



## What Is Cancer?

Cancer is a group of many related diseases that begin in cells, the body's basic unit of life. To understand cancer, it is helpful to know what happens when normal cells become cancerous.

The body is made up of many types of cells. Normally, cells grow and divide to produce more cells only when the body needs them. This orderly process helps keep the body healthy. Sometimes, however, cells keep dividing when new cells are not needed. These extra cells form a mass of *tissue*, called a growth or *tumor*. Tumors can be *benign* or *malignant*.

- **Benign tumors** are not cancer. They can often be removed and, in most cases, they do not come back. Cells from benign tumors do not spread to other parts of the body. Most important, benign tumors are rarely a threat to life.
- **Malignant tumors** are cancer. Cells in these tumors are abnormal and divide without control or order. They can invade and damage nearby tissues and organs. Also, cancer cells can break away from a malignant tumor and enter the bloodstream or the *lymphatic system*. That is how cancer spreads from the original cancer site to form new tumors in other organs. The spread of cancer is called *metastasis*.
- **Leukemia and lymphoma** are cancers that arise in blood-forming cells. The abnormal cells circulate in the bloodstream and lymphatic system. They may also invade (infiltrate) body organs and form tumors.

Most cancers are named for the organ or type of cell in which they begin. For example, cancer that begins in the lung is lung cancer, and cancer that begins in cells in the skin known as *melanocytes* is called *melanoma*.

When cancer spreads (metastasizes), cancer cells are often found in nearby or regional *lymph nodes* (sometimes called lymph glands). If the cancer has reached these nodes, it means that cancer cells may have spread to other organs, such as the liver, bones, or brain. When cancer spreads from its original location to another part of the body, the new tumor has the same kind of abnormal cells and the same name as the primary tumor. For example, if lung cancer spreads to the brain, the cancer cells in the brain are actually lung cancer cells. The disease is called metastatic lung cancer (it is not brain cancer).

### Possible Causes and Prevention of Cancer

The more we can learn about what causes cancer, the more likely we are to find ways to prevent it. In the laboratory, scientists explore possible causes of cancer and try to determine exactly what happens in cells when they become cancerous. Researchers also study patterns of cancer in the population to look for *risk factors*, conditions that increase the chance that cancer might occur. They also look for protective factors, things that decrease the risk.

Even though doctors can seldom explain why one person gets cancer and another does not, it is clear that cancer is not caused by an injury, such as a bump or bruise. And although being infected with certain viruses may increase the risk of some types of cancer, cancer is not contagious; no one can "catch" cancer from another person.

Cancer develops over time. It is a result of a complex mix of factors related to lifestyle, heredity, and environment. A number of factors that increase a person's chance of developing cancer have been identified. Many types of cancer are related to the use of tobacco, what people eat and drink, exposure to *ultraviolet (UV) radiation* from the sun, and, to a lesser extent, exposure to cancer-causing agents (*carcinogens*) in the environment and the workplace. Some people are more sensitive than others to factors that can cause cancer.

Still, most people who get cancer have none of the known risk factors. And most people who do have risk factors do not get the disease.

Some cancer risk factors can be avoided. Others, such as inherited factors, are unavoidable, but it may be helpful to be aware of them. People can help protect themselves by avoiding known risk factors whenever possible. They can also talk with their doctor about regular checkups and about whether cancer screening tests could be of benefit.

These are some of the factors that increase the likelihood of cancer:

- **Tobacco.** Smoking tobacco, using smokeless tobacco, and being regularly exposed to environmental tobacco smoke are responsible for one-third of all cancer deaths in the United States each year. Tobacco use is the most preventable cause of death in this country.

Smoking accounts for more than 85 percent of all lung cancer deaths. For smokers, the risk of getting lung cancer increases with the amount of tobacco smoked each day, the number of years they have smoked, the type of tobacco product, and how deeply they inhale. Overall, for those who smoke one pack a day, the chance of getting lung cancer is about 10 times greater than for nonsmokers. Cigarette smokers are also more likely than nonsmokers to develop several other types of cancer, including oral cancer and cancers of the larynx, esophagus, pancreas, bladder, kidney, and cervix. Smoking may also increase the likelihood of developing cancers of the stomach, liver, prostate, colon, and rectum. The risk of cancer begins to decrease soon after a smoker quits, and the risk continues to decline gradually each year after quitting.

