

ABDOMEN

ANATOMY

ANATOMY OR SYSTEM AFFECTED: Bladder, gastrointestinal system, intestines, kidneys, liver, reproductive system, stomach, urinary system, uterus

SPECIALTIES AND RELATED FIELDS: Gastroenterology, gynecology, internal medicine, nephrology, urology

DEFINITION: The cavity in the central portion of the trunk that contains the vital organs most closely associated with the digestive process and the elimination of waste material.

KEY TERMS:

chyme: the semiliquid state of foods that have gone through the first stage of digestion in the stomach

Kupffer cells: specialized cells in the liver that perform the function of removing bacterial debris from the blood that has circulated throughout the body

urea: the major waste product produced in the kidneys that, when gathered in sufficient quantity and liquefied, flows into the bladder for elimination as urine

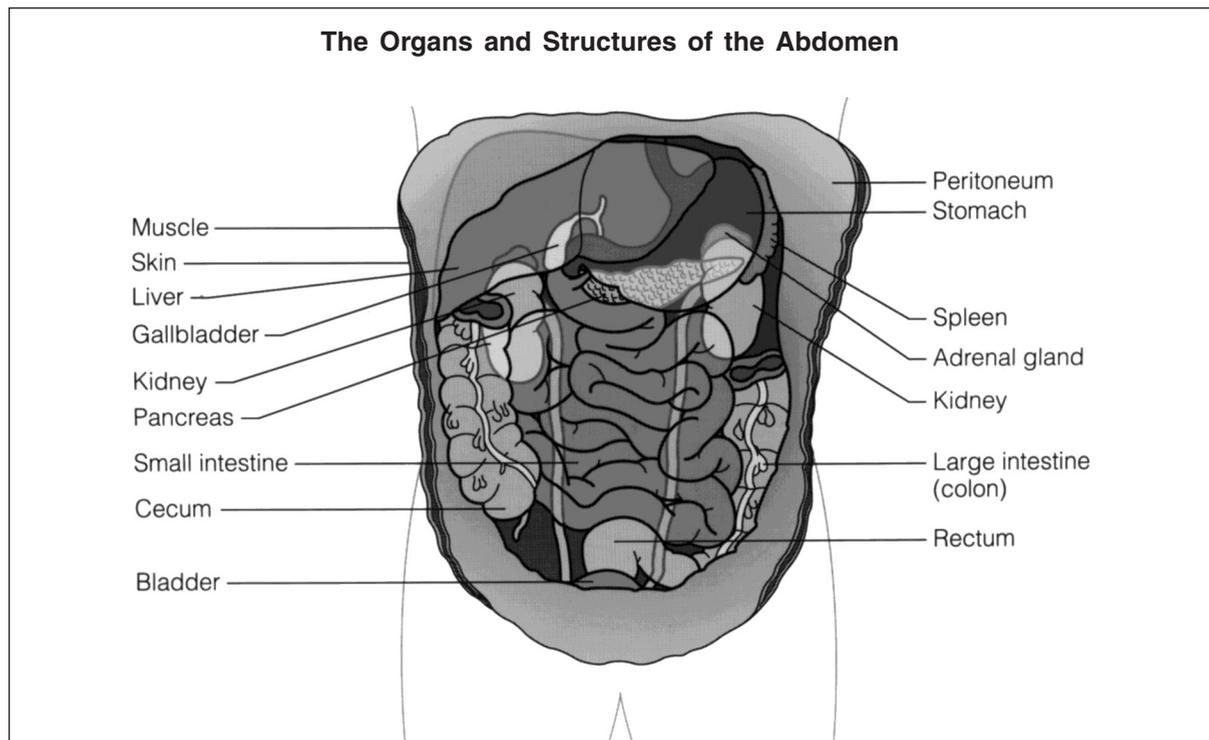
STRUCTURE AND FUNCTIONS

The abdomen is the portion of the body's trunk that begins immediately below the diaphragm, which is the

main respiratory muscle in the chest cavity, and extends to the lower pelvic region. The abdominal area is defined by a muscular wall made up of fatty tissue and skin, which determines the general shape of the body from the chest to the lower pelvis. The entire abdominal cavity is lined by a membrane called the peritoneum. This membrane encloses the essential organs of the abdomen: the stomach, small and large intestines, liver, gallbladder, bladder, pancreas, and kidneys. In females, the abdominal casing also contains the uterus, ovaries, and Fallopian tubes. At the front of the abdomen is the navel, essentially a scar which forms following the cutting of the umbilical cord after birth.

Any overview of the abdomen requires a composite view of the functions performed by each of the organs contained in it. With the exception of the female reproductive organs, all the organs contained in the abdominal cavity serve in one way or another in the process of food digestion, the transfer of diverse essential food by-products to the rest of the body, and the disposal of waste products via the urinary tract and the anal passage.

The esophagus is the tube through which all solid and liquid foods enter the stomach, which is the top-most organ in the abdominal cavity. Because it is essen-



Abdominal organs and structures are those located between the rib cage and the pelvic bone.

tially a bag, the stomach can assume different shapes and adjust in size to accommodate different volumes of food that reach it through the esophagus. In adult humans, the average capacity of the stomach is about one quart. The essential digestive function of the stomach is to convert foods from their original states to a general semiliquid state referred to as chyme.

This first stage of digestion is carried out by the chemical action of some thirty-five thousand gastric glands which make up the inner folds of the inner layer of the stomach, the gastric mucosa. As the gastric glands actively secrete gastric juice, the second layer of the stomach wall, which is muscle tissue, contracts and expands, providing the physical movement that is necessary for the gastric juice and food material to come into full contact.

Gastric juice actually begins to flow from the inner lining of the stomach even before food is present. This may occur when one smells food or even when one imagines the flavor of food. Among the component parts of gastric juice are the enzymes pepsin and rennin, hydrochloric acid, and mucus, the latter of which protects the lining of the stomach from the effects of high acidity. Pepsin and rennin begin to break down different types of proteins when an optimum acid environment (a pH between 1 and 3) exists.

