



ESSENTIALS OF CANCER EXERCISE®

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WHAT IS CANCER?
CHAPTER 1

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1. WHAT IS CANCER?

The term “cancer” refers to a group of diseases in which abnormal (malignant) cells divide and form additional abnormal cells without any order or control. It is an umbrella term for over 200 different diseases. In normal tissues, the rates of new cell growth and old cell death are kept in balance. In cancer this balance is disrupted. This disruption can result from uncontrolled cell growth or loss of a cells’ ability to undergo “apoptosis.” “Apoptosis,” or “cell suicide,” is the mechanism by which old or damaged cells normally self-destruct. The problem with these malignant cells is that they are unable to perform the functions that they were designed for – such as to replace worn-out cells or repair damaged cells – and they continue to grow and multiply without constraint. The normal cells do not respond appropriately to the body’s signals to divide only when needed and to stop when the need is fulfilled. In other words, these cells can be thought of as taking on a life of their own. The gradual increase in the number of growing cells creates a growing mass of tissue called a “tumor,” or “neoplasm.”

If the rate of cell division is relatively rapid, and no “suicide” signals are in place to trigger cell death, the tumor will grow quickly in size; if the cells divide more slowly, tumor growth will be slower. Regardless of the growth rate, tumors ultimately increase in size because new cells are being produced in greater numbers than needed. The cells can invade and destroy healthy tissue and can spread and grow in other areas of the body through two mechanisms: invasion and metastasis. Invasion refers to 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 then invade normal tissues elsewhere in the body.

DEVIATION FROM NORMAL CELL GROWTH

Cancer tissue has a distinctive appearance when viewed under a microscope. Pathologists will look for a large number of dividing cells, variation in nuclear size and shape, variation in cell size and shape, loss of normal tissue organization, and a poorly defined tumor boundary.

Sometimes pathologists will detect a condition known as “hyperplasia.” This refers to tissue growth based on an excessive rate of cell division, leading to a larger than usual number of cells. Everything else in the cells’ structure seems to remain normal and potentially reversible. Hyperplasia can be a normal tissue response to an irritating stimulus, for example a callus that forms on your hand when you begin playing tennis on a regular basis.

Another non-cancerous condition is called “dysplasia.” This, too, is an abnormal type of cell proliferation characterized by loss of normal tissue arrangement and cell structure. Often times

these cells will revert back to normal behavior, but occasionally, they gradually become malignant. These areas are usually closely monitored by a professional in case they need treatment. The most severe cases of dysplasia are sometimes referred to as “carcinoma in situ.” This term refers to an uncontrolled growth of cells that remains in its original location. It does, however, have the potential to develop into an invasive malignancy and, is therefore, usually removed surgically when possible. Lastly, there is invasive cancer. Unlike carcinoma in situ, this cancer has spread beyond its’ original location and has begun to infiltrate into other, previously healthy, tissue. These tumors tend to grow more quickly, spread to other organs more frequently, and be less responsive to therapy. These cancers are surgically removed when possible and often accompanied by radiation and/or chemotherapy to kill any cancerous cells that have spread outside of the tumor.

Cancers are divided into six categories with carcinomas making up 90% of all cancers. They arise in the epithelium, the membranous tissue that forms the inner lining and outer covering of organs, glands, and vessels, as well as the surface layer of the skin. Carcinomas include lung, breast, cervical, prostate, and colon cancer.

The following five categories make up the remaining 10%:

2. **Sarcomas** – bone, cartilage, fat, muscle, and blood vessels
3. **Leukemias** – blood, blood cells, and bone marrow
4. **Lymphomas (including multiple myeloma)** – lymph nodes and lymphatic system
5. **Melanomas** – skin cells that produce pigment responsible for skin color
6. **Gliomas** – brain and spinal cord

WHAT CAUSES CANCER

Although cancer affects people of all ages, the risk of developing most types of cancer increases with age. Cancer is often perceived as a disease that strikes for no apparent reason because there are many unproven theories. Scientists don’t know all of the reasons however, many have been identified. Besides heredity, which only accounts for approximately 10% of all cancer cases, scientific studies point to three main categories of factors that contribute the development of cancer: chemicals (e.g., from smoking, diet, inhalation...), radiation (e.g., x-rays, ultraviolet, radioactive chemicals...), and viruses or bacteria (e.g., Human Papillomavirus, Epstein Barr Virus, hepatitis B...)

Chemicals and radiation that are capable of causing cancer are known as “carcinogens.” Carcinogens initiate a series of genetic alterations or mutations and encourage cell proliferation. This usually doesn’t happen overnight. Sometimes several decades can pass between exposure to a carcinogen and the onset of cancer. Since exposure to carcinogens is

responsible for triggering most cancers, we can reduce our risk by taking steps to avoid such agents whenever possible. The use of tobacco products has been implicated in one out of every three cancer deaths. In spite of the Surgeon Generals' repeated warnings, as well as the fact that smoking is the largest single cause of death from cancer, the tobacco industry continues to thrive. Avoiding tobacco products, cigarettes, cigars, and chewing tobacco, is the single most effective lifestyle decision you can make in an effort to prevent cancer.