People who smoke cigars or pipes have a risk for cancers of the oral cavity that is similar to the risk for people who smoke cigarettes. Cigar smokers also have an increased chance of developing cancers of the lung, larynx, esophagus, and pancreas.

The use of smokeless tobacco (chewing tobacco and snuff) causes cancer of the mouth and throat. Precancerous conditions, tissue changes that may lead to cancer, often begin to go away after a person stops using smokeless tobacco.

Studies suggest that exposure to environmental tobacco smoke, also called secondhand smoke, increases the risk of lung cancer for nonsmokers.

People who use tobacco in any form and need help quitting may want to talk with their doctor, dentist, or other health professional, or join a smoking cessation group sponsored by a local hospital or voluntary organization.

- **Diet.** Researchers are exploring how dietary factors play a role in the development of cancer. Some evidence suggests a link between a high-fat diet and certain cancers, such as cancers of the colon, uterus, and prostate. Being seriously overweight may be linked to breast cancer among older women and to cancers of the prostate, pancreas, uterus, colon, and ovary. On the other hand, some studies suggest that foods containing fiber and certain nutrients may help protect against some types of cancer.

People may be able to reduce their cancer risk by making healthy food choices. A well-balanced diet includes generous amounts of foods that are high in fiber, vitamins, and minerals, and low in fat. This includes eating lots of fruits and vegetables and more whole-grain breads and cereals every day, fewer eggs, and not as much high-fat meat, high-fat dairy products (such as whole milk, butter, and most cheeses), salad dressing, margarine, and cooking oil.

Most scientists think that making healthy food choices is more beneficial than taking vitamin and mineral supplements.

- **Ultraviolet (UV) radiation.** UV radiation from the sun causes premature aging of the skin and skin damage that can lead to skin cancer. (Two types of ultraviolet radiation -- UVA and UVB -- are explained in the Dictionary.) Artificial sources of UV radiation, such as sunlamps and tanning booths, also can cause skin damage and probably an increased risk of skin cancer.

To help reduce the risk of skin cancer caused by UV radiation, it is best to reduce exposure to the midday sun (from 10 a.m. to 3 p.m.). Another simple rule is to avoid the sun when your shadow is shorter than you are.

Wearing a broad-brimmed hat, UV-absorbing sunglasses, long pants, and long sleeves offers protection. Many doctors believe that in addition to avoiding the sun and wearing protective clothing, wearing a *sunscreen* (especially one that reflects, absorbs, and/or scatters both types of ultraviolet radiation) may help prevent some forms of skin cancer. Sunscreens are rated in strength according to a *sun protection factor* (SPF). The higher the SPF, the more sunburn protection is provided. Sunscreens with an SPF of 12 through 29 are adequate for most people, but sunscreens are not a substitute for avoiding the sun and wearing protective clothing.

- **Alcohol.** Heavy drinkers have an increased risk of cancers of the mouth, throat, esophagus, larynx, and liver. (People who smoke cigarettes and drink heavily have an especially high risk of getting these cancers.) Some studies suggest that even moderate drinking may slightly increase the risk of breast cancer.
- **Ionizing radiation.** Cells may be damaged by ionizing radiation from x-ray procedures, *radioactive* substances, rays that enter the Earth's atmosphere from outer space, and other sources. In very high doses, ionizing radiation may cause cancer and other diseases. Studies of survivors of the atomic bomb in Japan show that ionizing radiation increases the risk of developing leukemia and cancers of the breast, thyroid, lung, stomach, and other organs.

Before 1950, x-rays were used to treat noncancerous conditions (such as an enlarged thymus, enlarged tonsils and adenoids, ringworm of the scalp, and acne) in children and young adults. Those who have received radiation therapy to the head and neck have a higher-than-average risk of developing thyroid cancer years later. People with a history of such treatments should report it to their doctor.

Radiation that patients receive as therapy for cancer can also damage normal cells. Patients may want to talk with their doctor about the effect of radiation treatment on their risk of a second cancer. This risk can depend on the patient's age at the time of treatment as well as on the part of the body that was treated.

X-rays used for diagnosis expose people to lower levels of radiation than x-rays used for therapy. The benefits nearly always outweigh the risks. However, repeated exposure could be harmful, so it is a good idea for people to talk with their doctor about the need for each x-ray and to ask about the use of shields to protect other parts of the body.