Once the initial stage of digestion has occurred, food passes from the stomach into the upper portion of the small intestine, or duodenum, via the pyloric sphincter. This passageway will not allow food to enter the small intestine until it is suitably modified by the action of the stomach.

In the small and large intestines, partially broken-down food is reduced further by the action of gastric juices that are either secreted into the intestines from other abdominal organs (the pancreas and liver, most notably) or secreted by the mucous membranes of the intestines themselves. It is in the small intestine that most of the breaking-down digestive work of gastric juices takes place. Food particles reach a certain level of decomposition so that they may be absorbed into the bloodstream through the mucous membranes of the intestine. The bulk of what is left is allowed to pass, through a gatelike passageway called the cecum, from the small to the large intestine, or colon.

The function of the colon and the component juices that it contains is to separate out the three essential components that remain following the absorptive work of the small intestine: water, undigested foodstuff, and bacteria. Most of the water passes back into the body

through the walls of the colon, while undigested food and bacteria are propelled farther down the gastrointestinal tract for eventual elimination as feces.

The importance of other organs in the abdomen—the liver, kidneys, pancreas, gallbladder, and bladder—is as complex as that of the intestines and in several cases goes beyond the basic function of digestion. Closest to the stomach and the digestive process itself, perhaps, is the action of the pancreas. The pancreas is the glandular organ located directly beneath the stomach. It is connected to the duodenum, to which it provides pancreatic juice containing three digestive enzymes: trypsin, amylase, and lipase. These agents join the secretions of the small intestine, as well as bile flowing from the liver, to complete the digestive process that breaks down proteins, carbohydrates, and fats. They can then be absorbed through the walls of the intestine for the general nourishment of the body. In addition to its role in the digestive process, the pancreas possesses endocrine cells, called the islets of Langerhans, that secrete two hormones, insulin and glucagon, directly into the bloodstream. These two hormones work together to influence the level of sugar in the blood. When the insulin-secreting cells of the pancreas fail to function effectively, then diabetes mellitus may result.

Like the pancreas, the liver, which is the largest glandular organ of the body, shares in the digestive process by producing bile, a fluid essential for the emulsification of fats passing through the small intestine. Bile salts, as they are called, are stored in the gallbladder until they are released into the small intestine. This contribution to the digestive process, however, represents only a minimal part of the liver's functions, many of which have vital effects on body functions far beyond the abdominal cavity. Because blood filled with oxygen flows into the liver from the aorta through the hepatic artery, on one hand, and blood containing digested food enters the liver from the small intestine via the portal vein, on the other, the relationship between "harmonizing" liver functions and the content of the blood is absolutely critical.

The metabolic cells that make up liver tissue, known as hepatic cells, are highly specialized. According to their specialized function, the hepatic cells in the four unequal-sized lobes of the liver may affect several factors: the amount of glycogen (converted and stored glucose) that should be reconverted to glucose and passed (for added energy) into the bloodstream; the conversion of excess carbohydrates and protein into fat; the counteraction of the harmful ammonia by-product of

protein breakdown by the production of urea; the production of several essential components of blood, including plasma proteins and blood-clotting agents; the storing of key vitamins and minerals such as vitamins A, D, K, and B/2; and the removal of bacteria and other debris that collect in the blood itself—a function of the phagocytic, or Kupffer, cells in particular.

It is the next pair of vital abdominal organs, the kidneys, that separates many of the waste products associated with the liver's metabolic functions, including urea and mineral salts, out of the blood and removes them from the body in the form of urine. This separation is performed by millions of tiny filtering agents called nephrons. Blood penetrates the interior of the kidney by way of an incoming arteriole that branches off from the main renal artery. After the filtering process has been completed, cleansed blood flows back into the main bloodstream via an outgoing arteriole and a system of blood vessels leading to the main renal vein. Waste materials remain, after filtering, in a tube-like extension of each nephron until they can be concentrated, in the form of urine, in a chamber in the middle of the kidney, the kidney pelvis. From this chamber, urine is propelled by muscular compression through the ureter tubes leading to the bladder, the last organ (in males) contained within the lower abdominal cavity. In addition to removing waste products from the blood, the kidneys can adjust the level in the blood of other substances, such as sodium, potassium, and calcium, that are needed by the body but that may exist in excess at certain times. Because the two kidneys perform exactly the same functions, it is possible to survive as long as one of the two is healthy.

Although obviously essential for temporary storage of urine and final elimination of liquid waste through the process of urination, the bladder is the least complicated organ in the abdominal cavity. The bladder is essentially a sac with a liquid capacity of about one pint. Its functions are governed by varied tension in, and loosening of, muscles in the walls of the sac and the external sphincter. When the pressure of collected urine reaches a certain point, nervous impulses cause the external sphincter to relax. Urine flow out of the bladder into the urethra tube can be controlled, up to a certain point, in humans and most mammals by conscious thought.

DISORDERS AND DISEASES

Given the concentration in the abdomen of vital regulatory organs, much medical research has focused on the pathology of this area of the body. Although there are a

number of specific diseases that attack individual abdominal organs, the entire region is vulnerable to cancerous tumors. Medical science has tended to associate cancers in certain abdominal organs with dietary habits that are either of recent origin (consumption of highly processed foodstuffs in industrialized Western societies, for example) or geographically or ethnically distinctive—the East Asian, specifically Japanese, vulnerability to certain types of stomach cancer, for example. The latter vulnerability may, however, also be tied to dietary or other environmental considerations that vary in different populated areas of the globe.

Although cancers may strike any of the vital abdominal organs, chances of successful surgical intervention to remove tumors vary greatly according to the location of the cancer. Liver cancer, for example, is essentially untreatable through surgery, while the treatment of cancer of the colon has a significant success rate. This variation is partially attributable to the fact that the vital processes performed by the intestines may not be seriously threatened when a portion of the organ is removed in cancer surgery.

