

Module 5: What is Cancer?

This module consists of four units which will provide the user a basic knowledge of cancer as a disease.

After completing this module, cancer abstractors will be able to:

- Define the term "cancer"
- Be familiar with the common terms related to cancer
- Name some of the known cancer risk factors
- Name some examples of cancer types

Module 5.1: Definition of Cancer

General Definition of Cancer

The American Cancer Society (ACS) defines cancer as a group of diseases characterized by uncontrolled growth and spread of abnormal cells. If the spread is not controlled, it can result in death.

A cancer cell is a cell that grows out of control. Unlike normal cells, cancer cells ignore signals to stop dividing, to specialize, or to die and be shed. Growing in an uncontrollable manner and unable to recognize its own natural boundary, the cancer cells may spread to areas of the body where they do not belong.

Cancer cells have defects in normal cellular functions that allow them to divide, invade the surrounding tissue, and spread by way of vascular and/or lymphatic systems.

Characteristics of Cancer

Abnormality

Cells are the structural and functional units of all living things. The trillions of cells in the human body include some 200 different types that vary greatly in shape, size, and function. Cells make it possible for us to carry out all kinds of functions of life: the beating of the heart, breathing, digesting food, thinking, walking, and so on. However, all of these functions can only be carried out by normal healthy cells. Some cells fail normal controls of cell division and stop functioning or behaving as they should, as a result, serve no useful purpose in the body at all, and can become cancerous cells.

Uncontrollability

The most fundamental characteristic of cells is their ability to reproduce themselves. They do this simply by dividing. The division of normal and healthy cells occurs in a regulated and systematic fashion: one cell becomes two, the two become four, and so on. Cancer was once perceived as disorganized cell growth, however, it is now known to be a logical, coordinated process in which a precise sequence of tiny alterations changes a normal cell. When these cells fail normal controls of cell division and multiply excessively, an abnormal mass forms.

Invasiveness

Sometimes tumors do not stay harmlessly in one place. They destroy the part of the body in which they originate and then spread to other parts where they start new growth and cause more destruction. This characteristic distinguishes cancer from benign growths, which remain in the part of the body in which they start. Although benign tumors may grow quite large and press on neighboring structures, they do not spread to other parts of the body. Frequently, they are completely enclosed in a protective capsule of tissue and they typically do not pose danger to human life like malignant tumors (cancer) do.

A Group of Diseases

Although cancer is often referred to as a single condition, it actually consists of more than 100 different diseases. These diseases are characterized by uncontrolled growth and spread of abnormal cells. Cancer can arise in many sites and behave differently depending on its organ of origin. Breast cancer, for example, has different characteristics than lung cancer. It is important to understand that cancer originating in one body organ takes its characteristics with it even if it spreads to another part of the body. For example, metastatic breast cancer in the lungs continues to behave like breast cancer when viewed under a microscope, and it continues to look like a cancer that originated in the breast.

Module 6.2: Cancer Terms

Cancer, Neoplasia, Tumor, Neoplasm

The word cancer comes from the Latin (originally Greek) derived term for crab, because of the way a cancer adheres to any part that it seizes upon in an obstinate manner like the crab. Hippocrates first described cancer as having a central body with the tendency to reach out and spread like, "the arms of a crab." Besides the popular, generic term "cancer" used by most people, there is another more technical term: neoplasia. Neoplasia (neo = new, plasia = tissue or cells) or neoplasm literally means new tissue in Greek. This term indicates that cancers are actually new growths of cells in the body.

Another term for cancer is "malignant tumor." Tumor literally means "swelling" or "mass." In this case, it refers to a mass of non-structured new cells, which have no known purpose in the physiological function of the body.

There are two general types of tumors: benign (non-cancerous) tumors and malignant (cancerous) tumors. A benign tumor is composed of cells that will not invade other unrelated tissues or organs of the body, although it may continue to grow in size abnormally. A malignant tumor is composed of cells that resemble immature cells and invade the basement membrane or spread to other parts of the body. Malignant cells can also break away from the primary tumor and travel by blood or lymph to other body organs or by seeding or implantation in body cavities. This capability is called metastasis.

Terms such as "mass" and "lump" are used to describe any overgrowth of tissue. However, these terms may not necessarily mean that such growths contain cancer cells.

Types of Abnormal Cell Growth

In addition to neoplasia, there are several other terms referring to abnormal cell growth. These include the following:

- Hyperplasia refers to an abnormal increase in the number of cells, which are in a normal component of that tissue and are arranged in a normal fashion with subsequent enlargement of the affected part. One example is thyroid hyperplasia, an enlargement of the thyroid gland caused by an abnormal rapid growth of the epithelial cells lining the follicles. Another example is: Guitar strumming leads to hyperplasia of the cells on the thumb (a callus is formed). The callus on the thumb is a hyperplastic growth.
- Hypertrophy refers to an abnormal increase in the size of each cell, for example, the increase in cell size of cardiac muscle.
- Metaplasia refers to the replacement of one mature cell type with another mature cell type, for example, squamous metaplasia of the respiratory columnar epithelium - as evidenced by the metaplastic cough of a smoker.
- Dysplasia refers to the replacement of one mature cell type with a less mature cell type, for example, dysplasia of the cervix epithelium.