- **Chemicals and other substances.** Being exposed to substances such as certain chemicals, metals, or pesticides can increase the risk of cancer. Asbestos, nickel, cadmium, uranium, radon, vinyl chloride, benzidine, and benzene are examples of well-known carcinogens. These may act alone or along with another carcinogen, such as cigarette smoke, to increase the risk of cancer. For example, inhaling asbestos fibers increases the risk of lung diseases, including cancer, and the cancer risk is especially high for asbestos workers who smoke. It is important to follow work and safety rules to avoid or minimize contact with dangerous materials.
- **Hormone replacement therapy (HRT).** Doctors may recommend HRT, using either *estrogen* alone or estrogen in combination with *progesterone*, to control symptoms (such as hot flashes and vaginal dryness) that may occur during menopause. Studies have shown that the use of estrogen alone increases the risk of cancer of the uterus. Therefore, most doctors prescribe HRT that includes progesterone along with low doses of estrogen. Progesterone counteracts estrogen's harmful effect on the uterus by preventing overgrowth of the lining of the uterus; this overgrowth is associated with taking estrogen alone. (Estrogen alone may be prescribed for women who have had a *hysterectomy*, surgery to remove the uterus, and are, therefore, not at risk for cancer of the uterus.) Other studies show an increased risk of breast cancer among women who have used estrogen for a long time; and some research suggests that the risk might be higher among those who have used estrogen and progesterone together.

Researchers are still learning about the risks and benefits of taking HRT. A woman considering HRT should discuss these issues with her doctor.

- **Diethylstilbestrol (DES).** DES is a synthetic form of estrogen that was used between the early 1940s and 1971. Some women took DES during pregnancy to prevent certain complications. Their DES-exposed daughters have an increased chance of developing abnormal cells (*dysplasia*) in the cervix and vagina. In addition, a rare type of vaginal and cervical cancer can occur in DES-exposed daughters. DES daughters should tell their doctor about their exposure. They should also have *pelvic* exams by a doctor familiar with conditions related to DES.

Women who took DES during pregnancy may have a slightly higher risk for developing breast cancer. These women should tell their doctor about their exposure. At this time, there does not appear to be an increased risk of breast cancer for daughters who were exposed to DES before birth. However, more studies are needed as these daughters enter the age range when breast cancer is more common.

There is evidence that DES-exposed sons may have testicular abnormalities, such as undescended or abnormally small testicles. The possible risk for testicular cancer in these men is under study.

- **Close relatives with certain types of cancer.** Some types of cancer (including melanoma and cancers of the breast, ovary, prostate, and colon) tend to occur more often in some families than

in the rest of the population. It is often unclear whether a pattern of cancer in a family is primarily due to heredity, factors in the family's environment or lifestyle, or just a matter of chance.

Researchers have learned that cancer is caused by changes (called *mutations* or alterations) in *genes* that control normal cell growth and cell death. Most cancer-causing gene changes are the result of factors in lifestyle or the environment. However, some alterations that may lead to cancer are inherited; that is, they are passed from parent to child. But having such an inherited gene alteration does not mean that the person is certain to develop cancer; it means that the risk of cancer is increased.

People who have any of the cancer risk factors listed above should talk with their doctor. The doctor may be able to suggest ways to reduce the risk and can recommend an appropriate schedule of checkups.

### **Screening and Early Detection**

Sometimes, cancer can be found before the disease causes symptoms. Checking for cancer (or for conditions that may lead to cancer) in a person who does not have any symptoms of the disease is called *screening*.

In routine physical exams, the doctor looks for anything unusual and feels for any lumps or growths. Specific screening tests, such as lab tests, x-rays, or other procedures, are used routinely for only a few types of cancer.

- **Breast.** A screening *mammogram* is the best tool available to find breast cancer before symptoms appear. A mammogram is a special kind of x-ray image of the breasts. Breast cancer screening has been shown to reduce the risk of dying from this disease. The National Cancer Institute recommends that women in their forties and older have mammograms on a regular basis, every 1 to 2 years.
- **Cervix.** Doctors use the *Pap test*, or Pap smear, to screen for cancer of the cervix. For this test, cells are collected from the cervix. The cells are examined under a microscope to detect cancer or changes that may lead to cancer.
- **Colon and rectum.** A number of screening tests are used to find colon and rectal (colorectal) cancer. If a person is over the age of 50 years, has a family medical history of colorectal cancer, or has any other risk factors for colorectal cancer, a doctor may suggest one or more of these tests.

