Society of Nuclear Medicine (SNM) is an international scientific and professional organization founded in 1954 to promote the science, technology and practical application of nuclear medicine. Its 16,000 members are physicians, technologists and scientists specializing in the research and practice of nuclear medicine. In addition to publishing journals, newsletters and books, the Society also sponsors international meetings and workshops designed to increase the competencies of nuclear medicine practitioners and to promote new advances in the science of nuclear medicine.

The SNM will periodically define new procedure guidelines for nuclear medicine practice to help advance the science of nuclear medicine and to improve the quality of service to patients throughout the United States. Existing procedure guidelines will be reviewed for revision or renewal, as appropriate, on their fifth anniversary or sooner, if indicated.

Each procedure guideline, representing a policy statement by the Society, has undergone a thorough consensus process in which it has been subjected to extensive review, requiring the approval of the Committee on SNM Guidelines, Health Policy and Practice Commission, and SNM Board of Directors. The SNM recognizes that the safe and effective use of diagnostic nuclear medicine imaging requires specific training, skills, and techniques, as described in each document. Reproduction or modification of the published procedure guideline by those entities not providing these services is not authorized.

The SNM PRACTICE GUIDELINE FOR SOMATOSTATIN RECEPTOR SCINTIGRAPHY DRAFT V1.4

PREAMBLE

These guidelines are an educational tool designed to assist practitioners in providing appropriate 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 Society of Nuclear Medicine (SNM) 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 of available resources, or advances in knowledge or technology subsequent to publication of the guidelines.

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. Therefore, it should be recognized 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

The purpose of this guideline is to assist nuclear medicine practitioners in recommending, performing, interpreting, and reporting the results of somatostatin receptor scintigraphy with $^{111}$In pentetreotide. The EANM (European Association of Nuclear Medicine) guideline on $^{111}$In-pentetreotide scintigraphy (1) was taken into consideration throughout this guideline. This guideline only covers imaging with $^{111}$In-pentetreotide. Imaging with other somatostatin analogs is not a subject of this guideline.

II. GOALS

The goal of somatostatin receptor scintigraphy (SRS) is to detect and localize a variety of neuroendocrine tumors in patients often with elevated neuroendocrine tumor markers, as well as some non-neuroendocrine tumors. SRS may help in pre-operative evaluation, staging and restaging of these tumors.

III. DEFINITIONS

$^{111}$Indium pentetreotide is an agent used primarily for scintigraphic localization of primary and metastatic neuroendocrine tumors bearing somatostatin receptors. $^{111}$In-pentetreotide is $^{111}$In-DTPA-octreotide, a somatostatin analog that binds to somatostatin receptors on cell surfaces. This octapeptide binds to somatostatin receptor-rich normal tissues and concentrates in neuroendocrine tumors (NET) and some non-neuroendocrine tumors containing somatostatin receptors (predominantly somatostatin receptor subtypes 2 and 5 [sst2 and sst5]). Disorders that may be detected by SRS with $^{111}$In-pentetreotide include, but are not limited to:

A. Tumors with high expression of somatostatin receptors:
   - adrenal medullary tumors (pheochromocytoma, neuroblastoma, ganglioneuroma, paraganglioma)
   - GEP-NET’s [gastroenteropancreatic neuroendocrine tumors] (formerly termed carcinoid, gastrinoma, insulinoma, glucagonoma, vasoactive intestinal polypeptide-secreting tumor, pancreatic polypeptide-secreting tumor, etc., or non-functioning GEP tumors); more recently classified by the WHO as low grade, intermediate grade and high grade [G1, G2, G3]
   - medullary thyroid carcinoma
   - Merkel cell tumor of the skin
   - pituitary adenoma
   - small-cell lung carcinoma

B. Tumors with low expression of somatostatin receptors:
   - astrocytoma
   - benign and malignant bone tumors
   - breast carcinoma
   - differentiated thyroid carcinoma (papillary, follicular, Hürthle cell)
   - lymphoma (Hodgkin’s and non-Hodgkin’s)
   - melanoma
   - meningioma
   - non-small cell lung carcinoma
C. Non-neoplastic processes:
- autoimmune diseases (e.g., rheumatoid arthritis, Graves’ disease, Graves’ ophthalmopathy)
- bacterial pneumonia
- cerebrovascular accident
- fibrous dysplasia
- granulomatous diseases (e.g., tuberculosis, sarcoid)
- post-radiation inflammation

Thus, knowledge of the patient’s medical history is important. In addition to these pathologies, normal organs such as the pituitary, thyroid, spleen, liver, and renal parenchyma also demonstrate avidity for $^{111}$In-pentetreotide. The gallbladder, bowel, renal collecting systems, ureters, and urinary bladder are seen as a result of tracer clearance.

