Oxidative stress and response to radiation

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Free radicals

- Organic or inorganic molecules unstable
- To reaction with biomolecules through oxidation
- They are produced by normal processes such as respiration , exercise or food metabolism.
- becomes free radical



ROLE OF MOLECULAR OXYGEN

O2 leads to forms of active oxygen. In the cell it is harmful for the formation of the reactive species generated during oxidation:



PLACE OF PRODUCTION OF FREE RADICALS

(1)

mitochondria :more importene source

- reticuloendothelial membrane
- nuclear membrane
- plasma membran
- [peroxisomes
- cytosolic enzymes



MITOCHONDRIA

- It is the main source of free radicals.
- 1. The phenomenon takes place at the level of the electron transport chain (last stage of production of high energy protons).
- 2. The protons pass through the inner mitochondrial membrane and generate the electrical gradient that provides energy to form ATP.
- 3. Oxygen acts as the ultimate recipient of the process of oxidative phosphorylation.
- 4. Several molecules are produced with different oxidation.
- 5. Molecules can deliver one or two electrons to oxygen and producing partially reduced intermediates that are free radicals. (1)

ORIGIN OF FREE RADICALS

Endogenous sources	Exogenous sources
electron complimentary chain	reducing substances
oxidizing enzymes	drug oxidation
phagocytic cells	smoking
autoxidation reactions	ionizing radiation
redox reactions	high fat intake
Oxygen cell metabolism	sunlight
pathological processes	heat shock
	trauma

DEFENSE SYSTEM: ANTIOXIDANTS



Compounds which retard or prevent oxidation.

The antioxidant interacts with the free → radical. Gives it an electron at the same time it is oxidized. It is transformed:

free radical week no toxic.

(1)

OXIDATIVE STRESS

Imbalance due to an increase in free radicals and / or a decrease of antioxidants.



WHAT IS IONIZING RADIATION?

Energy transfer from one source to another.

The emission of radiation can not be avoided.

Exposure to high doses of radiation

Acute radiation syndrome (RAS)

Generate free radicals short time (EROS)

(3)

RADIATION AND OXIDATIVE STRESS



INTERACTION OF IONIZING RADITION

DIRECTS

INDIRECTS

Interacts with:

- > Components.
- Biological structures.



Producing:

- Free Radicals
- Increased oxidative stress
- Increased ROS (reactive oxygen species) and increased RNS (nitrogen).

EFFECT OS EXPOSURE TO IONIZING RADITION

If there is an excess of free radicals released by ionizing radiation

causes genetic and molecular phenomena

clinical and histological organ damage

+

- Parenchymal cell damage
- Vascular tissue damage
- Tissue damage in the support
- Skin damage
- aging

- Trisomy 21 (Down syndrome) is characterized by a short life expectancy and low antioxidant defenses.

- Age-related diseases characterized by increased oxidative stress such as cancer or atherosclerosis

- Neurodegenerative diseases such as Alzheimer's or Parkinson's are associated with oxidative stress.

TOXICITY OF FREE RADICALS



EXAMPLE: SKIN

> First organ exposed to the harmful effects caused by ionizing radiation.

> Table. Absorbed dose-effect relationship. (SRA)

Absorbed dose	Effects
>100 Gy	Death of the individual in a short time, a few hours to a few days and injuries occur in the central nervous system.
10-50 Gy	Death between one and two weeks after irradiating due to gastrointestinal lesions.
5-10 Gy	Swelling, erythema, dry skin or moist desquamation.
3- 5 Gy	Death of half of those irradiated in two months because the bone marrow, which produces blood cells are affected.
<3 Gy	Alterations in organs and tissues, then healing and repair. Recovery is total or partial. In the testes a dose of 2 Gy can cause permanent sterility and 0.1 Gy produces temporary sterility.
	(3)

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