Sometimes tumors in the colon or rectum can bleed. The *fecal occult blood test* checks for small amounts of blood in the stool.

The doctor sometimes uses a thin, lighted tube called a *sigmoidoscope* to examine the rectum and lower colon. Or, to examine the entire colon and rectum, a lighted instrument called a *colonoscope* is used. If abnormal areas are seen, tissue can be removed and examined under a microscope.

A *barium enema* is a series of x-rays of the colon and rectum. The patient is given an enema with a solution that contains barium, which outlines the colon and rectum on the x-rays.

A *digital rectal exam* is an exam in which the doctor inserts a lubricated, gloved finger into the rectum to feel for abnormal areas.

Although it is not certain that screening for other cancers actually saves lives, doctors also may suggest screening for cancers of the skin, lung, and oral cavity. And doctors may offer to screen men for prostate or testicular cancer, and women for ovarian cancer.

Doctors consider many factors before recommending a screening test. They weigh factors related to the individual, the test, and the cancer that the test is intended to detect. For example, doctors take into account the person's age, medical history and general health, family history, and lifestyle. The doctor pays special attention to a person's risk for developing specific types of cancer. In addition, the doctor will assess the accuracy and the risks of the screening test and any followup tests that may be necessary. Doctors also consider the effectiveness and side effects of the treatment that will be needed if cancer is found.

People may want to discuss any concerns or questions they have about screening with their doctors, so they can weigh the pros and cons and make informed decisions about having screening tests.

### **Symptoms of Cancer**

Cancer can cause a variety of symptoms. These are some of them:

- Thickening or lump in the breast or any other part of the body
- Obvious change in a wart or *mole*
- A sore that does not heal
- Nagging cough or hoarseness
- Changes in bowel or bladder habits
- Indigestion or difficulty swallowing
- Unexplained changes in weight
- Unusual bleeding or discharge

When these or other symptoms occur, they are **not** always caused by cancer. They may also be caused by infections, benign tumors, or other problems. It is important to see the doctor about any of these symptoms or about other physical changes. Only a doctor can make a diagnosis. One should **not** wait to feel pain: Early cancer usually does not cause pain.

### **Diagnosis**

If symptoms are present, the doctor asks about the person's medical history and performs a physical exam. In addition to checking general signs of health, the doctor may order various tests and exams. These may include laboratory tests and *imaging* procedures. A *biopsy* is usually necessary to determine whether cancer is present.

### **Laboratory Tests**

Blood and urine tests can give the doctor important information about a person's health. In some cases, special tests are used to measure the amount of certain substances, called tumor markers, in the blood, urine, or certain tissues. Tumor marker levels may be abnormal if certain types of cancer are present. However, lab tests alone cannot be used to diagnose cancer.

## Imaging

Images (pictures) of areas inside the body help the doctor see whether a tumor is present. These pictures can be made in several ways.

X-rays are the most common way to view organs and bones inside the body. A *computed tomography* (CT or CAT) scan is a special kind of imaging that uses a computer linked to an x-ray machine to make a series of pictures.

In *radionuclide scanning*, the patient swallows or receives an injection of a radioactive substance. A machine (scanner) measures radioactivity levels in certain organs and prints a picture on paper or film. The doctor can detect abnormal areas by looking at the amount of radioactivity in the organs. The radioactive substance is quickly eliminated by the patient's body after the test is done.

*Ultrasonography* is another procedure for viewing areas inside the body. High-frequency sound waves that cannot be heard by humans enter the body and bounce back. Their echoes produce a picture called a *sonogram*. These pictures are shown on a monitor like a TV screen and can be printed on paper.

In *MRI*, a powerful magnet linked to a computer is used to make detailed pictures of areas in the body. These pictures are viewed on a monitor and can also be printed.

## Biopsy

A biopsy is almost always necessary to help the doctor make a diagnosis of cancer. In a biopsy, tissue is removed for examination under a microscope by a *pathologist*. Tissue may be removed in three ways: *endoscopy*, needle biopsy, or surgical biopsy.