**IV. EXAMPLES OF CLINICAL AND RESEARCH INDICATIONS**

Somatostatin receptor scintigraphy (SRS) may be used clinically for:

A. Detection and localization of suspected neuroendocrine and some non-neuroendocrine tumors and their metastases (2-11)

B. Staging of patients with neuroendocrine tumors (7, 12-17)

C. Follow-up of patients with known disease to evaluate for progression or recurrence (restaging) (10, 12, 17-20)

D. Determination of somatostatin-receptor status (patients with somatostatin receptor-positive tumors may be more likely to respond to peptide receptor radionuclide therapy. (21-24)

E. Evaluation of acute inflammation in rheumatologic disorders (25-27)

F. Recommendation for appropriate use of SRS in the management of various neuroendocrine tumors and lung neuroendocrine tumors is addressed in the National Comprehensive Cancer network (NCCN) Clinical Practice Guidelines in Oncology (17).

**V. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL (in the United States)**

Please see Section V of the SNM Procedure Guideline on General Imaging.
VI. PROCEDURE/SPECIFICATIONS OF THE EXAMINATION

A. Request

The request should be made by a qualified physician or other licensed healthcare professional familiar with the patient's clinical history. A relevant history, the type of suspected or known primary tumor, its hormonal activity, the results of other imaging studies (CT, MRI, US), laboratory results (tumor markers), history of recent surgery, chemotherapy, radiation therapy, and/or octreotide therapy should be obtained. History of cholecystectomy and splenectomy should also be noted.

B. Patient Preparation and Precautions

1. When safe and appropriate, consideration should be given to discontinuing octreotide acetate therapy prior to $^{111}$In-pentetreotide administration in consultation with the referring clinician. The length of withdrawal will depend on the type (half-life) of the therapeutic agent; at least 1 day is recommended for standard agents and 4-6 weeks for long-acting/slow release formulations.

2. To minimize radiation exposure, patients should be well hydrated before and for at least one day after tracer injection. The use of $^{111}$In-pentetreotide in patients with impaired renal function should be considered, as the rate of tracer excretion may be much slower than that in normal patients.

3. While there is no definitive literature on the use of $^{111}$In-pentetreotide in patients on dialysis, interpretable images may be obtained after dialysis.

4. The use of laxatives should be considered, especially when the abdomen is the area of interest. A mild oral laxative (e.g., bisacodyl or lactulose) may be administered in the evening before injection and in the evening following injection. The need for bowel preparation should be assessed on an individual basis and laxatives should not be used in patients with active diarrhea or in patients with insulinoma.

5. In patients suspected of having insulinoma, an intravenous infusion of glucose should be administered just before and during the injection of $^{111}$In-pentetreotide because of the potential for inducing severe hypoglycemia.

6. $^{111}$In-pentetreotide should not be injected into I.V. lines used for, or together with, solutions for total parenteral nutrition.

7. $^{111}$In-pentetreotide is classified as category C for use in pregnant women.

C. Radiopharmaceuticals
Indium pentetreotide (OctreoScan®) is \[^{111}\text{In}\ \text{DTPA-D-Phe-1} \] octreotide, a standard somatostatin analog. The recommended administered activity is 222 MBq (6 mCi) in adults and 5 MBq/kg (0.14 mCi/kg) in children. Based on in vitro studies, the hormonal effect of pentetreotide is approximately 10% that of octreotide. The amount of pentetreotide injected per dose of OctreoScan® is 10 micrograms. This dose is not expected to have a clinically significant pharmacologic effect (except in insulinoma, see VI.B.4.).

\[^{111}\text{In}\]pentetreotide is cleared rapidly from the blood pool (one-third of the injected dose remains in the blood pool at 10 min, 1% at 20 hr post injection). Excretion is almost entirely via the kidneys (50% of the injected dose is recovered in the urine by 6 hr, 85% within 24 hr). Hepatobiliary excretion represents about 2% of the administered dose. The biological half-life is 6 hrs. Dosage adjustment in patients with decreased renal function has not been studied.

D. Protocol/Image Acquisition/Processing

1. Patients should void before imaging.

2. Imaging protocol:

Images are routinely acquired at 24 hr. Four hr and 48 hr post-injection imaging is optional. The delayed images may be needed to allow clearance of significant bowel activity. Four-hour images may be obtained to enable evaluation before the appearance of activity in the gut, but since tumor-to-background ratio is lower at 4 hours than at 24 and 48 hours, some lesions may be missed at 4 hrs. SPECT (or SPECT/CT if available) images are preferably performed at 24 hours post-injection due to the higher target-to-background ratio at that time. Early and delayed SPECT may be helpful in distinguishing physiologic bowel activity from pathologic lesions.

