**Understanding Cancer**

Answering the Important Questions

1. Introduction

Cancer is a scary word to hear in our society. According to the Mayo Clinic, cancer is the second-leading cause of death among humans throughout the world (2018). This considering, most of us, if not all, have had first-hand experiences with it. Whether it has been through our own battle with it, a loved one’s diagnosis, or through popular culture where it is depicted and discussed regularly. Due to cancer’s vast prognoses and broad scope of symptoms/illnesses, it can be intimidating to begin learning about. The knowledge you may already have about one type of cancer or one patient may not be applicable to the many other diagnoses out there. In this chapter we are going to learn about the fundamentals of cancer. We are going to address the question, “What actually is cancer?” We will discuss not only the biology of cancer but also the causes, different types of prevention, and treatment options available. While we cannot go into detail about each individual cancer, we will also discuss the most common one, such as breast cancer, leukemia, and lymphoma. After reading this chapter we hope you have a newfound understanding of the disease and can educate others around you in this topic.

1. Cancer 101: What is it?

What is cancer? According to the National Cancer Institute (NCI), cancer covers a collection of different diseases (2019). However, there is a common thread among each type which includes a proliferation of abnormal cells. Simply put, cancer is the abnormal growth of cells. Cancerous cells are irregular and begin dividing at a much faster rate than healthy cells. These cells then accumulate into clusters called tumors and can spread to other parts of the body. Unlike normal cells, cancer cells keep growing and replicating with no pattern or purpose. They are invasive and uncontrollable.

Not only do they rapidly go through mitosis, cancer cells can also impact their surroundings or microenvironment through various methods. Cancer cells do not experience **apoptosis**, or programmed cell death like healthy cells. Usually when the body senses that cells are unnecessary or coming to the end of their life cycle, they will receive signals to undergo this programmed death. In addition to this, cancer cells can influence the environment around them including, other cells, blood vessels, and tissues. They may take a vital organ’s blood and nutrient supply and give it to the growing tumor. Cancer can also take control of the body’s immune system. Cancer cells may evade, disrupt, or utilize the body’s natural defense. For example, a cancer tumor may be able to go undetected by immune cells, cause the immune system to attack their own healthy cells, or inhibit it from working properly so the cancer cells can proliferate at a constant rate. When the amount of cancer cells begins to grow, they can separate from the main tumor and spread throughout the body, through a process known as **metastasis**. Once a cancer is considered metastatic, it is usually harder to treat, it is best to catch it sooner in one localized area.

The NCI also discusses three “drivers” that can all lead to developing cancers (2019). These include proto-oncogenes, tumor suppressor genes, and DNA repair genes. Each of these play a role in maintaining a healthy environment, and when altered have detrimental effects on the human body. First, **proto-oncogenes** are genes that help promote healthy cell growth and division. When they are mutated, or become hyperactivated, they become oncogenes, or tumor forming genes, that make up the cancerous cells and are able to resist apoptosis and continue to survive and flourish when they should be programmed to die. Second, **tumor suppressor gene** alterations lead to a proliferation of tumors that is random and uncontrollable by the body’s immune system. Third, the **DNA repair genes**, that normally help repair the DNA, do the opposite when altered. They begin causing even more mutations to arise within the DNA and are the most likely to result in cancer.

1. Main Causes of Cancer and Ways to Avoid It

According to the NCI, cancer is a genetic disease, which means it is caused by alterations to our DNA (2019). These changes in the genes lead to **mutations**, some that have no effect and some with detrimental effects. Mutations that poorly affect the DNA include deletions, insertions, frameshift, or nonsense of the amino acids that create the codons of the proteins that make up the DNA. As the cells with these mutations rapidly go through mitosis, more and more cells with the same mutation are created. In addition to this, more mutations may arise through the generations of the cells, which are then passed on to their daughter cells; creating a sort of snowball effect. You may then ask, “how do these mutations arise?”

To answer that question, a person may inherit specific genes from their parents that are more susceptible to certain cancers. Then, if a person with these cancer-prone genes is surrounded by **epigenetic factors** (non-genetic influences) that promote cancer development, they are likely to get cancer. Sometimes being in cancer inducing environments is enough to cause the cancer alone or it could all be due to a very random mutation in an unlucky person. And finally, one can cause cancer by exposure to unhealthy or cancer-causing environments. Our cells are constantly dividing so there is a lot of room for mistakes, however, our body usually catches them or they are considered synonymous mutations because they have no effect due to our genetic code’s redundancy.