The most important specific diseases associated with the abdomen include peritonitis, hepatitis, and diabetes. Among these diseases, diabetes has received the most attention, both for its widespread impact on all sectors of the population and for the amount of research that has gone into the task of finding a cure. Diabetes occurs when the pancreas fails to produce enough insulin to metabolize the sugar substance glucose. A breakdown in this function impairs proper cell nourishment and results in excessive sugar in the blood and urine. This state, referred to as hyperglycemia, can affect a number of body functions outside the abdominal cavity, leading, for example, to atherosclerosis and vascular degeneration in general. Because many diabetes patients must inject insulin into their bodies to counteract malfunctioning of the pancreas, an opposite, equally dangerous side effect, hyperinsulinism, may also occur. The most serious degenerative effect that menaces patients suffering from diabetes, however, occurs when the chemical and hormonal imbalance originating in the pancreas brings negative reactions to the kidneys, causing the latter to fail. Medical science has perfected various technical means for addressing this problem, most connected with the mechanical process called dialysis.

Hepatitis is an inflammation that attacks the liver. The two common forms are hepatitis A (formerly called infectious hepatitis) and hepatitis B (formerly

called serum hepatitis). Both are transmitted as a result of unsanitary conditions, the first in food and water supplies and the second when unsterile hypodermic needles or infected blood come into contact with the victim's own bloodstream. Unlike most other diseases associated with the abdominal organs, hepatitis is extremely contagious. Hepatitis B can present dangers in using plasma supplied by donors, as there can be an incubation period from six weeks to six months before external signs of the disease occur.

Perhaps the most common abdominal disease, curable through the use of antibiotics if treated in time, is peritonitis. This is an acute inflammation of the peritoneum, the membrane that lines the entire abdominal cavity. It can occur as a result of direct bacterial invasion from outside the body or as a side effect of ruptures occurring in one of the organs contained in the abdomen. Peritonitis typically develops as a result of complications from appendicitis, bleeding ulcers, or a ruptured gallbladder.

PERSPECTIVE AND PROSPECTS

The history of medical analysis of disorders of the abdominal area goes back as far as written history itself, ranging from simple indigestion and painful (and possibly fatal) gallstones to very serious and only recently understood diseases such as diabetes.

Perhaps the most noteworthy advancement in medical knowledge affecting the organs of the abdominal region has been the development of more sophisticated means to counteract the effects of kidney disorders. While there were some striking advances (but not full levels of success) in organ transplant surgery beginning in the 1970's, a technique called dialysis made remarkable strides. First used shortly after World War II as an effective but costly and physically limiting treatment, dialysis involves the use of a machine that receives blood pumped directly from the patient's heart and processes this blood in place of the kidney. This involves filtering out excretory products, adding essential components that "refresh" blood needs (such as heparin, to combat clotting, and proper amounts of saline fluid), and then returning the blood to resume its vital function within the circulatory system.

Although the essential principles of dialysis did not change drastically in the last quarter of the twentieth century, levels of efficiency in a process that had to be repeated over a ten-hour period several times a week definitely did. Development of much smaller, portable dialysis devices made it possible for patients to follow

their doctors' instructions in carrying out their own treatment between hospital or office visits, thus lessening the chances of very dangerous crises at the outset of kidney failure.

The most notable hope for patients afflicted with kidney disorders is successful transplant from a healthy or recently deceased donor. By the early twenty-first century, transplants had also become foreseeable for those suffering from diseases that strike other organs in the abdominal cavity, especially the liver. Thus, healthy organ transplant technology can be said to represent one of the most important domains of future research, involving specialists of all the subsections of medicine relating to the abdominal cavity.

—Byron D. Cannon, Ph.D.

See also Abdominal disorders; Adrenalectomy; Amniocentesis; Anatomy; Appendectomy; Appendicitis; Bariatric surgery; Bladder removal; Bypass surgery; Cesarean section; Cholecystectomy; Colitis; Colon; Colon therapy; Colonoscopy and sigmoidoscopy; Colorectal cancer; Colorectal polyp removal; Colorectal surgery; Constipation; Crohn's disease; Dialysis; Diaphragm; Diarrhea and dysentery; Digestion; Diverticulitis and diverticulosis; Endoscopy; Enemas; Fistula repair; Gallbladder; Gallbladder diseases; Gastrectomy; Gastroenterology; Gastroenterology, pediatric; Gastrointestinal disorders; Gastrointestinal system; Gastrostomy; Hernia; Hernia repair; Ileostomy and colostomy; Incontinence; Indigestion; Internal medicine; Intestinal disorders; Intestines; Irritable bowel syndrome (IBS); Kidney transplantation; Kidneys; Laparoscopy; Liposuction; Lithotripsy; Liver; Liver transplantation; Nephrectomy; Nephritis; Nephrology; Nephrology, pediatric; Obstruction; Ovaries; Pancreas; Pancreatitis; Peristalsis; Peritonitis; Pregnancy and gestation; Prostate gland; Reproductive system; Roundworms; Small intestine; Splenectomy; Sterilization; Stomach, intestinal, and pancreatic cancers; Stone removal; Stones; Tubal ligation; Ultrasonography; Urethritis; Urinary disorders; Urinary system; Urology; Urology, pediatric; Uterus; Worms.

FOR FURTHER INFORMATION:

Bernard, Claude. *Memoir on the Pancreas and on the Role of Pancreatic Juice in Digestive Processes*. Translated by John Henderson. New York: Academic Press, 1985. An English translation of a classic mid-nineteenth century study, published by a physiologist concerned with the main organs of the abdominal cavity. Illustrated.

