Measurement of Whole-Body I-131 Retention

**Primary Indications:** To determine the whole-body retention of I-131, as an estimate of the fraction of the administered dose accumulated in thyroid tissue. This information is used to document that a patient with thyroid carcinoma who is to be treated with I-131 can be released immediately based on patient-specific calculations in accordance with NRC regulations governing such release (10 CFR 35.75). This study is usually performed as an isolated test only in patients who are being evaluated for I-131 ablation of residual thyroid tissue soon after thyroidectomy. The measurement is also performed in conjunction with Whole-Body I-131 Imaging.

**Rationale:** The portion of a dose of radioactive iodine that is taken up by normal thyroid tissue and by iodine-avid tumors (the thyroidal fraction) will be cleared from the tissue with a T\text{biol} of 80 days (T\text{eff} = 7.2 days). The extrathyroidal fraction of the administered dose will be cleared with a T\text{biol} of 0.33 days (T\text{eff} = 0.32 days). Determination of the whole-body retention of I-131 at approximately 48 hours (or later) is a conservative estimate of the thyroidal fraction of an administered dose of I-131.

**Interfering Conditions:** Thyroid hormone therapy; recent administration of iodinated contrast agents or other iodine-containing drugs, and non-elevated TSH will all interfere with I-131 uptake in thyroid tissue. These conditions do not preclude performing this test, but may reduce the effectiveness of a subsequent treatment with a large dose of I-131.

**Contraindications:** Measurement of Whole-Body I-131 Retention is contraindicated in pregnant women because of the potential for ablation of the fetal thyroid gland (which begins to accumulate radioiodine at 8-10 weeks gestational age). Accordingly, it must be documented that a female patient is not pregnant (or does not have child-bearing potential) before administration of I-131, by establishing that the patient is premenarchal or postmenopausal; has had tubal ligation or hysterectomy; or has had a negative serum (or urine) pregnancy test (qualitative beta-HCG) performed within the previous 7-8 days. In some circumstances, documentation of non-pregnancy by careful clinical history will be sufficient if so judged by the responsible staff nuclear medicine physician.

Measurement of Whole-Body I-131 Retention is contraindicated in women who are breast feeding because a large fraction of the administered activity will be secreted in breast milk, which when ingested will cause radiation exposure to the infant’s thyroid gland (potentially resulting in thyroid ablation or radiation-induced thyroid carcinoma). Additionally, I-131 administration should be delayed for > 2 weeks postpartum or after cessation of breast feeding to allow breast tissue to return to a basal state (in order to minimize the dose to the patient’s breasts).

**Precautions:** In a patient with a history of nausea and vomiting, appropriate precautions should be taken to avoid environmental contamination in the event vomiting occurs soon after I-131 administration. Pretreatment with an antiemetic should be considered in some patients.
Radiopharmaceutical: I-131 sodium iodide solution or capsule.

Adult Dosage: Per physician prescription as specified in a written directive. The standard adult dose is 1 mCi when Measurement of Whole-Body I-131 Retention is performed without concomitant Whole-Body I-131 Imaging. See procedure for Whole-Body I-131 Imaging for I-131 dose when the two studies are performed together.

Pediatric Dosage: Per physician prescription as specified in a written directive. The standard pediatric dose is 15 µCi/kg (minimum dose to be determined by the attending physician) when Measurement of Whole-Body I-131 Retention is performed without concomitant Whole-Body I-131 Imaging. See procedure for Whole-Body I-131 Imaging for I-131 dose when the two studies are performed together.

Radiation Dosimetry: Assuming 0% Thyroid Uptake. (If any functioning thyroid tissue is present, this will be the tissue receiving the highest dose.)
- Adult. Critical organ (bladder): 2.3 rem. Effective dose: 0.3 rem.
- Infant (1-year). Critical organ (bladder): 8.6 rem. Effective dose: 0.2 rem.

