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ACR PRACTICE GUIDELINE FOR THE PERFORMANCE OF THYROID SCINTIGRAPHY AND UPTAKE MEASUREMENTS

PREAMBLE

These guidelines are an educational tool designed to assist practitioners in providing appropriate radiologic care for patients. They are not inflexible rules or requirements of practice and are not intended, nor should they be used, to establish a legal standard of care. For these reasons and those set forth below, the American College of Radiology cautions against the use of these guidelines in litigation in which the clinical decisions of a practitioner are called into question.

The ultimate judgment regarding the propriety of any specific procedure or course of action must be made by the physician or medical physicist in light of all the circumstances presented. Thus, an approach that differs from the guidelines, standing alone, does not necessarily imply that the approach was below the standard of care. To the contrary, a conscientious practitioner may responsibly adopt a course of action different from that set forth in the guidelines when, in the reasonable judgment of the practitioner, such course of action is indicated by the condition of the patient, limitations on available resources or advances in knowledge or technology subsequent to publication of the guidelines. However, a practitioner who employs an approach substantially different from these guidelines is advised to document in the patient record information sufficient to explain the approach taken.

The practice of medicine involves not only the science, but also the art of dealing with the prevention, diagnosis, alleviation, and treatment of disease. The variety and

complexity of human conditions make it impossible to always reach the most appropriate diagnosis or to predict with certainty a particular response to treatment. It should be recognized; therefore, that adherence to these guidelines will not assure an accurate diagnosis or a successful outcome. All that should be expected is that the practitioner will follow a reasonable course of action based on current knowledge, available resources, and the needs of the patient to deliver effective and safe medical care. The sole purpose of these guidelines is to assist practitioners in achieving this objective.

I. INTRODUCTION

This guideline was developed by the American College of Radiology (ACR) to guide interpreting physicians performing thyroid scintigraphy and in-vivo radioiodine thyroid uptake measurements. Properly performed imaging and uptake studies provide critical information on a variety of conditions that relate to the thyroid gland. Although certain patterns suggest specific disease entities, the radiologist should be aware of clinical data (e.g., thyroid hormone levels; the presence of clinically palpable neck masses; and potentially interfering substances such as medications, vitamins, and health foods containing large amounts of iodine and iodinated radiographic contrasts). Correlation with other radiographic modalities such as ultrasonography, chest radiography, or imaging with radiotracers not discussed in this guideline may also be helpful. Adherence to this guideline should maximize the probability of detecting and characterizing abnormalities of anatomy and function.

Application of this guideline should be in accordance with the [ACR Technical Standard for Diagnostic Procedures Using Radiopharmaceuticals](#).

(For pediatric considerations see Sections V.A.1; V.B.1; and V.C.)

II. GOALS

Thyroid scintigraphy enables the detection of focal and/or global abnormalities of thyroid anatomy, correlation of anatomy with function, and detection of aberrant or metastatic functioning thyroid tissue or residual normal tissue after therapy.

Thyroid uptake allows measurement of global function of the thyroid gland as reflected by the quantitative evaluation of radiotracer accumulation by the gland.

III. INDICATIONS

A. Thyroid imaging is useful in, but not limited to:

1. Evaluation of the size and location of thyroid tissue.
2. Evaluation of suspected thyroid masses.
3. Evaluation of abnormal clinical laboratory tests of thyroid function.
4. Evaluation of patients at risk for thyroid neoplasm (e.g., post neck irradiation).
5. Evaluation of congenital thyroid abnormalities.

B. Thyroid uptake is useful for:

1. Calculating iodine-131 administered activity for patients to be treated for hyperthyroidism or ablative therapy (see the ACR Practice Guideline for the Performance of Therapy with Unsealed Radiopharmaceutical Sources).
2. Differentiating hyperthyroidism from other forms of thyrotoxicosis (e.g., thyroiditis and thyrotoxicosis factitia).

C. Whole-body imaging for thyroid carcinoma is useful for:

1. Determining the presence and location of residual functioning thyroid tissue after surgery for thyroid cancer or after ablative therapy with radioactive iodine.
2. Determining the presence and location of metastases from iodine-avid forms of thyroid cancer.

IV. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

See the [ACR Technical Standard for Diagnostic Procedures Using Radiopharmaceuticals](#).

V. SPECIFICATIONS OF THE EXAMINATION

A. Thyroid Scintigraphy

1. Radiopharmaceutical

The preferred radioiodine agent is iodine-123 (sodium iodide) given orally in administered activity of 200-400 microcuries (7.4-14.8 MBq). Technetium-99m sodium pertechnetate, given intravenously in administered activity of 2.0-10.0 millicuries (74-370 MBq), is an acceptable alternative that has higher photon flux and lower thyroid radiation exposure. Use of iodine-131 is strongly discouraged for routine use because of the much greater radiation dose to the thyroid. The radiologist should be aware that findings, particularly in nodular disease, may rarely be discordant when the radioiodine and technetium images are compared since pertechnetate is not handled by the same physiologic mechanism as iodine.

Administered activity for children should be reduced according to body surface area or weight. The pediatric administered activity should be as low as possible to achieve appropriate image quality.

2. Pharmacologic considerations

Many agents interfere with the accumulation of radiopharmaceuticals in the gland (e.g., iodinated contrast media; thyroid replacement hormones; antithyroid medications; and some medications such as lithium, amiodarone, and foods or vitamins containing high levels of iodine). A thorough medical history should be obtained prior to administering the radiopharmaceuticals, and, if necessary, the study should be delayed appropriately.

3. Patient

The patient should be placed in a supine position, with the neck comfortably extended. It may be helpful to immobilize the head with gentle restraints. When indicated, the physician should palpate the thyroid gland while the patient is in the imaging position as well as when the patient is upright.