- During an **endoscopy**, the doctor can look at areas inside the body through a thin, lighted tube. Endoscopy allows the doctor to see what's going on inside the body, take pictures, and remove tissue or cells for examination, if necessary.
- In a **needle biopsy**, the doctor takes a small tissue sample by inserting a needle into the abnormal (suspicious) area.
- A **surgical biopsy** may be *excisional* or *incisional*. In an excisional biopsy, the surgeon removes the entire tumor, often with some surrounding normal tissue. In an incisional biopsy, the doctor removes just a portion of the tumor. If cancer is present, the entire tumor may be removed immediately or during another operation.

Patients sometimes worry that having a biopsy (or any other type of surgery for cancer) will spread the disease. This is a very rare occurrence. Surgeons use special techniques and take many precautions to prevent cancer from spreading during surgery. For example, if tissue samples must be removed from more than one site, they use different instruments for each one. Also, a margin of normal tissue is often removed along with the tumor. Such efforts reduce the chance that cancer cells will spread into healthy tissue.

Some people may be concerned that exposing cancer to air during surgery will cause the disease to spread. This is not true. Exposure to air does not cause the cancer to spread.

Patients should discuss their concerns about the biopsy or other surgery with their doctor.

## Staging

When cancer is diagnosed, the doctor will want to learn the *stage*, or extent, of the disease. *Staging* is a careful attempt to find out whether the cancer has spread and, if so, to which parts of the body. Treatment decisions depend on the results of staging. The doctor may order more laboratory tests and imaging studies or additional biopsies to find out whether the cancer has spread. An operation called a *laparotomy* can help the doctor find out whether cancer has spread within the abdomen. During this operation, a surgeon makes an incision into the abdomen and removes samples of tissue.

## Handling the Diagnosis

It is natural for anyone facing cancer to be concerned about what the future holds. Understanding the nature of cancer and what to expect can help patients and their loved ones plan treatment, anticipate lifestyle changes, and make financial decisions. Cancer patients frequently ask their doctor or search on their own for statistics to answer the question, "What is my *prognosis*?"

Prognosis is a prediction of the future course and outcome of a disease, and an indication of the likelihood of recovery from that disease. However, it is only a prediction. When doctors discuss a patient's prognosis, they are attempting to project what is likely to occur for that individual patient. A cancer patient's prognosis can be affected by many factors, particularly the type of cancer, the stage of the disease, and its grade (how closely the cancer resembles normal tissue and how fast the cancer is likely to grow and spread). Other factors that may also affect the prognosis include the patient's age, general health, and response to treatment. As these factors change over time, a patient's prognosis is also likely to change.

Sometimes people use statistics to try to figure out their chances of being cured. However, for individual patients and their families, statistics are seldom helpful because they reflect the experience of a large group of patients. Statistics cannot predict what will happen to a particular patient because no two patients are alike; treatment and responses vary greatly.

If people want prognostic information, they should talk with the doctor. The doctor who is most familiar with a person's situation is in the best position to help interpret statistics and discuss prognosis. But even the doctor may not be able to describe exactly what to expect.

Seeking information about prognosis and statistics can help some people reduce their fears. How much information to seek and how to deal with it are personal matters.

## Treatment

Treatment for cancer depends on the type of cancer; the size, location, and stage of the disease; the person's general health; and other factors. The doctor develops a treatment plan to fit each person's situation.

People with cancer are often treated by a team of specialists, which may include a surgeon, *radiation oncologist*, *medical oncologist*, and others. Most cancers are treated with *surgery*, *radiation therapy*, *chemotherapy*, *hormone therapy*, or *biological therapy*. The doctors may decide to use one treatment method or a combination of methods.

*Clinical trials* (research studies) offer important treatment options for many people with cancer. Research studies evaluate promising new therapies and answer scientific questions. The goal of such trials is to find treatments that are more effective in controlling cancer with fewer side effects.



## Getting a Second Opinion

Before starting treatment, the patient may want to have a second opinion from another doctor about the diagnosis and the treatment plan. Some insurance companies require a second opinion; others may cover a second opinion if the patient requests it.