3. Image Acquisition:

a. Planar images are acquired using a large-field-of-view gamma camera fitted with a medium-energy collimator. Symmetric 20% energy windows are centered over both photopeaks of \[^{111}\text{In}\] (173 and 247 keV) and the data is summed. Planar localized images of the head, chest, abdomen, pelvis, and, if needed, the extremities can be acquired for 10-15 minutes per image, using a 512 x 512 or 256 x 256 matrix.

For whole-body images using a dual-head camera, it is suggested that anterior and posterior images are acquired into 2048 x 512 or 1024 x 256 matrices at a speed that balances information density with practicability and patient comfort in a single pass. Since cervical lymph node metastases may be missed on whole body images, it is suggested that additional planar localized images of the head and neck, including lateral views, are obtained.
b. **SPECT** imaging of the appropriate regions, as indicated based upon the clinical history and/or the planar images is strongly recommended. It should be performed with a multi-detector gamma camera when possible. Although imaging systems may vary, an example of potentially useful acquisition parameters for a multi-detector system is: 3° angular sampling, 128 x 128 matrix, 360° rotation, 20–30 sec per stop.

c. **SPECT/CT** imaging may help localize foci of abnormal tracer accumulation more accurately than planar imaging or SPECT alone, and should be considered whenever indicated and available (28, 29). The patient’s history, planar images and other prior imaging studies should be reviewed to determine which body areas may benefit from using SPECT/CT. However, to limit the radiation dose to the patient, CT performed as part of hybrid SPECT/CT should be used judiciously.

An example of potentially useful CT acquisition parameters for attenuation correction/anatomic localization (AC/AL) performed as part of a hybrid SPECT/CT acquisition could include: 5.0 mm slice thickness with a 2.5 mm collimation for AC.

4. **Image processing:**

Iterative reconstruction with OSEM is the recommended reconstruction algorithm, as it may eliminate some of the artifacts seen with filtered back projection in areas near intense tracer activity. Specific parameters depend on vendor recommendations and local preferences.

Upon completion, the processed data can be fused with CT data for attenuation correction and combined interpretation.

Upon reconstruction, the above CT acquisition parameters could yield a 3.0 mm slice thickness with a B31 smooth kernel and a reconstruction increment of 1.5mm.

A low count processing protocol should be considered when SPECT/CT is done in areas of low tracer activity. An algorithm is used to amplify the data, which is then processed and fused with the CT data.

For more information see the Society of Nuclear Medicine Procedure Guideline for General Imaging and the Society of Nuclear Medicine Procedure Guideline for SPECT/CT Imaging.

E. **Interpretation**

1. When possible, images should be evaluated in conjunction with relevant anatomical images (e.g., CT, MRI, US). Where available, fusion imaging (SPECT/CT) should be considered for better characterization of tracer accumulation and more accurate lesion localization. The interpreting
physician should carefully consider the clinical question raised in the request for $^{111}$In-pentetreotide imaging.

2. Images are best viewed using computer display with individualized physician-directed optimization of intensity and contrast. Three-dimensional rendering of the SPECT data and its review in cinematic display is encouraged.

3. Knowledge of normal tissue accumulation of $^{111}$In- pentetreotide is important for study interpretation. This radiotracer can be seen in the pituitary, thyroid, liver, spleen, kidneys, bladder, and occasionally the gallbladder. Intestinal activity is usually not present at 4 hr, but may be present at 24 hr; thus, 48 hr images may be necessary to clarify abdominal activity.

4. Additional issues to be taken into consideration include: comparison between pattern and intensity of uptake on early vs. delayed images, sensitivity of $^{111}$In-pentetreotide for the detection of the tumor type of interest as it relates to histology and expression/density of somatostatin receptor subtypes, potential sources of false-negative and false-positive results (see section IX.D).

### F. Clinical Utility in Specific Tumor Types

1. GEP-NET’s: peptide hormone-producing gastroenteropancreatic endocrine tumors including gastrinomas, insulinomas, vasoactive intestinal polypeptide-secreting tumors (VIPomas), glucagonomas, as well as non-functioning tumors. The sensitivity is generally high and varies depending on the tumor expression of somatostatin receptors. The sensitivity for insulinoma may be 25–60% due to the absence of somatostatin receptor subtype 2 (sst2).

