

Publisher's Note

Since 1995, *Magill's Medical Guide* has been acclaimed by every major reference reviewer, and it has become a staple in high school, college, medical school, and public libraries. Designed for laymen and written for health care consumers, the *Medical Guide* is a perfect mix of accessibility and depth, providing general readers with an authoritative reference source that helps bridge the gap between medical encyclopedias for professionals and popular self-help guides. It is an up-to-date and easy-to-use compendium of medical information suitable for student research as well as use by general readers, including patients and caregivers. This *Eighth Edition* continues to build on this value.

Purchase of the printed set entitles the buyer to free online access to the *Medical Guide's* content. This online version is made available through Salem's reference platform Salem Health. Users can search the full text or browse the contents by demographic (men, women, children, elderly) and by subject categories (Anatomy & Physiology; Diagnosis & Testing; Diseases, Disorders, & Symptoms; Mental Health; Prevention & Lifestyle; Social Issues; Specialties & Health Care Providers; Treatment & Therapy), which are further divided into numerous subcategories. Information about how to activate online access to Salem Health can be found at the end of this Publisher's Note.

Scope of Coverage

The 1,289 entries in this encyclopedia (128 more than the previous edition) describe major diseases and disorders of the human body, the basics of human anatomy and physiology, specializations in medical practice, and common surgical and nonsurgical procedures. The *Eighth Edition* offers entries by 400 writers from the fields of life science, medicine, and biopsychology. Every essay is signed by the original author(s), including medical or other advanced degrees, and each updated entry is also signed by the revising author. These writers examine various diseases and disorders, both genetic and acquired, the detailed knowledge of human bodily systems and structures that medical practice requires, and the medical professions and procedures that apply this knowledge. Hundreds of photographs and medical drawings provide invaluable visual context for entries about diseases, research, surgery, and human anatomy. For each disease and disorder, a concise *Information On* box lists causes, symptoms, duration, and treatments, acting as a quick reference tool for the reader.

Readers will find topics that focus on specific disorders, as well as those that survey the range of afflictions attacking a particular system. The majority of entries treat physical disorders:

- bacterial and viral infections
- cancers of various types
- genetic defects
- heart and circulatory disorders
- abdominal and gastrointestinal disorders
- bone and muscle defects
- brain and nervous system problems
- dental diseases
- eating and nutritional disorders
- endocrine disorders
- immune disorders
- kidney and urinary system disorders
- liver disorders
- reproductive system disorders of both men and women
- respiratory diseases
- sexually transmitted diseases
- skin disorders
- sleep disorders
- trauma-related disorders
- vector-borne diseases
- visual disorders

Other entries consider psychological, emotional, and learning disorders that originate in or have significant impact on the physical health of the body. Some basic conditions that are often the object of medical attention are covered, including Aging, Pregnancy and Gestation, Childbirth and its complications, Puberty and Adolescence, Menopause, and Sexuality.

Entries on anatomy and biology include overviews of anatomical organs and systems and of biological components and processes. A broad view of medical practice—its areas of specialization and health care provision—is offered by entries on such topics as Emergency Medicine, Nursing, and Orthopedics. Diagnostic and imaging techniques, nonsurgical and surgical procedures, both major and minor, are covered. In addition, other areas of medical science are represented: alternative medicine, medical and neuroethics, genetics, organizations, procedures in the field of psychiatry, general surgical procedures, testing and examinations, and various types of transplantation.

Entry Length and Format

The essays in the *Eighth Edition* are arranged in an encyclopedic format—alphabetically from Abdomen through Zoonoses. The lengths of the entries vary from shorter entries of 500 words to medium-length entries of 1,000 words to full, essay-length treatments of 2,500 to 3,500 words. All entries begin with standard information about the type of entry, the anatomy or bodily system affected, the specialties involved, and a brief definition of the topic. For essays of 1,000 words or more, next comes a list of key terms with brief definitions. Several main subsections of text follow and depend on the type of entry.

Entries on Diseases or Disorders: “Causes and Symptoms” defines the condition and describes its cause and its possible manifestations in patients, and “Treatment and Therapy” explores the various treatments available to alleviate symptoms or effect a cure.

