Al-Mustaqbal University
Radiological Techniques
Department

Biological Radiation hazards

Fourth Lecture

Third Stage

By
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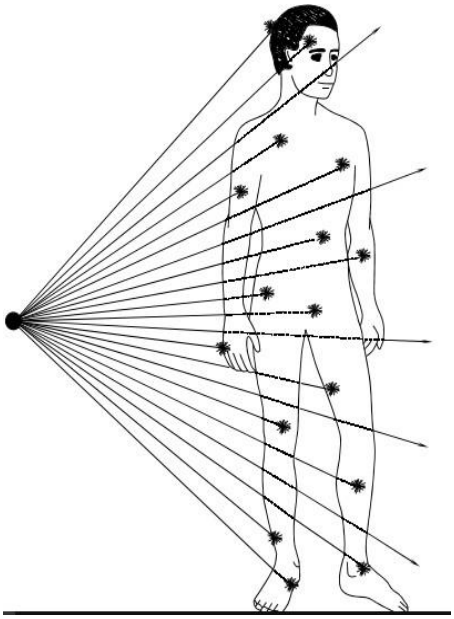
Biological Factors Affecting Radio-sensitivity

Whether the source of radiation is natural or man-made, whether it is a small dose of radiation or a large dose, there will be some biologicaleffects

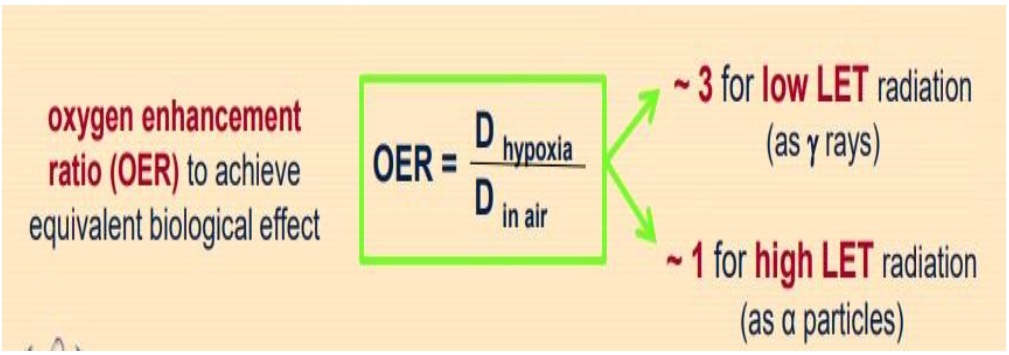
- **Oxygen Effect**
- **Age**
- **Gender**
- **Recovery**
- **Chemical Agents**
- **Hormesis**



➢ Oxygen Effect

Tissue is more sensitive when irradiated in oxygenated oraerobic state than in anoxic (without oxygen) or hypoxic (low oxygen) state

This characteristic of biologic tissue described numerically by the oxygen enhancement ratio (OER).

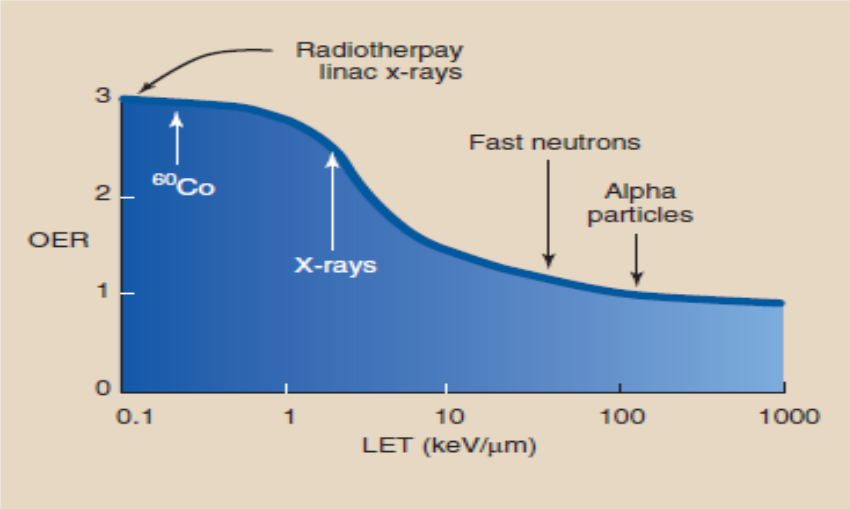


OER is LET dependent

OER is highest for low-LET radiation

It has a maximum value of 3 approx.