4. Imaging

With iodine-123, imaging can commence as early as 3 hours after dosing. Interpretable images can be obtained as long as 36 hours later. With technetium-99m pertechnetate, the study should commence 5-30 minutes after injection. Some measure of size is desirable, as is demarcation of anatomic landmarks such as the sternal notch and thyroid cartilage. The position of palpable nodules should be demarcated with radioactive point source markers or lead markers to correlate their function with anatomy and images obtained.

B. Thyroid Uptake

1. Radiopharmaceutical

If a thyroid scan is performed simultaneously, the radioiodine administered activity given for that will suffice. If done separately or in conjunction with a technetium-99m pertechnetate scan, as little as 100 microcuries (3.0 MBq) of iodine-123 or 4 microcuries (0.15 MBq) of iodine-131 can be used. If only a thyroid uptake with iodine-131 is obtained, the administered activity should not exceed 15 microcuries (0.55 MBq).

Administered activity for children should be reduced according to body surface area or weight. The pediatric administered activity should be as low as possible to achieve appropriate image quality.

2. Pharmacologic considerations: See Section V.A.2.

3. Procedure

The usual time of study is approximately 24 hours after dosing. It may also be performed earlier than 24 hours, keeping in mind that the normal values would differ from the 24-hour normal values. The patient sits or lies with neck extended; an open-faced collimated detector probe is directed at the neck, with the crystal usually no more than 20-25 cm away. There are several acceptable techniques; the following is one example. Counts are taken for 1 minute. The patient's thigh is then counted for a similar amount of time and at the same distance (taking care to exclude the urinary bladder from the field of view). A calibrated source of the same radionuclide in a strength and physical form identical to that given to the patient is placed in a

standardized lucite scattering neck phantom and is counted for the same length of time using the same geometry. The radioiodine uptake (RAIU) is calculated using the formula:

$$\frac{\text{Neck Counts} - \text{Thigh Counts}}{\text{Phantom Counts} - \text{Room Background}} \times 100 = \text{RAIU}$$

C. Imaging for Thyroid Carcinoma

In the absence of normal thyroid tissue, most well-differentiated thyroid carcinomas may accumulate iodine. Detection of thyroid remnants after surgery and of functioning thyroid metastases is possible using iodine-131. Administered activity of 2.0-5.0 millicuries (74-185 MBq) is given orally, and imaging of the neck or the entire body is performed 48-96 hours later using a collimator designed for iodine-131.

Administered activity for children should be reduced according to body surface area or weight. The pediatric administered activity should be as low as possible to achieve appropriate image quality.

Imaging may also be performed 2-14 days (typically at 5-7 days) after thyroid ablative therapy (usually 100-200 millicuries [3,700-7,400 MBq] iodine-131) to search for occult metastases present at the time. Uptake values may also be calculated for the residual thyroid tissue in the thyroid bed using the technique described in Section V.B.3.

Thyroid hormone replacement must be withheld for a time sufficient to render the patient hypothyroid (TSH level greater than 50 mU/L), or thyrotropin alpha (Thyrogen) should be used according to an established protocol.

The use of a low iodine diet may increase the sensitivity of the examination.

Some investigators have used iodine-123, thallium-201, technetium-99m sestamibi, or technetium-99m tetrofosmin whole-body imaging as an alternative for follow-up of remnants and carcinoma metastases. (See the [ACR Practice Guideline for the Performance of Tumor Scintigraphy](#).)

FDG PET has been used to evaluate patients who have a history of well-differentiated thyroid cancer that is not I-131 avid and have elevated thyroglobulin levels. Studies have shown that PET detects metastatic disease in approximately 70 percent of these patients. Most of the studies have been performed while patients are on thyroid hormone, and it is unclear if the sensitivity would increase with elevated thyroid stimulating hormone levels. (See the [ACR Practice Guideline for the Performance of FDG-PET Scintigraphy in Oncology](#).)

VI. EQUIPMENT SPECIFICATIONS

A. Thyroid Imaging

Normally, a pinhole collimator-equipped gamma camera is used. Images are acquired in the anterior and often both anterior oblique projections for a minimum of 100,000 counts or 8 minutes, whichever occurs first. The distance between the collimator aperture and the neck should be such that the thyroid occupies most of the field of view. With pinhole collimators, significant geometric distortion occurs. Additional views with a parallel-hole collimator may be useful when searching for ectopic tissue or estimating size.

B. Thyroid Uptake

A thyroid probe is normally used. A gamma camera with a parallel-hole collimator may be used instead of a probe, but the use of a standardized neck phantom remains necessary.

C. Imaging for Thyroid Carcinoma

Imaging may be performed using either a scintillation camera (spot views) or a whole-body imaging device. A high-energy (300+ keV) collimator must be used with iodine-131, and the detector head must be shielded sufficiently for such an energy. Pinhole collimator imaging of the thyroid bed may also be useful.

VII. DOCUMENTATION

Reporting should be in accordance with the [ACR Practice Guideline for Communication: Diagnostic Radiology](#).

VIII. QUALITY CONTROL AND IMPROVEMENT, SAFETY, INFECTION CONTROL, AND PATIENT EDUCATION CONCERNS

Policies and procedures related to quality, patient education, infection control, and safety should be developed and implemented in accordance with the ACR Policy on Quality Control and Improvement, Safety, Infection Control, and Patient Education Concerns appearing elsewhere in the ACR Practice Guidelines and Technical Standards book.

Equipment performance monitoring should be in accordance with the [ACR Technical Standard for Medical Nuclear Physics Performance Monitoring of Nuclear Medicine Imaging Equipment](#).

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