

- electron capture (EC)—a mode of radioactivity decay involving the capture of an orbital electron by its nucleus
- gamma-radiation—electromagnetic radiation emitted in the process of a change in configuration of a nucleus or particle annihilation and having wavelengths shorter than those of X-rays
- gray (Gy)—the SI unit of absorbed dose, defined as 1 J/kg. The rad was formerly used as the unit of absorbed dose. 1 Gy = 100 rads
- isomeric transition (IT)—the decay of one isomer to another having a lower energy state. The transition is accompanied by the emission of gamma-radiation
- isomers—nuclides with the same mass number and atomic number but with nuclei having different energy states
- isotopes—nuclides with the same atomic number but different mass numbers
- nuclide—a species of atom having a specific mass number, atomic number, and nuclear energy state
- photon—a quantum of electromagnetic radiation
- positron—a positive beta particle
- rad (radiation absorbed dose)—now superseded as a unit of absorbed dose by the gray. A rad is equal to 10^{-2} J/kg. The röntgen and the rad in soft tissue are approximately equivalent in magnitude for moderate energies. 1 rad = 10^{-2} Gy
- radioactive decay—the spontaneous change of a nucleus resulting in the emission of a particle or a photon
- radioactivity—the property of certain nuclides of spontaneously emitting particles or photons or of undergoing spontaneous fission
- radioisotope—an isotope that is radioactive
- radionuclide—a nuclide that is radioactive
- rem (röntgen-equivalent-man)—now superseded as a unit of dose equivalent by the sievert (Sv). A rem is numerically equal to the absorbed dose in rads multiplied by the appropriate quality factor defining the biological effect and by any other modifying factors. The sievert is the joule/kg (J kg^{-1}) equal to 100 rem
- röntgen (R)—a unit of exposure of X- or gamma-radiation, equal to 2.58×10^{-4} coulombs/kg in air; superseded by the SI unit of exposure, the coulomb/kg (C kg^{-1}). $1 \text{ C kg}^{-1} = 3.876 \times 10^3 \text{ R}$
- sievert (Sv)—the SI unit of dose equivalent numerically equal to the absorbed dose in grays multiplied by the appropriate quality factor defining the biological effect and by any other modifying factors expressed in J/kg
- specific activity—the activity per unit mass of a material containing a radioactive substance
- X-rays—electromagnetic radiation other than annihilation radiation originating in the extranuclear part of the atom and having wavelengths much shorter than those of visible light

Carbon-11

Carbono 11.

CAS — 14333-33-6.

HALF-LIFE. 20.4 minutes.

Profile

Carbon-11 is a positron-emitter that is used in positron-emission tomography (see Emissions from Radioisotopes, p.2052). Compounds that have been labelled with carbon-11 include L-methionine for the detection of malignant neoplasms, acetic and palmitic acids for the study of myocardial metabolism, raclopride and mepiperone for the study of CNS dopaminergic D_2 receptors, and flumazenil for the study of GABA receptors. Labelled carbon monoxide may be used to assess blood volume.

Preparations

Ph. Eur.: -Methionine ((C)Methyl) Injection; Flumazenil (N-(C)Methyl) Injection; Raclopride ((C)Methoxy) Injection; Sodium Acetate ((I-(C)Methyl) Injection;
USP 31: Carbon Monoxide C 11; Flumazenil C 11 Injection; Mepiperone C 11 Injection; Methionine C 11 Injection; Raclopride C 11 Injection; Sodium Acetate C 11 Injection.

Carbon-14

Carbono 14.

CAS — 14762-75-5.

HALF-LIFE. 5730 years.

The symbol † denotes a preparation no longer actively marketed

Profile

Carbon-14 has been used to label many organic compounds that may be employed in breath tests.

Urea (p.1620) labelled with carbon-14 is used in a breath test to detect *Helicobacter pylori* as an aid in the diagnosis of peptic ulcer disease (p.1702).

