

Thyroid Uptake Measurement and Imaging

Date Last Reviewed: 12/19/2019

RESPONSIBLE DIVISION: Division of Nuclear Medicine, Department of Radiology, UT Southwestern

Policy Basis for Protocol:

• To establish a protocol for thyroid uptake measurement and imaging.

DESCRIPTION OF STANDARD PROCEDURE

Scope:

 All NUCLEAR MEDICINE Technologists and Physicians must adhere to these guidelines when administering I-123 Sodium Iodide capsule for thyroid uptake and I-123 Sodium Iodide or Tc99m Pertechnetate for Thyroid imaging.

Indications:

- A. Evaluation of palpable nodules
- B. Evaluation of abnormal gland by palpation, but without definite nodules
- C. Evaluation of patients who had irradiation of the head and neck in childhood with or without palpable nodules.
- D. Evaluation for ectopic thyroid tissue, e.g. struma ovarii (image over pelvis) and lingual thyroid (image upper neck and jaw).
- E. Evaluation of hyperthyroidism
- F. Evaluation of sub-acute and chronic thyroiditis.

Examination Time:

- A. Initially: 30 minutes for radiopharmaceutical administration
- B. Delayed Images at 24 hours (I¹²³): Approximately 1 hour
- C. For Tc^{99m} Pertechnetate: Approximately 1.5 hours since radiopharmaceutical administration and imaging occur on the same day

Patient Preparation:

- A. The NUCLEAR MEDICINE physician takes a pertinent history and palpation findings to be included in the dictated report.
- B. The patient must discontinue iodide containing preparations, be off thyroid hormones, patient must not be taking anti-thyroid medications or other agents that may interfere with uptake, for times indicated below (end of the document).



- C. The patient must not have had intravenous or intrathecal iodinated contrast material (IVP, CT with contrast, myelogram, and angiogram) for at least 6 weeks.
- D. It may be preferable to have the patient NPO after midnight and 1 hour after ingesting the radioactive capsule.

Equipment and Energy Windows:

- A. Gamma camera: Small or large field of view
- B. Collimator: Pinhole collimator with 5mm insert
- C. Energy window: 20% window centered at 159 keV or 140keV for pertechnetate
- D. Detector: Uptake probe (single crystal probe with flat field collimator) if not performing camera based uptake

Radiopharmaceutical, Dose, and Technique of Administration:

- A. I-123 as Sodium Iodide
 - 1) 200-300 uCi capsule
 - 2) Oral administration
- B. Technetium-99m Sodium Pertechnetate
 - 1) 5.0 -10.0 mCi
 - 2) Intravenous injection

Patient Position & Imaging Field:

- A. Uptake: Sitting upright in a chair (probe based). Supine on table for camera based.
- B. Images: Position the patient supine with head and neck extended and immobilized for imaging. Acquire the following images:
 - 1) Anterior
 - 2) Anterior with marker
 - 3) Distant Anterior to include salivary glands (The distance between the collimator and patient's neck is adjusted so that the thyroid gland fills three quarters of the field of view. Use the persistence scope to determine this distance.)
 - 4) RAO
 - 5) LAO



- 6) Acquire ANT, LAO, and RAO images of the thyroid with the pinhole collimator 6 cm from the patient's neck. If using LEHR collimator, image 20cm from the patient's neck. On the anterior image, mark the suprasternal notch using a Co-57 marker.
- C. Imaging field: Neck (additional areas may be requested by the radiologist as indicated by the patient's medical history)

Acquisition Protocol for uptake measurement:

- A. The uptake is done at 24 hours. If requested, the uptake may also be performed at 4 hours. Note an uptake is not performed for Tc^{99m} Sodium Pertechnetate. Images are acquired approximately 20 minutes after injection.
- B. Place the standard radiopharmaceutical capsule in the neck phantom and position probe perpendicular to phantom with the positioning bar centered on the capsule at a standard distance (usually 20 cm).
- C. Position the probe in front of the patient's neck with the positioning perpendicular to the neck and with the bar centered half way between the thyroid cartilage and the suprasternal notch. Be certain that there are no other sources of external radiation behind the patient, for example, an injected patient in the hallway.
- D. Position the probe over the thigh for a "background" measurement. The positioning bar should be perpendicular to the thigh with the bar centered just above the knee. The patient should void before counting over the thigh and the bladder must be clearly outside the field of view.
- E. Time: acquisition times for counting the capsule, background and patient thyroid is 2 minutes.

