

Cancer and How to Improve its Survival Rate

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ABSTRACT

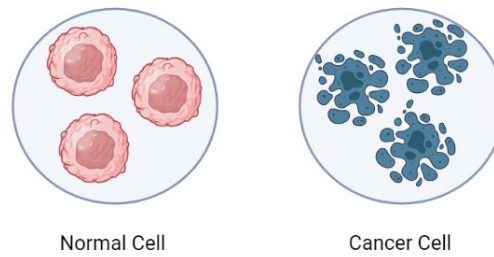
Cancer affects millions of people throughout the world in unimaginable ways. People end up really sick or even pass away due to this sickness. In this paper, various parts of cancer such as its formation, its spread, its treatments, and how many people are affected by it are discussed. There are many cancer causing factors that can be decreased. Along with that, treatments such as radiation, chemotherapy, surgery, and more can be studied to create a better chance at survival for cancer patients. All of these factors allow for a deeper understanding of cancer which is vital to improving cancer's survival rate and how many people it affects on a day-to-day basis.

Introduction

Cancer is one of the most draining sicknesses a person can have and it is the second leading cause of death in the world. People first go to the doctor thinking it is nothing and then they have cancer and their entire life is flipped upside down. You go from living life to the fullest and the next you are stuck in a hospital bed with your hair falling out and your appetite disappearing. These patients show symptoms such as lumps, nausea, pale skin, and more. These patients now have to go through surgeries, various types of radiation, chemotherapy, immunotherapy, stem cell transplants, and targeted therapy. These treatments take a huge toll on a person's body and not only does cancer affect a person physically, but it also affects them mentally. Sometimes these treatments do not work on patients and they are left terminal and most often in pain. Cancer is such an enormous part of our society and it continues to affect more and more people. It is extremely important, especially now, that cancer can be identified and classified so that cancer treatments can be improved. When they are improved it will greatly improve the survival rate of cancer patients.

What is Cancer and its causes?

Cancer begins to form in the body when a person's cells start to grow uncontrollably rather than growing and dividing. Then these cells that continue to grow uncontrollably start to metastasize in other parts of the body. DNA plays an enormous role in cancer formation. Cancer typically grows in areas where there is damaged DNA because the cells cannot repair the damage to the DNA. Cancer is typically identified with a tumor but some cancers do not form tumors. These tumors can be benign or malignant. Benign tumors are not cancerous and do not grow but malignant tumors are typically cancerous and grow uncontrollably. Cancer cells vary greatly from normal, healthy cells. Normal cells are circular in shape and do not have any abnormalities. On the other hand, cancerous cells and their nuclei are oddly shaped.



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Figure 1. The visual differences between a normal cell and a cancerous cell.

Cell proliferation is a major part of how cancer forms in the body. Cell proliferation is how fast cells in the body divide and multiply. The early stages of tumor formation in the body require a fibrogenic response which causes the early stages of the cancer cells to develop even further in the body. A fibrogenic response causes a hypoxic environment in the body which is key for cancer formation. A hypoxic environment means that there is a depletion of oxygen. Many cancers that begin as benign are transformed because of this hypoxic environment in the body and that is what causes the cancer to metastasize and spread throughout all the systems of the body. Carcinogenesis is when cancer formation in the body begins. It causes changes in tissue structure and with the identification of preneoplastic nodules tumors can be identified early and the cancer forming processes can be treated. In adults, cancer usually develops because of mutations in various genes. These genes play a massive role in how the metabolism works in the cells and they also control the growth and development of these cancerous cells.

Metabolism plays a large role in the growth of cancerous cells in the human body. When cancer grows it uses proteins, lipids, and nucleic acids and these cells acquire metabolic intermediates. This process is called metabolic perturbation. Metabolic perturbation allows cells to accumulate something called metabolic intermediates. These metabolic intermediates then become building blocks of these metabolic processes of cancer formation. One of the most well-known of this process is called the Warburg effect. This is where the carbon obtained from glucose, rather than oxidizing all the cells to carbon dioxide, is used to build other various types of molecules. The Warburg effect mainly uses the process of fermentation as opposed to oxidizing carbon dioxide.