Route of Administration: Oral

Patient Scheduling: Telephone scheduling requests for Measurement of Whole-Body I-131 Retention should be directed to a staff or resident physician, who should obtain all required scheduling information and enter it on the appropriate “Record of Telephone Scheduling” form (attached). In most cases, Measurement of Whole-Body I-131 Retention will be requested by staff of the Division of Radiation Oncology to be initiated on the same day. Usually the patient will first be sent to have blood drawn for measurement of TSH and, in a woman of childbearing potential, a STAT pregnancy test (qualitative serum beta-HCG). In most cases, the TSH result will not be available before the test is started. However, if a pregnancy test was performed, the result must be obtained before the I-131 is administered.

Patient Preparation: 1. The patient should be given a copy of “Instructions for Patients Receiving Radiiodine” (attached) and orally instructed in radiation precautions by a physician before the radiiodine is administered.
2. The patient should be given 2 bisacodyl (Dulcolax) tablets (or substitute laxative per physician prescription) to be taken on the evening before the retention measurement.

Dose Administration: Written Directive Before administration of sodium iodide I-131 for Measurement of Whole-Body I-131 Retention, a written directive must be prepared by, or under the supervision of an authorized user/staff nuclear medicine physician (in accordance with the Division of Nuclear Medicine Quality Management Program and the “Radiopharmaceutical Administration Policy for I-131 Sodium Iodide and for Radiopharmaceutical Therapy”). A “Radioiodine Prescription” form (see Administrative Policies and Procedures) must be completed in its entirety. The top portion of this form (including patient name; birth date;
sex; requisition number, accession number, and/or medical record number; prescribed dosage of I-131 sodium iodide; and purpose of administration) must be signed and dated by the responsible physician (staff nuclear medicine physician, nuclear medicine or radiology resident). The center portion of the form (including the drug lot number; volume; and dose calibrator reading) is to be completed by the nuclear medicine technologist or radiopharmacist who dispenses the I-131 sodium iodide. Finally, an authorized user/staff nuclear medicine physician must complete the bottom portion of the form and thereby confirm (1) the order from the referring physician; (2) the non-pregnant status of the patient; (3) the non-lactating status of the patient; (4) instruction of the patient in radiation safety; (5) the vial identity and lot number; (6) the final dose calibrator reading and concordance with prescribed dose; and (7) identification of the patient by more than one method (see below). The authorized user must then sign and date this form.

Patient Identification  Before administering the dose of I-131 sodium iodide, both the responsible staff physician and the administering technologist must verify by more than one method the identity of the patient as the individual named in the written directive. Examples of dual methods for establishing patient identity include (1) asking the patient”’s name and birth date (or address or social security number) and confirming both by comparison with the information on the requisition or in the patient”’s record and (2) asking the patient”’s name and inspecting the patient”’s ID bracelet or hospital ID card, and confirming both by comparison with the information on the requisition or in the patient”’s record.

Administration of I-131 Sodium Iodide Dispensed from Bulk Solution  For administration of the dose of I-131, the patient should be seated in front of the fume hood in the radiopharmacy. The patient”’s chest and lap should be draped with plastic-lined absorbent pads. Place paper medicine cup in lead cup holder. Add 5-10 mL water to cup. Gently discharge contents of the syringe containing the I-131 dose into the medicine cup. Rinse the syringe with water from another cup and discharge into the cup containing the dose. Repeat rinse. Have the patient drink the dose through a flexible straw. The cup and straw should be held by the technologist (not by the patient!). Rinse the cup with water and have the patient drink contents through the straw. Repeat. Dispose of cup and straw in I-131 radioactive waste bin. Remove drapes from the patient and dispose. After the patient leaves the dosing area, monitor area for contamination with Geiger counter.

