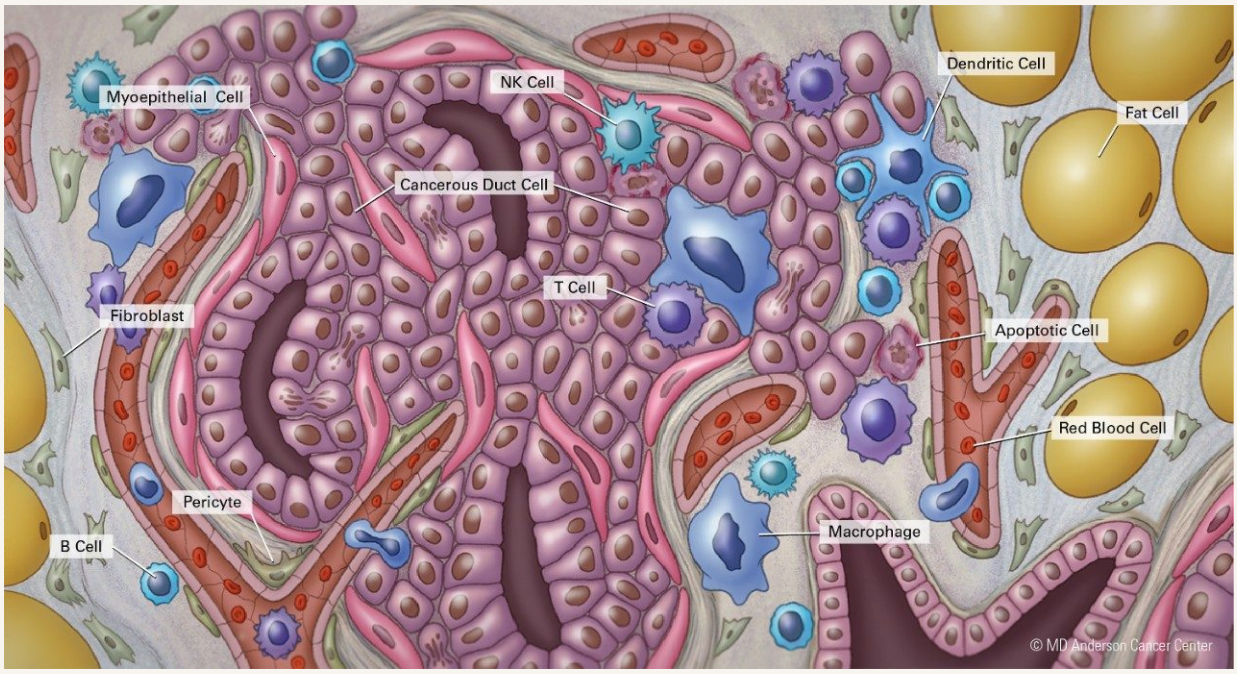


The image to the left is an artistic rendering of the tumor microenvironment. Some of the different components that may be found are labeled on the image[3].

Reshaping the Battle Against Cancer

How understanding the tumor microenvironment may alter modern research to battle cancer

The war against cancer continues to be long and arduous for scientists all around the world, with no true end in sight. Some battles have been won, while others still seem insurmountable. Presently, more and more discoveries are being made, and more tools are being developed, to give scientists an advantage.

One such discovery is of the cancer microenvironment, a term that refers to the totality of the tumor and the additional cells that the cancer takes control of, such as nearby body cells, immune cells, and cells involved in communication throughout the body. This new information about cancer will allow scientists to develop new treatments that can specifically target all components of the cancer, rather than the tumor alone.

