Henrietta Lacks and Her "Immortal" Cells

HUNTER KAPPEL '14

In 1951, a scientist at the Johns Hopkins University Medical Center created the first immortal human cell line. He used a tissue sample taken from a young black woman with cervical cancer named Henrietta Lacks. Her cells had a groundbreaking impact on modern medicine (1).

Henrietta Lacks—born in 1920 in rural Maryland—was a poor illiterate tobacco farmer. She was the great-great-granddaughter of slaves, and she died at the age of 31. She left behind five children. No obituaries of her appeared in newspapers, and she was buried in an unmarked grave (2).

To scientists, Henrietta Lacks became known as HeLa, from the first two letters of her first and last names. The cells taken from her cervix were the first "immortal" human cells to grow in culture (2).

Lacks' husband took her to Hopkins in 1951, as it was the only major hospital near their home that treated black patients (3). Doctors at Hopkins diagnosed her with cervical cancer, specifically "Epidermoid carcinoma of the cervix, Stage I." Cancer originates from a single cell gone wrong and is categorized based on that cell type. Henrietta Lacks developed a type of cervical cancer called a carcinoma, which grows from the epithelial cells that cover and protect the surface of the cervix. When Henrietta Lacks visited Johns Hopkins, doctors at the hospital were involved in a nationwide debate over what constitutes cervical cancer and how best to treat it (3).

Cervical carcinomas are divided into two types: invasive and noninvasive. In 1951, most doctors believed that invasive carcinomas were fatal, and noninvasive carcinomas, or carcinomas *in situ*, were not fatal. Doctors aggressively treated the invasive type and generally did not worry about the noninvasive type because they thought that it could not spread. Richard TeLinde, one of the top cervical cancer experts in the country, disagreed. He believed carcinoma *in situ* was an early stage of invasive carcinoma (3).

TeLinde would review all medical records from patients who had been diagnosed with invasive cervical cancer at Hopkins in the past decade to see how many initially had noninvasive carcinomas. TeLinde often used patients from the public wards for research, usually without their knowledge (3). He found that 62 percent of women with invasive cancer first had noninvasive carcinomas. TeLinde tried to grow living samples from normal cervical tissue and from living samples from both types of cancerous tissue in order to compare all three. He contacted the head of tissue culture research at Hopkins, George Gey (3).

Gey was "determined to grow the first immortal human cells: a continuously dividing line of cells all descended from one original sample, cells that would constantly replenish themselves and never die" (3). Thus when TeLinde offered Gey a supply of cervical cancer tissue, Gey gladly attempted to grow living samples from this tissue. TeLinde began collecting cervical cancer tissues from all women with cervical cancer who visited Hopkins, including Henrietta Lacks (3).

Lawrence Wharton Jr., a surgeon at Hopkins, proceeded to treat Henrietta Lacks' invasive carcinoma with radium. Before treating her tumor, however, he collected samples of both her cancerous and healthy cervical tissues (3).

When Wharton finished operating on Lacks, he wrote in her chart, "The patient tolerated the procedure well and left the operating room in good condition." He also wrote, "Tissue given to Dr. George Gey" (3).

Gey successfully grew a culture of Lacks' cancerous cells. According to journalist Rebecca Skloot, author of *The Immortal Life of Henrietta Lacks*, "Henrietta's cells weren't merely surviving, they were growing with mythological intensity" (3).

Following Lacks' death in 1951, doctors began planning a massive operation to produce trillions of HeLa cells each week: a HeLa factory. One of the primary purposes of starting such a factory was to help stop polio (3).

HeLa cells improved and standardized the field of tissue culture. Doctors froze HeLa cells and, for the first time, closely examined cell division. Freezing was one of the first of several major improvements HeLa cells brought to the field of tissue culture. Besides freezing HeLa cells, doctors also cloned HeLa cells. They were the first human cells to be cloned (3).

The early cloning technology that started because of HeLa cells led to many other advances that also necessitated the ability to grow cells in culture. Such advances included isolating stem cells, cloning entire animals, and *in vitro* fertilization (3).

HeLa cells also led to advances in human genetics. Scientists had long incorrectly believed that human cells contained forty-eight chromosomes. They struggled to get an accurate count because chromosomes clumped together. In 1953, however, a geneticist in Texas accurately calculated the number of chromosomes in a human cell after mix-

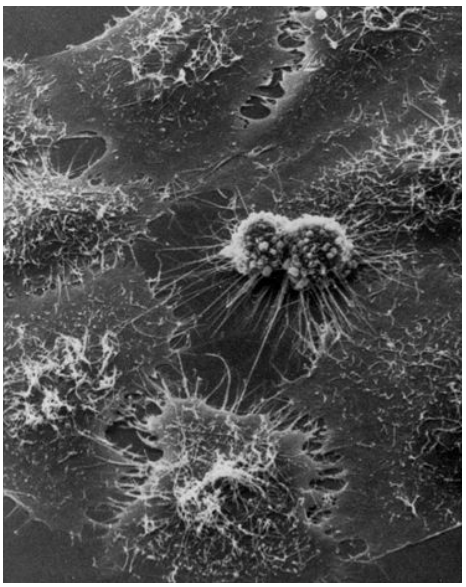

Image retrieved from http://commons.wikimedia.org/wiki/File:Hela_Cells_Image_3709-PH.jpg (Accessed 8 May 2011).