Although it is usually not life-threatening, skin cancer caused by exposure to sunlight is the most frequently observed type of cancer. Most of us don't take skin cancer very seriously because it is often easy to cure. Melanoma, a more serious form of skin cancer also associated with sun exposure, is potentially lethal. Once again, we choose to ignore the repeated and ever-present warnings to stay out of the sun and continue to bask in the sun's glory for hours on end. Risk of skin cancer can be greatly reduced by wearing clothing to shield the skin from ultraviolet radiation, wearing protective sunscreen, or by avoiding direct sun exposure altogether.

Actions can also be taken to avoid exposure to some of the viruses that are associated with cancers. The most common of which is the human papillomavirus (HPV), which is involved in the transmission of cervical cancer. "Safe sex," including limiting exposure to multiple sex partners, is the best way to prevent this virus which is sexually transmitted. Many carcinogens have become "occupational" hazards to those who come in contact with them on a regular basis. These include arsenic, asbestos, benzene, chromium, leather dust, naphthylamine, radon, soots, tars, oils, vinyl chloride, and wood dust. Workers who are exposed to these chemicals have a higher incidence of cancer. Although a person's chance of developing cancer at some point in his/her lifetime is almost twice as great today as it was fifty years ago, cancer is still not considered an epidemic. The increase in identifiable cancer cases is due largely in part to increased life span because cancer is more prevalent among older people.

Obesity (being extremely overweight) raises the risk of type II diabetes, high blood pressure, heart disease, and cancer. There are approximately 40,000 cancer diagnoses in the U.S. each year are caused by obesity. In addition, being overweight and obesity cause 15% to 20% of all cancer-related deaths each year. Several studies have explored why being overweight or obese may increase cancer risk and growth. People who are obese have more fat tissue, which can produce hormones, such as insulin or estrogen, and may cause cancer cells to grow. How much a person weighs throughout various points in his or her life may also affect the risk for cancer. Research has shown that the following are modestly associated with an increased risk:

- High birth weight
- Weight gain during adulthood
- Gaining and losing weight repeatedly

Cancer cells come in all different shapes and sizes and are classified by their aggressiveness and from the tissue where they originate. Cancer cells that essentially resemble their non-cancerous counterparts and can still perform some of their normal functions are described as **well differentiated**. On the flip side, the cells that are identified by their disorganized structure and their ability to divide rapidly and chaotically are known as **poorly differentiated cells**. A tumor that remains confined to its' original, or **primary** location, is referred to as **localized**. There are two ways that a cancer can spread; it can grow straight through the primary organ and directly into adjacent tissue (referred to as a **local extension or regional disease**), or in **metastatic cancer**, a colony of malignant cells can break away and ride the circulatory system to nearby lymph nodes or a distant organ where it forms a **secondary cancer**. Sometimes, despite batteries of tests, a metastatic tumor is diagnosed, but no primary tumor is found. When this happens, the cancer is declared a **cancer of unknown primary origin**.

GENETICS

Over 200 hereditary cancer susceptibility syndromes have been identified, although heredity only accounts for about 5-10% of all cancers, in those cases the cancer is caused by an abnormal gene that is being passed along from generation to generation. This takes place when an abnormal gene that can lead to cancer is inherited.

Genes are pieces of *DNA*. They contain the instructions on how to make the proteins the body needs to function, when to destroy damaged cells, and how to keep your body's cellular composition in balance. They control everything that makes you **YOU** and they can also affect your risk of getting cancer. when there is an abnormal change in a gene it's called gene *mutation*. The 2 types of mutations are *inherited* and *acquired* (somatic).

- An inherited gene mutation is one that is transmitted through genes that have been passed from parents to their offspring
- Acquired (somatic) mutations are changes in DNA that develop throughout a person's lifetime

We are born with two copies of most genes – one from our mom and one from our dad. When we inherit an abnormal copy of a gene, our cells already start out with one mutation. If the other copy of the gene stops working (because of an acquired mutation, for example), the gene can stop functioning altogether. When the gene that stops working is a *cancer susceptibility gene*, cancer may develop. Some cancer susceptibility genes function as *tumor suppressor genes* (normal genes that slow down cell division, repair DNA mistakes, or tell cells when to die – a process known as *apoptosis* or programmed cell death). When tumor suppressor genes don't work properly, cells can grow out of control, which can lead to cancer. Many family cancer syndromes are caused by inherited defects of tumor suppressor genes. Cancers that are caused by inherited genes tend to occur earlier in life than those that are acquired.

