ONCOLOGY BASICS

PART 1. WHAT IS CANCER?

By MaryAnn Foote, PhD

Director, Global Regulatory Writing, Amgen Inc., Thousand Oaks, California

ABSTRACT
Cancer is the uncontrolled growth of malignant cells, which if left unchecked, can destroy organs or their functions. Oncology, the study of cancer and its treatment, is very complex, as more than 200 distinct forms of cancer have been identified and hundreds of chemotherapeutic agents are approved for the treatment of cancer. This article provides a review of the basic information needed by a biomedical communicator regarding cancer, its cause, its relationship to genetics, its diagnosis, and its treatment. A glossary of terms is provided for reference.

The National Cancer Institute (NCI) estimated that 1,334,100 people living in the US were diagnosed with some form of cancer in 2003 and that 556,500 deaths were attributed to cancer that year. The popular media are replete with reports of cancer prevention through diet, lifestyle modification, or early detection. Cancer remains a frightening and mysterious disease that appears to strike indiscriminately.

As biomedical communicators, we must understand the facts and avoid being swayed by sensationalism or rumors. Thus, it is important for biomedical communicators to understand the complex subject of oncology. In this article, I attempt to provide basic information about cancer—what it is, how it is diagnosed, how it spreads, and how it can be treated. The article is not meant to be definitive and complete, but it should provide a base for the reader to undertake further study on the topic. This article is the first in a 2-part series about oncology; the second article will highlight targeted therapies and molecular oncology.

To enhance learning, a glossary is included to to clarify words that are underlined in the text. Some readers may benefit from a review of both cell biology and human genetics in 2 articles published earlier in the AMWA Journal. This article is designed to guide biomedical communicators and should not be construed to provide any medical advice or diagnostic information.

WHAT IS CANCER?
The word “cancer” is derived from the Latin word for “crab.” Because many tumors, or clusters of cancer cells, are capable of wildly uncontrolled cell division, malignant tumors often are thought to have the silhouette of a crab, with many appendages radiating from a central body. (Normally, cells form orderly layers or sheets of tissue.) Other names for a tumor are lesion, malignancy, mass, or neoplasm. Cancer cells are able to divide more rapidly than normal cells and can displace normal neighboring cells. Intrinsic changes in cancer cell composition allow them to multiply without the usual restraints placed on cells (ie, most cells must “obey” territorial limits placed on them by their neighboring cells, but cancer cells do not); cancer cells appear to divide more rapidly than normal cells and fewer daughter cells undergo apoptosis. When cells divide rapidly but keep within their normal territory and do not invade the surrounding tissues, the cell cluster is referred to as a benign tumor. Usually, benign tumors pose no threat, but if they are contained in an enclosed space, such as the cranial cavity, they can continue to increase in size and put pressure on an organ. For this reason, benign tumors are often removed.

Malignant cancers are capable of spreading through the body by 2 mechanisms: invasion and metastasis. Invasion is the direct migration and penetration by cancer cells into neighboring tissues. Metastasis refers to the ability of cancer cells to penetrate into lymphatic and blood vessels, circulate through the bloodstream, and invade normal tissues elsewhere in the body.

Almost all cells in the body are susceptible to cancer, and more than 200 distinct varieties of cancers have been described. Most varieties of cancer are rare, and deaths due to cancer are mainly attributable to only a few common ones such as lung, breast, colon, skin, and blood cancers. Cancers are classified according to the type of tissue and type of cell in which they originate. For example, if the disease is believed to have originated in the tissues of the breast, the diagnosis may be breast cancer. The cancer may spread to other organs such as the lung, and the diagnosis would be primary breast cancer with lung metastases.

All cancers can be placed into 1 of 6 broad categories: carcinoma, sarcoma, leukemia, lymphoma, melanoma, and glioma. The different types of cancers are defined by the organ of the body in which the cancer started. Carcinomas originate in epithelial tissues, such as the liver, lungs, glands (eg, prostate or thyroid), bladder, kidney, breast, ovary, uterus, testes, colon, skin, and brain. Approximately 80% of all cancer cases are carcinomas. Sarcomas originate in bone, muscle, cartilage, fat, and fibrous tissue. Sarcomas are rare, representing approximately 1% of all cancers. Leukemias originate in the bone
marrow; myeloma is a subset of leukemia and is a cancer of plasma cells. When cancers affect the blood or blood-forming organs, they are called myeloid; when the cancer involves other tissues that do not directly affect the formation of blood cells, it is referred to as nonmyeloid. Lymphomas originate in the lymphatic system, ie, the lymph nodes. Melanomas are cancers that originate in skin cells called melanocytes (although melanomas can be found in organs other than skin), and gliomas are cancers of the nervous tissue, ie, the brain and spinal cord.