Entries on Anatomy or Biology: “Structure and Functions” defines the physiological or biological system, including its components and role, and “Disorders and Diseases” describes the medical conditions that can result from malfunction of and injury to this physiological system.

Entries on Development: “Physical and Psychological Factors” charts the stages of development and analyzes the underlying physiological and emotional/psychological components, and “Disorders and Effects” addresses the overall impact of the developmental process.

Entries on Procedures: “Indications and Procedures” relates the circumstances under which the procedure is usually performed, identifying the condition it is intended to correct and detailing the basic steps involved, and “Uses and Complications” discusses the various applications and possible risks and complicating factors.

Entries on Specialties: “Science and Profession” addresses the training and responsibilities of various specialists, and “Diagnostic and Treatment Techniques” outlines the means by which they counsel patients, diagnose conditions, perform operations or procedures, and otherwise treat medical problems.

The last section of all longer entries is “Perspective and Prospects,” which places the topic in a larger context within medicine—past, present, and future. For example, an entry on a disease may cover the earliest known investigation into the condition, the evolution of its treatment over time, and promising areas of research for a greater understanding of its causes and cure. An entry on a procedure may address the innovations that led to contemporary technology, improvements or changes that have been made in the procedure, and where this medical technique may be headed. Every entry lists the author’s byline, and cross-references to other entries of interest in the encyclopedia. All essays conclude with the section “For Further Information,” which lists general bibliographic works and relevant websites for the reader to consult; bibliographies for many longer entries provide brief annotations evaluating the features, contents, and value of the sources.

Special Features

Several special features assist readers in locating topics of interest. The “Complete Table of Contents,” found at the beginning of each volume, allows the scope of the encyclopedia to be seen in its entirety. Shading behind the entries of each specific volume helps to anchor the user to the contents of the volume they are using.

Volume I includes this Publisher’s Note, and the Editor’s Introduction that details the content changes and additions in this eighth edition. At the back of each volume are “Entries by Specialties and Related Fields” and “Entries by Anatomy or System Affected,” which direct the reader to essays by category; for example, a reader looking up “Oncology” on the specialty list will find entries on diseases (such as Cancer, Malignancy and Metastasis, and Sarcoma), specialties (such as Cytology and Pathology), diagnostic procedures (such as Mammography), and treatments (such as Chemotherapy, Radiation Therapy, and Tumor Removal). The back of Volume V includes these valuable features:

- Glossary of medical terms;
- Definitions of almost 700 diseases and other medical conditions;
- Appendix detailing training, degrees, and duties of various health care professionals;
- General bibliography arranged by category;
- List of organizations and support groups, with full contact information;
- Symptoms and warning signs of various diseases and conditions;
- Pharmaceutical list;
- Comprehensive index.

Editors and Contributors

The contributors to this work are academicians from a variety of disciplines in the life sciences, as well as health care professionals and faculty members at universities and medical teaching institutions; their names, degrees, and affiliations are listed in the front matter to Volume I. We thank them for generously sharing their expertise. Special acknowledgment is extended to the panel of Medical Editors for *Salem Health Magill's Medical Guide, Eighth Edition*: Bryan C. Aday, Ph.D., Gordon College (Wenham, MA); Michael Buratovich, Ph.D., Spring Arbor University; Geraldine Marrocco, EdD., APRN, CNS, ANP-BC, Yale University School of Nursing; Paul Moglia, Ph.D., South Nassau Communities Hospital. Their efforts ensured a thorough revision.

Salem Health Database

Activating online access to Salem Health is easy. Volume I of every set of *Salem Health Magill's Medical Guide* includes an Activation Number attached to the inside back cover. This number is used to activate your Salem Health online account. Purchasers of the set should go to www.health.salempress.com and click on the "Salem Health Activation" button there for activation information, or call us at (800) 221-1592 and we will be glad to do the activation for you.