In cancer formation in the body metabolism plays a huge role and for the metabolism process to occur fatty acids are extremely important. Fatty acids play an enormous role in cancer cell proliferation. It is believed that limiting fatty acids in the body can decrease the formation of cancer. This would help decrease cancer cell formation because fatty acids fuel the metabolic processes of the body such as metabolic perturbation. Fatty acids can be limited by increasing fatty acid degradation through oxidation processes, transforming the fatty acids to storage, blocking fatty acid synthesis in the body, or releasing fatty acid release from where it is stored. Fatty acids block a lot of systems in the body. Without these fatty acids processes can occur like normal and there are no major blockages in the various parts of the body that can cause the formation of cancer.

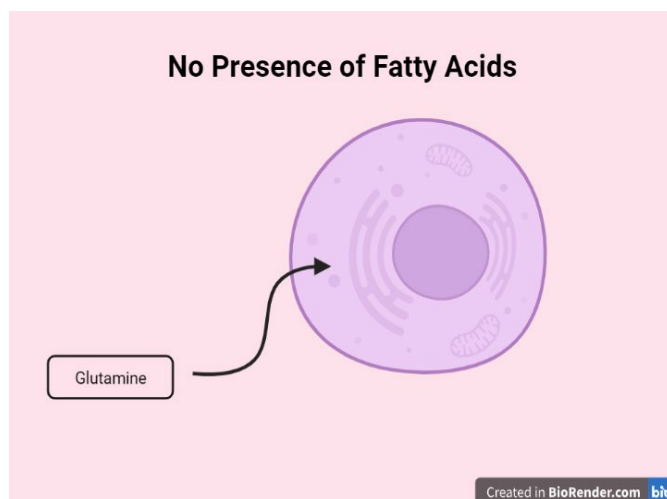


Figure 2. Without the presence of fatty acids glutamine can freely flow into a cell.

Certain molecular mechanisms alter the way the body works and functions. This can then cause cancer but with further study of molecular mechanisms cancer can be identified earlier and it can help identify risk factors. Furthermore, identifying these molecular mechanisms can improve treatments and drugs. “Proven methods of prevention and early detection could further reduce the incidence of adult cancers in the U.S. by at least a third to a half and reduce cancer deaths by $\geq 50\%$ ” (Golemis et al., 2018).

It is well known that smoking can contribute to lung cancer and skin cancer, but smoking can actually not only contribute to lung and skin cancer but all other types of cancers as well. It is also known that cancer susceptibility increases at older ages.

At first, it was believed that cancer formation consisted of about six main stages but now it is known that it is a combination of many different factors that then contribute to uncontrollable cell growth. This includes various factors such as changes in genes like oncogenes and tumor suppressor genes. Both processes occur before rapid cell growth, and they cause DNA sequence changes and mutations that can lead to cancer. It is not exactly certain how many stages it takes for cancer to form because it varies from cancer to cancer, but it is confirmed that cancer formation is due to a number of internal and external factors. As mentioned earlier, mutations are a major part of the internal factors that cause cancer, but they can also be a part of the external events that can cause cancer cell growth. Either way, these mutations are causing changes in the chemistry and structure of cells which then can increase the speed of the cancerous cell growth.

Cancer treatments

Cancer treatments encompass a plethora of methods that aim at shrinking and even eliminating cancer in parts of the body. These treatments can include Chemotherapy, Gene therapy, Stem cell, Radiation, and surgery. Each of these methods uses various techniques and approaches when trying to eliminate cancer from a patient’s body.

Chemotherapy is one of the treatments used to treat cancer. No cancer cells have the possibility of survival with chemotherapy, but chemotherapy targets all cells. When chemo targets all the cells it is killing the cancer cells but it is also killing the healthy cells. This begins to decrease and even destroy some functions that occur in the body. A way to improve the survival rate and even the quality of life with chemotherapy is being studied. Scientists are trying to isolate only the cancerous cells and not the healthy cells along with it. Doxorubicin (DOX), a large part of chemotherapy, is known to kill the healthy parental cells along with the cancerous ones and studies are being done to find a drug to save the healthy parental cells and kill just the cancerous ones. A trial was done to test the parental cell

survival with different concentrations of DOX in the body. It was discovered that one drug alone can not kill just the cancerous cells. Instead, a mixture of at least two drugs needs to be used. It was discovered that a combination of DOX and taxol (PTX) was the answer. This combination of DOX and PTX kept the parental cells healthy and destroyed the cancerous cells.