"In 2019, Cancer was listed as the second leading cause of death in the United States"

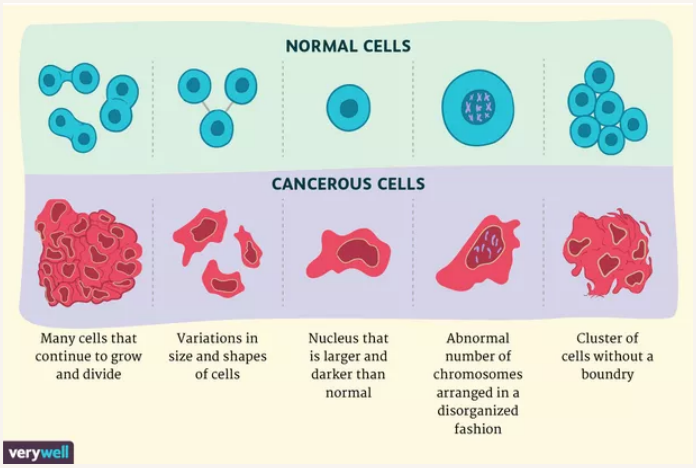
What is Known

Cancer is a disease defined by the uncontrolled growth of abnormal cells in the body; these cells clump together to form a mass known as a tumor.

In 2019, cancer was listed as the second leading cause of death in the United States, resulting in almost 600,000 deaths, according to the CDC[1]. Further, more than 1.6 million people are diagnosed with cancer in the United States alone each year.

Due to the fact that there are many different types of cancer that exist, it is very difficult to cure cancer as a whole; each type of cancer requires a specialized treatment plan. For example, breast cancer can be treated with surgery or hormone-blockers. On the other hand, prostate cancer can be treated with chemotherapy or cryotherapy, where a probe is used to freeze and kill the cancer cells[2].

It is especially difficult to cure a patient's cancer when it is caught in the later stages. Stages is a common term used by doctors to describe the size of the cancer and how far it has spread in the patient's body. Stage I is the lowest stage, sometimes referred to as early-stage cancer, and defines a small tumor that is localized to one area of the



The image to the left differentiates characteristics in normal and cancerous cells. The images on the top, in blue, showcase the behavior of normal cells. The images on the bottom, in red, reveal the behavior of cancerous cells[4].

body. Stage IV is the highest stage and is sometimes referred to as advanced cancer; this stage is when the tumor is large and the cancer has spread far into the body.

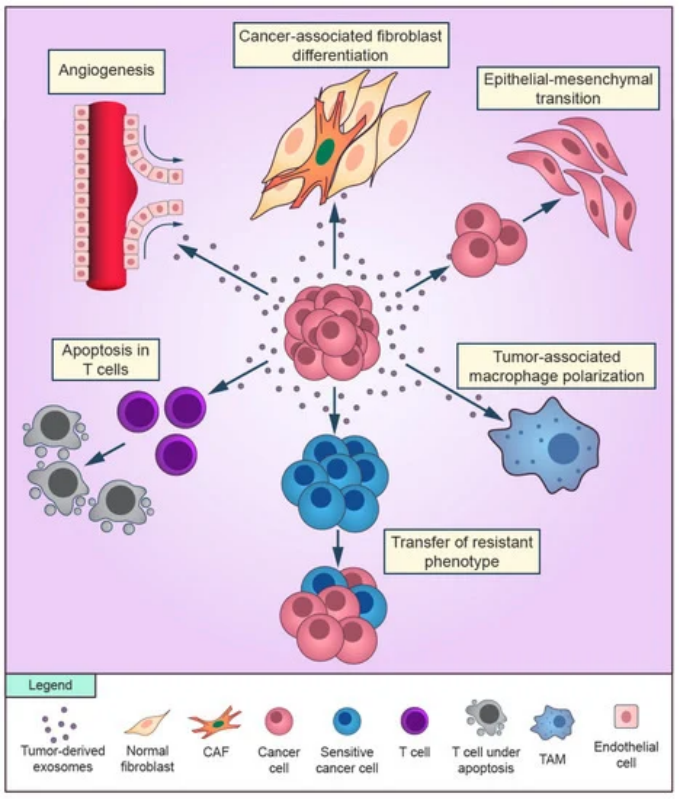
While there are currently some existing cures for specific types of cancers, there are still untreatable forms of cancer as well, such as mesothelioma - cancer within the lining of the abdomen, or pancreatic cancer, which both have a survival rate of about 7%[6]. Thankfully, scientists are learning more about cancer and how it works everyday.

