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Internal Exposure

Updated: March 28, 2011 15:00 (JST)

In our everyday life, we are exposed to radiation from various sources (radioactive materials) even without occupational exposure from handling radioactive materials or ionizing radiations. From the perspective of radiological protection, it is effective to divide types of radiation exposure into two categories, depending on whether the source of radiation is inside or outside our body. The exposure to radiation from the source that exists inside a human body is called "internal exposure." When the source of radiation exists outside a human body, it is called "external exposure," thus dealt separately by radiological protection principle.

Internal exposure is caused by the intake of radioactive material. In our daily lives, internal exposure occurs by inhalation of airborne radioactive material or by digestion through food or water that contains radioactive materials. The radioactive material taken into the body via these routes may move through the body with blood or lymph. Internal organs and tissues have their own specific tendencies to retain certain types of radioactive material. For example, iodine (131I, etc.) is known to be retained in thyroid gland.

Internal exposure results from irradiation of the deposited and surrounding organs and tissues by the rays emitted by radioactive materials. Among radioactive materials, iodine (such as 131I) irradiates a part of human body (partial exposure) since it is retained in the specific organ and tissue. However, tritium, potassium (40K), and cesium (137Cs) irradiate the entire parts of body since they are distributed throughout the whole body (uniform radiation of the whole body).

The amount of radioactive material in a body decreases in accordance with the ratio (effective half life) determined by the half life specific to the radionuclide (physical half life Tp) and the metabolic half life (biological half life Tb). For instance, while the physical half life of 137Cs is 30.07 years, the biological half life that indicates the speed of the absorbed 137Cs to be excreted is 110 days (ICRP Pub. 78). The period of time for a human body to be irradiated by the radioactive material (effective half life T eff) is determined by these two factors. The sum of reciprocal of each factor is the reciprocal of effective half life of the nuclide. $1/T_{eff}=1/T_p+1/T_b$

The degree of internal exposure (internal exposure dose) can be evaluated based on factors such as the deposited amount of radioactive material to the respective organs and tissues, the kind of radioactive ray emitted by the deposited radioactive material, the energy released to organs and tissues, and the amount of time actually deposited (effective half life). "Effective dose coefficient (Sv/Bq)" is used to assess internal exposure dose. It specifies the total absorbed dose (committed effective dose) when a person continues to be internally irradiated by an intake of 1Bq radioactive material.

The integration period for dose assessment of internal exposure is 50 years for operational workers and ordinary adults. For children the dose is evaluated to the age 70 years. This method allows assessment of the total dose of absorbed radioactive material, taking into account the subsequent period it remains inside the body.

More information on the effective dose coefficient is available at:
http://www.remnet.jp/lecture/b05_01/4_1.html.

While the measurement and assessment of the dose of internal exposure is not easy compared to those for external exposure, taking preventative measures against intake of radioactive material (such as covering mouth with towel or wearing mask) is greatly encouraged. Note that the effect of internal exposure and that of external exposure on a human body is the same, given that both situations yield the same value of effective dose (Sv).

More information on the unit of measurement Sievert and the effective dose may be available at: http://www.radi-edu.jp/pages/columns/11.

References:
"ATOMICA" (http://www.rist.or.jp/atomica/)
Radiation Emergency Medicine Information Network (http://www.remnet.jp/)
Introduction to Radiation and Isotope (http://www.radi-edu.jp/pages/columns/11)