Editor's Introduction

Every year, our understanding of the field of medicine and healthcare grows exponentially. As basic research in a variety of scientific disciplines increases, efforts to apply this newly discovered knowledge to disease and illness follow a similar trajectory. One challenge we editors faced in assembling this *Eighth Edition* concerns how to capture and represent the major changes within medicine over the past four years. Several new developments were identified and incorporated into this new edition. For example, advances in medical technology can often stimulate rapid progress in diagnostic and treatment protocols. One response to addressing the use of technology in medicine was to add new entries. These included applications of deep brain stimulation, functional magnetic resonance imaging (fMRI), and transcranial magnetic stimulation (TMS), which today play an important role in treating and aiding our understanding of neurological disorders.

In addition, new entries in this edition fill gaps in the table of contents regarding anatomy, physiology, and diseases. A more comprehensive list of new or revised articles from the rapidly expanding area of neuroscience is included in the *Eighth Edition*. A sampling of these include: Neurorehabilitation, Brain damage, Strokes, Dementias, Parkinson's disease, Brain disorder, Depression, and Asperger's syndrome. Also, numerous entries from the disciplines of neurology, psychiatry, and clinical neuropsychology from previous editions have been revised. These include entries such as Antipsychotic drugs, Addiction, and Traumatic brain injury. Another area that received attention concerns medical ethics. Questions that raise important ethical issues abound concerning the appropriate use of new technologies. Besides updating the previous entry on Ethics, two new entries were added. A new entry on the topic of Brain death discusses the difficulty of determining exactly when death occurs and the importance of addressing end of life discussions with medical specialists. A second new entry addresses Memory erasure procedures that involve the use of pharmaceuticals to diminish emotional content of memories as a means to alleviate people suffering from post-traumatic stress.

The *Eighth Edition* also includes multiple entries addressing issues of the aging population in the United States. Demographic trends clearly indicate that the biopsychosocial needs of Baby Boomers, today's senior citizens, require a new and better way of approaching healthcare. Patient-centered models, using inter-professional, or multidisciplinary-teams, will disseminate the specific aims of Healthy People 2020 and the Affordable Care Act and strengthen programs aimed at disease prevention and health promotion, and promote a climate that protects consumers from unnecessary cost and over utilization of valuable health care dollars.

In the previous edition, we expanded our coverage of ge-

netic concepts and diseases, developmental malformations, and infectious diseases. In this new edition, we have significantly updated articles relating to cancer, infectious diseases, and basic medicine. We have also added new articles that discuss new treatment modalities, such as ASTYM[®], Carticel[®], hyaluronic acid injection, and drugs not discussed in previous editions, such as anticoagulants, NSAIDs, and opioids. Additionally, we have included new articles about CRISPR, an exciting genomic-editing tool, and tissue engineering, both of which we believe will change how clinical medicine is practiced. Finally, we have included new articles about contentious issues in health care, such as physician-assisted suicide, and the anti-vaccine movement.

The intensive updates throughout have revised the articles for clarity, completeness, relevance and recency. Several articles like Alcoholism, Safety issues for children, and Venous insufficiency have been extensively rewritten. The entry on Antibodies contains an expanded discussion on phagocytosis, polyclonal antibodies, and clinical diagnostic agents. Fractures and dislocations now includes discussion of vertebroplasty and kyphoplasty, new methods that result in improved spine stabilization and health, and medicine's growing focus on nutritional deficiencies in bone health and healing. Steroid abuse is no longer only the purview of professional athletes and the *Eighth Edition's* update incorporates the key role of psychological factors. Rape and sexual assault includes the latest guidelines for forensic chain of custody protocols now routinely taught in emergency medicine and the available therapeutic interventions that are immediately available to victims seeking help, both new to this edition. The section on Ovaries includes the most recent breakthroughs in understanding gonadotrophies and hormone release during the process of ovulation. Take-home DNA testing kits, unheard of at the time of the *Seventh Edition's* publication, have democratized accessing genetic information. Genetic engineering also presents the now-available successful treatments of chronic lymphocytic leukemia, x-linked severe combined immunodeficiency gene therapies, and the potential treatment of Parkinson's disease. Bleeding now includes the latest understanding of the key role vitamin K plays in clotting and blood health. And Animal rights updates readers on the more proactive momentum of the century-old antivivisection movement and the resulting controversy. It also includes legal developments in criminalization of animal abuse, intentional harm, and neglect.

