College of Health and Medical Technologies

Department of Radiology Technologies

Radiobiology

The first stage

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Radiobiology of tissue and organs response to radiation

Lecture No.7

The three categories of radiation damage produced by ionizing radiations, are:

- **Lethal damage (LD)** is irreversible and irreparable, leading to cell death.
- **Sub-lethal damage** (SD) Under normal circumstances, sublethal damage can be repaired in a matter of hours when no additional sublethal damage is added (e.g. due to a second dose of radiation) that could lead accumulatively to lethal damage.
- **potentially lethal damage (PLD):** Potential lethal damage under normal circumstances can cause cell death, but may be prevented, and is influenced by appropriate post-irradiation environmental conditions, such as :
- delayed subculture of irradiated cells,
- incubation at suboptimal temperature
- minimal medium, or treatment with inhibitors of protein synthesis.

The most sensitive Lymphocyte /Immature hematopoietic cells /Intestinal epithelium /Spermatogonia /Ovarian follicle cells

Sensitive Bladder epithelium /Esophagus epithelium /Gastric mucosa Epidermal epithelium /Optic lens epithelium

Moderately sensitive Endothelium Growing bone and cartilage /Fibroblast Glial cells /Mammary gland epithelium /Lung epithelium /Renal epithelium /Hepatic epithelium/ Pancreas epithelium /Thyroid epithelium /Surrenal gland epithelium

Less sensitive Mature erythrocyte/ Muscle cell /Mature connective tissue Mature bone and cartilage Ganglion cell.

Factors Determining Radiation Damage According to Ancel and Vintemberger

- **Biological stress in the cell:**

Biological stress is important in cell division. While radiation damage to rapidly dividing cells is observed early, damage to slowly dividing cells is seen in late.

- **Cell status before and after radiation dose:**

This indicates the environmental conditions of the cell → the radiation response of a cell changes in optimal and suboptimal conditions:

• Radiation response increases in optimal conditions.

• Radiation response decreases in suboptimal conditions

Rubin and Casarett Tissue Sensitivity Classification

This classifies tissues according to proliferation kinetics:

1.Tissues consisting of vegetative intermitotic cells (VIM).

- ❖ These consist of undifferentiated cells.
- ❖ These cells have a very short cell cycle.

– Examples include stem cells and intestinal stem cells

– These have short lifetimes but can continuously repopulate.

– These are the most radiosensitive tissues.

2.Tissues consisting of differentiated intermitotic cells (DIM).

- ❖ These consist of cells with a partial proliferative capacity.
- ❖ Their mitotic activity stops when they become mature.

• An example is spermatogonia

3.Multipotential connective tissues (MPC).

- ❖ These consist of cells with relatively long lifetimes.
- ❖ These cells divide at irregular intervals.

• The most prominent example is the fibroblast.

4.Tissues consisting of reverting postmitotic cells (RPM).

- ❖ These cells do not divide under normal conditions; they only divide if necessary.
- ❖ These tissues consist of cells with long lifetimes.

• Examples include liver parenchymal cells, pulmonary cells and renal cells.

5.Tissues consisting of fixed postmitotic cells (FPM).

- ❖ These cells never divide.
- ❖ These tissues consist of cells with very long lifetimes.

The most sensitive	Lymphocyte Immature hematopoietic cells Intestinal epithelium Spermatogonia Ovarian follicle cells
Sensitive	Bladder epithelium Esophagus epithelium Gastric mucosa Epidermal epithelium Optic lens epithelium
Moderately sensitive	Endothelium Growing bone and cartilage Fibroblast Glial cells Mammary gland epithelium Lung epithelium Renal epithelium Hepatic epithelium Pancreas epithelium Thyroid epithelium Surrenal gland epithelium
Less sensitive	Mature erythrocyte Muscle cell Mature connective tissue Mature bone and cartilage Ganglion cell