Most organs of the body are composed of several types of tissue, which means that each organ can be the site of different types of cancers. For example, most cases of uterine cancer are carcinomas and are found in the endometrium of the uterus. Some uterine cancers, however, are found in the muscle of the uterus, classifying them as sarcomas.

SYMPTOMS OF CANCER

Symptoms of cancer can be silent, particularly in the early stages of development. Some symptoms are specific to certain types of cancer, such as difficult urination for prostate cancer or flu-like symptoms and easy bruising for acute leukemias. Sudden weight loss, a thickening or lump, unexplained bleeding, coughing, or a wound that will not heal are some of the many symptoms that may be related to cancer (Table 1). Often, symptoms are nonspecific; that is, common to many other conditions.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Signs and Symptoms that May Indicate Cancer</th>
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<tbody>
<tr>
<td>• Change in bowel or bladder habits</td>
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<tr>
<td>• Sore that will not heal</td>
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<tr>
<td>• Unusual bleeding or discharge</td>
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<tr>
<td>• Thickening or lump in the breast or other part of the body</td>
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<tr>
<td>• Indigestion or difficulty in swallowing</td>
<td></td>
</tr>
<tr>
<td>• Obvious change in a wart or a mole</td>
<td></td>
</tr>
<tr>
<td>• Persistent cough or hoarseness</td>
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</tbody>
</table>

DIAGNOSIS OF CANCER

Cancers are diagnosed a variety of ways, again depending on the primary source of the cancer. The biopsy, which involves surgically obtaining a small tissue sample and examining it under a microscope, is often used to help identify the primary cancer. A biopsy can be done on all tissues including the bone marrow. When examined microscopically, cancer tissue has a distinctive appearance, including a large number of dividing cells, variation in the size and shape of cells and nuclei, loss of specialized cell features and normal tissue organization, and poorly defined tumor boundary.

Microscopic examination of a biopsy specimen will sometimes detect a condition called hyperplasia. The cell structure and orderly arrangement of cells within the tissue remain normal, and the process of hyperplasia is potentially reversible. Microscopic examination of a biopsy specimen can detect another type of noncancerous condition called dysplasia, an abnormal type of excessive cell proliferation characterized by loss of normal tissue arrangement and cell structure. Often such cells revert to normal behavior, but occasionally they gradually become malignant. Because of their potential for becoming malignant, areas of dysplasia should be closely monitored and sometimes require treatment. The most severe cases of dysplasia are sometimes referred to as carcinoma in situ ("cancer in place"), which refers to an uncontrolled growth of cells that remains in the original location. Carcinoma in situ may develop into an invasive, metastatic malignancy and, therefore, is usually removed surgically, if possible.

Microscopic examination also provides information regarding the likely behavior of a tumor and its responsiveness to treatment. Cancers with highly abnormal cell appearance and large numbers of dividing cells tend to grow more quickly, spread to other organs more frequently, and be less responsive to therapy than cancers whose cells have a more normal appearance.

Based on these differences in microscopic appearance, oncologists assign a numerical grade to most cancers. In this grading system, a low number grade (grade I or II) refers to cancers with fewer cell abnormalities than those with higher numbers (grade III or IV).

Disease progression is determined by the size of the tumor and its invasion into surrounding tissues, and metastases to regional lymph nodes or other regions of the body. Based on these criteria, the cancer is assigned a stage. A patient’s chances for survival are better when cancer is detected at a lower stage number.