What is New

It is known that cancer causes a tumor to form in the patient's body. However, there is more to cancer than just the tumor, as scientists are now discovering. The tumor, and all the other cells that it controls, is now referred to as the cancer microenvironment.

Think of it like this: the tumor is the base of operations where the battle, where the cancer, is localized. However, a battle needs more than a base of operations, which is where the tumor microenvironment comes in. In order to control its forces, the base of operations needs messengers; in order to continue to grow, the tumor needs to take over cells involved in communication. To prevent others from destroying it, the base of operations needs soldiers; to prevent the body from getting rid of it, the tumor takes control of immune cells to hide itself. To continue building, the base of operations needs architects; to continue growing, the tumor needs nearby cells to build it up and allow it to spread. All these additional pieces make up the tumor microenvironment.

As such, scientists now understand that there is more to cancer than the tumor itself. This helps to answer questions scientists have had about how cancer works. For example, how is the tumor able to grow so continuously without being destroyed by the body? As mentioned in the analogy above, the tumor is able to take over some of the immune cells that would otherwise destroy it, preventing any news of its appearance from reaching the rest of the body.



The image to the left is another artistic depiction showing a tumor taking control of various components that may be found in the tumor microenvironment[5].

There are additional elements to the tumor microenvironment that were not mentioned above; some examples are the blood vessels and tumor stroma, which usually refers to the connective tissues holding the tumor together. Most importantly about this information is that, as a result of this new understanding of the tumor and it's microenvironment, new treatments for cancer may be developed.

"The nanovaccine acts as the opposing force to the cancer, where the nanoparticles are the vehicles and planes that carry the opposing forces, and the vaccine is the medicine that acts as that opposing force."

Future Treatments

There are various types of treatments being used right now against cancer. There is chemotherapy, where the patient's body is bombarded with drugs that do harm both to the cancer and the rest of the patient as well. There is surgery, where the tumor is cut out of the body, but runs the risk of the surgeon missing a piece or being unable to remove everything due to its location. And, more recently, scientists have begun trying to use vaccines to prevent cancer and, in some cases, treat cancer.

Specifically, nanovaccines are becoming more common as researchers turn to nanomaterials to help guide their medicine to specific areas of the body; nanovaccines themselves are simply the combination of vaccines and nanoparticles, which are particles between 1 and 100 nanometers in diameter - smaller than the diameter of the period at the end of this sentence. The nanovaccine acts as the opposing force to the cancer, where the nanoparticles are the vehicles and planes that carry the opposing forces, and the

vaccine is the medicine that acts as that opposing force.

Dr. Prabhani Atukorale, professor at the University of Massachusetts, Amherst, is one researcher who is taking advantage of her knowledge on the tumor microenvironment. The Atukorale lab, located at the UMass Medical Campus, is attempting to create a cancer nanovaccine that actively targets different components of the tumor microenvironment. Her hypothesis is that targeting the nanoparticles at and around the tumor, utilizing the microenvironment, will allow more of the vaccine to arrive at the tumor than a vaccine without any specific targeting in place.

Looking further into the future, additional research into the tumor and the tumor microenvironment is required to further advance treatments. Scientists may study the differences between the patient's cells and cells that are under the cancer's control, producing a comprehensive list of targets for the nanoparticles to carry the vaccine to. Other research may even be conducted into how the cancer recruits the patient's cells for itself, allowing researchers to prevent cancers from spreading from the start. A greater understanding of how the tumor works can only lead to a greater understanding on how to stop it, once and for all.

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Additional Information

For an animated video explaining different components of the tumor microenvironment, check out this video: "Cancer Cell Culture: Diversity of Cells in the Tumor Microenvironment (TME)"

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