Hyperplasia, metaplasia, and dysplasia are reversible because they are results of a stimulus. Neoplasia is irreversible because it is autonomous.

Tumor Terminology Generalizations

Names of benign tumors usually end with "oma" as suffixes regardless of their cell type. For example, a benign glandular tumor (epithelium tissue) is called adenoma and a benign bone tumor is called osteoma while a malignant glandular tumor is called adenocarcinoma and a malignant bone tumor is called osteosarcoma.

In addition to benign tumors, there are in situ tumors and invasive tumors. In situ tumors do not invade the basement membrane, whereas invasive tumors do invade the basement membrane.

Module 6.3: Risk Factors

Risk Factors

Smoking

Cigarette smoking alone is directly related to at least one-third of all cancer deaths annually in the United States. Cigarette smoking is the most significant cause of lung cancer and the leading cause of lung cancer death in both men and women. Smoking is also responsible for most cancers of the larynx, oral cavity, and esophagus. In addition, it is highly associated with the development of, and deaths from bladder, kidney, pancreatic, and cervical cancers. Tobacco smoke contains thousands of chemical agents, including 60 substances that are known to cause cancer (carcinogens).

The health risks with cigarette smoking are not limited to smokers. Exposure to environmental tobacco smoke significantly increases a nonsmoker's risk of developing lung cancer. Environmental tobacco smoke is the smoke that nonsmokers are exposed to when they share air space with someone who is smoking.

Diet

The life style factor that has received the most attention in recent years is diet. Evidence suggests that about one-third of the cancer deaths each year that occur in the United States are related to dietary factors. These include types of food, preparation methods, portion size, variety, and overall caloric balance

Genetics

Research has determined that certain genetic factors may predispose individuals to specific cancers. In some families cancer can recur generation after generation. Some of the most common cancers that can recur are: breast, colon, ovarian, and uterine cancer.

Occupation and Environment

People who have direct contact to carcinogenic agents in the workplace are at the highest risk for developing cancer. For example, a recent study suggests that people with brain cancer are more likely to have worked in certain occupations than similarly aged people without brain cancer. Many cancer-causing chemicals have been identified and many of them are banned from manufacture in the United States.

The common body surfaces that are exposed to carcinogens are the skin, nasal passages, and lung. The primary internal body surface that has contact with carcinogens is the urinary bladder

Infectious Agents

Because viruses can invade and alter cells' genetic material, viral infections are implicated in some cancers. The Epstein-Barr virus, for example, is associated with Burkitt lymphoma, a tumor found mainly among children in Africa. The hepatitis B virus is responsible for much of the liver cancer around the world. The highest rates of hepatitis B infection in the world are in China, Taiwan, Japan, and Thailand with equally high rates of liver cancer in these countries. The human papilloma virus that causes genital warts has been shown to play an important causative role in cervical cancer. The human T-cell leukemia virus, a close relative of the virus that causes acquired immunodeficiency syndrome (AIDS), is associated with a cancer known as Kaposi sarcoma and some types of Non-Hodgkin lymphomas.

Cancer risk factors are not limited to those listed above. There are still other risk factors such as ethanol use, use of certain medications, hormones, and reproductive and sexual behavior. With further scientific research, more cancer risk factors will be identified in the future.

Module 6.4: Cancer Classification

Cancers are classified in two ways: by the type of tissue in which the cancer originates, also known as the cancer's histological type, and by the primary site, also known as the location in the body where the cancer first developed. This unit introduces you to the first method: cancer classification based on histological type. The international standard for the classification and nomenclature of histologies is the International Classification of Diseases for Oncology, Third Edition (ICD-O-3).

From a histological standpoint there are hundreds of different cancers, which are grouped into five major categories: carcinoma, sarcoma, myeloma, leukemia, and lymphoma. In addition, there are also some cancers of mixed types.

Carcinoma

Carcinoma refers to a malignant neoplasm of epithelial origin, also referred to as cancer of the internal or external lining of the body. Carcinomas account for 80 to 90 percent of all cancer cases.

Epithelial tissue is found throughout the body. It is present in the skin, as well as the covering and lining of organs and internal passageways, such as the gastrointestinal tract.

Carcinomas are divided into two major subtypes: adenocarcinoma, which develops in an organ or gland, and squamous cell carcinoma, which originates in the squamous epithelium.

Adenocarcinoma generally occurs in mucus membranes and is first seen as a thickened plaque-like white mucosa. They often spread easily through the soft tissue where they occur. Squamous cell carcinoma occurs in many areas of the body.

Most carcinomas affect organs or glands capable of secretion, such as the breasts, which produce milk, or the lungs, which secrete mucus, or colon or prostate or bladder.