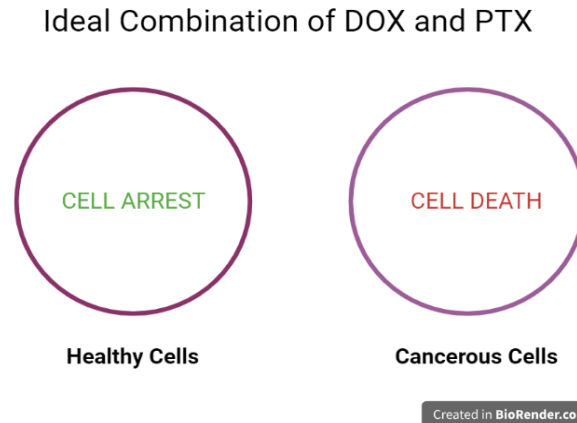


Figure 3. A combination of DOX and PTX produces the best results regarding chemotherapy.

An alternate treatment method for cancer is Gene therapy. Until fairly recently, gene therapy has not really been approved in the United States as a way to treat cancer. With gene therapy, there are many processes that can occur to fight the cancer cells in the body. This can include targeting certain tumors, “gene delivery of tumor antigens and growth factors, gene-modified antigen-presenting cells, gene editing in vivo, gene interference by vectored RNA interference, suicide gene therapy, and native oncolytic viruses and bacteria” (Husain et al., 2015). In the United States gene therapy studies and processes are mainly overseen by two federal agencies: the Food and Drug Administration (FDA) and the Office of Biotechnology Activities (OBA).

There are generally two main types of gene transfer vectors that assist with gene therapy related to cancer cells. The two types fall under the categories of viral and nonviral. Viral vectors typically have a better chance of spreading and getting to the targeted cells. Some of these viral vectors include “retrovirus, lentivirus, adenovirus, adeno-associated virus (AAV), herpes simplex virus, poxvirus” (Husain et al., 2015) and they usually send genes for tumor-related parts of the body.

Stem cell research is another treatment used with cancer patients. The idea of stem cells was first introduced in the 1800s. It began as just a simple theory about the structure of cells but it took more than 100 years for it to be theorized as stem cell research. Stem cells were first discovered in brain cancer, then breast cancer, and lastly in skin cancer. Most stem cells were believed to exist within these cancers but further studies proved they were not. It was understood that markers on these cancer cells did not necessarily mean that they were in accordance with cancer stem cell research. There is still a large number of studies taking place because some aspects of stem cells are still being studied and, in the future, it can greatly change the treatment of cancer.

With cancer treatments radiation is another type of treatment and it is used quite frequently. Radiation has been greatly improved from when it was discovered and studied a long time ago by Wilhelm Conrad Röntgen and Marie Curie. Radiation is a physical agent, and it uses ionization to kill cancerous cells. The charged particles leave deposits of energy in bodily tissue which then kills these cells. Although the process of radiation is fairly effective it can still have many negatives. While radiation kills cancerous tissue and cells it also destroys the DNA found within the body. Radiation can either shrink and it can even sometimes completely kill the cancer.

Radiation is used both as a cure and also as a part of treatment. It can sometimes be used alongside surgery or chemotherapy and when radiation is used as a treatment it allows the patient to experience fewer symptoms. The radiation is usually delivered to the cancer with external beams and internal. External radiation is more common and it uses high, powerful beams to target the tumor. Internal radiation usually involves some sort of radioactive element

that is transferred through tubes or catheters. Cancers such as skin cancers, cervix carcinomas, and lung carcinomas can be completely eradicated with radiation therapy alone. On the other hand, there are some cancers that can not be completely destroyed with just radiation therapy. That includes cancers such as breast carcinomas, rectal carcinomas, and more. Radiation is now being studied even more and more and more improvements are being made so the efficiency of radiation therapy increases even more.

Lastly, Surgery is a treatment used to kill the spread of cancer throughout the body. It is sometimes used solely by itself but in many cases, it is used along with some of the other treatments previously mentioned. All of these treatments work together in one way or another to stop and kill all the existing cancer cells in the body.

As beneficial as cancer treatments are they can still have numerous negative effects on the people undergoing them. Treatments such as chemotherapy and radiation can cause fatigue and sickness. They can also cause hair loss which people commonly associate with cancer treatment. Most of these treatments are uncomfortable and painful for the patients undergoing them but without them the mortality rate of cancer would greatly increase.