Preparations

USP 31: Urea C 14 Capsules.

Proprietary Preparations (details are given in Part 3)

Cz.: HeliCap; **Neth.:** HeliCap; **Port.:** HeliCap; **USA:** Pytest.

Chromium-51

Cromo 51.

CAS — 14392-02-0.

ATC — V09CX04 (chromium edetate (^{51}Cr)).

ATC Vet — QV09CX04 (chromium edetate (^{51}Cr)); QV09GX03 (chromate labelled cells (^{51}Cr)).

HALF-LIFE. 27.7 days.

Profile

Chromium-51, as sodium chromate (^{51}Cr), is used to label red blood cells so that red cell survival and red cell volume can be measured. Chromium-51 activity in the faeces can be used to estimate gastrointestinal blood losses. Red blood cells labelled with chromium-51 and damaged by heat before re-injection have been used for spleen scanning.

As chromium edetate (^{51}Cr) given intravenously, chromium-51 is used in the determination of the glomerular filtration rate.

As chromic chloride (^{51}Cr), chromium-51 has been given intravenously for the determination of loss of serum protein into the gastrointestinal tract.

Preparations

Ph. Eur.: Chromium(Cr) Edetate Injection; Sodium Chromate(Cr) Sterile Solution;

USP 31: Chromium Cr 51 Edetate Injection; Sodium Chromate Cr 51 Injection.

Cobalt-57

Cobalto 57.

CAS — 13981-50-5.

ATC — V09XX01 (cobalt cyanocobalamin (^{57}Co)).

ATC Vet — QV09XX01 (cobalt cyanocobalamin (^{57}Co)).

HALF-LIFE. 271 days.

Profile

Cobalt-57, in the form of an aqueous solution or capsules of cyanocobalamin (^{57}Co), is given orally for the measurement of absorption of vitamin B_{12} in the diagnosis of pernicious anaemia and other malabsorption syndromes. It is also used with cyanocobalamin (^{58}Co), see below.

Preparations

Ph. Eur.: Cyanocobalamin(Co) Capsules; Cyanocobalamin(Co) Solution;

USP 31: Cyanocobalamin Co 57 Capsules; Cyanocobalamin Co 57 Oral Solution.

Proprietary Preparations (details are given in Part 3)

Multi-ingredient: **Cz.:** Dicopac†; **UK:** Dicopac.

Cobalt-58

Cobalto 58.

CAS — 13981-38-9.

ATC — V09XX02 (cobalt cyanocobalamin (^{58}Co)).

ATC Vet — QV09XX02 (cobalt cyanocobalamin (^{58}Co)).

HALF-LIFE. 70.8 days.

Profile

Cobalt-58, in the form of an aqueous solution or capsules of cyanocobalamin (^{58}Co), is given orally for the measurement of absorption of vitamin B_{12} in the diagnosis of pernicious anaemia and other malabsorption syndromes.

The different emissions of cobalt-57 and cobalt-58 allow the isotopes to be distinguished. This can be used to differentiate between failure of absorption due to lack of intrinsic factor (pernicious anaemia) and that due to ileal malabsorption, by giving both free cyanocobalamin (^{58}Co) and cyanocobalamin (^{57}Co) bound to intrinsic factor. A dual isotope kit has been used for this purpose.

Preparations

Ph. Eur.: Cyanocobalamin(Co) Capsules; Cyanocobalamin(Co) Solution;

USP 31: Cyanocobalamin Co 58 Capsules.

Proprietary Preparations (details are given in Part 3)

Multi-ingredient: **Cz.:** Dicopac†; **UK:** Dicopac.

Erbium-169

CAS — 15840-13-8.

ATC — V10AX04 (erbium citrate colloid (^{169}Er)).

ATC Vet — QV10AX04 (erbium citrate colloid (^{169}Er)).

HALF-LIFE. 9.4 days.