Sarcoma

Sarcoma refers to cancer that originates in supportive and connective tissues such as bones, tendons, cartilage, muscle, and fat. Generally occurring in young adults, the most common sarcoma often develops as a painful mass on the bone. Sarcoma tumors usually resemble the tissue in which they grow.

Examples of sarcomas are:

- Osteosarcoma or osteogenic sarcoma (bone)
- Chondrosarcoma (cartilage)
- Leiomyosarcoma (smooth muscle)
- Rhabdomyosarcoma (skeletal muscle)
- Mesothelial sarcoma or mesothelioma (membranous lining of body cavities)
- Fibrosarcoma (fibrous tissue)
- Angiosarcoma or hemangioendothelioma (blood vessels)
- Liposarcoma (adipose tissue)
- Glioma or astrocytoma (neurogenic connective tissue found in the brain)
- Myxosarcoma (primitive embryonic connective tissue)
- Mesenchymous or mixed mesodermal tumor (mixed connective tissue types)

Myeloma

Myeloma is cancer that originates in the plasma cells of bone marrow. The plasma cells produce some of the proteins found in blood.

Leukemia

Leukemias ("liquid cancers" or "blood cancers") are cancers of the bone marrow (the

site of blood cell production). The word leukemia means "white blood" in Greek. The disease is often associated with the overproduction of immature white blood cells. These immature white blood cells do not perform as well as they should, therefore the patient is often prone to infection. Leukemia also affects red blood cells and can cause poor blood clotting and fatigue due to anemia. Examples of leukemia include:

- Myelogenous or granulocytic leukemia (malignancy of the myeloid and granulocytic white blood cell series)
- Lymphatic, lymphocytic, or lymphoblastic leukemia (malignancy of the lymphoid and lymphocytic blood cell series)
- Polycythemia vera or erythremia (malignancy of various blood cell products, but with red cells predominating)

Lymphoma

Lymphomas develop in the glands or nodes of the lymphatic system, a network of vessels, nodes, and organs (specifically the spleen, tonsils, and thymus) that purify bodily fluids and produce infection-fighting white blood cells, or lymphocytes. Unlike the leukemias which are sometimes called "liquid cancers," lymphomas are "solid cancers." Lymphomas may also occur in specific organs such as the stomach, breast or brain. These lymphomas are referred to as extranodal lymphomas. The lymphomas are subclassified into two categories: Hodgkin lymphoma and Non-Hodgkin lymphoma. The presence of Reed-Sternberg cells in Hodgkin lymphoma diagnostically distinguishes Hodgkin lymphoma from Non-Hodgkin lymphoma.

Mixed Types

The type components may be within one category or from different categories. Some examples are:

- Adenosquamous carcinoma
- Mixed mesodermal tumor
- Carcinosarcoma
- Teratocarcinoma

Cancer Types by Site

Medical professionals frequently refer to cancers based on their histological type. However, the general public is more familiar with cancer names based on their primary sites. The most common sites in which cancer develops include the skin, lungs, female breasts, prostate, colon and rectum, cervix and uterus.

Compared to those based on histological type, cancers named after the primary site may not be as accurate. For example lung cancer; the name does not specify the type of tissue involved. It simply indicates where the cancer is located. In fact, depending on how the cells look under a microscope, there are two major types of lung cancer: non-small cell lung cancer and small cell lung cancer. Non-small cell lung cancer can be further divided into various types named for the type of cells in which the cancer develops, typically: squamous cell carcinoma, adenocarcinoma, and large cell carcinoma. Small cell lung cancer, sometimes called oat cell carcinoma, is the less common form of lung cancer, making up 20% of cases. There are three types of small cell lung cancer named for the kinds of cells found in the cancer and how the cells look when viewed under a microscope. These include small cell, mixed small cell/large cell and combined small cell.

Cancers are named according to the organ in which they originate. Even if a cancer metastasizes to another part of the body, it keeps its original name. Cancer names such as breast cancer, brain cancer, lung cancer, skin cancers are examples.

Review for Module 6

The American Cancer Society defines cancer as "a group of diseases characterized by uncontrolled growth and spread of abnormal cells. If the spread is not controlled, it can result in death."

Cancer does not refer to a single disease. Rather, it consists of more than 100 different diseases.

A few cancer related terms are introduced: cancer, neoplasia, tumor, neoplasm, and growth. Neoplasia, a synonym of cancer, is often used by medical professionals. Neoplasm is a synonym for tumor, which literally means "new growth." Several other terms referring to abnormal cell growth which are not cancer include: hyperplasia, metaplasia, and dysplasia.

Although scientists have not yet pinpointed an exact cause for cancer, many factors have been identified that are likely to cause development of cancer in the body. These factors are called "cancer risk factors" and include smoking, diet, genetics, occupation, environment, and infectious agents.

Cancers can be classified based either on histological type or their primary site (the location where the cancer originated).

Five major categories of cancer, based on their histological characteristics, are: carcinoma; sarcoma; myeloma; leukemia; and lymphoma. In addition, there are also some mixed types.

The most common sites in which cancer develops include skin, lung, female breast, prostate, and colon, rectum, and corpus uteri.