There are a number of ways to find a doctor who can give a second opinion:

- The patient's doctor may be able to suggest specialists to consult.
- The Cancer Information Service, at 1-800-4-CANCER, can tell callers about cancer treatment facilities all over the country, including cancer centers and other programs supported by the National Cancer Institute.
- Patients can get the names of doctors from their local medical society, a nearby hospital, or a medical school.
- The American Board of Medical Specialties (ABMS) has a list of doctors who have met certain education and training requirements and have passed specialty examinations. The *Official ABMS Directory of Board Certified Medical Specialists* lists doctors' names along with their specialty and their educational background. The directory is available in most public libraries. Also, ABMS offers this information on the Internet at <http://www.abms.org>.

## Preparing for Treatment

Many people with cancer want to take an active part in decisions about their medical care. They want to learn all they can about their disease and their treatment choices. However, the shock and stress that people often feel after a diagnosis of cancer can make it hard for them to think of everything they want to ask the doctor. Often it is helpful to prepare a list of questions in advance. To help remember what the doctor says, patients may take notes or ask whether they may use a tape recorder. Some people also want to have a family member or friend with them when they talk to the doctor -- to take part in the discussion, to take notes, or just to listen.

These are some questions a patient may want to ask the doctor before treatment begins:

- What is my diagnosis?
- Is there any evidence the cancer has spread? What is the stage of the disease?
- What are my treatment choices? Which do you recommend for me? Why?
- What new treatments are being studied? Would a clinical trial be appropriate for me?
- What are the expected benefits of each kind of treatment?
- What are the risks and possible *side effects* of each treatment?
- Is infertility a side effect of cancer treatment? Can anything be done about it?
- What can I do to prepare for treatment?
- How often will I have treatments?
- How long will treatment last?
- Will I have to change my normal activities? If so, for how long?
- What is the treatment likely to cost?

Patients do not need to ask all their questions or remember all the answers at one time. They will have many chances to ask the doctor to explain things and to get more information.

### **Methods of Treatment and Their Side Effects**

Treatment for cancer can be either *local* or *systemic*. Local treatments affect cancer cells in the tumor and the area near it. Systemic treatments travel through the bloodstream, reaching cancer cells all over the body. Surgery and radiation therapy are types of local treatment. Chemotherapy, hormone therapy, and biological therapy are examples of systemic treatment.

It is hard to protect healthy cells from the harmful effects of cancer treatment. Because treatment does damage healthy cells and tissues, it often causes side effects. The side effects of cancer treatment depend mainly on the type and extent of the treatment. Also, the effects may not be the same for each person, and they may change for a person from one treatment to the next. A patient's reaction to treatment is closely monitored by physical exams, blood tests, and other tests. Doctors and nurses can explain the possible side effects of treatment, and they can suggest ways to reduce or eliminate problems that may occur during and after treatment.

**Surgery** is therapy to remove the cancer; the surgeon may also remove some of the surrounding tissue and lymph nodes near the tumor. Sometimes surgery is done on an outpatient basis, or the patient may have to stay in the hospital. This decision depends mainly on the type of surgery and the type of *anesthesia*.

The side effects of surgery depend on many factors, including the size and location of the tumor, the type of operation, and the patient's general health. Although patients are often uncomfortable during the first few days after surgery, this pain can be controlled with medicine. Patients should feel free to discuss ways of relieving pain with the doctor or nurse. It is also common for patients to feel tired or weak for a while after surgery. The length of time it takes to recover from an operation varies among patients. Some patients have concerns that cancer will spread during surgery.

**Radiation therapy** (also called radiotherapy) uses high-energy rays to kill cancer cells. For some types of cancer, radiation therapy may be used instead of surgery as the primary treatment. Radiation therapy also may be given before surgery (*neoadjuvant therapy*) to shrink a tumor so that it is easier to remove. In other cases, radiation therapy is given after surgery (*adjuvant therapy*) to destroy any cancer cells that may remain in the area. Radiation also may be used alone, or along with other types of treatment, to relieve pain or other problems if the tumor cannot be removed.

Radiation therapy can be in either of two forms: *external* or *internal*. Some patients receive both.

External radiation comes from a machine that aims the rays at a specific area of the body. Most often, this treatment is given on an outpatient basis in a hospital or clinic. There is no radioactivity left in the body after the treatment.