- De Wardener, H. E. *The Kidney: An Outline of Normal and Abnormal Function*. 5th ed. New York: Churchill Livingstone, 1985. Although this text on the functions and pathology of the kidney predates the impressive advances made in kidney transplant techniques, it is extremely comprehensive and comprehensible for the general, educated reader.
- Feldman, Mark, Lawrence S. Friedman, and Lawrence J. Brandt, eds. *Sleisenger and Fordtran's Gastrointestinal and Liver Disease: Pathophysiology, Diagnosis, Management*. New ed. 2 vols. Philadelphia: Saunders/Elsevier, 2010. A comprehensive textbook of gastrointestinal diseases and physiology. Contains excellent chapters on abdominal disorders.
- Marieb, Elaine N. *Essentials of Human Anatomy and Physiology*. 9th ed. San Francisco: Pearson/Benjamin Cummings, 2009. This introductory anatomy and physiology textbook, easily accessible to those with little science background, is richly illustrated with diagrams and photographs, which help to illuminate body systems and processes.
- Palmer, Melissa. *Dr. Melissa Palmer's Guide to Hepatitis and Liver Disease*. Rev. ed. Garden City Park, N.Y.: Avery, 2004. Palmer, a nationally recognized hepatologist, divides her text into four units: "The Basics," "Understanding and Treating Viral Hepatitis," "Understanding and Treating Other Liver Diseases," and "Treatment Options and Lifestyle Changes."
- Ronco, Claudio, and Rinaldo Bellomo, eds. *Critical Care Nephrology*. 2d ed. Philadelphia: Saunders/Elsevier, 2009. This text provides an overview of the treatment of critically ill patients with renal failure and multiple organ dysfunction syndrome.
- Tortora, Gerard J., and Bryan Derrickson. *Principles of Anatomy and Physiology*. 12th ed. Hoboken, N.J.: John Wiley & Sons, 2009. An outstanding textbook of human anatomy and physiology.

ABDOMINAL DISORDERS

DISEASE/DISORDER

ANATOMY OR SYSTEM AFFECTED: Abdomen, bladder, gastrointestinal system, intestines, kidneys, liver, stomach, urinary system

SPECIALTIES AND RELATED FIELDS: Emergency medicine, family medicine, gastroenterology, internal medicine

DEFINITION: Disorders affecting the wide range of organs found in the torso of the body, including diseases of the stomach, intestines, liver, and pancreas.

KEY TERMS:

gastrointestinal: referring to the small and large intestines

pathogen: any microorganism that can cause infectious disease, such as bacteria, viruses, fungi, or other parasites

peritoneum: a membrane enclosing most of the organs in the abdomen

CAUSES AND SYMPTOMS

The main trunk, or torso, of the human body includes three major structures: the chest cavity, contained within the ribs and housing the lungs and heart; the abdomen, containing the stomach, kidneys, liver, spleen, pancreas, and intestines; and the pelvic cavity, housing the sexual organs, the organs of elimination, and related structures.

The abdomen is, for the most part, contained within a membrane called the peritoneum. The stomach lies immediately below the chest cavity and connects directly with the small intestine, a long tube. It fills the bulk of the abdominal cavity, winding around and down to the pelvic bones in the hips. The small intestine then connects to the large intestine, which extends upward and crosses the abdomen just below the stomach and then turns down to connect with the rectum. Other vital organs within the abdominal cavity include the liver, kidneys, spleen, pancreas, and adrenal glands. All these structures are subject to infection by viruses, bacteria, and other infective agents; to cancer; and to a wide range of conditions specific to individual organs and systems.

Diseases in the abdominal cavity are usually signaled by pain. Identifying the exact cause of abdominal pain is one of the most difficult and important tasks that the physician faces. The familiar stomachache may

INFORMATION ON ABDOMINAL DISORDERS

CAUSES: Appendicitis, cancer, cirrhosis, colitis, constipation, Crohn's disease, diabetes mellitus, diverticulitis, food poisoning, gastritis, gastroenteritis, hepatitis, obstruction, pancreatitis, peritonitis, stones, ulcers, etc.

SYMPTOMS: Pain

DURATION: Acute or chronic

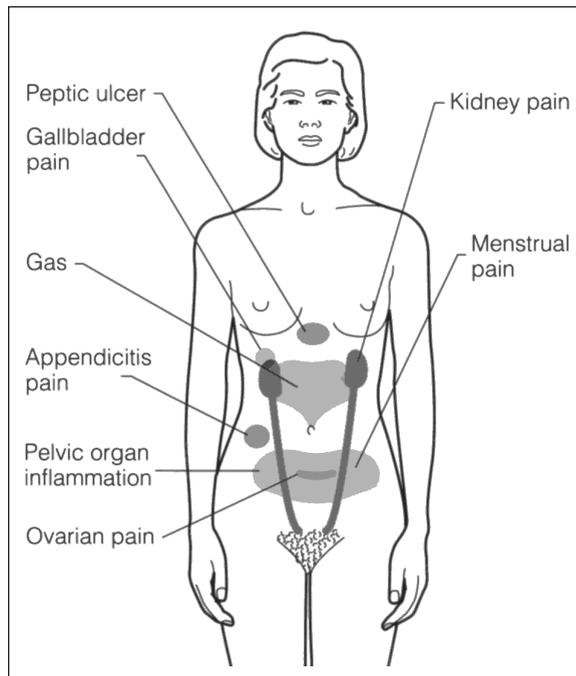
TREATMENTS: Lifestyle changes, acid-neutralizing drugs, surgery

be simple indigestion, or it may be caused by spoiled, toxic foods or by infection, inflammation, cancer, obstruction, or tissue erosion, among other causes. It may arise in the stomach, the intestines, or other organs contained within the abdominal cavity. In addition, pain felt in the abdomen may be referred from other sources outside the abdominal cavity. A good example would be a heart attack, which arises in the chest cavity but is often felt by the patient as indigestion. Another example is the abdominal cramping that is often associated with menstruation and premenstrual syndrome (PMS). However, because severe abdominal pain could mean that the patient is in great danger, the physician must decide quickly what is causing the pain and what to do about it.

