

Ionizing Radiation – The Silent Killer

Paul Wallin

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Biology Education Centre, Uppsala University

Radiation is energy in form of waves or particles that is emitted from cosmic sources and different organic sources from the ground. Because of this every organism gets exposed by radiation daily. Humans have developed inventions, such as nuclear power plants and X-ray machines, that emit large amounts of radiation called ionizing radiation, which can damage the cells of organisms. After the Chernobyl and Fukushima incidents where nuclear power reactors got destroyed, a large amount of ionizing radiation was emitted which people who lived near these areas got exposed to. After these incidents scientists have seen a connection between exposure to ionizing radiation and development of cancer. In my project, I have investigated the effect of ionizing radiation on cells and how it induces cancer.

Cells exposed to ionizing radiation

Ionizing radiation can damage different parts of the cell, but a damaged nucleus has the most severe consequences since it contains the DNA. However, depending on which cell is being irradiated the damage may vary, because different cells vary in radiation sensitivity. Ionizing radiation can damage the DNA, directly or indirectly. A direct effect is when the radiation hits the DNA strand directly, whereas an indirect effect is when the radiation ionizes the atoms and releases radicals near the DNA which thereafter hits the DNA strand. The damage that the ionizing radiation causes can result in single-stranded breaks and double-stranded breaks in the DNA. Though this does not make a cell cancerous. It is partly the repair mechanisms that are responsible for repairing specific genes incorrectly that can result in cancer.

How faulty reparation can lead to cancer

The most serious damage by ionizing radiation is double stranded breaks because if the damage is unrepaired or misrepaired it can result in mutations in genes which thereafter can lead to development of cancer. There are two primarily mechanisms responsible for repairing this type of damage, Non-homologous end joining (NHEJ) and Homologous recombination (HR). NHEJ repairs double stranded breaks by binding the two broken DNA parts together, whereas HR copies the missing DNA site of the damaged DNA from a nearby identical DNA strand. These two mechanisms are not flawless, because they can repair the double stranded breaks incorrectly or miss the damaged site completely, which can result in a mutation of a gene. If genes responsible for cell division are mutated, they cannot work properly which can make the cell cancerous. This is because the cell will continue to divide and ignore incoming signals from nearby cells that normally inhibits the division when something abnormal has occurred. The risks that ionizing radiation introduces is a serious problem since cancer is well known to be deadly if not treated in time.

More information

Wallin P. 2017. Hur kan joniserande strålning inducera cancer? Independent Project in Biology, Uppsala University.