Profile

Erbium-169 is a radionuclide that has been used in the treatment of arthritic conditions particularly of the small joints.

Preparations

Proprietary Preparations (details are given in Part 3)

Cz.: Ermm-1.

Fluorine-18

Flúor 18.

CAS — 13981-56-1.

ATC — V09IX04 (fludeoxyglucose (^{18}F)).

ATC Vet — QV09IX04 (fludeoxyglucose (^{18}F)).

HALF-LIFE. 110 minutes.

Profile

Fluorine-18 is a positron-emitting radionuclide that is used in positron-emission tomography (see Emissions from Radioisotopes, p.2052).

Fludeoxyglucose (^{18}F) (2-deoxy-2-fluoro- ^{18}F - α -D-glucopyranose; ^{18}F -fluorodeoxyglucose) is given by intravenous injection for the assessment of cerebral and myocardial glucose metabolism in various physiological or pathological states including stroke and myocardial ischaemia. It is also used for the detection of malignant tumours including those of the brain, liver, lung, and thyroid gland. Fluorodopa (^{18}F) is also used in cerebral imaging. Sodium fluoride (^{18}F) is used in bone scanning.

Preparations

Ph. Eur.: Fludeoxyglucose (F) Injection; Sodium Fluoride (F) Injection;

USP 31: Fludeoxyglucose F 18 Injection; Fluorodopa F 18 Injection; Sodium Fluoride F 18 Injection.

Proprietary Preparations (details are given in Part 3)

Austria: 18F-FDG; Efdage; Flucis; **Cz.:** Efdage; FDG Scan; **Hung.:** Pozitron-Scan-FDG; **Neth.:** Efdage; Flucis; GlucoTrace; **Port.:** Contracer; Flucis; Stenpet; **Spain:** Farna FDG; FDG Scan; Fluodos; Fluoscan; Fluotracer.

Gallium-67

Galio 67.

CAS — 14119-09-6.

ATC — V09HX01 (gallium citrate (^{67}Ga)).

ATC Vet — QV09HX01 (gallium citrate (^{67}Ga)).

HALF-LIFE. 3.26 days.

Profile

Gallium-67 is used in the form of an intravenous injection of gallium citrate (^{67}Ga).

Gallium citrate (^{67}Ga) is concentrated in some malignant tumours of the lymphatic system, as well as in some other tissues, and is used for tumour visualisation. Concentration also occurs in inflammatory lesions and the injection is therefore used for the localisation of focal inflammatory sites, such as may occur in abscesses, osteomyelitis, or sarcoidosis. Gallium scans have proved useful for the detection of the various infections and malignancies that may be encountered in patients with AIDS.

Breast feeding. The American Academy of Pediatrics has stated¹ that temporary cessation of breast feeding is required after exposure to gallium-67 since radioactivity has been reported to be present in breast milk for 2 weeks.

1. American Academy of Pediatrics. The transfer of drugs and other chemicals into human milk. *Pediatrics* 2001; **108**: 776–89. Correction. *ibid.*: 1029. Also available at: <http://aappolicy.aappublications.org/cgi/content/full/pediatrics%3b108/3/776> (accessed 01/07/04)

Preparations

Ph. Eur.: Gallium(Ga) Citrate Injection;

USP 31: Gallium Citrate Ga 67 Injection.

Gold-198

Oro 198.

CAS — 10043-49-9.

ATC — V10AX06 (colloidal gold (^{198}Au)).

ATC Vet — QV10AX06 (colloidal gold (^{198}Au)).

HALF-LIFE. 65 hours (2.7 days).

Profile

Gold-198, as colloidal gold (^{198}Au) with most of the activity associated with particles of diameter 5 to 20 nm, has been used by intrapleural or intraperitoneal injection in the treatment of malignant ascites and malignant pleural effusion, and by intravenous injection for the measurement of liver blood flow, in liver scanning, and for general investigations of the reticuloendothelial