By far the most common cause of stomach pain is indigestion, but this term is so broad as to be almost meaningless. Indigestion can be brought on by eating too much food or by eating the wrong foods or tainted foods; it can be brought on by alcohol consumption, smoking, poisons, infection, certain medications such as aspirin, and a host of other causes. It may be merely an annoyance, or it may indicate a more serious condition, such as gastritis, gastroenteritis, an ulcer, or cancer.

The stomach contains powerful chemicals to help digest foods. These include hydrochloric acid and chemicals called pepsins (digestive enzymes). To protect itself from being digested, the stomach mounts a defense system that allows the chemical modification of foods while keeping acid and pepsin away from the stomach walls. In certain people, however, the defense mechanisms break down and bring the corrosive stomach chemicals into direct contact with the stomach walls. The result can be irritation of the stomach lining, called gastritis. Gastritis may progress to a peptic ulcer, identified as a gastric ulcer if the inflammation occurs in the stomach wall or a duodenal ulcer if it occurs in the wall of the duodenum, the first section of the small intestine. In most cases, the ulcer is limited to the surface of the tissue. In severe cases, the ulcer can perforate the entire wall and can be life-threatening.

A common cause of stomach pain is the medication used to treat arthritis and rheumatism. These drugs include aspirin and a group of related drugs called non-steroidal anti-inflammatory drugs (NSAIDs). As part of their activity in reducing bone and joint inflammation and pain, NSAIDs interfere with part of the stomach's network of self-protective devices and allow acids to attack stomach and duodenal walls, sometimes resulting in gastritis or ulceration.



Abdominal disorders are many and varied; some common disorders and their sites are shown here.

Bacterial and viral infections often result in abdominal distress. Foods that sit too long unrefrigerated provide a good environment for bacteria to grow. These bacteria may be inherent in the food itself (for example, *Salmonella* in poultry and *E. coli* in meats) or they may come from the hands of people who prepare and serve them. The bacteria may cause human infection directly, or they may release toxins into the food. The result can be mere annoyance, debilitating illness, or deadly infection, depending upon the organism involved. *Salmonella* and *Staphylococcus* are two of the many bacteria that can cause food poisoning. Toxin-producing *E. coli* can be acquired from improperly cooked meat and can cause fatal infections. *Clostridium botulinum* toxin, occasionally found in canned or preserved foods, leads to probably the most serious form of food poisoning; victims often do not recover.

Other bacterial and viral infections of the gastrointestinal tract are also common causes of abdominal disease. Some of these viruses and bacteria include noroviruses, rotavirus, and *Shigella*. Viral gastroenteritis is the second most common disease in the United States (after upper respiratory tract infections) and a leading cause of death in infants and the elderly.

Appendicitis (inflammation of the appendix) is frequently seen. The appendix is a tiny organ at the end of

the small intestine. It has no known purpose in the physiology of modern humans, but occasionally it becomes infected. If the infection is not treated quickly, the appendix can burst and spread infection throughout the abdominal area, a condition that can be life-threatening.

Diarrhea, with or without accompanying abdominal pain, is a major symptom of gastrointestinal disease. It is commonly associated with bacterial or viral infection but may also be attributable to the antibiotics used to treat bacterial infections, or to noninfectious inflammatory conditions such as Crohn's disease or ulcerative colitis.

Other gastrointestinal diseases are peritonitis (inflammation of the membrane that covers the abdominal organs), diverticulitis, constipation, obstruction, colitis, and the various cancers that can afflict the gastrointestinal system, such as stomach and colon cancers. The latter is one of the more common, yet preventable, forms of cancer in the United States.

The liver is the largest internal organ in the human body and perhaps the most complicated; it is subject to a wide range of disorders. It is the body's main chemical workshop, and it is responsible for a large number of activities that are vital to body function. The liver absorbs nutrients from the intestinal tract and metabolizes them; that is, the liver modifies nutrients so that they can be used by the cells. The liver introduces nutrients into the bloodstream, supplying it with the glucose, protein, and other substances that the body needs. The liver detoxifies the blood and allows poisons, drugs, and other harmful agents to be eliminated. The liver also manufactures and stores many important substances, such as vitamin A and cholesterol.

Chief among liver disorders are the various forms of hepatitis and cirrhosis. Hepatitis is inflammation of the liver, and it can be caused by a viral infection, alcohol, or drugs. There are many forms of viral hepatitis; the three most significant are hepatitis A, B, and C.

Hepatitis A is the most common form; it is caused by a virus that is transmitted through contaminated food or water. Hepatitis B and C are blood-borne diseases; that is, these viruses are carried in the blood and in other body fluids, such as semen and saliva. They can be transmitted only when infected body fluids are transferred from one person to another. These diseases are commonly spread through the use of contaminated needles and during surgical and dental procedures. Nurses and other staff members in health care facilities can be exposed to hepatitis B and C when taking and

handling infected blood samples. A pregnant woman who is infected can pass the disease on to her fetus. In the past, blood transfusions were a common source of infection; however, blood tests for these viruses are now available. Potential blood donors are screened, and those who test positive cannot donate blood.

Cirrhosis develops when the liver is damaged by some substance such as alcohol. Liver cells are destroyed, and as the liver attempts to regenerate, scar tissue is formed. The steady flow of blood through the organ is impeded, as are vital functions such as the removal of waste materials from the blood.

The liver is also subject to a number of cancers. Cancer cells can spread to liver tissue from other parts of the body, or they can originate there as a result of hepatitis B or C or other chronic liver diseases such as cirrhosis.

The gallbladder is a small sac connected to the liver. The liver manufactures bile, a substance that aids in the digestion of fats. Bile is stored in the gallbladder and passes through the bile duct into the small intestine. A common disorder of the gallbladder is the formation of gallstones, crystalline growths that can be as fine as sand or as large as a golf ball. If the stones clog the passage to the bile duct, severe pain may result. Removal of the gallbladder (cholecystectomy) is often necessary.