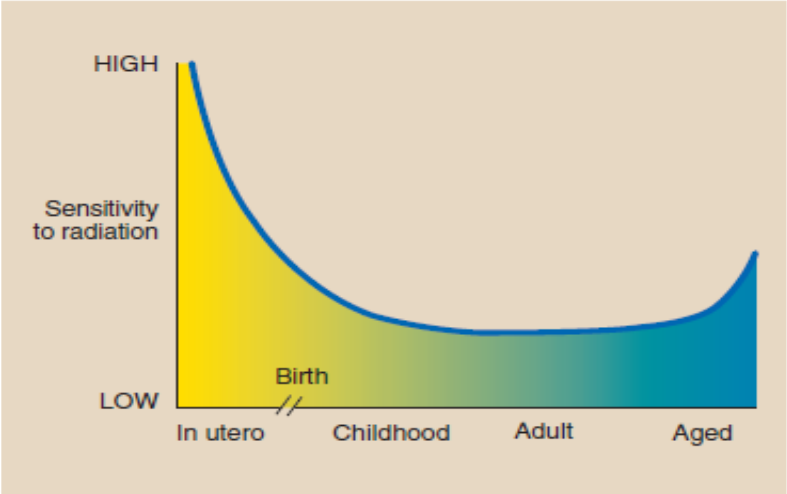
It decrease to 1 for high-LET radiation



The oxygen enhancement ratio (**OER**) is high for low linear energy transfer (**LET**) radiation and decreases in value as the LET increases.

➢ Age

- Age of biological structure affects radio-sensitivity
- Humans are most sensitive at birth
- Sensitivity decreases until maturity
- In old age radio-sensitivity increases



Radiosensitivity varies with age. Experiments with animals have shown that very young and very old individuals are more sensitive to radiation.

- **Gender**

Females are 5-10% less sensitive radiation than males.

- **Recovery**

Cells can recover from radiation injury if dose was nothigh enough to kill the cells before next cell division.

They can also recover due to biochemical repair mechanism or by use of chemical agents which canmodify response of cells.

Radio protectors can be used to prevent cell damage.

Recovery = Intracellular Repair + Repopulation

Types of Recovery

- Potentially Lethal Damage Repair (PLDR)
- Sublethal Damage Repair (SLDR)
- Long-term recovery (repopulation of damaged tissues)

High irradiation cause cells to shrink This is called Atrophy

➢ Chemical Agents

- Radio-sensitivity of cells, tissues, and organs can be modified bychemical organs
- For the chemical agents to be effective they generally Must be present during irradiation

can be classified into two main categories:

A- Radio-sensitizers: Agent that enhance the effect of radiation are called sensitizing agents.

Examples:

- Halgenated pyrimidines
- Methotrexate
- Actinomycin D
- Hydroxyurea
- Vitamin K

All radiosensitisers have effectiveness ratio of approx 2

As, 90% of the cell culture is killed by 200 rad

But when sensitising agent is present only 100 rad is enough

B- Radio-protectors

The radio-protective compound include molecules a sulfhydryl group (sulfer and hydrogen bound together)

such as

Cysteine and Cysteamine

➢ Hormesis

A separate and small body of radiobiologic evidence suggests that a little bit of radiation is good for you.

Some studies have shown that animals given low radiation doses live longer than controls. The prevailing explanation is that a little radiation stimulates hormonal and immune responses to other toxic environmental agents.

Many nonradiation examples of hormesis can be found. In large quantities, fluoride is deadly. In small quantities, it is a known tooth preservative.

Regardless of radiation hormesis, we continue to practice ALARA ("as low as reasonably achievable") vigorously as a known safe approach to radiation management

Cell Damage Classification:

1. **Lethal damage**. It is irreversible, irreparableand leads to cell death.

2. **Sub-lethal damage**. It can be repaired in hoursunless additional sub-lethal damage is added thateventually leads to lethal damage.

3. **Potentially lethal damage**. It can be manipulated by repair when cells are allowed toremain in a non-dividing state.