This edition also includes *In the News* sidebars that evaluate media stories about ongoing research and experimental treatments. These boxes both highlight the latest information and provide readers with a critical view of popular reports that may (or may not) prove crucial to the future understanding and treatment of certain medical conditions. The topics covered

include chemotherapy targeting cancer stem cells, the Accord Trial concerning cardiovascular risks for type 2 diabetes, and new screening methods for Down syndrome.

Our goal is for this new edition of *Magill's Medical Guide* is to provide easy access to the full range of medical and health care concerns with ample resources for further research. We anticipate that readers will either have experience with one of the topics covered here, or have a loved one who has. To reach

our goal, we have reviewed the majority of entries from the previous edition, updated and revised many of them, and added a significant number of new topics. We hope that we have succeeded.

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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

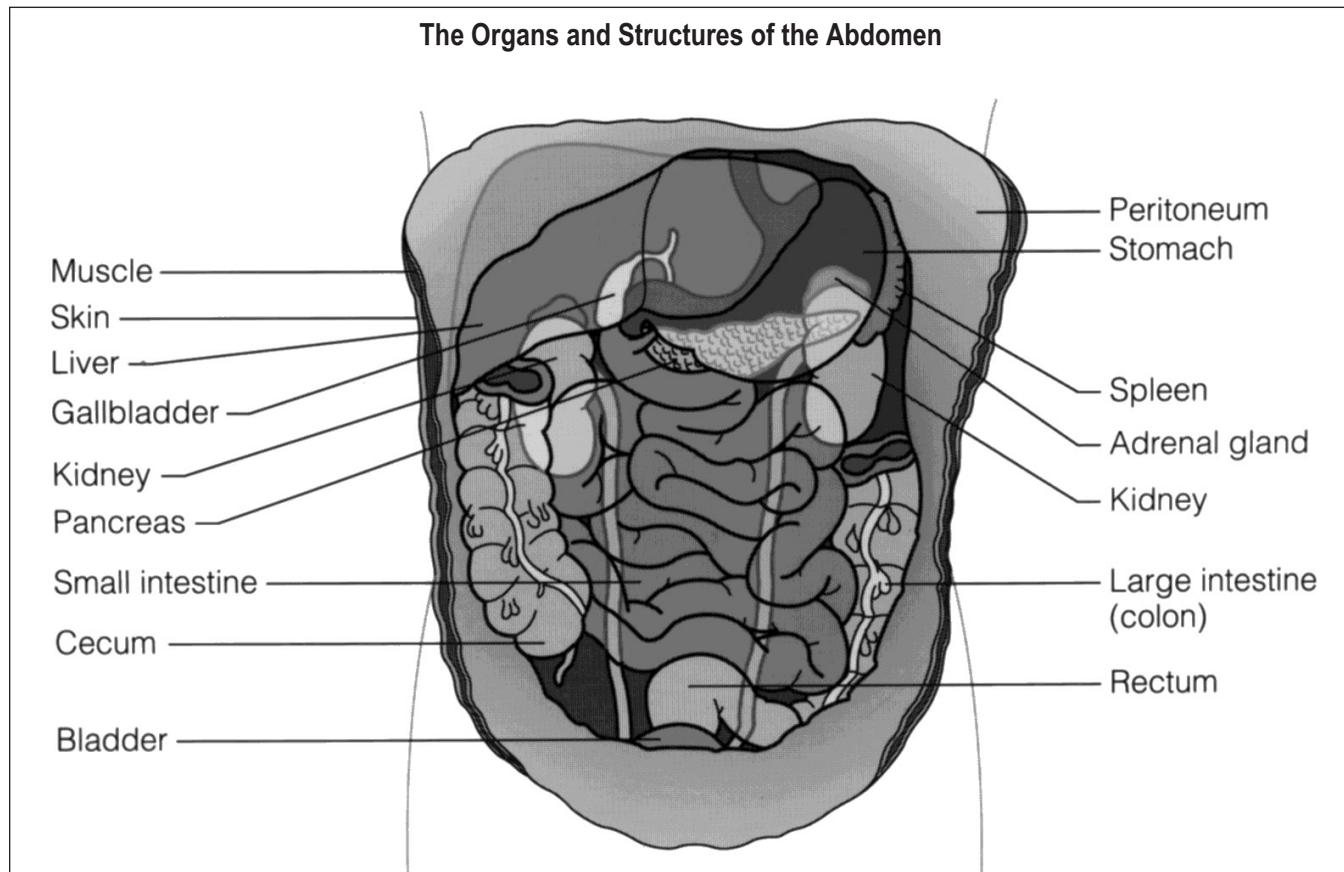
The abdomen is the portion of the body's trunk that begins immediately below the diaphragm, which is the main respiratory muscle in the chest cavity, and extends to the lower pelvic region. The abdominal area is defined by a muscular wall made up of fatty tissue and skin, which determines the general 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 topmost organ in the abdominal cavity. Because it is essentially 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 that