The pancreas, a vital gland situated near the liver, contains both exocrine tissue (which produces digestive enzymes) and endocrine tissue (which produces the hormone insulin). Both are subject to disease. Dysfunction of the endocrine portion ("Islets of Langerhans") causes diabetes mellitus, a disorder of glucose metabolism. Pancreatitis is a potentially life-threatening inflammation of the pancreas caused most frequently by gallstones or by alcohol and other toxins.

The other major organ system in the abdomen is comprised of the kidneys and the urinary tract. The system includes the two kidneys, which sit in the middle of the back on either side of the spine; the two ureters, which transport urine from the kidneys; the bladder, a pouchlike organ that collects the urine; and the urethra, which expels urine from the body. The kidneys and related organs are subject to several disorders. Infection of the bladder or kidneys is quite common, particularly in young women and in the elderly. Kidney stones are also common and may be familial. Illnesses in other organs and systems may be reflected in the kidneys, and cancer may be primary in the kidney or may spread there from another site. Medications, other drugs, and toxins may cause severe kidney damage as well.

The peritoneum is the membranous lining of the abdominal cavity. When the organs within the cavity become inflamed, and particularly if there is any leakage of their contents, the peritoneum also becomes inflamed, a condition called peritonitis.

TREATMENT AND THERAPY

Many abdominal disorders are related to the overproduction of stomach acids, which damage the intestinal walls; the treatment of such conditions is often associated with changes in lifestyle. In treating gastrointestinal reflux disease, or GIRD, in which stomach acid backs up into the throat, physicians may suggest that the patient change habits that may be contributing to the condition, perhaps by stopping smoking, reducing the intake of alcohol, losing weight, and avoiding certain foods and medications. Preparations to neutralize stomach acids are used, as well as drugs that reduce the amount of stomach acid produced. Surgery is rarely indicated.

Hiatal hernia, the protrusion of part of the stomach through the diaphragm, usually produces no symptoms. There may be reflux of stomach acids into the esophagus, which can be treated by the same methods used in treating gastrointestinal reflux disease. Surgery is sometimes indicated.

Gastritis is commonly treated with agents that neutralize stomach acid or other agents that reduce the production of stomach acid. When gastritis appears to be caused by drugs taken for arthritis or rheumatism (for example, aspirin or NSAIDs), the physician may change the drug or the dosage to reduce stomach irritation.

In treating gastric and duodenal ulcers, the physician seeks to heal the ulcers and prevent their recurrence. Acid-neutralizing agents are sometimes helpful, but more often agents such as histamine (H₂) blockers and proton pump inhibitors that reduce the flow of stomach acids are used. It has been suggested that gastritis and ulcers are associated with certain bacteria. Consequently, some physicians add antibiotics to the regimen to destroy the pathogens. Surgery is sometimes required to control bleeding from ulcers.

Bacterial infections in the gastrointestinal tract are, as a rule, self-limiting. They run their course, and the patient recovers. Sometimes, however, appropriate antibiotics are needed. Likewise, little other than supportive therapy can be offered for most viral infections.

Appendicitis is usually treated surgically. Peritonitis, whether resulting from appendicitis or from other

causes, is treated with antibiotics following surgical repair of the primary problem.

Most cases of hepatitis A resolve without complication; no specific treatment is available. Bed rest, dietary measures, and general support procedures are the only steps that can be taken. Hepatitis B and C can become chronic and can progress to chronic active hepatitis, which may lead to liver failure, cirrhosis, liver cancer, and death. New treatments with antiviral drugs and immune modulators such as interferon are curative in some patients. Vaccines against both hepatitis A and B are available and recommended for all children and for adults who are at high risk. There is no vaccine for hepatitis C. There is no treatment for cirrhosis, although physicians may be able to treat some of its complications.

Kidney infections are usually readily treated with antibiotics. Kidney stones often require surgical removal or lithotripsy, a procedure in which ultrasonic waves are used to break up the stones. Recurrence is common, but sometimes can be prevented with dietary changes or medication.

PERSPECTIVE AND PROSPECTS

Medical science has made great progress in the treatment of disorders arising in the abdominal cavity, but there is much to be done. Most important is the identification of agents to treat or immunize against various viral diseases, particularly those that occur in the gastrointestinal tract and the liver.

The vaccine against hepatitis B has been in use for years, but the incidence of the disease has remained relatively constant. In the United States, the practice now is to vaccinate all young children. If this immunization approach is successful, the rate of hepatitis B infection among American children should drop.

New treatment modalities are being developed for many of the diseases that occur in the abdominal cavity. One of the most significant successes has been in the treatment of peptic ulcers. The new drugs being used not only neutralize acid in the stomach but also cut off the secretion of acid into the stomach. One of these agents was the most-prescribed drug in the world for many years, indicating the importance of this therapeutic approach.

Innovations are also occurring in the treatment of diabetes mellitus, the disease caused by malfunction in the pancreas. Medications have been found that promise to treat and prevent some of the potentially fatal diseases that diabetes can cause.

Because the abdominal area contains so many vital organ systems, it is the seat of perhaps the widest range of diseases that afflict the human body—and hence, the target for the greatest amount of research and, potentially, the greatest advances in medicine.

—C. Richard Falcon;

updated by Margaret Trexler Hessen, M.D.

See also Abdomen; Appendectomy; Appendicitis; Bladder cancer; Bladder removal; Cholecystectomy; Colitis; Colon; Colon therapy; Colonoscopy and sigmoidoscopy; Colorectal cancer; Colorectal polyp removal; Colorectal surgery; Constipation; Crohn's disease; Diabetes mellitus; Dialysis; Diarrhea and dysentery; Digestion; Diverticulitis and diverticulosis; Endoscopy; Gallbladder diseases; Gastroenterology; Gastroenterology, pediatric; Gastrointestinal disorders; Gastrointestinal system; Gastrostomy; Hernia; Hernia repair; Incontinence; Indigestion; Internal medicine; Intestinal disorders; Irritable bowel syndrome (IBS); Kidney cancer; Kidney transplantation; Kidneys; Laparoscopy; Lithotripsy; Liver; Liver transplantation; Nephrectomy; Nephritis; Nephrology; Nephrology, pediatric; Nonalcoholic steatohepatitis (NASH); Obstruction; Peristalsis; Peritonitis; Prostate cancer; Prostate enlargement; Shunts; Small intestine; Splenectomy; Stomach, intestinal, and pancreatic cancers; Stone removal; Stones; Ultrasonography; Urethritis; Urinary disorders; Urinary system; Urology; Urology, pediatric.