Another diagnostic tool is the endoscope, which can be used to examine major organs and the entire digestive system. Endoscopy is routinely used to screen for the presence of colon cancer. Radiographs (ie, x-rays), ultrasonography, computed axial tomography (CAT; often called computed tomography or CT) scan, positron emission tomography (PET) scan, and magnetic resonance imaging (MRI) are other ways that tumors can be detected. Additionally, blood tests may help to diagnose cancers. Some tumors have tumor markers that include genetic markers, cellular and tissue markers, and circulating markers that can be detected in the blood (Table 2). A blood test for prostate cancer measures the amount of prostate-specific antigen (PSA), a tumor marker. Higher-than-normal concentrations of PSA may indicate cancer. Recently, a blood test for ovarian cancer, known as CA-125, has become available. It should be stressed that blood tests by themselves, however, are inconclusive because more than 300 markers have been identified but their relationships to cancer are not fully elucidated. Presence of a tumor marker is not conclusive proof that a tumor exists.
**Table 2. Some Circulating Markers**

<table>
<thead>
<tr>
<th>Marker</th>
<th>Abbreviation</th>
<th>Tumor Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha-fetoprotein</td>
<td>AFP</td>
<td>Germ cell; hepatocellular</td>
</tr>
<tr>
<td>Carcinoembryonic antigen</td>
<td>CEA</td>
<td>Gastrointestinal, colorectal, breast</td>
</tr>
<tr>
<td>Human chorionic gonadotropin</td>
<td>hCG</td>
<td>Gestational trophoblastic; germ cell; urothelial; gastrointestinal</td>
</tr>
<tr>
<td>Lactate dehydrogenase</td>
<td>LDH</td>
<td>Germ cell</td>
</tr>
<tr>
<td>CA 125</td>
<td>—</td>
<td>Ovarian</td>
</tr>
<tr>
<td>CA19,9</td>
<td>—</td>
<td>Pancreatic; gastrointestinal; ovarian</td>
</tr>
</tbody>
</table>

**RISK FACTORS FOR CANCER**

The biggest risk for the development of cancer is aging. The longer a person lives, the more likely it is that some form of cancer will develop. Some types of cancer are preventable (eg, lung cancer from tobacco), while other types of cancer are caused by environmental factors (eg, lung cancer in heavy smokers who use beta carotene supplements) or by genetic factors (eg, MYC marker in lung cancer). Because cancer usually requires a number of genetic mutations, the chances of developing cancer increases as a person gets older because more time has been available for mutations to accumulate. (This discussion is continued in the section, Genes and Cancer: Is Cancer Hereditary?)

In addition to chemicals and radiation, bacteria and a few viruses can trigger the development of cancer. The bacterium *Helicobacter pylori*, which can cause stomach ulcers, has been associated with an increased risk for the development of gastric cancer. In the case of cancer viruses, some of the viral genetic information is inserted into the chromosomes of the infected cell, causing the cell to become malignant. Very strong evidence suggests that the human papilloma viruses (HPV) are associated with most types of cervical cancer (squamous and adenocarcinomas), and results of several large studies suggest that HPV infection precedes the development of cervical cancer by 10 to 15 years.

The use of tobacco products has been implicated in nearly 30% of cancer-related deaths, making it the largest single cause of death from cancer. Cigarette smoking is responsible for nearly all cases of lung cancer, and smoking has been implicated in cancer of the mouth, larynx, esophagus, stomach, pancreas, kidney, and bladder. Tobacco is the main environmental risk factor for lung cancer, and it has been estimated that each cigarette smoked shortens the smoker’s life by 14 minutes.

Skin cancer caused by exposure to sunlight is the most frequently observed type of human cancer. Because skin cancer is often easy to cure, the danger posed by sunlight is perhaps not taken seriously enough. Mortality may be low, but morbidity can be high if the lesions must be excised from a cosmetically sensitive area (ie, the face). Chronic exposure to radiation in sunlight and fair skin that is susceptible to sunburns appear to be the most important risk factors, with increasing frequency of exposure, age, immune status, male gender, and DNA repair disorders (such as xeroderma pigmentosum) as other risk factors.

Drinking excessive amounts of alcohol is linked to an increased risk for several kinds of cancer, especially those of the mouth, throat, and esophagus. The combination of alcohol and tobacco appears to be especially dangerous: in heavy smokers or heavy drinkers, the risk of cancer of the esophagus is approximately 6 times greater than that for nonsmokers/non-drinkers. For people who both smoke and drink, the risk of cancer is 40 times greater than that for nonsmokers/non-drinkers. Alcohol cannot cause cancer but can convert damaged cells into malignant cells. (This discussion is continued in the section, Genes and Cancer: Is Cancer Hereditary?)

