

“The beginning of wisdom is to call things by their right names”.
– Chinese proverb –

- *Radioactivity* – the rate at which nuclear transformations occur; 1 becquerel (Bq)=1 transformation/s (old unit 1 Ci=37 GBq).
- *Absorbed dose* – the amount of energy imparted by ionizing radiation to mass unit; unit 1 gray (Gy)=1 J/kg. The absorbed dose is measured in a unit called gray (Gy). A dose of 1 Gy is equivalent to a unit of energy (joule) deposited in 1 kg of substance.
- *Equivalent dose* – the absorbed doses in the tissue or organ due to radiation. The radiation-weighting factor W_R measures the relative harmfulness of different radiations; the unit is Sievert (Sv).
- *Effective dose* – the sum of the weighted equivalent doses in all tissues or organs of the body; the unit is Sievert (Sv).
- *Collective equivalent or effective dose* – the sum of individual effective doses in a population used to assess collective risks, unit person-Sv (man-Sv)
- *Grey (Gy)* – the special name for the SI unit of absorbed dose. The previous unit of absorbed dose, rad, has been replaced by the gray; 1 Gy=100 rad.
- *Roentgen (R)* – a unit of exposure to ionizing radiation. It is the amount of γ or X-rays required to produce ions carrying one electrostatic unit of the electric charge (either positive or negative) in 1 cm³ of dry air under standard conditions.
 - 1 C/kg=2,876 R
 - 1 R=2.58 $\times 10^4$ C/kg
- *Rad* – the former unit of absorbed dose, equivalent to an absorption energy of 10⁻²J/kg; 1 rad=0.001 Gy.
- *Sievert (Sv)* – unit of the equivalent dose or effective dose in the SI system (International Unit System). Sv replaces the classical radiation unit: the rem. Multiples of sievert (symbol Sv) used in practice include millisievert (mSv) and microsievert (μ Sv).
 - 1 Sv=100 rem
 - 1 mSv=100 mrem=0.1 rem
- *Rem* – former unit of equivalent and effective dose. It is the product of absorbed dose (in rads) and the radiation-weighting factor.
 - 1 rem=1 $\times 10^{-2}$ Sv=0.01 Sv=10 mSv
 - 1 mrem=0.01 mSv
 - 1 mrem=0.01 $\times 10^3$ μ Sv=10 μ Sv
- *Becquerel (Bq)* – unit of radioactivity, corresponding to one radioactive disintegration per second
 - 1 Bq=1 dez/s
 - 1 GBq=10⁹ Bq
 - 3.7 $\times 10^{10}$ Bq=1 Ci
- *Curie (Ci)* – former unit of radioactivity, corresponding to 3.7 $\times 10^{10}$ radioactive disintegrations per second. Now replaced by the becquerel.
 - 1 Ci=3.7 $\times 10^{10}$ dez/s

- *X-ray* – a penetrating form of electromagnetic radiation admitted either if the inner orbital electrons of an excited atom return to their normal state (these are characteristic X-rays) or if a metal target is bombarded with high-speed electrons. X-rays are always nonnuclear in origin.
- *Gamma rays* (γ) – high-energy, short wavelength electromagnetic radiation. γ -radiation frequently accompanies α - and β -emissions and always accompanies fission. γ -rays are very penetrating. Dense materials such as lead or depleted uranium stop the γ -rays. The γ -rays originate inside the nucleus, while X-rays originate from the outside.
- *Beta particle* (β) – an elementary particle emitted from a nucleus during radioactive decay, with a single electric charge and a mass equal to 1/1,837 part of a proton. A negatively charged β -particle is identical to an electron. A positively charged β -particle is called a positron. β -radiation may cause skin burns, and β -emitters are harmful if they enter the body. A thin sheet of metal, however, stops β -particles, easily.
- *Alpha particle* (α) – a positively charged particle emitted by radioactive materials. It consists of two neutrons and two protons bound together; hence, it is identical with the nucleus of a helium atom. It is the least penetrating of the common types of radiation – alpha, beta and gamma – since a single sheet of paper could stop it.
- *Half-life* ($T_{1/2}$), *physical* (T_p) – the time taken for the activity of a radionuclide to decay to half of its initial value.
- *Half-life, biological* (T_b) – the time required for a biological system, such as a human or an animal, to eliminate by natural processes half of the amount of a substance, such as a radioactive material, which has entered the system.
- *Half-life, effective* (T_{eff}) – the effective half-life is defined as is presented in Eq. 2.1.

$$T_{\text{eff}} = \frac{T_b \times T_p}{T_b + T_p} \quad (2.1)$$

T_{eff} – effective half-life of the radionuclide
 T_b – biological half-life of the radionuclide
 T_p – physical half-life of the radionuclide

A schematic presentation of the specific doses useful for the daily practice of endocrinologists goes as follows:

Absorbed dose (Gy)

The energy of radiation in one kilogram of a substance



Equivalent dose (Sv)

Absorbed dose weighted for the degree of the effect of different radiations



Effective dose (Sv)

Equivalent dose measured according to susceptibility of different tissues to the effect

Regarding the doses and the units of measurements in nuclear medicine, endocrinologists should be familiar with some of the multiples or submultiples of these units. The most frequent amounts of radioactive substances used in the diagnosis and treatment of endocrinology diseases are submultiples of 10^{-3} (μCi) or multiples of 10^3 (MBq) and 10^6 (GBq).

The metric system introduced in 1975 is presented in Table 2.1.

It is mandatory for endocrinologists to be familiar with some of these units, used in nuclear endocrinology.

The most frequent nuclear units' transformations are presented below:

100 μCi = 0.1 mCi
 1000 μCi = 1 mCi
 1000 mCi = 1 Ci
 10^6 μCi = 1 Ci
 100 MBq = 0.1 GBq
 1000 MBq = 1 GBq
 100 mCi = 3.7 GBq

Table 2.1 Metric system

Prefix	Yotta	Zetta	Exa	Peta	Tera	Giga	Mega	Kilo	Hecto	Deca
Symbol	Y	Z	E	P	T	G	M	K	H	Da
10 ⁿ	10 ²⁴	10 ²¹	10 ¹⁸	10 ¹⁵	10 ¹²	10 ⁹	10 ⁶	10 ³	10 ²	10 ¹
<i>Unit 1</i>										
Prefix	Deci	Centi	Mili	Micro	Nano	Pico	Femto	Atto	Zepto	Yocto
Symbol	d	c	m	μ	n	p	f	a	z	y
10 ⁿ	10 ⁻¹	10 ⁻²	10 ⁻³	10 ⁻⁶	10 ⁻⁹	10 ⁻¹²	10 ⁻¹⁵	10 ⁻¹⁸	10 ⁻²¹	10 ⁻²⁴

Further Reading

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