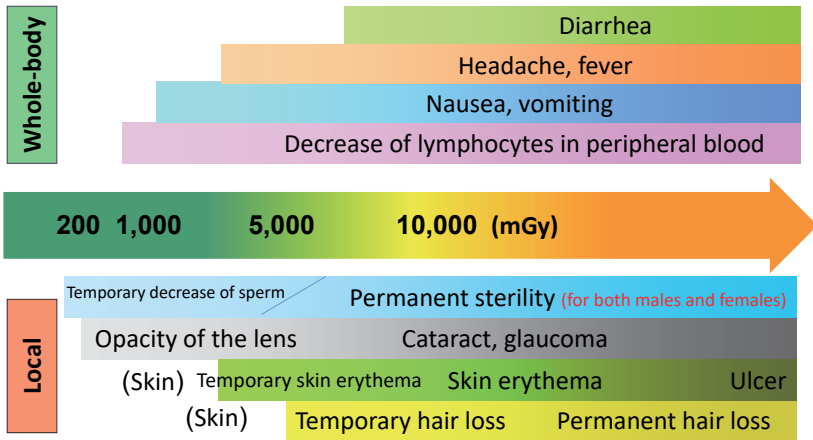


Whole-body Exposure and Local Exposure



Source: Rearranged based on the report of the Health Management Study Committee of the Nuclear Safety Commission (2000), etc

Radiation exposure at levels exceeding 100 mGy at one time may cause effects on the human body due to cell deaths. Organs highly sensitive to radiation are more likely to be affected with a small amount of radiation.

As the testes in which cells are dividing actively are highly sensitive to radiation, even low doses of radiation at the levels of 100 to 150 mGy temporarily decrease the number of sperm and cause transient sterility. Bone marrow is also highly sensitive to radiation and lymphocytes in blood may decrease due to exposure to radiation even less than 1,000 mGy (= 1 Gy). However, these symptoms naturally heal.

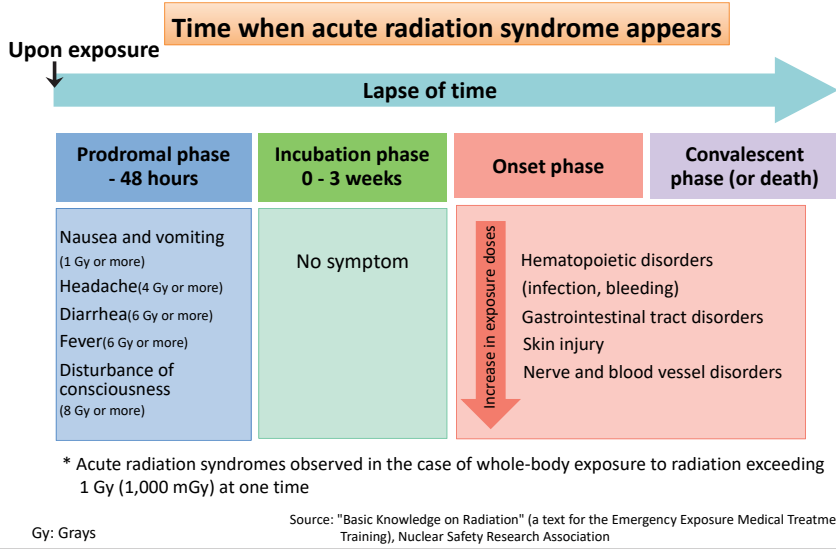
On the other hand, radiation exposure at levels exceeding 2,000 mGy (= 2 Gy) at one time often causes clinical symptoms that require proper treatment.

In the case of local exposure, disorders appear in the exposed organs.
(Related to p.82 of Vol. 1, "Damage and Repair of DNA")

Included in this reference material on March 31, 2013

Updated on March 31, 2015

Acute Radiation Syndromes



Whole-body exposure to radiation exceeding 1 Gy (1,000 mGy) at one time causes disorders in various organs and tissues, leading to complicated clinical developments. This series of disorders in organs is called acute radiation syndrome, which typically follows a course from the prodromal phase to the incubation phase, the onset phase, and finally to the convalescent phase or to death in the worst case.

From prodromal symptoms that appear within 48 hours after the exposure, exposure doses can roughly be estimated. Exposure to radiation exceeding 1 Gy may cause loss of appetite, nausea and vomiting, and exposure to radiation exceeding 4 Gy may cause headaches, etc. When exposure doses exceed 6 Gy, such symptoms as diarrhea and fever may appear.

In the onset phase after the incubation phase, disorders appear in the hematopoietic organ, gastrointestinal tract, and nerves and blood vessels, in this order, as doses increase. Disorders mainly appear in organs and tissues highly sensitive to radiation. In general, the larger an exposure dose, the shorter the incubation phase.

Skin covers a large area of 1.3 to 1.8 m² of the whole body of adults. Epidermis, which is the result of repeated division of basal cells that are created at the basal stratum, finally becomes a stratum corneum and is separated from the body surface as scurf.

It is said to take approx. 20 to 40 days until basal cells move from the basal stratum to the skin surface, which means* that two to more than four weeks is required for exposed subcutaneous cells existing in the stratum corneum to the basal stratum to come up to the skin surface. Therefore, skin erythema sometimes appears immediately after exposure depending on radiation intensity, but skin injury generally appears after the lapse of a few weeks (p.25 of Vol. 1, "External Exposure and Skin").

*Source: United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) 1988 "Radiation Sources, Effects and Risks," translated by the National Institute for Radiological Sciences (Jitsugyo-koho Co., Ltd.; March 1990)

Included in this reference material on March 31, 2013
 Updated on March 31, 2016

Threshold Values for Various Effects

Threshold acute absorbed doses of γ -rays

Disorders	Organs/Tissues	Incubation period	Threshold value (Gy)*
Temporary sterility	Testis	3 to 9 weeks	Approx. 0.1
Permanent sterility	Testis	3 weeks	Approx. 6
	Ovary	Within 1 week	Approx. 3
Deterioration of hemopoietic capacity	Bone marrow	3 to 7 days	Approx. 0.5
Skin rubor	Skin (large area)	1 to 4 weeks	3 to 6 or lower
Skin burn	Skin (large area)	2 to 3 weeks	5 to 10
Temporary hair loss	Skin	2 to 3 weeks	Approx. 4
Cataract (failing vision)	Eyes	20 years or longer	Approx. 0.5

* Threshold doses for symptoms with clear clinical abnormalities (doses causing effects on 1% of people)

Source: 2007 Recommendations of the International Commission on Radiological Protection (ICRP), and ICRP Report 118 (2012)

Sensitivity to radiation differs by organ. The testes are most sensitive.

When the testes are exposed to γ -rays or other types of radiation exceeding 0.1 Gy (100 mGy) at one time, this may cause temporary sterility with a temporary decrease in the number of sperm, which is due to radiation damage to cells in the testes that create sperm.

When bone marrow is exposed to radiation exceeding 0.5 Gy (500 mGy), the number of blood cells decreases due to deterioration of hemopoietic capacity.

Some deterministic effects such as cataract take several years to appear.

The threshold dose for cataract had been set at 1.5 Gy, but the ICRP revised this value downward to approx. 0.5 Gy and set a new equivalent dose limit for the eye lens for occupational exposures.

Included in this reference material on March 31, 2013

Updated on March 31, 2015