Studies suggest that differences in diet may play a role in determining cancer risk. In contrast to the clear-cut identification of tobacco, sunlight, and alcohol, the exact identity of the dietary components that influence cancer risk has been difficult to determine. Limiting fat consumption and calorie intake appears to be one possible strategy to decrease the risk of some cancers because people who consume large amounts of meat (rich in fat) and large numbers of calories have an increased risk for cancer, especially for colon cancer.

**CAUSES OF CANCER**

Cancer is a multifaceted disease, sometimes the result of the unlucky convergence of genetics and environment. The etiology of cancer is different from the risk of cancer. Avoidance of the causes (etiology) of cancer may greatly reduce a person’s risk of cancer. For example, smoking is a cause of cancer; not smoking reduces one’s risk of cancer, even if he or she has a genetic defect that is a predisposition to cancer. Table 3 lists some causes of cancer.

**GENES AND CANCER: IS CANCER HEREDITARY?**

All cancers are caused by a defect in a gene that allows the cell to proliferate wildly. The genetic effect occurs through small mutations in the DNA, little “hits” over many years. (Dr. Alfred Knudson developed the “2-hit” theory of cancer; he was the McGovern Award recipient at the 1999 AMWA meeting in Philadelphia.) Not all cancers are hereditary—actually only 5% of cancers are due to genetic inheri-
normal cells can cause the cells to become malignant by instructing cells to make proteins that stimulate excessive cell growth and division. By producing abnormal versions or quantities of cellular growth-control proteins, oncogenes cause a cell’s growth-signaling pathway to become hyperactive. A cancer cell may contain 1 or more oncogenes, which means that 1 or more components in this pathway will be abnormal. Oncogenes are related to proto-oncogenes, a family of normal genes that code primarily for proteins involved in a cell’s normal growth.

A second class of genes implicated in cancer are tumor suppressor genes. Tumor suppressor genes are normal genes whose absence can lead to cancer. Tumor suppressor genes instruct cells to produce proteins that restrain cell growth and division. Because tumor suppressor genes code for proteins that slow down cell growth and division, the loss of such proteins allows a cell to grow and divide in an uncontrolled fashion. One particular tumor suppressor gene codes for a protein called p53 that can trigger apoptosis. In cells that have undergone DNA damage, the p53 protein halts cell growth and division. If the damage cannot be repaired, the p53 protein eventually initiates cell suicide, thereby preventing the genetically damaged cell from growing out of control. If a pair of tumor suppressor genes are either lost from a cell or inactivated by mutation, their functional absence can cause cancer. Individuals who inherit an increased risk for the development of cancer often are born with one defective copy of a tumor suppressor gene. Because genes come in pairs (one inherited from each parent), an inherited defect in one copy will not cause cancer because the other normal copy is still functional. If the second copy undergoes mutation, cancer may then develop because there no longer is any functional copy of the gene.

A third class of genes implicated in cancer are called mismatch repair genes. Mismatch repair genes code for proteins whose normal function is to correct errors that arise when cells duplicate their DNA before cell division. Mutations in mismatch repair genes can lead to a failure in DNA repair, which in turn allows subsequent mutations in tumor suppressor genes and proto-oncogenes to accumulate. People with a condition called xeroderma pigmentosum have an inherited defect in a mismatch repair gene. As a result, the DNA damage that normally occurs when skin cells are exposed to sunlight cannot be effectively repaired, and so the incidence of skin cancer is abnormally high for people with this condition. Certain forms of hereditary colon cancer also involve defects in DNA repair.

Cancer often arises because of the accumulation of mutations involving oncogenes, tumor suppressor genes, and mismatch repair genes. Colon cancer can begin with a defect in a tumor suppressor gene that allows excessive cell proliferation. The proliferating cells acquire subsequent mutations involving a mismatch repair gene, an oncogene, and several other tumor suppressor genes. The accumulated damage yields a highly malignant, metastatic tumor.

Another type of gene involved in the development of cancer is the telomerase gene. The ends of chromosomes are called telomeres, pieces of DNA that allow the chromosome to survive functionally intact after a lifetime of cell divisions. When cells divide, little bits of DNA are lost from each telomere, and eventually cells are unable to divide. Errant telomere genes repair the ongoing damage from cell division and allow the cell to divide indefinitely.