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

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 from the small intestine and through a gate-like passageway called the cecum and then 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 (the first and shortest segment of the small intestine), 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-12; 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 called 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 with only one healthy kidney.

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 a malfunctioning 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 of which are 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 1970s, 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 as well as 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.

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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 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 nonsteroidal 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.

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,

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

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 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.

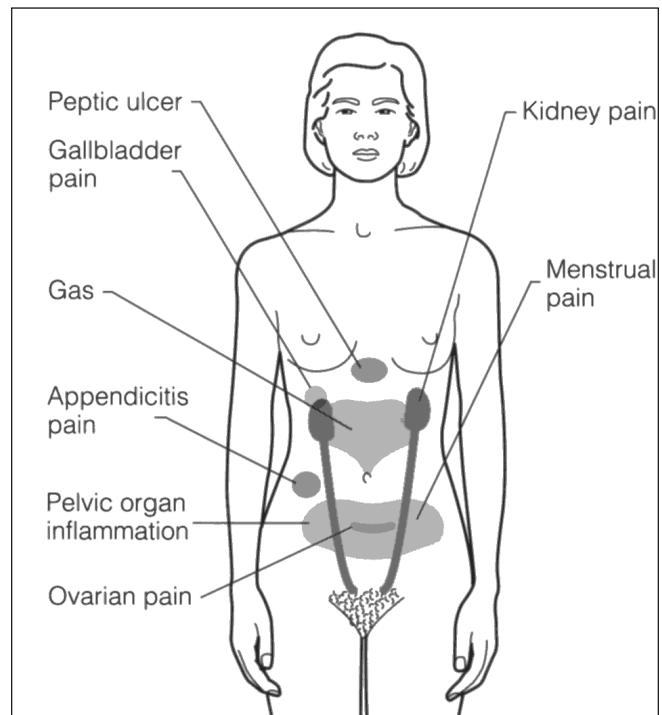
The other major organ system in the abdomen is comprised of the kidneys and the urinary tract. The system includes the two kidneys, which sit in the middle of the back on either side of the spine; the two ureters, which transport urine from the kidneys; the bladder, a pouchlike organ that collects the 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.



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

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. If immunization is used for children successfully, however, the rate of hepatitis B infection among 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.

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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