HeLa cells undergoing division.

ing a liquid with a HeLa cell. The chromosomes inside the HeLa cell spread out, and the geneticist was able to clearly see the chromosomes inside it (3).

As a result of the discovery in Texas, two other geneticists from Spain and Sweden discovered that the normal human cell has 46 chromosomes. Now that scientists knew the number of chromosomes contained by such a cell, they could tell when a person had a surplus or a dearth of chromosomes. Scientists in turn made it possible for doctors to diagnose genetic diseases. Researchers began identifying and classifying chromosomal disorders. Researchers discovered that the cells of patients with Down's syndrome, Klinefelter syndrome, or Turner syndrome all either contained too many or too few chromosomes (3).

Scientists also exposed HeLa cells to radiation to better understand the effects of nuclear radiation on human cells. Scientists put HeLa cells in centrifuges, in which the pressure was 100 times that of gravity, to examine what happened to cells under the conditions of spaceflight and deep-sea diving (3).

HeLa is not the only cell line used in research today. Even though it is the most commonly used cell line, others common cell lines and their origins include: 3T3 (mouse embryo), MCF7 (69 year old woman), VERO (African green monkey), JURKAT (14 year old boy), HEK-293 (human embryo), HT-29 (44 year old woman), COS-7 (African green monkey), MDCK (Cocker Spaniel), and LNCAP (50 year old man) (4).

Scientists used HeLa cells in order to make advances in all of the following: virology, polio, scientific standards, live cell transport, genetic medicine, clones, for profit distribution of cells, space biology, genetic hybrids, ethics, salmonella, HPV, HIV, telomerase, tuberculosis, and nanotech (4).

In 1952, researchers infected HeLa cells with many diseases such as mumps and measles, which led to the creation of the modern field of virology. Researchers also discovered that the cells were susceptible to polio; they used the cells in Salk's vaccine, the largest vaccine field trial to date. The cells were grown in bulk and used to test glass used in beakers and slides. Scientists also discovered a way to transport live cells and to therefore mail them around the world.

In 1953, geneticists discovered that when a stain called hematoxylin is mixed with a HeLa cell, the chromosomes contained by the cell become visible. In 1954, scientists developed a method for keeping single cells alive long enough to replicate them. HeLa cells thus allowed for many advances and developments to be made in the field of cloning human cells (4).

In 1954, Microbiological Associates began commoditizing HeLa cells and mass producing them. In 1960, HeLa cells were sent into space in a Soviet satellite prior to the flight of any astronauts. NASA later included HeLa cells in their first manned mission, and they discovered that cancer cells grow faster in space (4).

In 1965, scientists fused HeLa cells with mouse cells and created the first cross-species hybrid. This genetic hybrid allowed for advances to be made in the field of gene mapping (4).

HeLa cells also allowed for advances and developments to be made in the field of medical ethics. It was after scientists injected patients with cancer cells to discover how cancer spreads that medical review boards and informed consent by patients were both institutionalized (4).

In 1973, scientists used HeLa cells to better understand the invasiveness and infectiousness of salmonella, and they also used HeLa cells to study the behavior of salmonella inside human cells (4).

In 1984, more than thirty years after Lacks' death, German virologist Harald zur Hausen helped uncover how Lacks' cancer started and why her cells never died. He discovered a new strain of a sexually transmitted virus called Human Papilloma Virus 18 (HPV-18). He used HeLa cells to prove that HPV-18 causes cancer (3).

A molecular biologist named Richard Axel used HeLa cells to determine what was required for HIV to infect a cell. He infected HeLa cells with HIV and discovered that HIV infects not only blood cells. This was an important step toward understanding and potentially stopping HIV (3).

In 1989, a scientist at Yale University explained the mechanics of HeLa's immortality. He used the cells to discover that human cells contain telomerase, an enzyme that rebuilds a cell's telomeres. The presence of this enzyme prevents HeLa cells from dying (3).

In 1993, scientists exposed HeLa cells to *M. tuberculosis* to learn how the disease attacks human cells (4).

In 2005, researchers used HeLa cells to test nanotechnology, injecting HeLa cells with iron nanowares and silica-coated nanoparticles (4).

Scientists have used HeLa cells to develop many vaccines. They have exposed the cells to radiation, cosmetics, drugs, household chemicals, viruses, and biological weapons. Without HeLa cells, we would not have tests for diseases such as polio, HIV, and tuberculosis. We would not be able to test potential drugs for breast cancer and leukemia. Without HeLa cells, the human biological materials industry would be short millions of dollars. HeLa cells have become essential to the groundbreaking biological research that continues today.

References

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