Whatever gene is involved, the result is cancer, fed by relentless cell

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### Table 3. Causes of Cancer

<table>
<thead>
<tr>
<th>Cause</th>
<th>Percentage of Cancer-related Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tobacco</td>
<td>30</td>
</tr>
<tr>
<td>Unhealthy diet and obesity</td>
<td>30</td>
</tr>
<tr>
<td>Lack of exercise</td>
<td>5</td>
</tr>
<tr>
<td>Genetic inheritance</td>
<td>5</td>
</tr>
<tr>
<td>Viruses and bacteria</td>
<td>5</td>
</tr>
<tr>
<td>Occupational carcinogens</td>
<td>5</td>
</tr>
<tr>
<td>Excessive alcohol consumption</td>
<td>3</td>
</tr>
<tr>
<td>Reproductive history</td>
<td>3</td>
</tr>
<tr>
<td>Environmental pollution</td>
<td>2</td>
</tr>
<tr>
<td>Solar radiation and radon</td>
<td>2</td>
</tr>
<tr>
<td>Food additives and contaminants</td>
<td>1</td>
</tr>
<tr>
<td>Medical treatment (radiation, chemotherapy, immunosuppressants, hormone therapy)</td>
<td>1</td>
</tr>
<tr>
<td>Other factors</td>
<td>8</td>
</tr>
</tbody>
</table>
division that has escaped the normal constraints. The mass of cells eventually invades other tissues and organs and disrupts their function.

**TREATMENT FOR CANCER**

The primary and oldest treatment for cancer is surgery, and several special surgical techniques can be used (Table 4). Surgery is used also in diagnosis and staging to determine the extent and amount of disease. Patients may elect to have prophylactic surgery, which is done to remove tissue that is not malignant but which may become malignant. Some women with a known mutation in the *BRCA* gene elect to have prophylactic mastectomies of healthy breasts to avoid breast cancer. Curative surgery removes the tumor and is often done in conjunction with chemotherapy or radiotherapy to achieve a cure. Palliative surgery is not done to cure cancer but is used to treat complications of advanced disease. For example, palliative surgery can debulk tumors that are blocking the function of organs. Palliative surgery is also used to treat pain that is difficult to control in other ways.

**Radiotherapy** uses radiation to kill cells. Cells cycle through stages of division: G0, G1, S, G2, and M. Radiation is most effective on cells in the dividing stages and less effective on cells in the “resting” phase of G0. The aim of radiotherapy is to stop cancer cells from dividing, thus killing them and destroying the tumor. Unfortunately, other rapidly dividing cells, such as cells that line the mouth and hair cells, are often destroyed also, leading to mucositis and alopecia, respectively. Other rapidly dividing cells that are often destroyed are blood cells, leading to neutropenia, anemia, or thrombocytopenia when white cells, red cells, and platelets, respectively, are damaged or destroyed. Radiotherapy is a gradual process, with the total dose measured in grays given over an extended period of time. Very often, patients receive radiotherapy every week day (ie, Monday through Friday) for 6 weeks.

Because normal cells repair faster, the “weekend break” allows them to recover while the cancer cells die and are naturally removed from the body. Radiotherapy often incorporates drugs such as radioprotectors or radiosensitizers to lessen damage to healthy tissue and improve the outcomes. Hyperfractionated radiotherapy delivers radiation in smaller doses administered every 4 to 6 hours, 2 or 3 times a day. Hyperfractionated radiotherapy works well on tumors that are known to divide extremely rapidly, particularly those of the head and neck. Another form of radiotherapy is internal radiation, in which an implanted radioactive material is used to deliver a continuous dose of radiation over several days. Unlike with other forms of radiotherapy, with internal radiation, sometimes grouped in the general category of brachytherapy, the patient is radioactive for a few days. Children under the age of 18 years must not visit patients receiving internal radiation; others must remain at least 6 feet away and can only stay in the same room for 45 minutes.

**Chemotherapy** is the administration of drugs to kill cancer cells. Chemotherapeutic drugs can be administered as a pill, as an injection, or as an intravenous infusion. Hundreds of chemotherapeutic drugs are used, alone or in combination, to treat cancer. Like radiotherapy, chemotherapy targets rapidly dividing cells, usually aiming to disrupt cell division. Most patients who have surgery to remove tumors also have chemotherapy to “clean up” stray cancer cells in the body. Various forms of chemotherapy exist and most are categorized as antineoplastic therapy. Many types of drugs are used as antineoplastic therapy, including alkylating agents, antimetabolites, and enzyme inhibitors. Chemotherapy is given in cycles, with a rest period between cycles, and cycles can last from 3 months to 3 years, depending on a number of factors, including disease (ie, what type of cancer), drugs (eg, antimetabolites or monoclonal antibodies), and responses (ie, tumor shrinkage or progression). Chemotherapy is generally given as 3 courses: induction, consolidation, and maintenance. The number of cycles in each course can vary. Chemotherapy is further classified as adjuvant or neoadjuvant, if given after or before surgery, respectively.

