Radionuclide thyroid scans

1. Purpose
The purpose of this guideline is to assist specialists in Nuclear Medicine and Radionuclide Radiology in recommending, performing, interpreting and reporting radionuclide thyroid scans. This guideline will assist individual departments in the formulation of their own local protocols.

2. Background
Thyroid scintigraphy is an effective imaging method for assessing the functionality of thyroid lesions including the uptake function of part or all of the thyroid gland. $^{99}$Tc$^m$ pertechnetate is trapped by thyroid follicular cells. $^{123}$I-Iodide is both trapped and organified by thyroid follicular cells.

3. Common Indications
   3.1 Assessment of functionality of thyroid nodules.
   3.2 Assessment of goitre including hyperthyroid goitre.
   3.3 Assessment of uptake function prior to radio-iodine treatment
   3.4 Assessment of ectopic thyroid tissue.
   3.5 Assessment of suspected thyroiditis
   3.6 Assessment of neonatal hypothyroidism

4. Procedure
   4.1 Patient preparation
   4.1.1 Information on patient medication should be obtained prior to undertaking study. Patients on Thyroxine (Levothyroxine Sodium) should stop treatment for four weeks prior to imaging, patients on Tri-iodothyronine (T3) should stop treatment for two weeks if adequate images are to be obtained.
   4.1.2 All relevant clinical history should be obtained on attendance, including thyroid medication, investigations with contrast media, other relevant medication including Amiodarone, Lithium, kelp, previous surgery and diet.
   4.1.3 All other relevant investigations should be available including results of thyroid function tests and ultrasound examinations.
   4.1.4 Studies should be scheduled to avoid iodine-containing contrast media prior to thyroid imaging.
   4.1.5 Carbimazole and Propylthiouracil are not contraindicated in patients undergoing $^{99}$Tc$^m$ pertechnetate thyroid scans and need not be discontinued prior to imaging. However both these agents will affect the
uptake values. If $^{123}$I-Iodine is to be used as the radiopharmaceutical for imaging and uptake values are to be used in dosimetric calculations, both Carbimazole and PTU should be stopped for a minimum of 48 hours before imaging.

4.2 Injection Technique
If uptake values are to be obtained using either $^{99}$Tc$^{m}$ pertechnetate or $^{123}$I-Iodine then the syringe may need to be imaged under the gamma camera prior to i.v. injection.

4.3 Special Precautions
Prior to imaging patients should be asked to drink water to clear $^{99}$Tc$^{m}$-labelled saliva from the oesophagus.

5. Radiopharmaceutical

5.1 $^{99}$Tc$^{m}$ pertechnetate - 80MBq (ARSAC Diagnostic reference level)
5.2 $^{123}$Iodide - 20MBq

6. Image Acquisition

6.1 Camera
A standard field of view or small field of view camera may be used.

6.2 Collimator
The following are appropriate collimators for thyroid imaging:
- Low energy high resolution collimator
- Pinhole collimator
- Snout-nosed parallel hole collimator

6.3 Patient position
Patients should be clinically examined to ensure that if nodules are present they are identified.

Patients should be positioned under the gamma camera supine with the neck extended. Claustrophobic patients may be imaged sitting.

The sternal notch should be identified.

The injection site should be imaged if quantitation is to be performed.

Markers should be positioned to identify the nodule with patient lying supine under the camera.

6.4 Views
Anterior views should be routinely acquired, one of which should include salivary glands and suprasternal notch marker. Lateral and oblique views may be taken if a nodule is suspected but not identified on the anterior views. A large field of view image should be obtained if retrosternal extension or ectopic thyroid tissue is suspected, and in infants a lateral view should also be obtained when ectopic
thyroid tissue is suspected. In patients in whom retrosternal extension is suspected prior to the study $^{123}$Iodide will give better information than $^{99}$Tc$^{m}$ pertechnetate.

6.5 Computer Acquisition

$^{99}$Tc$^{m}$ pertechnetate imaging should be undertaken 20 minutes after injection
A 100-200K count anterior image should be acquired
$^{123}$Iodine imaging should commence 3 hours after injection
A 50-100 K count anterior image should be acquired

6.6 Interventions

Perchlorate may be given after imaging with $^{123}$Iodide to evaluate organification of the whole thyroid or a thyroid nodule. Imaging should be continued at 5 min intervals for up to 1 hour to assess washout.

7. Data Analysis

7.1 Data analysis

The $^{99}$Tc$^{m}$ pertechnetate 20 minute uptake value may be calculated using a thyroid ROI and a background ROI, to determine the percentage of the injected dose present in the gland at 20 min. A local normal range should be established.

7.2 Data Output

All views should be labelled as per Generic Guidelines and labelling should include an indication of side and clear labelling of marker views.

8. Interpretation

8.1 Reporting format

The following should be assessed and described in the report as appropriate:

- Homogeneity of tracer uptake.
- Presence of discrete thyroid nodules.
- Functionality of nodules.
- Presence or absence of thyroid tissue suppression.
- Presence of ectopic thyroid tissue.
- Presence of retrosternal extension.
- The uptake measurement (if calculated).
- Response to perchlorate.

9. Discussion

9.1 Pitfalls

- Activity in the oesophagus.
- Failure to correlate the finding of clinical palpation and ultrasound examination with the radionuclide scan.
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Low or absent uptake due to block by ingested or administered iodine, or iodine-containing medication or Thyroxine (Levothyroxine Sodium) medication. The adequacy of $^{99}$Tc$^{m}$ pertechnetate in the assessment of thyroid nodules as some trapping may occur in nodules that appear non-functioning on $^{123}$I-Iodide scans.

10. Controversies
Nil.

11. References
SNM Guidelines on Thyroid Imaging

12. Date Agreed / Approved
April 2001

13. Date for Review / Update
April 2005

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These guidelines do not constitute a formal protocol but highlight the aspects of a study where variation in practice may significantly affect the quality of outcome of the study.