

Cancer Article

Cancer (medicine), any of more than 100 diseases characterized by excessive, uncontrolled growth of abnormal cells, which invade and destroy other tissues. Cancer develops in almost any organ or tissue of the body, but certain types of cancer are more lethal than others. Cancer is the leading cause of death in Canada and second only to heart disease in the United States. Each year, more than 1.2 million Americans and 132,000 Canadians are diagnosed with cancer, and more than 1,700 people die from cancer each day in the United States and Canada. For reasons not well understood, cancer rates vary by gender, race, and geographic region. For instance, more males have cancer than females, and African Americans are more likely to develop cancer than persons of any other racial and ethnic group in North America. Cancer rates also vary globally—residents of the United States, for example, are nearly three times as likely to develop cancer than are residents of Egypt.

Although people of all ages develop cancer, most types are more common in people over the age of 50. Cancer usually develops gradually over many years, the result of a complex mix of environmental, nutritional, behavioral, and hereditary factors. Scientists do not completely understand the causes of cancer, but they know that certain lifestyle choices can dramatically reduce the risk of developing most types of cancer. Not smoking, eating a healthy diet, and exercising moderately for at least 30 minutes each day reduce cancer risk by more than 60 percent.

Just 50 years ago a cancer diagnosis carried little hope for survival because doctors understood little about the disease and how to control it. Today 60 percent of all Americans diagnosed with cancer live longer than five years. While it is difficult to claim that a cancer patient is disease free, long-term survival significantly improves if the patient survives five years. The National Cancer Institute of the United States (NCI) estimates that as many as 8.4 million Americans are living with cancer or have been cured of the disease thanks largely to advances in detecting cancers earlier. The sooner cancer is found and treated, the better a patient's chance for survival. In addition, advances in the fundamental understanding of how cancer develops have reduced deaths caused by certain cancers and hold promise for new and better treatments.

A healthy human body is composed of 30 trillion cells, most of which are in constant turnover as cells die and others reproduce to replace them in an orderly fashion. Healthy cells of the skin, hair, lining of the stomach, and blood, for example, regularly reproduce by dividing to form two daughter cells (*see* Mitosis). This cell division cycle proceeds under the regulation of the body's intricately tuned control system. Among other functions, this control system ensures that cells only divide when needed, so that organs and tissues maintain their correct shape and size. Should this system fail, a variety of backup safety mechanisms prevent the cell from dividing uncontrollably. In order for a cell to become cancerous, every one of these safety mechanisms must fail.

Cancer begins in genes, bits of biochemical instructions composed of individual segments of the long, coiled molecule deoxyribonucleic acid (DNA). Genes contain the instructions to make proteins, molecular labourers that serve as building blocks of cells, control chemical reactions, or transport materials to and from cells. The proteins produced in a human cell determine the function of each cell, and ultimately, the function of the entire body.

In a cancerous cell, permanent gene alterations, or *mutations*, cause the cell to malfunction. For a cell to become cancerous, usually three to seven different mutations must occur in a single cell. These genetic mutations may take many years to accumulate, but the convergence of mutations enables the cell to become cancerous.

While each human cell performs its own specialized function, it also exerts influence on the cells around it. Cells communicate with one another via receptors, protein molecules on the cell surface. A cell releases chemical messages, which fit into the surface receptors of cells nearby, much as a key fits into a lock. A cell may instruct other cells in its neighbourhood to divide, for example, by releasing a growth-promoting signal, or *growth factor*. The growth factor binds to receptors on adjacent cells, activating a message within each individual cell. This message travels to the nucleus, where a cell's genes are located. In cancer cells these cell to cell messages are largely ignored and the cell divides on its own (very rapid) schedule.

A normal cell has a life span of about 40 cell divisions. This life span is controlled in part by telomeres, protective segments at the ends of the cell's DNA. Telomeres shorten with each cell division until they can no longer protect the DNA. At this point cell division severely damages the DNA, ultimately killing the cell. This normal process ensures that older cells, which may have accumulated mutations, no longer reproduce. Cancer cells escape this protective mechanism by producing a protein called telomerase. Telomerase extends the length of telomeres indefinitely, rendering the cells immortal and capable of never-ending cell division.

When a cell does not do its normal job, ignores other cell communication and grows out of control without stopping its referred to as malignant.

A tumour is a mass of cells not dependent upon an extracellular matrix. These cells can grow on top of each other, creating a mass of abnormal cells. Often a tumour develops its own network of tiny blood vessels to supply itself with nutrient-rich blood, a process called *angiogenesis*.

There are two general types of tumours. Benign tumours do not invade other tissues and are limited to one site, making surgical removal possible and the odds for a full recovery excellent. Some benign tumours are quite harmless and are not surgically removed unless they are unsightly or uncomfortable. For example, warts are benign tumours of the outer layer of the skin. Although they are usually not dangerous, warts may cause discomfort. Other benign tumours are thought to be precursors to cancerous, or malignant, tumours.

Questions

Answer the following questions in full sentences on a separate sheet of paper

- 1) Give several statistics as to why one would consider cancer such a significant disease.
- 2) Does cancer affect all groups of people the same? Give some data from the article to support your answer.
- 3) What factors are understood to contribute to the development of cancer?
- 4) What process do cells usually use to divide? When/Why should cells divide in the healthy body?
- 5) How does cancer begin? How many mutations are required to lead to cancer?
- 6) What make a cell malignant?
- 7) What is a tumour? What make a tumour benign?