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**College of Health and Medical Technologies**

**Department of Radiology Technologies**

**Radiobiology**

**The first stage**

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**Types of cellular Damage by Radiation**

**Lecture No.6**

**1.Cell Killing**

Radiation can kill cells by two distinct mechanisms:

* The first is **apoptosis**, also called **programmed cell death** or **interphase death.**
* Cells undergoing apoptosis as an immediate consequence of radiation damage usually die in **interphase** within a few hours of irradiation.
* Loss of **apoptotic** control is thought to be an important factor in **tumor** development.
* The second mechanism for cell killing is radiation-induced **reproductive failure.**
* Radiation in sufficient doses can inhibit **mitosis**, that is, the cell's ability to divide and proliferate indefinitely.
* As Radiation kills cells by **inhibiting their ability to divide**, its effects in human beings occur primarily in tissues with high cell turnover or renewal rates characterized by a large amount of proliferative activity.

**2. Mutagenesis**

* DNA structural analyses show that the majority of radiation-induced **mutations** in human cells result from large-scale genetic events involving loss of the entire active gene and often extending to other loci on the same chromosome.
* The major potential consequence of radiation-induced **mutations** in human populations is heritable genetic effects resulting from **mutations** induced in germinal cells

**3**. **Chromosomal Aberrations**

A **chromosomal abnormality**, or **chromosomal aberration**, is a disorder characterized by a morphological or numerical alteration in single or multiple chromosomes, **affecting autosomes, sex chromosomes, or both.**

Radiation can induce two types of **chromosomal aberrations** in mammalian cells:

* The first have been termed “**unstable**” aberrations in that they are usually lethal to dividing cells.

 They include such changes as **dicentrics**, **ring chromosomes**, **large deletions**, and **fragments**.

* The second type has been termed “**stable**” aberrations.

These include changes such as **small deletions**, **reciprocal translocations**, and **aneuploidy**—changes that do not preclude the cell from dividing and proliferating.

 4.**Neoplastic Transformation In Vitro**

(**Abnormal and uncontrolled cell growth**).

**Tumors** can occur almost anywhere in the body. There are three main types of tumor; **benign**, **premalignant**, and **malignant**.

**Benign** and **premalignant** tumors can be harmless, whereas **malignant** tumors are cancerous.

 An important cellular effect of radiation is **neoplastic** transformation, or the conversion of a normal cell to one with the phenotype of a **cancer cell**, including the ability to form an invasive, **malignant tumor** upon re-injection into syngeneic hosts.



**5.Radiation-Induced Genomic Instability**

The increased tendency for **DNA mutations** (changes) and other genetic changes to occur during cell division.

**Genomic instability** is caused by defects in certain processes that control the way cells divide. It occurs in many types of **cancer**.

This term refers to a phenomenon observed in a number of different cellular systems whereby radiation exposure appears to induce a type of **transmissible genetic instability** in individual cells that is transmitted to their progeny, leading to a persistent enhancement in the rate at which **genetic changes** arise in the descendants of the irradiated cell after many generations of replication.

**6.Bystander Effects in Irradiated Cell Populations**

is the phenomenon in which un-irradiated cells exhibit **irradiated effects** as a result of signals received from nearby irradiated cells.

It has long been thought that the cell nucleus is the target for the important biologic effects of radiation; these effects occur in the irradiated cell as a direct result of **DNA damage** that has not been correctly restored by **enzymatic repair processes.**