FOR FURTHER INFORMATION:

American College of Gastroenterology. <http://www.acg.gi.org>. An informative site covering abdominal disorders and health that includes discussion of digestive health and disease and also resource links.

Guillory, Gerard. *IBS: A Doctor's Plan for Chronic Digestive Disorders*. 3d ed. Point Roberts, Wash.: Hartley & Marks, 2001. Guillory includes both preventive and treatment recommendations for people suffering from chronic gastrointestinal problems, often referred to as irritable bowel syndrome.

Kapadia, Cyrus R., James M. Crawford, and Caroline Taylor. *An Atlas of Gastroenterology: A Guide to Diagnosis and Differential Diagnosis*. Boca Raton, Fla.: Parthenon, 2003. Provides a fully illustrated, nonspecialist understanding of myriad gastrointestinal diseases, including heartburn, dyspepsia, diarrhea, irritable bowel syndrome, and pancreatitis. Includes bibliographic references and an index.

Litin, Scott C., ed. *Mayo Clinic Family Health Book*. 4th ed. New York: HarperResource, 2009. Diseases

of the abdominal cavity are discussed in sections titled "Diseases and Disorders" and "Tests and Treatments."

Runge, Marschall S., and M. Andrew Gregnati, eds. *Netter's Internal Medicine*. 2d ed. Philadelphia: Saunders/Elsevier, 2009. A comprehensive but concise text written in a style accessible to all readers. Includes classic illustrations.

ABORTION

PROCEDURE

ANATOMY OR SYSTEM AFFECTED: Reproductive system, uterus

SPECIALTIES AND RELATED FIELDS: Ethics, gynecology

DEFINITION: The induced termination of pregnancy, which usually is legal only before the fetus is viable.

KEY TERMS:

dilation: making something wider or larger

embryo: the unborn young from conception to about eight weeks

fetus: the unborn young from about eight weeks to birth

quickenning: the point at which a fetus first begins to move in the uterus

uterus: a hollow, muscular organ located in the pelvic cavity of females, in which a fertilized egg develops

viability: the point at which a fetus is able to survive outside the uterus

THE CONTROVERSY SURROUNDING ABORTION

Induced abortion is the deliberate ending of a pregnancy before the fetus is viable or capable of surviving outside a female's body. Abortion has been practiced in every culture since the beginning of civilization. It has also been controversial. The first law designating it as a crime dates to ancient Assyria, where, in the fourteenth century B.C.E., women who were convicted of abortion were impaled on a stake and left to die. Early Hebrew law also condemned abortion, except when necessary to save the woman's life. The Greeks allowed abortion, but the famous physician Hippocrates (c. 460-c. 370 B.C.E.) denounced the procedure and said that it violated a doctor's responsibility to heal. Roman law said that a fetus was part of a woman and that abortion was her decision, although a husband could divorce his wife if she had an abortion without his consent. Most abortions in ancient times seemed to be related to unwanted pregnancies.

The Christian Church determined abortion to be a sin in the first century. In the fifth century, however,

Saint Augustine argued that the fetus did not have a soul before “quickening,” that point during a pregnancy, usually between the fourth and sixth months, at which the woman first senses movement in her womb. Until 1869, abortion until quickening was legal in most of Europe. In that year, however, Roman Catholic pope Pius IX declared abortion at any point to be murder. This position has been upheld by all subsequent popes.

In Protestant countries, the principle of legality until quickening held true until around 1860. In that year, the British parliament declared abortion a felony; that law remained on the books for more than one hundred years. In 1968, the Abortion Act passed by Parliament radically reduced the restrictions, allowing abortions in cases in which doctors determined that the pregnancy threatened the physical or mental health of the woman.

In the United States, abortion before quickening was legal until the 1840’s. By 1841, ten states had declared abortion to be a criminal act, but punishments were weak and the laws frequently ignored. The movement against abortion was led by the American Medical Association (AMA), founded in 1847. In 1859, the AMA passed a resolution condemning abortion as a criminal act. Within a few years, every state declared abortion a felony. Not until 1950 did the AMA reverse its position, when it began a new campaign to liberalize abortion laws. Many doctors were concerned about the thousands of women suffering from complications and even death from illegal abortions. Consequently, seventeen states, including California, passed laws providing for legal abortions under certain conditions. The remaining states, however, continued to prohibit abortions. In 1973, the U.S. Supreme Court ruled in *Roe v. Wade* that abortions in all states were generally legal. This ruling made abortions in the United States available on the request of the pregnant woman.

More than fifty countries—about 25 percent of the world’s population—continue to criminalize abortion. Most other nations authorize abortions under various conditions. The World Health Organization (WHO) estimates that there are more than 50 million abortions per year throughout the world, and that about 20 million of these are considered illegal.

