Sodium Iodide I-123 • Oral Solution

PACKAGE INSERT

Radiodiagnostic Agent

BWXT VANCOUVER B.C. CANADA

REV. 2

NAME OF DRUG

Sodium Iodide I-123 Oral Solution

PHARMACOLOGICAL CLASSIFICATION

Radiodiagnostic agent for thyroid imaging.

DESCRIPTION

Sodium Iodide I-123 (Na ^{123}I) for diagnostic use is supplied as a solution for oral administration. The solution is available in 74 megabequerel (MBq) doses at time of calibration.

Sodium Iodide I-123 is an odourless compound, freely soluble in water. The I-123 is produced in an accelerator by bombardment of enriched Xe-124 with protons {Xe-124 (p,2n) Cs-123 → Xe123→ I-123}.

The radionuclidic composition at calibration is not less than 99.8 percent I-123, not more than 0.2 percent total other nuclides. The radionuclidic composition at expiration time is not less than 99.8 percent I-123, not more than 0.2 percent total other nuclides. The constituents of the impurities are 0.1% I-125 and 0.1% Te-121.

PHYSICAL CHARACTERISTICS

Sodium Iodide I-123 decays by electron capture with a physical half-life of 13.2 hours. The photon that is useful for detection and imaging studies is listed in Table 1.

TABLE 1
Principal Radiation Emission Data[3]

Radiation	Mean % Disintegration	Mean Energy (keV)
Gamma-2	83.4	159

[3]Kocher, David C., Radioactive Decay Data Tables. DOE/TIC-11026, 122, (1981)

EXTERNAL RADIATION

The specific gamma ray constant for I-123 is 1.6 R/hr.-mCi (11.2 µC/kg-MBq-hr) at 1 cm. The first half value thickness of lead (Pb) for I-123 is 0.005 cm. A range of values for the relative attenuation of the radiation emitted by this radionuclide that results from the interposition of various thicknesses of lead is shown in Table 2. For example, the use of 1.63 cm. of lead will decrease the external radiation exposure by a factor of about 1,000.

TABLE 2
Radiation Attenuation by Lead Shielding

Shield Thickness (Pb), cm.	Coefficient of Attenuation
0.005	0.5
0.10	10^{-1}
0.88	10^{-2}
1.63	10^{-3}
2.48	10^{-4}

Note that these estimates of attenuation do not take into consideration the presence of contaminants.

To correct for physical decay of I-123, the fractions that remain at selected intervals after the time of calibration are shown in Table 3.

TABLE 3
Sodium Iodide I-123 Decay Chart: Half-Life 13.2 Hours

Hours	Fraction Remaining	Hours	Fraction Remaining
0*	1.000	18	.389
3	0.854	21	.322
6	0.750	24	.284
9	0.623	27	.242
12	0.535	30	.207
15	0.455		

• Time of calibration.

CLINICAL PHARMACOLOGY [1,2,4,5]

The thyroid gland secretes thyroxin and other closely related hormones that are essential for proper regulation of the metabolism. Three hormones are known to be produced by the thyroid gland: thyroxine, triiodothyronine and thyrocalcitonin (which helps to regulate calcium metabolism). Thyroxine (T_4) and triiodothyronine (T_3) contain four and three atoms of iodine respectively. Iodine is essential for thyroid hormone synthesis. Hence, sodium iodide is readily absorbed by the stomach into the blood plasma. The iodide is "trapped" by the thyroid gland by an active transport process. This leads to concentrations within the gland from twenty to several hundred times that of the blood plasma. In the follicular lumen, near the apex of the cells, iodide is oxidized to I_2 or hypoiodite. In successive stages, the iodine combines with tyrosine in protein molecules to form monoiodotyrosine (MIT), diiodotyrosine (DIT), and is then coupled to form tetraiodothyronine (thyroxine or T_4).

A glycoprotein, thyroglobulin is synthesized within the thyroid. It contains tyrosine, an amino acid which reacts with the iodine to form the thyroid hormones. The thyroglobulin-thyroid hormone complex is stored in the follicles of the thyroid gland and is termed "colloid". Approximately 30% of the thyroid mass is stored thyroglobulin (containing the iodine).

Normally thyroglobulin is not released into circulation, but undergoes proteolytic digestion, which releases the thyroid hormones. Hormone synthesis, iodine trapping, iodination and proteolysis of thyroglobulin and hormone release is controlled by the thyroid-stimulating hormone (TSH) from the anterior pituitary.

Iodines are returned into the blood plasma "pool" through metabolism of the thyroid hormones in the liver. The iodine is either trapped by the thyroid or eliminated by the renal excretory mechanism.

Uptake of radioiodine by the thyroid can be affected by many factors. Uptake is decreased if the patient has had prolonged increase in dietary iodine of several hundred micrograms. Exposure to much greater quantities of iodine, of the order of 50 milligrams or more, results in suppression of radioiodine uptake altogether. Uptake of radioiodine is reduced in the hypothyroid patient (either cretinism or myxedema).

In hyperthyroid patients, the thyroid gland is overactive and iodine uptake is increased. This is usually due to excessive formation of thyroid hormones and their escape into circulation.

Normal thyroid uptake and clearance are the same for children as for adults. Both thyroid and renal iodine clearance decrease progressively with age beyond the fifth decade. Differences between men and women are small and may be disregarded for clinical purposes.

INDICATIONS AND CLINICAL USE

Sodium Iodide I-123 Oral Solution is indicated as a diagnostic agent for use in evaluating thyroid function and/or morphology.

CONTRAINDICATIONS

To date there are no known contraindications associated with the use of Sodium Iodide I-123 Oral Solution.