Administration of I-131 Sodium Iodide Capsule  An I-131 sodium iodide capsule of the activity prescribed by the authorized user/staff nuclear medicine physician for a specific patient will be ordered from a commercial radiopharmacy for administration to inpatients at Barnes-Jewish Hospital or St. Louis Children's Hospital who cannot be transported to the radiopharmacy at Barnes-Jewish Hospital-South Campus for administration of I-131 solution. The lead container in which the capsule was delivered should be vented in the fume hood and then the activity of the capsule should be measured in the dose calibrator (and the assay checked by an authorized user/staff nuclear medicine physician). The capsule should then be returned to its container and transported to the patient's location. The patient”’s chest and lap (and the bed, if appropriate) should be draped with plastic-lined absorbent pads. The capsule should be transferred into a paper medicine cup, and patient should ingest into mouth without touching capsule. Water is then added to the cup to be drunk by patient while swallowing capsule. The empty container should be returned to the radiopharmacy. The empty cup, as well as
drapes and gloves used during the administration should be transferred to a plastic bag and transported back to the radiopharmacy for disposal in I-131 radioactive waste bin.

Patients with Swallowing Disorders  In neurologically or mentally impaired patients who are unable to swallow (or who expectorate involuntarily), the I-131 solution may be given by nasogastric tube per physician direction. A two-tube technique (feeding tube within nasogastric tube) is recommended to minimize the chances for external contamination.

**Equipment Setup:** Instrument: Capintec CAPTUS 600 Uptake Probe (Barnes-Jewish Hospital-South Campus)
Collimator: Single-bore uptake collimator
Energy Window: Multichannel-analyser acquisition. I-131 counts recorded in energy range from 336-396 keV.

**Patient Positioning:** Sitting for retention measurements

**Procedure:** 1. Following the procedure outlined in Bench Manual attached to the system, perform Calibration (Test) of uptake probe to ensure constancy of the system.
2. Following procedure outlined in Bench Manual attached to the system, perform Background Count and record on Whole-Body I-131 Retention Worksheet (attached). Background counting should be performed for 300 seconds (5 minutes).
3. Before dispensing of the I-131 dose, the technologist should confirm that the patient has not received other radiopharmaceuticals (especially previous administration of I-131). The latter should be checked by performing a survey count of the patient’s neck with the Series 900 Mini-monitor (a Geiger-Mueller detector) kept in the radiopharmacy. This is done as follows. In the dose administration room, first observe the background counting rate of the Mini-monitor for approximately 40 seconds and record the average value during the last 20 seconds. If average background exceeds 2 counts per second (cps), move to another room and repeat background measurement. Then place probe against the patient’s thyroid region for approximately 40 seconds and record the average value during the last 20 seconds. If the patient’s neck reading is more than 1 cps higher than background reading, it should be assumed that the patient has previously received another radiopharmaceutical. The patient should be carefully questioned to determine the nature of other radiopharmaceutical; a "residual" count of the patient's body may need to be obtained before giving the I-131 dose (per physician direction).
4. Administer I-131 orally to patient as described under “Dose Administration”.
5. Following the procedure outlined in Bench Manual attached to the system, perform initial patient count approximately 15 minutes after dose administration. Standard counting should be performed for 300 seconds (5 minutes). The uptake probe should be positioned parallel to floor at level of patient’s xiphoid process. The distance from the end of the collimator to the patient’s chest should be approximately 7 feet (per positioning marks on floor of uptake room). Record date, time (military format), and counts on Whole-Body I-131 Retention Worksheet.
6. Instruct patient when to return for completion of measurement. In most cases, the patient should return 48 hours after administration of I-131. However, when I-131 is given on Friday, patient should be instructed to return on Monday (72 hours).

7. When patient returns, repeat steps 1, 2, and 5 (constancy check, background count, and patient count). Before the patient count is performed, the patient should be asked to empty bladder.

6. Calculation Whole-Body I-131 Retention. Be certain to correct the delayed net patient counts for radioactive decay. Enter the data on the worksheet and solve for % retention.

**Items Required For Complete Study:**

1. Printouts of data (Background, Initial Patient Count and 48-Hour (or 72-Hour) Patient Count) from Uptake Probe.