Some newer therapies are antiangiogenesis therapy and photodynamic therapy. Tumors, like all cells in the body, need a rich blood supply to grow. Antiangiogenesis therapy involves the use of drugs to stop the formation of new blood vessels, effectively limiting the size of a tumor to a few millimeters.
in diameter. Photodynamic therapy combines light and a photosensitizing agent (ie, a drug that is activated by light). The drug accumulates in the target of interest, the diseased organ. When the drug is exposed to laser light or another light source, chemicals are produced that destroy the cancer cells. Photodynamic therapy is limited to areas close to the surface. A common use of photodynamic therapy is for the treatment of actinic keratosis, a pre-cancerous skin condition caused by repeated and prolonged sun exposure. A solution is applied to the face or scalp and a special light is used to activate the drugs.

Gene therapy is a new area of cancer treatment and is highly experimental. The goal of gene therapy is to alter the genetic makeup of the tumor or of the body by inserting a desirable gene into the DNA of cells that have been removed from the patient. The removed cells are "reprogrammed" to produce different proteins and then are injected into the patient's body or into the tumor. In some cases, the reprogrammed cells fortify the patient's immune system; in other cases, the reprogrammed cells sensitize cancer cells to antineoplastic agents.

Bone marrow transplantation and stem cell transplantation are often the primary therapy for leukemias and lymphomas and are being used as experimental treatments for other cancers. Transplantation allows the use of very intense chemotherapy with or without radiotherapy to better eradicate tumor cells; the greater eradication comes at the cost of the bone marrow. Both bone marrow and stem cell transplantation are complex, worthy of a paper on the topic alone.

CONCLUDING REMARKS

Oncology is a complex area of study. Research suggests that both genetic makeup and the environment, including behaviors, interact to allow cancers to develop. It is difficult to state unequivocally “X causes cancer”; in reality, “X” probably allows other factors to engage in the development of a cancer.

Extraordinary therapies have been developed in the past few decades that employ the knowledge of cell physiology, chemistry, and genetics. We are aware of behavioral changes (eg, modification of diets, avoiding tobacco and alcohol) that can deter the development of some cancers. The second paper in this series will provide an overview of molecular oncology, targeted therapies, and other advancements in the field of oncology.

References

GLOSSARY

adjunct therapy
Treatment used in addition to the primary treatment, ie, chemotherapy or radiotherapy given after surgical removal of a tumor to increase the chance of cure

alkylating agent
A substance that acts on DNA and interferes with replication by replacing hydrogen atoms with itself

alopecia
Loss/absence of hair; side effect of cancer treatment; hair often grows back

anemia
Abnormally low amount of red blood cells

antiangiogenesis
Approach to prohibiting the formation of blood vessels

antimetabolite
Analog of the end product of a metabolic pathway that causes feedback inhibition but cannot replace the original product

antineoplastic agent
A drug that stops or slows the maturation and spread of tumor cells

apoptosis
A drug that stops or slows the maturation and spread of tumor cells

benign
Not malignant

biopsy
Removal and examination of tissues from the living body

bone marrow transplantation
Treatment for cancer that involves removal of some of the patient's or a donor's bone marrow, which is purged of cancer cells and stored; after destruction of the patient's bone marrow through radiation and drugs, the stored bone marrow is transfused, finds its way back into the marrow cavity of bones, and re-establishes bone marrow function

brachytherapy
Radiotherapy in which the source of radiation is in a device implanted in the body in or close to the area to be treated

carcinogen
A substance that produces cancer
carcinoma
Malignant new growth composed of epithelial cells tending to infiltrate the surrounding tissues

carcinoma in situ
Neoplasm in which cells are confined to the epithelium of origin without invasion into other tissues