WARNINGS

Females of childbearing age and children under 18 should not be studied unless the benefits anticipated from the performance of the test outweigh the possible risk of exposure to the amount of ionizing radiation associated with the test.

PRECAUTION

General

The contents of the vial are radioactive. Adequate shielding of the preparation must be maintained at all times.

Do not use after the expiration date (24 hours after calibration time) stated on the label.

Sodium Iodide I-123, as well as other radioactive drugs, must be handled with care and appropriate safety measures should be used to minimize radiation exposure to clinical personnel. Care should also be taken to minimize radiation exposure to the patient consistent with proper patient management.

Radiopharmaceuticals should be used only by those medical practitioners who are appropriately qualified in the use of radioactive prescribed substances in or on humans.

Carcinogenesis, mutagenesis, impairment of fertility

No long-term animal studies have been performed to evaluate carcinogenic potential, mutagenic potential, or whether Sodium Iodide I-123 affects fertility in males or females.

Nursing Mothers

Since I-123 is excreted in human milk, formula-feeding should be substituted for breast-feeding if the agent must be administered to the mother during lactation.

Pediatric Use

Safety and effectiveness in children have not been established.

Use in Pregnancy

Animal reproduction studies have not been conducted with this drug. It is also not known whether Sodium Iodide I-123 can cause fetal harm when administered to a pregnant woman, or can affect reproductive capacity. Sodium Iodide I-123 should be given to a pregnant woman only if clearly needed.

ADVERSE REACTIONS

Although rare, reactions associated with the administration of Sodium Iodide isotopes for diagnostic use include, in decreasing order of frequency, nausea, vomiting, chest pain, tachycardia, itching skin, rash and hives.

DOSAGE AND ADMINISTRATION

The recommended oral dose for the average patient (70 kg) is 3.7 - 14.8 MBq of Sodium Iodide I-123. The lower part of the dosage range 3.7 MBq (100 µCi) is recommended for uptake studies alone, and the higher part 14.8 MBq (400 µCi) for thyroid imaging. The determination of I-123 concentration in the thyroid gland may be initiated at six hours after administering the dose and should be measured in accordance with standardized procedures.

TABLE 4

Radiation Dose Estimates as a Function of Maximum Thyroid Uptake for I-123* Sodium Iodide At Time of Calibration

Target Organ	Maximum Thyroid Uptake (%)	Estimated Radiation Absorbed Dose: Absorbed Dose (mGy/MBq)	Estimated Radiation Absorbed Dose: Absorbed Dose (rad/mCi)
Thyroid	5	0.676	2.50
	15	2.03	7.50
	25	3.45	12.75
Liver	5	0.006	0.023
	15	0.006	0.023
	25	0.006	0.023
Ovaries	5	0.012	0.045
	15	0.012	0.045
	25	0.011	0.040
Red Marrow	5	0.009	0.035
	15	0.009	0.035
	25	0.010	0.038
Stomach Wall	5	0.065	0.240
	15	0.068	0.250
	25	0.068	0.250
Small Intestine	5	0.043	0.160
	15	0.043	0.160
	25	0.043	0.160
Testes	5	0.005	0.020
	15	0.005	0.020
	25	0.005	0.019
Bladder	5	0.095	0.350
	15	0.081	0.300
	25	0.074	0.275
Bone Surface	5	0.007	0.025
	15	0.007	0.028
	25	0.007	0.028
Other Tissues	5	0.006	0.023
	15	0.007	0.025
	25	0.008	0.040
Effective Dose** (mSv/14.8 MBq)	5	0.051	0.190
	15	0.119	0.440
	25	0.187	0.693

**Concentration at Time of Calibration: 99.8% I-123, 0.1% I-125, 0.1% Te-121 with the dosimetry calculated using the MIRD method.*

***For the determination of effective doses, the weighting factors given in ICRP Publication 60 are used[6].*

The patient dose should be measured by a suitable radioactive calibration system immediately prior to administration. The solution can be used up to 24 hours after calibration time and date. Thereafter discard the solution in accordance with standard safety procedures. The user should wear waterproof gloves at all times when handling the solution or container.

RADIATION DOSIMETRY

The estimated absorbed radiation doses to several organs of an average patient (70 kg) following oral administration of the maximum dose of 14.8 MBq (400 µCi) of I-123 are shown in Table 4 for thyroid uptakes of 5, 15, and 25%.

HOW SUPPLIED

Sodium Iodide I-123 is supplied as solution for oral administration in 0.08 mL doses with an activity of 74 MBq at time of calibration. The iodide is dissolved in a 0.1N NaOH solution. It is supplied in a 5 mL serum vial.

STORAGE

Dispense and preserve the solution in well-closed containers that are adequately shielded. Store at room temperature, below 30° C (86° F).

EXPIRY

The expiration date has been determined to be 24 hours after calibration time and date.

REFERENCES

1. Bergersen, B.S. *Pharmacology In Nursing*, 13th ed.,The C.V. Mosby Company, Saint Louis, 1976.
2. Ingbar, S.H., Braverman, L.E., *The Thyroid A Fundamental and Clinical Text*, 5th ed., J.B. Lippincott Company, Philadelphia, 1986.
3. Kocher, D. C., *Radioactive Decay Tables, DOE/TIC-11026*, 122, (1981).
4. Schottelius, B.A., and Schottelius, D.D., *Textbook of Physiology*, 17th ed., The C.V. Mosby Company, Saint Louis, 1973.
5. Seeman, P., Sellers, E.M., Roschiau, W.H.E., *Principles of Medical Pharmacology*, 3rd ed., The University of Toronto Press, Toronto, 1980.
6. Smith, H., *Annals of the ICRP*, 1st, ed., Pergamon Press Inc., New York, 1991.