Summary Article: Radiation Exposure
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Through many years of research and scientific studies, researchers have found that radiation is a carcinogen. The three most common forms of radiation that are seen in clinical settings include alpha radiation, beta radiation, and gamma radiation. Although some types of radiation such as X-ray are important in diagnosing possible cancer sites, too much of it can cause cancer. The primary damage caused by radiation is to the deoxyribonucleic acid (DNA)—the genetic materials of living cells. Thus, to lower the risk of radiation-induced cancer, people need to be more aware of the kinds of radiation that they can become exposed to.

INCIDENTS SHOWING THE LINK BETWEEN CANCER AND RADIATION

There have been many past incidents that indicate that radiation can cause cancer. Most of the data come from people who have inadvertently been exposed to various types of radiation in the past. As part of his discussion on radiation carcinogenesis, Steven B. Oppenheimer explained that the incidence of thyroid cancer is higher in people who have been treated with radioactive iodine. Radioactive iodine gathers in the thyroid once it is injected into the body. In another case, individuals who were once treated by x-ray irradiation of the head to get rid of scalp ringworms often developed head and neck cancers 10 to 20 years later. Also, people who have had jobs that exposed them to X-ray and radioactive chemicals (atomic bomb or the nuclear industry) often developed some kind of cancer in the future. Oppenheimer also mentioned that while anyone can get skin cancer, fair-skinned people and those who often work outdoor under the sun for long periods are most susceptible to getting skin cancer.

PARTICULATE RADIATIONS AND ELECTROMAGNETIC RADIATION

Experimental studies in the Online Neurological Encyclopedia have found that both particulate radiations (neutrons, electrons, and alpha particles) and electromagnetic radiation (ultraviolet lights and X-rays) can cause cancer. Despite being a carcinogen, radiation is an important and necessary part of clinical diagnosing. Radiation has been commonly used as medication and trace markers to allow physicians and clinical researchers to image the internal structures of the human body and detect possible cancerous sites. Higher doses of radiation are often necessary to kill cancerous cells.

THREE KINDS OF RADIATION: ALPHA, BETA, AND GAMMA

The U.S. Environmental Protection Agency (EPA) states that the three kinds of radiation that are used in the clinical setting include alpha, beta, and gamma radiation. Alpha radiation is the flow of alpha particles while the beta radiation is the flow of electrons. Gamma radiation is very high-energy ionizing radiation containing gamma photons. While gamma photons have no mass and no electrical charge, they are pure electromagnetic energy that has much more energy than the photons of the visible range of the electromagnetic spectrum. Because of their high energy, gamma photons can travel at the speed...
of light and pass through many different kinds of materials, including human tissue.

Most also have enough energy to go through the body's internal organs which can cause many health problems and diseases. According to Wolfram Research, alpha radiation is a type of radioactive decay consisting of alpha particles. These alpha particles are relatively large and, thus, do not move fast enough to penetrate through human tissue. Light shielding often blocks alpha radiation. According to the EPA, beta radiation is the flow of electrons. Because this type of radiation consists of electrons, beta particles have an electrical charge of minus 1. The speed of beta particles is not constant; the speed depends on how much energy they have. They can also travel over a wide range.

When beta particles have high excess energy, they travel fast and can cause potential damages to the human body. Researchers have found that beta radiation can cause both acute and chronic health problems in people. Acute exposures and effects are uncommon. People can get this kind of exposure by being exposed to a very strong beta source coming from an abandoned industrial tool or instrument. The chronic exposures and effects are more common.

People get chronic health problems when they are exposed to low levels of beta radiation over a long period. These kinds of effects develop at a slow rate and can take between five to 30 years to manifest. Cancer is the main chronic health effect that comes from beta radiation. The risk of cancer increases as the dose increases. Carbon-14 is a type of beta emitter that travels throughout the entire human body. However, iodine-131 concentrates mainly in the thyroid gland and increases the risk factor of getting thyroid cancer and other disorders. Strontium-90 is another beta emitter that collects in the bone and teeth. Too much of this beta emitter can cause health problems in those specific areas of the body.

TECHNIQUES TO MINIMIZE THE DOSAGE OF RADIATION IN CANCER DIAGNOSIS AND TREATMENT

The fact that ionizing radiation causes cancer has caused many researchers and healthcare professionals to question the safety in the use of X-rays in diagnosis. Although the use of diagnostic X-rays has saved many lives, people are taking precautionary measures to lower the risk of possible cancer from X-rays. Oppenheimer explains that new tools have been developed that uses ultrasensitive x-ray films. This enables much smaller doses of radiation to be used. Another precautionary measure that has been used recently is that routine and massive x-ray screening is only used when scientists and diagnosticians deem it necessary.

In one specific example, women are no longer given routine mammography and xeroradiography unless they are in a specific high-risk group, such as if a woman has a history of female relatives with breast cancer. Thus, the use of X-rays to detect breast lumps has decreased for younger age groups. Although X-rays are still widely used in clinical settings, new techniques are being made to use only the minimal amount of radiation to the patient.

According to the Neurological Encyclopedia, two new radiation techniques that use minimal amounts of radiation have been developed to treat brain tumors. One of the techniques is called three-dimensional conformal radiation therapy. In this process, multiple beams are arranged so that they match the shape of the tumor. The second technique is called stereotactic radiosurgery. This technique uses gamma knives and cyberknives to specifically irradiate specific portions of the brain tumors. Gamma knives use focused beams, while cyberknives use many specific pinpoint beams that come from one source of irradiation. New radiation techniques are continuing to be made to diagnose and

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treat human cancers while minimizing the dosage of irradiation.

**RADIATION CAUSES DAMAGE TO DNA**

The major damage produced by radiation is to the DNA. Research and studies have shown that when DNA is exposed to radiation, the mutation frequency of DNA substantially increases.

In his book, *Cancer: A Biological and Clinical Introduction with Cancer Prevention Guide*, Oppenheimer explains that there are basically three kinds of damage that occur: breaks in single strands of DNA, double-strand breaks of the DNA, and the alteration of bases in the DNA. When the double-stranded DNA breaks, the entire DNA molecule becomes fragmented. Single-strand breaks cause the least problems because they can be efficiently repaired. Double-strand breaks can also be repaired; however, the repair of double-strand breaks often results in translocation (different chromosomes exchange different fragments). If a particular translocation leads to the activation of oncogenes, cancer can arise. Oncogenes are genes that induce cancer. The alteration of bases is the major cause of radiation-induced cancer.

Radiation causes cancer. Whether it is excessive medical X-rays or excessive exposure to the sun, precautions must be taken to lower the risk of getting too much radiation. Any kind or form of radiation can cause damage to the DNA by changing its informational content and activating the oncogene. This alteration, as a result, can cause the local uncontrolled growth of cells (benign tumor) and lead to a more dangerous form that spreads out to other parts of the body. The spreading out of cancer cells to distant sites in the body is called malignant tumor (cancer).

**SEE ALSO:**
- Base Excision Repair; Brain Diseases; Breast Diseases; Cancer (General); Cancer Radiation Therapy; Chromosome; DNA Repair; Genetic Disorders; Mismatch Repair; Point Mutation; Radiology.

**BIBLIOGRAPHY**


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