With internal radiation (also called implant radiation, interstitial radiation, or *brachytherapy*), the radiation comes from radioactive material that is sealed in needles, seeds, wires, or catheters and placed directly in or near the tumor. Patients may stay in the hospital while the level of radiation is highest. They may not be able to have visitors during the hospital stay or may have visitors for only a short time. The implant may be permanent or temporary. The amount of radiation in a permanent implant goes down to a safe level before the person leaves the hospital. The doctor will advise the patient if any special precautions should be taken at home. With a temporary implant, there is no radioactivity left in the body after the implant is removed.

The side effects of radiation therapy depend on the treatment dose and the part of the body that is treated. Patients are likely to become extremely tired during radiation therapy, especially in the later weeks of treatment. Extra rest is often necessary, but doctors usually encourage patients to try to stay as active as they can between rest periods.

With external radiation, there may be permanent darkening or "bronzing" of the skin in the treated area. In addition, it is common to have temporary hair loss in the treated area and for the skin to become red, dry, tender, and itchy. Radiation therapy also may cause a decrease in the number of *white blood cells*, cells that help protect the body against infection.

Although radiation therapy can cause side effects, these can usually be treated or controlled. Most side effects are temporary, but some may be persistent or occur months to years later.

**Chemotherapy** is the use of drugs to kill cancer cells. The doctor may use one drug or a combination of drugs. Chemotherapy may be the only kind of treatment a patient needs, or it may be combined with other forms of treatment. Neoadjuvant chemotherapy refers to drugs given before surgery to shrink a tumor; adjuvant chemotherapy refers to drugs given after surgery to help prevent the cancer from recurring. Chemotherapy also may be used (alone or along with other forms of treatment) to relieve symptoms of the disease.

Chemotherapy is usually given in cycles: a treatment period (one or more days when treatment is given) followed by a recovery period (several days or weeks), then another treatment period, and so on. Most anticancer drugs are given by injection into a vein (*IV*); some are injected into a muscle or under the skin; and some are given by mouth.

Often, patients who need many doses of IV chemotherapy receive the drugs through a *catheter* (a thin, flexible tube) that stays in place until treatment is over. One end of the catheter is placed in a large vein in the arm or the chest; the other end remains outside the body. Anticancer drugs are given through the catheter. Patients who have catheters avoid the discomfort of having a needle inserted into a vein for each treatment. Patients and their families learn how to care for the catheter and keep it clean.

Sometimes the anticancer drugs are given in other ways. For example, in an approach called *intraperitoneal chemotherapy*, anticancer drugs are placed directly into the *abdomen* through a catheter. To reach cancer cells in the *central nervous system* (CNS), the patient may receive *intrathecal chemotherapy*. In this type of treatment, the anticancer drugs enter the *cerebrospinal fluid* through a needle placed in the spinal column or a device placed under the scalp.

Usually a patient has chemotherapy as an outpatient (at the hospital, at the doctor's office, or at home). However, depending on which drugs are given, the dose, how they are given, and the patient's general health, a short hospital stay may be needed.

The side effects of chemotherapy depend mainly on the drugs and the doses the patient receives. As with other types of treatment, side effects vary from person to person. Generally, anticancer drugs affect cells that divide rapidly. In addition to cancer cells, these include blood cells, which fight infection, help the blood to clot, and carry oxygen to all parts of the body. When blood cells are affected, patients are more likely to get infections, may bruise or bleed easily, and may feel unusually weak and very tired. Rapidly dividing cells in hair roots and cells that line the digestive tract may also be affected. As a result, side effects may include loss of hair, poor appetite, nausea and vomiting, diarrhea, or mouth and lip sores.

Hair loss is a major concern for many people with cancer. Some anticancer drugs only cause the hair to thin, while others may result in the loss of all body hair. Patients may cope better if they prepare for hair

loss before starting treatment (for example, by buying a wig or hat). Most side effects go away gradually during the recovery periods between treatments, and hair grows back after treatment is over.

Some anticancer drugs can cause long-term side effects such as loss of *fertility* (the ability to produce children). Loss of fertility may be temporary or permanent, depending on the drugs used and the patient's age and sex. For men, *sperm banking* before treatment may be an option. Women's menstrual periods may stop, and they may have hot flashes and vaginal dryness. Periods are more likely to return in young women.