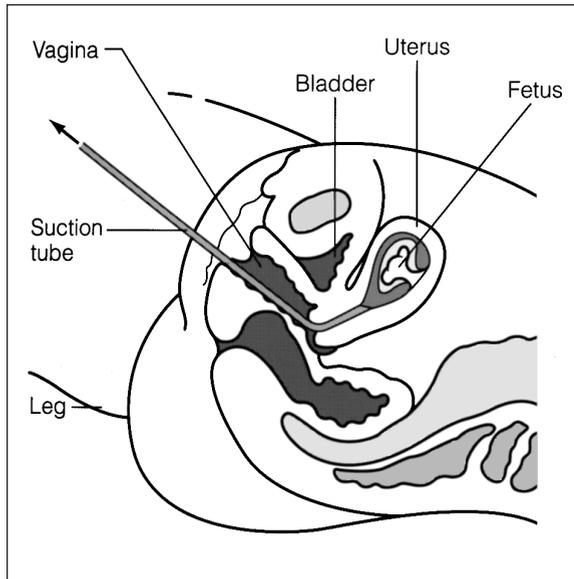
Before 1970, statistics on abortions in the United States were generally not kept or reported, and they can only be estimated. In the nineteenth century, it is believed that there was one abortion for every four live births, a rate only a bit lower than that in the latter part of the twentieth century. The number of abortions in any year varied from 500,000 to 1 million, most of

them illegal. In 1969, the Centers for Disease Control (CDC), a branch of the U.S. Department of Health and Human Services, began an annual abortion count. Legal abortions in 1970 numbered about 200,000. The number of illegal abortions is unknown. Ten years later, legal abortions reached 1,200,000, and by 1990 they had increased to 1,600,000; they have dropped slightly but steadily since 1990. The CDC estimated that there were about 325 abortions for every 1,000 live births in the 1980’s, a number consistent with findings for the 1990’s. The number of abortions in any year rarely fluctuated by more or less than 3 percent from these figures.

Ireland, which has the most stringent abortion laws, performs 139 abortions per 1,000 live births. Eastern European countries, with more abortions than live births, have abortion rates three to four times higher than Western European countries. Nearly 60 percent of all abortions occur in Asia, with Vietnam and China having the highest rates of abortion.

In *Roe v. Wade*, the Supreme Court ruled that abortions are legal under certain conditions. These conditions include the welfare of the woman and the viability of the fetus. During the first three months of pregnancy, according to the Court, the government has no legitimate interest in regulating abortions—with one exception: States can require that abortions be performed by a licensed physician in a “medical setting.” These physician-only statutes, enacted by some states, have made it more difficult for nurse practitioners and certified nurse midwives to expand their role to surgical abortion, but in many states they can provide medication abortion. In all other circumstances, the decision to abort is strictly that of the pregnant woman as a constitutional right of privacy.

During the second trimester, abortions are more restricted. They are legal only if the woman’s health needs to be protected, and they require the consent of a doctor. The interest of the fetus is protected during the third trimester, when it becomes able to survive on its own outside the woman’s body, with or without artificial life support. States, at this point, can prohibit abortions except in cases where the life or health of the mother is threatened. In a companion case, *Doe v. Bolton*, “health” was defined as “all factors—physical, emotional, psychological, familial, and the woman’s age.” This broad definition of health effectively makes it possible for a woman to have an abortion at any time during her pregnancy, circumventing state restrictions. The determination of viability is to be made by doctors,



Elective or induced abortions can be performed in the first trimester using a simple suction technique; after the third month, much riskier and more complex methods are required.

not by legal authorities. This ruling effectively struck down all antiabortion laws across the United States.

In the aftermath of *Roe v. Wade*, abortion became an intensely emotional political issue in the United States. The Hyde Amendment of 1976 eliminated federal funding for abortions, and other legislation blocked foreign aid to family planning programs, which members of Congress who were opposed to abortion saw as “pro-abortion.” In *Webster v. Reproductive Health Services* (1989), the Supreme Court upheld its ruling in *Roe v. Wade*, but it also sustained a rule forbidding the use of public facilities or public employees for carrying out abortions. The Court also supported a requirement that a test for viability be done before any late-term abortion and ruled that states could ban funding for abortion counseling. The issue continued to divide North Americans, with opponents arguing that abortion at any point during the pregnancy constituted murder.

A 2000 survey of women who had abortions, conducted by the Alan Guttmacher Institute, revealed the most common reasons for making that decision. Seventy-five percent said that having a baby would interfere with work or going to school. About two-thirds said they could not afford a child. Half of the women said that they did not want to be a single parent or that they were having problems with their husbands. This same survey revealed that almost 60 percent of the women seeking abortions were experiencing their first

pregnancy. Women beneath the poverty level, regardless of race, religion, or ethnic background, were more likely to have an abortion than were middle-class women. African American women and Latinas had higher rates of abortion than did white women (three and two times as likely, respectively). Fifty-two percent of abortions were performed on women under the age of twenty-five.

Religion appears to be a factor in the decision to seek an abortion: The percentage of Catholic women having abortions was 29 percent higher than the percentage of Protestant women. The lowest percentage of abortions was found among Evangelical, “born-again” Christians. Nonreligious women had abortions at four times the rate of religious women. Teenagers under the age of fifteen and women over the age of forty had the highest rates of abortion of any age group. Thirty-three percent of all abortions occur before the fetal period of development. Fifty-five percent of abortions were performed between eight and twelve weeks into the pregnancy. The risk of death associated with abortion increases from one death for every 530,000 abortions at eight weeks or fewer to one death per 6,000 abortions performed at twenty-one or more weeks of gestation.

TECHNIQUES AND PROCEDURES

A variety of techniques can be used to perform abortions. They vary according to the length of the pregnancy, which is usually measured by the number of weeks since the last menstrual period (LMP). Instrumental techniques are usually used very early in a pregnancy. They include a procedure called menstrual extraction, in which the entire contents of the uterus are removed. It can be done as early as fourteen days after the expected onset of a period. A major problem with this method is a high risk of error; the human embryo may still be so small at this age that it can be missed. It is also true that a high proportion of women undergoing this procedure are in fact not pregnant. Nevertheless, this method is easy and very safe. Death rates from this technique average less than 1 in 100,000.

The majority of abortions in the United States are done by a procedure known as vacuum aspiration, or suction curettage. This technique can be used up to about fourteen weeks after the LMP. It can be performed with local anesthesia and follows several steps. First, the cervix is expanded with metal rods that are inserted one at a time, with each rod being slightly larger than the previous one. When the cervix is expanded to the right size, a transparent, hollow tube called the vac-