CAT (CT) scan
Computed axial tomography or computed tomography; imaging test in which many x-rays are taken from different angles of a part of the body; images are combined by a computer to produce cross-sectional pictures of internal organs

chemotherapy
Use of drugs to destroy or incapacitate cancer cells

consolidation therapy
Chemotherapy treatments given after induction chemotherapy to further reduce the number of cancer cells

dysplasia
Abnormality of development, particularly any alteration in size, shape, and organization of adult cells

endoscope
An instrument for the examination of the interior of hollow organs, such as the bladder or colon

enzyme inhibitor
Compound or chemical that stops the action of an enzyme

etiology
Study or theory of factors that cause disease

gene therapy
The process of introducing new genes into the DNA of a person's cells to correct a genetic disease

glioma
Tumor composed of nervous tissue

gray
Unit of energy absorbed by 1 kg of matter; a measure of intensity of radiotherapy

hyperfractionated radiotherapy
Radiation given in smaller doses and more than once a day

hyperplasia
Abnormal multiplication or increase in the number of normal cells in normal arrangement in a tissue

induction therapy
Treatment designed to be used as the first step toward shrinking the cancer

initiator
Gene or substance able to start the process in question

internal radiation
A type of therapy in which a radioactive substance is implanted into or close to the area needing treatment. Also called brachytherapy.

invasion
Infiltration and active destruction of surrounding tissue, a characteristic of malignant tumors

leukemia
Any of several cancers of blood-forming organs that result in the uncontrolled production of abnormal white blood cells

lymphoma
Neoplastic disorder of lymphoid tissue

malignant
Refers to disease state that tends to progressively worsen and results in death

maintenance therapy
Extended treatment with chemotherapy at less-frequent time periods than original chemotherapy (eg, once every 2 months rather than 3 times a week for 2 months) given to lessen the chance of return of cancer

melanocyte
Epidermal cell that synthesizes the pigment melanin

melanoma
Tumor arising from melanocytic system of the skin

metastasis
Transfer of disease from one part of the body to another or from one organ to another that is not directly connected

mismatch repair gene
Genes that recognize damaged DNA; the protein encoded by the gene repairs the damaged DNA

morbidty
State of having a disease

mortality
Death

MRI
Magnetic resonance imaging; procedure in which a magnet linked to a computer is used to create detailed pictures of areas inside the body

myeloid
Pertaining to or derived from bone marrow

mucositis
Inflammation of the lining of the mouth and digestive tract

neoadjuvant therapy
Systemic treatment, such as chemotherapy or radiotherapy, used before surgery to shrink the tumor and make it easier to remove

neoplasm
Any new and abnormal growth, usually uncontrolled and progressive

neutropenia
Less than normal amount of white blood cells

oncogene
Gene found in chromosomes of tumor cells whose activation is associated with the transformation of normal cells into cancer cells

oncology
The study of cancer and its therapies

PET
Positron emission tomography; specialized imaging technique that uses low-dose radioactive sugar to measure metabolic activity; very sensitive and is able to detect active tumor tissue

photodynamic therapy
Use of drugs that are activated in the presence of a special light to kill rapidly dividing cancer cells

plasma cell
Specialized type of B cell involved in immunity

proto-oncogene
A normal gene that with slight alteration by mutation becomes an oncogene

radiograph
Film produced by x-rays

radioprotector
A substance applied or administered before radiotherapy that helps minimize damage to normal healthy cells

radiosensitizer
Drugs used to enhance the effect of radiation

radiotherapy
Use of ionizing radiation to kill rapidly dividing cancer cells

risk
The probability of being harmed

sarcoma
A tumor arising in bone, muscle, or connective tissue

stem cell transplantation
Treatment for cancer that involves removal of some of the patient's or a donor's peripheral blood progenitor cells (also called stem cells); after destruction of the patient's bone marrow through radiation and drugs, the collected progenitor cells are transplanted back into the bone's marrow cavity, and re-establish bone marrow function

telomere
Stabilizing caps on ends of chromosomes; telomeres shorten whenever a cell divides. When the telomeres become very small, the cell stops dividing

thrombocytopenia
Less than normal amounts of platelets

tumor
A new growth of tissue in which multiplication of cells is uncontrolled

tumor marker
Proteins found in the blood; the amount or level of the protein may correlate with the type and activity of some cancers

tumor suppressor gene
Genes that suppress tumors through production of proteins

ultrasonography
Use of high-frequency sound waves to visualize structures deep in the body