The Mayo Clinic describes a number of risk factors associated with cancer (2018). These include your age, habits, family history, health conditions, and the environment you live in. Cancers develop at many different rates and some take years to do so. Most cancers are found in patients 65 years or older. Habits such as smoking, drinking, having unprotected sex, or struggling with obesity also can increase the odds of someone getting cancer. In addition to this, one’s relatives may have passed down mutations to younger generations. Chronic health conditions, like diabetes or cardiovascular disease, may also lead to a greater risk of developing cancer.

Sometimes cancer-causing environments are well known and researched so they can be avoided, while others may be unknown until it is too late and the person has already been diagnosed. These avoidable environments include places with extreme radiation, intense UV rays, and excess chemicals. For example, if you spend time outside without sunscreen or protective clothing, in a place near the equator with intense sunlight and heat, you are going to be more likely to acquire melanoma or skin cancer. This is especially true if anyone in your family history has been diagnosed with skin cancer and you have fairer skin (also from genetics). You may also be more likely to get cancer if you work in a chemical plant or even sometimes live near one. While not everything is avoidable, we can do our best to become educated about the causes of cancer and avoid the most extreme places. It is also down to our behavior, for instance, if you go in a tanning bed often, you are increasing your chances significantly of getting skin cancer. Now hopefully with this knowledge, it will make you think before putting your body at risk.

In addition to this, our actions can lead to developing cancers. Whether it be using tobacco products, drinking too much alcohol, or other overuse of drugs, you are altering your DNA over time. While some things can be good in moderation, it is important to know what chemicals you are putting in your body and the potential risks that can accompany too much of them. Sometimes a bad habit is enough to become diagnosed, but other times a generally unhealthy life can too. It is important to always take care of your body and remember that what you put in, is what you get out of it. While eating dessert and junk food here and there is okay, a very poorly nutritious diet combined with a mostly sedentary lifestyle will not work in favor of never developing cancer. Like stated above, everything in moderation, along with a health, active life style, and scheduled cancer screenings, one will be able to avoid or discover a cancer treatment before it becomes lethal.

1. Overview of the Most Common Types

There are so many types of cancers that it would be impossible to cover them all within this chapter. Cancer is such an umbrella term that covers over 100 different diseases that are all potentially lethal. Most are named for where they originated from or are found first. Some originate in a specific organ of the body, while others may arise within due to mutations within specific cells. Therefore, the main categories will be addressed to give a quick overview of the most common types of cancer, based on where they are discovered in the body. These include carcinoma, melanoma, sarcoma, leukemia, and lymphoma.

The most common type and most diagnosed form of cancer is **carcinoma**. Carcinoma cancers are due to mutation in our epithelial cells. Epithelial cells cover the inside and outside of our body, lining our internal cavities and organs as well as forming our skin. Carcinomas are more common because our linings made up of these epithelial cells rapidly divide to protect our vital organs and us from the harsh environment outside. Skin cancer is often a form of carcinoma that can be caused by intense UV rays, which was described in an earlier section of this chapter. Other common carcinomas include lung and breast cancer since both are organs which are covered in epithelial cells. Another form of skin cancer that is common is **melanoma**. This is cancer that arises due to mutation in the body’s melanocytes, which give pigment to our skin and can be found in other tissues as well.

On the other hand, there are a number of cancers that develop in bones, muscles, tendons, and tissues, known as **sarcomas**. These are fairly uncommon. **Leukemia** consists of cancers of the blood that begin in the bone marrow (where blood cells originate from). This is a common kind of cancer found in children and is highly treatable today. The composition of this cancer includes abnormal white blood cells. These cancerous cells crowd the body leading to a smaller portion of healthy blood cells.

Another cancer that affects blood cells, specifically lymphocytes, is **lymphoma**. This cancer arises when there are mutations in the body’s B-cells and T-cells, which normally make up our body’s immune system and fight infections and diseases. These abnormal lymphocytes accumulate in a person’s lymph nodes and lymph vessels. Lymphoma is then typically divided into two main types: Hodgkin and Non-Hodgkin lymphoma. Hodgkin lymphoma usually arises from only B-cells, while the other type can form from either B-cells or T-cells.

1. How is Cancer Diagnosed?

Since cancer is so broad and can affect anywhere in the body, it is hard to describe specific symptoms that will unanimously affect every person diagnosed with it. However, the Mayo Clinic lists some general signs and symptoms to look for (2018). These include, but are not limited to, fatigue, a lump felt under skin, weight change, skin changes—moles, sores, rashes, etc., persistent pain, fever, and general discomfort not due to an illness or injury, and excessive and bleeding and bruising without clear cause. It is important to be aware of one’s body and notice if anything changes over time. If a lump appears and does not go away, one should go see a doctor immediately. Lots of times these signs can be due to underlying causes but it is best to be safe because there is a better prognosis when cancer is caught quickly. If cancer is suspected, a general care doctor might send you to an **oncologist**, a doctor who specializes in studying and treating cancer.