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

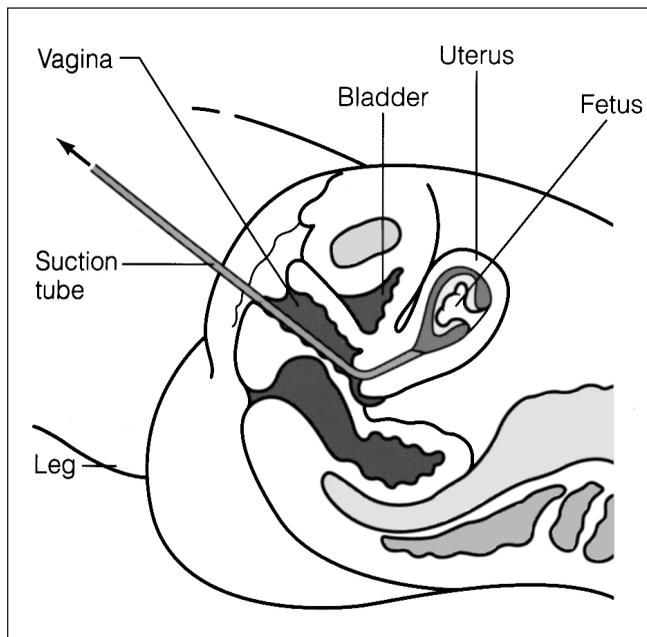
uterus: a hollow, muscular organ located in the pelvic cavity of females, in which a fertilized egg develops

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 BCE, 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 (ca. 460 BCE-ca. 370 BCE) 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



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.

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 1840s. 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 US 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.

About 25 percent of the world's population live in countries that have very restrictive abortion laws. Most other nations authorize abortions under various conditions. The World Health Organization (WHO) estimates that there are approximately 50 million abortions per year throughout the

world, and that about 40 to 50 percent 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 five hundred thousand to 1 million, most of them illegal. In 1969, the Centers for Disease Control (CDC), a branch of the US Department of Health and Human Services, began an annual abortion count. Legal abortions in 1970 numbered about two hundred thousand. The number of illegal abortions is unknown. Ten years later, legal abortions reached 1.2 million, and by 1990, they had increased to 1.6 million; they have dropped slightly but steadily since 1990. The CDC estimated that there were about 325 abortions for every one thousand live births in the 1980s, a number consistent with findings for the 1990s. The number of abortions in any year rarely fluctuated by more or less than 3 percent from these figures.

Ireland, which has traditionally had the most stringent abortion laws, passed legislation in 2013 allowing for abortion in cases in which the mother's life is threatened. 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. At this point, states 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, 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 2004 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 75 percent said they could not afford a child. Half of the women said that they did not want to be a single parent. 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 six thousand 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 one in one hundred thousand.

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 vacuum cannula is placed into the uterine cavity. This instrument is attached to a suction device, which looks something like a drinking straw. An electric or hand-operated vacuum pump then empties the uterus of its contents. Finally, a spoon-shaped device called a curette is used to check for any leftover tissue in the uterus. The entire procedure takes less than five minutes. This method, first used in China in 1958, is among the safest procedures in medicine. There are about six times more maternal deaths during regular birth than during vacuum aspiration.

An older method, dilation and curettage (D & C), was common up to the 1970s, but it has largely been replaced by vacuum aspiration. In a D & C, the cervix is expanded or dilated and a curette is used to scrape out the contents of the uterus. The biggest difference is the use of general anesthesia during the process. Since most abortion-related deaths result from complications from anesthesia, a method that requires only local anesthesia, such as aspiration, greatly reduces the dangers of the procedure.

For the period from thirteen to twenty weeks, a method called dilation and evacuation (D & E) is usually preferred. The cervix is expanded with tubes of laminaria (a type of seaweed), and the fetus is removed with the placenta, the part of the uterus by which the fetus is nourished. Forceps, suction, or a sharp curette is sometimes used. The procedure is usually safe, but sometimes if the fetus is large, it must be crushed and dismembered to remove it through the cervix. One variation of this procedure involves delivering the fetus breech, except for the head, and then inserting a suction tube through an incision made in the head. The brain is then sucked out, which collapses the skull, and the fetus is then easily removed. In 2003, legislation banning this procedure, called the Partial-Birth Abortion Ban Act of 2003, was passed by Congress and signed into law by President George W. Bush. The act’s constitutionality, which had been challenged, was upheld by the Supreme Court in 2007.

Along with these methods of menstrual extraction, physicians can use “medical induction” techniques when required. Amniocentesis is an old example of this method that was used on fetuses from sixteen to twenty weeks old. This process has largely been replaced by D & E, which has proven far less dangerous.