**Hormone therapy** is used against certain cancers that depend on *hormones* for their growth. Hormone therapy keeps cancer cells from getting or using the hormones they need. This treatment may include the use of drugs that stop the production of certain hormones or that change the way they work. Another type of hormone therapy is surgery to remove organs (such as the ovaries or testicles) that make hormones.

Hormone therapy can cause a number of side effects. Patients may feel tired, have fluid retention, weight gain, hot flashes, nausea and vomiting, changes in appetite, and, in some cases, blood clots. In women, hormone therapy may cause interrupted menstrual periods and vaginal dryness. Hormone therapy in women may also cause either a loss of or an increase in fertility; women taking hormone therapy should talk with their doctor about contraception during treatment. In men, hormone therapy may cause *impotence*, loss of sexual desire, or loss of fertility. Depending on the drug used, these changes may be temporary, long lasting, or permanent. Patients may want to talk with their doctor about these and other side effects.

**Biological therapy** (also called *immunotherapy*) helps the body's natural ability (*immune system*) to fight disease or protects the body from some of the side effects of cancer treatment. *Monoclonal antibodies*, *interferon*, *interleukin-2*, and *colony-stimulating factors* are some types of biological therapy.

The side effects caused by biological therapy vary with the specific treatment. In general, these treatments tend to cause flu-like symptoms, such as chills, fever, muscle aches, weakness, loss of appetite, nausea, vomiting, and diarrhea. Patients also may bleed or bruise easily, get a skin rash, or have swelling. These problems can be severe, but they go away after the treatment stops.

**Bone marrow transplantation** (BMT) or **peripheral stem cell transplantation** (PSCT) may also be used in cancer treatment. The transplant may be autologous (the person's own cells that were saved earlier), allogeneic (cells donated by another person), or syngeneic (cells donated by an identical twin). Both BMT and PSCT provide the patient with healthy *stem cells* (very immature cells that mature into blood cells). These replace stem cells that have been damaged or destroyed by very high doses of chemotherapy and/or radiation treatment.

Patients who have a BMT or PSCT face an increased risk of infection, bleeding, and other side effects due to the high doses of chemotherapy and/or radiation they receive. The most common side effects associated with the transplant itself are nausea and vomiting during the transplant, and chills and fever during the first day or so. In addition, *graft-versus-host disease* (GVHD) may occur in patients who receive bone marrow from a donor. In GVHD, the donated marrow (the graft) reacts against the patient's (the host's) tissues (most often the liver, the skin, and the digestive tract). GVHD can be mild or very severe. It can occur any time after the transplant (even years later). Drugs may be given to reduce the risk of GVHD and to treat the problem if it occurs.

## **Nutrition During Cancer Treatment**

Eating well during cancer treatment means getting enough calories and protein to help prevent weight loss and maintain strength. Eating well often helps people feel better and have more energy.

Some people with cancer find it hard to eat because they lose their appetite. In addition, common side effects of treatment, such as nausea, vomiting, or mouth and lip sores, can make eating difficult. Often, foods taste different. Also, people being treated for cancer may not feel like eating when they are uncomfortable or tired.

Doctors, nurses, and dietitians can offer advice on how to get enough calories and protein during cancer treatment.

## **Pain Control**

Pain is a common problem for people with some types of cancer, especially when the cancer grows and presses against other organs and nerves. Pain may also be a side effect of treatment. However, pain can generally be relieved or reduced with prescription medicines or over-the-counter drugs as recommended by the doctor. Other ways to reduce pain, such as relaxation exercises, may also be useful. It is important for patients to report pain so that steps can be taken to help relieve it.

## **Rehabilitation**

Rehabilitation is an important part of the overall cancer treatment process. The goal of rehabilitation is to improve a person's quality of life. The medical team, which may include doctors, nurses, a physical therapist, an occupational therapist, or a social worker, develops a rehabilitation plan to meet each patient's physical and emotional needs, helping the patient return to normal activities as soon as possible.

Patients and their families may need to work with an occupational therapist to overcome any difficulty in eating, dressing, bathing, using the toilet, or other activities. Physical therapy may be needed to regain strength in muscles and to prevent stiffness and swelling. Physical therapy may also be necessary if an arm or leg is weak or paralyzed, or if a patient has trouble with balance.