AESJ 日本原子力学会 Atomic Energy Society of Japan

Types of Radiation Exposure and Effects on Human Body

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The effects of radiation exposure on human body may vary with different types of radiation exposure, such as internal/external exposure and acute/chronic exposure.

1. External Exposure and Internal Exposure

Ultraviolet ray from the sun, X-ray, and radioactive ray may all cause damages to human cells, which in turn get activated to repair themselves. This means that, as long as the human cell is capable of activation, receiving ultraviolet ray, X-ray, or radioactive ray is harmless. Receiving these rays from outside human body is called "external exposure" and high-level of external exposure may be detrimental to health. It is thus important to minimize the possibility of external exposure.

Moreover, a material that emits "radioactive ray" is called a radioactive material, and "internal exposure" indicates the effect on human body by an intake of the radioactive material. Once a radioactive material is absorbed, it accumulates and continues to irradiate the specific part of cells in a body. Thus, in the case of internal exposure, an urgent excretion of the absorbed radioactive material is imperative. The metabolism of human body may accelerate the excretion process. Also, a short-lived radioactive material would expire/disappear by itself. As for internal exposure, the effect of a radioactive material on human body may vary according to its type. For example, the gaseous radioactive material (such as krypton) is rarely retained inside human body; it is easily flown out from lungs. Iodine is retained in thyroid gland when not excreted by metabolism. Cesium-137 is accumulated in muscle when not excreted.

Effective half life (the period of time in which the activity of a radioactive isotope in human body decreases by half) is 7.5 days for iodine-131 and 110 days for cesium-137 (ICRP Publication 78).

The maximum amount of radioactivity detected in drinking water at Fukushima-shi from March 17 through March 21 was 180 Bq/kg. Let us suppose that a person continues to drink two liters of this water for a year. Further, suppose that the entire radioactivity come from iodine-131 and the percentage of the iodine retained in the thyroid gland is 20%. Then, he/she would be internally exposed to approximately 820 Bq of iodine. This is relatively small amount compared to the 6000 Bq, the amount internally received from the potassium that naturally exists inside our body.

2. Acute Exposure and Chronic Exposure

Acute exposure, rather than chronic exposure, may cause more damage to human body if the cumulative amount of radiation received is the same for both situations. This could be explained in terms of an analogy: sunburn. While gradual tanning may cause minimal damage to the skin, getting sun-burnt all at once would cause skin irritation/inflammation or even bleeding. The gradual sun-tanning may induce cellular metabolism and thus cause less

damage. Similarly, when observing the effect of radiation exposure to cells, exposure over longer period of time may cause less damaging effect than an acute exposure.

While the effect of radiation exposure on DNA in cells may be damaging, human body can deploy its repair mechanism. In the case of an acute exposure, the degree of damage is greater than the repairing ability. This may cause negative effect to human body such as increased risk of cancer. Yet, receiving the same amount of ionized radiation over a prolonged period may lessen the effect on human body, since the repair mechanism works simultaneously.

Given these argument, the effect of radiation exposure over a prolonged period of time is smaller at locations with lower dose, such as areas 30 kilometers away from Fukushima Power Plants.