Amniocentesis usually requires hospitalization, local anesthesia, and the insertion of a large needle into the uterus. Between 100 and 200 milliliters of fluid is with-

drawn and a similar amount of hypertonic saline solution infused into the uterine cavity. Within ninety minutes, the fetal heart stops. The woman then goes into labor and delivers a dead fetus within twenty-four to seventy-two hours. These kinds of abortions generally have much higher risk of complications than did D & E. On rare occasions, a fetus has been born alive, but the main risks are infection, hemorrhage, and cervical injuries to the woman. The psychological difficulties associated with this procedure can be severe, especially the knowledge that the fetus delivered would be dead.

Another method uses prostaglandins, naturally occurring hormones that cause uterine contractions and expulsion of the fetus, rather than a saline solution. The hormones can be given to the patient in several different ways: intravenously, intramuscularly, through vaginal suppositories, or directly into the amniotic sac. Prostaglandins are used for inducing second-trimester abortions and are as safe as saline solutions. Their major advantage is to reduce the duration of the abortion, but they also have severe side effects. They cause intense stomach cramps and other gastrointestinal discomfort, and about 7 percent of the fetuses expelled show some sign of life.

Surgical techniques for abortion are very rare, although sometimes they prove necessary in special cases. Hysterotomy resembles a cesarean section. An incision is made in the abdomen, and the fetus is removed. Hysterotomy is usually used in the second trimester, but only in cases where other methods have failed. The risk of death is much higher in this procedure than in most others. Even more rare is a hysterectomy, the removal of the uterus. This is done only in cases in which a malignant tumor threatens the life of the pregnant woman.

In the late 1980s, the French “abortion pill,” RU-486, was approved for use in many parts of Europe. By the mid-1990s, it had been safely and effectively used in more than fifty thousand abortions. Progesterone is a hormone that causes the uterus to develop the lining that houses a fertilized egg. If the egg is not fertilized, the production of progesterone stops, and the uterine lining is discarded during menstruation. RU-486 contains an antiprogesterone; it prevents the production of progesterone.

The antiprogesterone mifepristone was approved for legal use in the United States in 2000. It is usually used in a regimen in conjunction with misoprostol, which augments the effect of mifepristone by causing the uterus to contract. The regimen begins with the oral administration of mifepristone, followed by at-home administration of misoprostol. It has proved to be highly safe and effective, although a few serious side effects can sometimes occur, the major one being sustained bleeding. Because of this, women are carefully screened to determine if they are candidates for mifepristone use; women with low blood counts are not offered the procedure. Cramps and nausea are also reported in a number of cases, and women are provided medication to relieve these symptoms. There is apparently no effect on subsequent pregnancies.

The drug is administered in the United States mostly un-

der protocols that involve an ultrasound or the testing of serum hormone levels to determine that the pregnancy is in an appropriately early stage. Next comes follow-up care with a physical examination, an ultrasound or test for hormone levels, and contraceptive counseling and provision that meets the woman’s needs. Properly done, medication abortion may be up to 95 to 97 percent effective, but women must return for follow-up care to ensure that the procedure was successful.

Because the abortion will take place at home, there is sufficient privacy. To be a candidate for the procedure, however, a woman must be capable of managing her medication and the passage of the fetus, with associated side effects. Various evidence-based protocols are employed in respect to timing the administration of the drug and the number of days of gestation at which the drug will be provided. The drug is intended only for termination of early first-trimester pregnancies. In many states, medication abortion is provided by nurse practitioners and certified nurse midwives, while surgical abortion is provided by physicians.

Perspective and Prospects

Abortion is the most frequently performed surgical procedure in the United States. As long as women have restricted access to contraceptive choice and unwanted pregnancies, that will continue to be the case. Abortion is a very safe procedure, although there can be complications. Generally, the earlier the procedure is performed, the less severe the risk. The lowest chance of medical complications occurs during the first eight weeks of pregnancy. After eight weeks, the risk of complications increases by 30 percent for each week of delay. Nevertheless, the death rate per case is very low, about half that for tonsillectomy. These statistics apply only to those areas of the world where abortion is legal, since women in those places tend to have earlier abortions.