When many people in one family have cancer, the assumption is that it is inherited however, it is more likely that it is due to chance or exposure to a common toxin. Less often, these cancers may be caused by an inherited gene mutation causing a family cancer syndrome. The following list (provided by the American Cancer Society) is cancers that are more likely to occur from an inherited gene:

- Many cases of an uncommon or rare type of cancer
- Cancers occurring at younger ages than usual
- More than one type of cancer in a single person (like a woman with both breast and ovarian cancer)
- Cancers occurring in both of a pair of organs (both eyes, both kidneys, both breasts)
- More than one childhood cancer in a set of siblings (like sarcoma in both a brother and a sister)
- Cancer occurring in the sex not usually affected (like breast cancer in a man)

Cancer in a parent, brother, or sister, is more cause for concern than cancer in a more distant relative. Even if a gene mutation is present, the chance of you getting it gets lower with more distant relatives. Having two relatives with cancer is more concerning if the people are related to each other. For example, if both relatives are your father's sisters it carries more weight than if one was your father's sister and the other was your mother's sister.

Having several different kinds of cancer among family members is not as concerning as many family members having the same type of cancer. There are, however, some family cancer syndromes, in which a few types of cancer seem to go hand-in-hand (breast cancer and ovarian cancer run together in families with hereditary breast and ovarian cancer syndrome, colon and endometrial cancers tend to go together in a syndrome called hereditary non-polyposis colorectal cancer – Lynch syndrome).

The age at which someone is diagnosed is also important. For example, colon cancer is rare in people under thirty. Having two or more cases in close relatives under thirty years of age could be a sign of an inherited cancer syndrome. On the other hand, breast cancer is very common in menopausal women, so if both your mother and her sister were found to have breast cancer when they were in their 50s, it is less likely to be due to an inherited gene change.

CANCER SIGNS & SYMPTOMS

Cancer signs and symptoms vary depending on many factors. These include, but are not limited to, the cancer type stage, size and location. The early stages of cancer may not produce any noticeable symptoms. Unfortunately, this can result in a less favorable prognosis when

diagnosis is made. Typically, symptoms are more obvious in the more advanced stages of the disease.

Some general symptoms of cancer include:

- Unexplained weight loss or gain
- Fever
- Fatigue
- Pain
- Appetite changes
- Nausea and/or vomiting
- Skin changes (dimpling, redness, swelling, crusting-over, bruising, etc.)

It is important to seek medical advice as soon as any of these symptoms become obvious. Many share characteristics of non-cancerous conditions, but it's better to be proactive and find out for certain. I also recommend getting a second opinion, whether the doctor says it is malignant (cancerous), or benign (non-cancerous).

The following are specific symptoms typically associated with certain cancer types:

Skin - some common symptoms of skin cancer include: change in a mole's size, shape, and color in the form of asymmetry, border/color irregularities or diameter (larger than 1/4 inch), itchiness, pain, and/or oozing around the affected area.

Hematologic - hematologic cancers include leukemia, non-Hodgkin lymphoma, Hodgkin lymphoma, or multiple myeloma. Some common symptoms include: flu-like symptoms, fever, chills, joint/bone pain, anemia, night sweats, lymph node swelling, itching, persistent cough, shortness of breath, abdominal discomfort, headaches, easy bruising or bleeding, and/or frequent infections.

Head and neck - some common symptoms of head and neck cancers include: persistent pain, difficulty swallowing, voice changes, mouth sores, dry mouth, changes in appearance, and/or taste changes.

Lung - some common symptoms of lung cancer include: a cough that doesn't go away, pain in the chest area, shortness of breath, hoarseness, wheezing, coughing up blood, blood in phlegm or mucus, neck or facial swelling, and/or headaches.

Digestive/Gastrointestinal - some common gastrointestinal cancer symptoms include: cramps, bloating, gas pain, changes in bowel/bladder habits, constipation, diarrhea, bloody stools, rectal bleeding, anemia, and/or jaundice.

Gynecologic - some common gynecologic cancer symptoms include: abnormal vaginal bleeding (after menopause, between periods, following sexual intercourse), pain during intercourse, pelvic/back pain, pain on urination, and/or watery, white or pinkish vaginal discharge.

Prostate - some common prostate cancer symptoms include: weak or interrupted flow of urine, need to urinate frequently (especially at night), blood in the urine, inability to urinate, or difficulty starting to urinate, urine flow that is not easily stopped, painful or burning urination with radiating pain in the back, pelvis, or hips.

An array of diagnostic tests will need to be done to accurately confirm a diagnosis of cancer and come up with an individualized treatment plan.

The following are some common diagnostic tests:

- A thorough review of health history
- Physical exam
- Lab tests (blood, urine, etc.)
- Biopsy
- Imaging (X-ray, PET scan, CT scan, MRI, ultrasound, etc.)
- Nuclear medicine scans – bone scans
- Endoscopy
- Genetic testing



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