

2020 PSBR High School Essay Contest
Grand Essayist

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In 2011, my grandmother was diagnosed with stage 3B lung cancer and given a 5% chance of surviving five years. Today, in 2020, she is still alive thanks to biomedical research dating back to 1909. A beneficial aspect of her treatment was radiation. During treatment, ionizing radiation passes through cells and deposits its energy to create a small break in the DNA of cancer cells, which eventually causes them to die. Radiation is extremely common and effective because it is given locally and targets only cancerous cells, with as little damage as possible to healthy cells.

Due to the unpredictable nature of cancer, specificity is a critical element of radiation. Recent technological advances have made it possible to specialize treatments. For example, my grandmother was given stereotactic body radiation therapy (SBRT). SBRT is an extremely precise type of radiation therapy which can be given in only one dose or in a few fractionated doses, because it involves multiple beams of radiation. It was beneficial for my grandmother because it was given immediately and in only one dose, so her tumor could be targeted as soon as possible.

SBRT and radiation in general were made possible due to a series of discoveries that enabled scientists to understand cancer, and thus, how to target it. In 1909, a biologist named Peyton Rous found a tumor on a chicken. He decided to remove a small piece of it, grind it up, and filter it in order to remove any cells. He injected this liquid into several other chickens and was shocked to find that they all also grew tumors. The results of this experiment were groundbreaking because until that point, there was no evidence of a noncellular agent that could cause cancer (understood today as a virus). Many years later, scientists began to understand the real significance of Rous' discovery. The virus became known as the Rous sarcoma virus (RSV), which would lead to many more breakthroughs and assist scientists in taking the first step to fully understand cancer.

When Rous' work resurfaced in the 1960s, scientists' first question regarded how the virus caused cancer. They inferred that because the virus was present in every tumor cell, it must be incorporated into the cell's DNA. In 1970, they finally narrowed in on one gene in the viral be incorporated into the cell's DNA. In 1970, they finally narrowed in on one gene in the viral (short for sarcoma). However, researchers were taken by surprise when they found that the genetic material of the virus was made of RNA instead of DNA, which went against biology's dogma. Eventually biologists Howard Temin and David Baltimore were able to provide an explanation: RSV contains an enzyme called reverse transcriptase, which transcribes RNA into DNA. This viral DNA is then incorporated into the cell's DNA. Viruses with this characteristic soon became known as retroviruses.

Further research by Harold Varmus and J. Michael Bishop presented a gene similar to src in other birds, such as ducks and quail (although RSV had only been found in chickens). Researchers were soon able to confirm that a gene similar to src was present in all animals. This implied that src was originally a normal gene, but became viral when RSV picked it up along its course, specifically in the chicken. Thus, oncogenes (genes that can transform cells into tumors) were finally understood to be constantly lurking in our DNA with the potential to cause cancer.

If src was originally a normal gene that was present in all animals, how could it cause cancer when picked up by a certain virus? Biologists eventually discovered that src makes an enzyme called kinase, which removes phosphates from ATP and attaches them to other proteins (changing their function), a process known as phosphorylation. For a period of time, kinases control the development of the cell, but the src gene typically turns them off. In mutant src, however, kinases cannot be turned off, so they continue phosphorylating without end, contributing to the feverish nature of cancer.

Since src was discovered, many other oncogenes have been discovered. Some have been picked up by viruses while others were mutated within a normal cell's genome. The knowledge of how oncogenes work and how cancer works in general has changed the treatment process dramatically. It was because of one chicken, some technological advancements, and excessive amounts of biomedical research that so many breakthroughs were made in treating cancer. Cancer is complicated, but understanding its complexity has saved many lives, including my grandmother's.

Works Cited

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