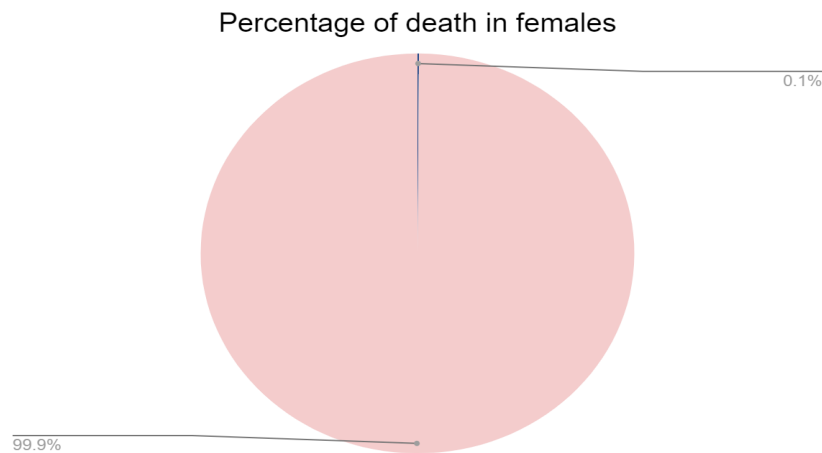
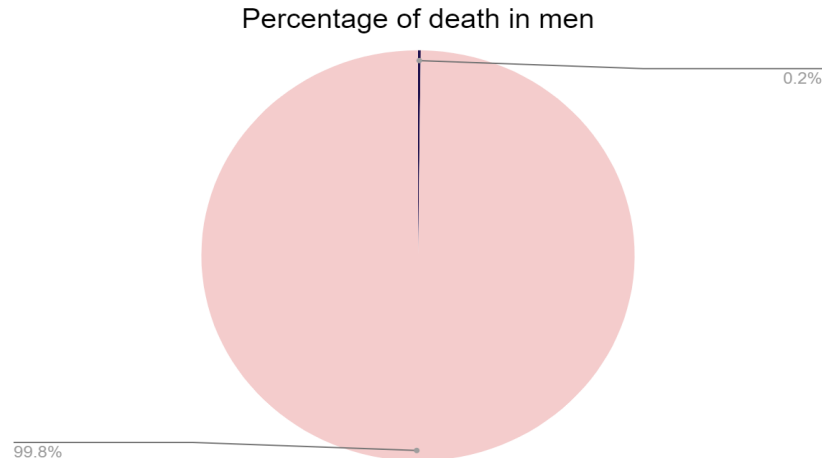
As advancements are being made on all of these treatments, they are slowly improving their effectiveness and as they continue to improve and implement the new processes that are being studied then cancer patients will have a much better chance at survival.

Who does cancer affect?

The most common type of cancer that is seen to affect the most people around the world is lung cancer but in the United States that is not the case. Breast cancer is the most common type of cancer found in the United States and although it is not common it can occur in not only women but also men. Along with breast cancer, the second most common types of cancer include lung cancer as well as prostate cancer. By the end of this year breast cancer is expected to have affected over 300,500 people just in the United States. Cancer rates continue to grow and affect people all over the world and the United States and by understanding how it forms, how to prevent cancer, and what the treatment options are, hopefully, that number can begin to decline in the upcoming years.