In parts of the world where it remains against the law, abortion is a leading cause of death for women. WHO estimates that as many as five hundred thousand women a year die during abortions. About two hundred thousand of these deaths result from complications following abortions performed by unqualified medical personnel. About half of the total deaths take place in Southeast Asia and Africa. Before the *Roe v. Wade* decision, it was estimated that anywhere from a few hundred to several thousand American women died every year from the procedure. The best estimate was that in the 1960s about 290 women died every year as a result of complications from abortions. In the 1980s, the average was twelve per year, mostly from anesthesia complications. As of 2013, 0.6 deaths result per one hundred thousand legal induced procedures. Safe and legal abortion is an important component of women’s health and reproductive freedom.

—Clair Kaplan, A.P.R.N./M.S.N.;
additional material by Leslie V. Tischauser, Ph.D.;
Paul J. Chara, Jr., Ph.D.

See also Amniocentesis; Cervical, ovarian, and uterine cancers; Childbirth; Childbirth complications; Contraception; Embryology; Ethics; Fetal tissue transplantation; Genetic counseling; Genetics

and inheritance; Gynecology; Hippocratic oath; Hysterectomy; Law and medicine; Pregnancy and gestation; Reproductive system; Sterilization; Uterus; Women's health.

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Abscess drainage

Procedure

Anatomy or system affected: Brain, breasts, gallbladder, glands, gums, kidneys, liver, lungs, nervous system, pancreas, respiratory system, skin, spleen, stomach, urinary system

Specialties and related fields: Dermatology, emergency medicine, family medicine, general surgery

Definition: The removal of a collection of pus in tissue through an opening in the skin.

Indications and Procedures

When bacteria infect tissue, the body's defense systems attempt to isolate them and destroy the infective agents. An abscess develops when the bacteria become walled off from surrounding noninfected tissues and white blood cells enter the area to rid the body of the pathogens. The ensuing battle between the white blood cells and bacteria causes the death of these cells as well as of surrounding tissue. These dead cells form pus.

Staphylococci bacteria are the most common pathogens that cause abscesses to form, resulting in pain, swelling,

and fever. If the abscess is near the skin, it is easily detected. The presence of abscesses in deeper tissues, however, may need to be confirmed using computed tomography (CT) scanning or magnetic resonance imaging (MRI).

The physician will usually prescribe antibiotics to help destroy the bacteria. Unfortunately, the antibiotics may not have access to the site of infection because the abscess is usually encapsulated by tissue. If this is the case, the physician must drain the abscess cavity. He or she will make an incision into the cavity to allow the pus to drain. Occasionally, a tube will be inserted to maintain the opening for continued drainage of the cavity. The tube can be removed once the infection is gone.

The patient will be asked to watch for signs of recurrent infection after the abscess is removed, because some bacteria may remain. The abscess can reappear if these bacteria are not destroyed by the body's immune system or by antibiotics.

Uses and Complications

Abscesses can develop in any organ. Common sites, however, are under the skin, in the breasts, and around the teeth and gums. In rare cases, abscesses are found in the liver or brain. Fungi and protozoans are important pathogens in liver abscesses.

Most abscesses dissipate after they are drained and/or the patient is treated with antibiotics. Occasionally, antibiotic treatment alone will cause the abscess to subside. The rapid detection and treatment of abscesses in the liver and brain are critical because the damage to these vital organs is irreparable.

—Matthew Berria, Ph.D.,
and Douglas Reinhart, M.D.

See also Abscesses; Antibiotics; Bacterial infections; Biopsy; Breast biopsy; Breast disorders; Breasts, female; Culdocentesis; Cyst removal; Cysts; Cytology; Cytopathology; Dermatology; Ganglion removal; Hydroceles; Infection; Otorhinolaryngology; Periodontal surgery; Periodontitis; Pus; Quinsy; Root canal treatment; Skin; Skin disorders; Staphylococcal infections; Testicular surgery.

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Abscesses

Disease/Disorder

Anatomy or system affected: All