (CCK):

- **Gastrin** causes the stomach to produce an acid for dissolving and digesting some foods. It is also necessary for the normal growth of the lining of the stomach, small intestine, and colon.
- Secretin causes the pancreas to send out a digestive juice that is rich in bicarbonate. It stimulates the stomach to produce pepsin, an enzyme that digests protein, and it also stimulates the liver to produce bile.
- CCK causes the pancreas to grow and to produce the enzymes of pancreatic juice, and it causes the gallbladder to empty.

Additional hormones in the digestive system regulate appetite:

- **Ghrelin** is produced in the stomach and upper intestine in the absence of food in the digestive system and stimulates appetite.
- **Peptide YY** is produced in the GI tract in response to a meal in the system and inhibits appetite.

Both of these hormones work on the brain to help regulate the intake of food for energy.

#### **Nerve Regulators**

Two types of nerves help to control the action of the digestive system. Extrinsic (outside) nerves come to the digestive organs from the unconscious part of the brain or from the spinal cord. They release a chemical called acetylcholine and another called adrenaline. Acetylcholine causes the muscle of the digestive organs to squeeze with more force and increase the "push" of food and juice through the digestive tract. Acetylcholine also causes the stomach and pancreas to produce more digestive juice. Adrenaline relaxes the muscle of the stomach and intestine and decreases the flow of blood to these organs.

Even more important, though, are the intrinsic (inside) nerves, which make up a very dense network embedded in the walls of the esophagus, stomach, small intestine, and colon. The intrinsic nerves are triggered to act when the walls of the hollow organs are stretched by food. They release many different substances that speed up or delay the movement of food and the production of juices by the digestive organs.

## National Digestive Diseases Information Clearinghouse

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