Acquisition Protocol for thyroid imaging:

- A. Time: Begin imaging ~24h after I-123 or 20 minutes after the injection of Tc99m pertechnetate.
- B. Acquire 50K counts or 5-10 minute per image
- C. Matrix size: 128 X128 or 256 x 256

Data Processing:

A. Computer software calculates the uptake based on ROIs drawn.

Optional Maneuvers:

- A. The physician may request additional imaging (SPECT or planar imaging) as indicated by the patient's medical history.
- B. Evaluation of substernal or ectopic activity: Take an anterior image of the chest or the suspected area with a large field of view camera.
- C. Evaluation of midline activity: If the images show midline activity which may be due to radioactive saliva, have the patient swallow water and repeat the image.



Equipment

- A. Gamma Camera with pinhole collimator (Low Energy High Resolution Collimator may be required for additional imaging).
- B. Uptake Probe
- C. Co57 Thyroid marker

Principle Radiation Emission Data (I-123, ref. 3)

- A. Physical half-life: 13.2 hours
- B. Radiation: Gamma
- C. Mean % per disintegration: 83.3%
- D. Mean energy: 159 keV

Principle Radiation Emission Data (Tc-99m, ref. 3)

- A. Physical half-life: 6.01 hours
- B. Radiation: Gamma
- C. Mean % per disintegration: 89.07%
- D. Mean energy: 140.5 keV

Dosimetry:

A. I¹²³ Sodium Iodide:

According to models recommended in ICRP 106, a 8.880 MBq injection for a I-123 NaI (25%) study would impart to a Adult Male an approximate effective dose of 1.0 mSv (0.10 rem). The critical organ for this study is the Thyroid, which would receive 28.4 mGy (2.84 rad).

B.^{99m}**Tc Pertechnetate:**

 According to models recommended in ICRP 106, a 370 MBq injection for a Tc-99m Pertechnetate study would impart to a Adult Male an approximate effective dose of 4.8 mSv (0.48 rem). The critical organ for this study is the Upper large intestine, which would receive 21.1 mGy (2.11 rad).

DEFINITIONS:

- A. SPECT- Single Photon Emission Tomography
- B. RAO- Right Anterior Oblique



- C. LAO- Left Anterior Oblique
- D. uCi- micro Curie
- E. mCi- milli Curie

REFERENCES

- 1. Society of Nuclear Medicine Procedure Guideline for Thyroid Scintigraphy Approved 09-10-2006.
- 2. ACR-SPR Practice Parameter for the Performance of Scintigraphy and uptake mesurements for benign and malignant thyroid disease 2014
- 3. 53-I-123: <u>In MIRD</u>: Radionuclide Data and Decay Schemes, KF Eckerman, A Endo, eds, Society of Nuclear Medicine, Reston, VA, 2008, p 303.

Compounds That May Decrease Thyroid Iodine Uptake

MEDICATION	TIME*
Tri-iodothyronine (Cytomel)	2 to 3 weeks
Thyroid extract (Synthroid, Proloid)	4 weeks
Iodine solution (Lugol's or SSKI**)	6-8 weeks
Kelp	4 weeks
Some cough medicines and vitamin preparations	4 weeks
Intravenous contrast agents	1 to 2 months
Oil-based iodinated contrast agents	3 to 6 months
Amiodarone	3 to 6 months
Adrenocorticosteroids	1 week
Bromides	1 week
Butazolidine	1 week
Mercurials	1 week
Methimazole (Tapazole)	1 week
Nitrates	1 week
Perchlorate	1 week
Propylthiouracil	1 week
Salicylates (large doses)	1 week
Sulfonamides	1 week
Thiocyanate	1 week

*Time that patients should wait after medication is discontinued in order to obtain accurate uptake.

**Saturated solution of potassium iodide (2).

Approval: Orhan K Oz, MD, PhD, Professor and Interim Chief, Division of Nuclear Medicine, UT Southwestern. Date: 12/19/2019.