According to WebMD, cancer may be diagnosed through a number of different techniques (2020). Self-examinations are a good place to start when detecting early signs of some cancers. Typically, breast, mouth, skin, and prostate cancers can be found visibly or tactilely. For example, women are encouraged to regularly feel for lumps in their breasts to remain vigilant of cancer. Also, skin cancers usually begin as a mole or unusual growth on the skin which can be monitored over time to see if changes occur. Typically, the most common way to diagnose cancer is through the discovery of a tumor which can be felt or due to unusual symptoms occurring to the patient, but occasionally cancer can be found accidentally.

The first step of diagnosis is a physical exam and overview of the patient’s medical history. The person's vitals are tested along with the composition of their blood, urine, stool, etc. that are sent to a laboratory. For example, the Mayo Clinic describes that leukemia can be diagnosed through an examination of their blood (2018). It is evident when a patient has an unusually high number of white blood cells in relation to red blood cells. Sometimes it takes X-rays, MRIs, CT scans, or arthroscopic surgery to discover if a tumor is malignant or benign, and make an accurate identification of the type of cancer. After the cancer is discovered, a **biopsy** is typically performed to officially identify the type of cancer a patient has. After it is performed, the oncologists study the composition of the tumor in a lab to determine what it is. After the initial diagnosis of cancer, staging occurs which includes figuring out the amount and location of the cancer and whether not it is spread or localized. Then the doctor will determine the stage of which the cancer is at, usually stages I-IV. Stage I meaning the cancer is small, localized, and caught early and Stage IV meaning the cancer is large and spread throughout the body. Typically, cancer in Stage IV is harder to treat and has a worse prognosis than the rest.

1. Treatment Options Available

After diagnosis, it is important to find an oncologist who specializes in the type of cancer and treatment in which the patient has. Luckily, more and more options have become available for the treatment of different cancers. With modern technology, new discoveries are being made every day in regards to cancer research. The rate of surviving cancer has increased dramatically along with increased life spans of those with terminal cases. The Mayo Clinic describes the goal of cancer treatment is to ultimately cure the cancer and restore the patient to their regular health (2018). In addition to this, there are three types of treatments doctors may use. The first treatment utilized is **primary treatment** and its intended goal is to remove the cancer entirely from the body. This is typically surgery, sometimes chemotherapy or radiation. Second, **adjuvant treatment** is used to kill any cancer that remains after the primary care is finished. This may include hormone, radiation, or chemotherapy to kill the few remaining cancerous cells. Finally, there is **palliative treatment** which is concerned with relieving the patients’ pain. This can be used during or after the other types of treatment and is typically in the form of pain medication. Palliative treatment can also be used when someone has a terminal diagnosis. It can be used to treat their symptoms, ease their pain, and allow them to enjoy their last few months or so of life even though there is no cure.

The most common, or well known, of cancer treatment is chemotherapy, but surgery, radiation, or other forms of treatment are also frequently used. **Chemotherapy** consists of drugs injected into a patients’ body that kill all rapidly dividing cells. It can be effective but also hard on the patient’s body because it can also kill healthy cells. People usually lose their hair, have dry lips and skin, have nausea, lose their appetite, and become immunocompromised. Sometimes **radiation** is used to kill cancer through the use of powerful X-rays. **Bone marrow transplan**ts are sometimes used so a patient can receive stronger doses of chemotherapy. It is usually donated by a person who matched with the recipient and is considered a painful surgery to undergo. **Hormone therapy** is also an effective treatment option. This involves blocking the effects of specific hormones that contribute to the survival of the cancer. Finally, there are **clinical trials**, which are experimental studies that try to find new ways to treat cancers that may not respond to the aforementioned treatments.

1. What We Learned

What we hope you will take away from this chapter is a greater understanding of this vast and powerful disease. We learned that cancer is actually a broad cluster of diseases that affect different parts of our bodies. We also learned about a few of the most common types of cancers, as well as the causes, diagnoses, and treatment of cancer. With this knowledge we hope the young readers who have encountered this chapter will look at their lives and consider whether or not they should make some healthy changes to their lifestyle, whether these changes be big or small. It will hopefully give the reader signs and symptoms to be aware of, as well as the tools needed to fight the illness and educate others. Overall, our goal is that this newfound understanding of cancer and its complexities will make the disease a little less intimidating since in our world it is a matter of “when” rather than “if” an individual will encounter cancer to some extent in their lifetime.

References

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