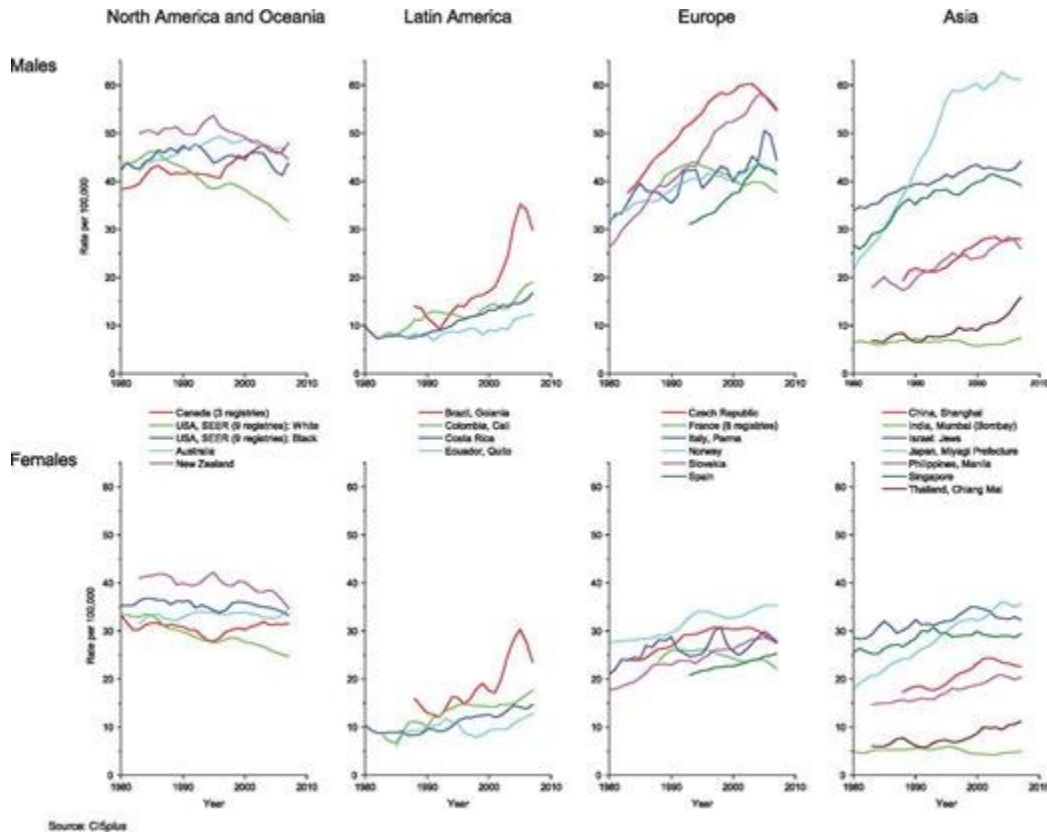
In most cases, cancer's fatality is dependent on how far it has spread throughout the body. If cancers are caught at earlier stages there are much better chances of survival compared to if cancer is caught at stage four or five. Studies are being done and even machines are being made to diagnose cancer at the earlier stages where it is sometimes difficult to detect. With the earlier detection survival rates of cancer will greatly increase.

Even with the technological improvements cancer cases are expected to increase being of the growing population and its exposure to cancer-causing events. "the number of cancer cases and deaths is expected to grow rapidly as populations grow, age, and adopt lifestyle behaviors that increase cancer risk" (Torre et al., 2016). It is also noted that cancer rates tend to be higher in higher-income countries compared to lower and middle-income countries. This is because of the higher obesity rate, tobacco consumption rate, and so many more. The cancer occurrence and death rates of cancer tend to be larger in men than women. There is not an exact explanation as to why but overall the most death rates experienced by men and women from cancer were in the countries North America, Oceania, and Europe.



Charts 1 and 2. Compare the percentage of cancer death in males and females.

As mentioned earlier environmental factors do play a huge role in cancer and because they do the cancer rates and even the types of cancer that each country is most affected by varies greatly. For example, prostate cancer is the most common in countries like North and South America. Lung cancer is most commonly diagnosed in Europe, and it is mainly diagnosed among males. Most commonly across the world males are most affected by prostate cancer and prostate cancer is slowly followed by lung cancer. In women across the world breast cancer is the most common by a large margin. It is then followed by cervical and lung cancer. Lung cancer is more often seen in males because smoking was introduced much earlier to men than it was to women. Colorectal cancer which included colon cancer as well as rectal cancer has had extremely high incidence cases and deaths. The graph below identifies colorectal cancer trends in males versus females in various countries of the world.



Graph 3. Shows the colorectal cancer trends in various countries. Copyrighted from (Torre et al., 2016)

Conclusion

After discussing the processes of cancer and how it forms in the body, its treatments, and more we can better understand what needs to change and what needs to stay the same. Risk factors of cancer were identified and many of these are easily preventable. In the future, they should be able to assist with the decrease of cancer incidences. Additionally, many treatment options for cancer were thoroughly discussed and these treatments are still being studied and improved to increase the human population's survival rate of people affected by cancer. Overall, I do believe with all of these considerations that improvements and advancements can be made in the field of cancer which in turn will increase survival rates of cancer and even decrease the cancer incidence rate.

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