2. Pheochromocytomas, neuroblastomas, and paragangliomas: Sensitivity: >85%. Imaging with $^{111}$In-pentetreotide may be particularly useful in detecting primary lesions and metastases in unexpected (extra-adrenal) sites not investigated by CT or MRI, when multiple tumors are suspected, or if conventional anatomic imaging is negative or equivocal. Tumors in the adrenal glands may be difficult to detect due to high renal activity; imaging with $^{123}$Iodine- or $^{131}$Iodine-meta-iodobenzylguanidine (MIBG) may therefore be preferable for tumor localization in the adrenal area (30). $^{111}$In-pentetreotide and $^{123}$I/$^{131}$I-MIBG have complementary roles in the evaluation of malignant pheochromocytomas, neuroblastomas and paragangliomas (31).

3. Medullary thyroid carcinoma: Sensitivity: 50–75%. The use of SPECT (+/- CT) or comparison with $^{99m}$Tc-sulfur colloid scintigraphy (for liver metastases) or with $^{123}$I-sodium iodide scintigraphy (for intrathyroidal tumors) may increase the rate of lesion detection, especially when the uptake of $^{111}$In-pentetreotide in these organs is homogeneous. $^{111}$In-
pentetreotide may be considered for imaging of oxyphil variant of follicular-cell derived thyroid cancers (32).

4. Carcinoid tumors: Sensitivity: 86 – 95%. For extrahepatic lesions >1 cm in diameter, sensitivity may exceed 90%. Hepatic lesions may appear isointense relative to surrounding liver parenchyma, therefore, SPECT (+/- CT) imaging of the liver is recommended even if planar images appear normal.

5. Intracranial tumors: Meningioma: Sensitivity and specificity of 100% and 50%, respectively, has been reported by some (33). Medulloblastoma - sensitivity 61-93%. 111In-pentetreotide scintigraphy may be used for post-operative follow-up of meningioma. Grade I and II astrocytomas are also somatostatin receptor-positive, grade III astrocytomas may or may not be, and grade IV astrocytomas (glioblastoma multiforme) are typically somatostatin receptor-negative. Localization of 111In-pentetreotide in an astrocytoma also requires that the blood-brain barrier be impaired.

VII. DOCUMENTATION/REPORTING

In addition to the general information to be provided in each Nuclear Medicine report as recommended in the Society of Nuclear Medicine Guideline on General Imaging, it is suggested that the report contain the following information:

A. Indication: clinical findings, results of laboratory tests (e.g., neuroendocrine tumor markers, if applicable), or results of other imaging studies as well as other relevant history (known tumor and its type, recent radiation therapy, chemotherapy).

B. Relevant medications: octreotide therapy and length of time since discontinued, chemotherapy, laxatives, if given.

C. Procedure description: timing of imaging relative to radiopharmaceutical administration; areas imaged; whether SPECT or SPECT/CT was performed, its timing and body areas included.

D. Study limitations: the referring physician may be reminded that some tumors can lack somatostatin receptors or the appropriate receptor subtypes and, therefore, might not be detected. The differential diagnosis should consider the many potential causes for a false-positive study, as listed in section IX.D.1.

VIII. EQUIPMENT SPECIFICATION

A gamma camera (preferably dual-head) with medium-energy collimation should be used. The use of a hybrid SPECT/CT camera is strongly encouraged for selected body areas when available and indicated.

IX. QUALITY CONTROL AND IMPROVEMENT, SAFETY, INFECTION CONTROL, AND PATIENT EDUCATION CONCERNS
A. Prior to the administration of $^{111}$In-pentetreotide, the labeling yield of the radiopharmaceutical should be tested according to the manufacturer’s instructions. The product should not be used if radiochemical purity is less than 90%.

B. The radiopharmaceutical should be stored at or below 25 °C (77 °F) between preparation and administration, and should be used within 6 hrs of preparation (15).

C. $^{111}$In-pentetreotide should be inspected visually prior to administration. Preparations containing particulate matter or color should not be administered.

D. Sources of Error

1. Potential causes for a false-positive interpretation:
   a. Accumulation of $^{111}$In-pentetreotide in the nasopharynx and pulmonary hilar areas may be seen with respiratory infections.
   b. Diffuse pulmonary or pleural accumulation of $^{111}$In-pentetreotide can be observed following radiation therapy to the lung or bleomycin therapy.
   c. The tracer may accumulate at recent surgical and colostomy sites.
   d. Accumulation of the tracer in normal structures (pituitary, thyroid, liver, spleen, kidneys, bowel, gallbladder, ureters, bladder, stimulated adrenal glands) and in multiple non-neoplastic disorders (some listed in Section III.C) must be kept in mind. Caution must be used to avoid interpreting physiologic gallbladder activity as hepatic metastasis.
   e. In breast feeding women, physiologic uptake may be seen in the breast.

2. Potential causes for a false-negative interpretation:
   a. Presence of unlabeled somatostatin, either as a result of octreotide therapy (patients will often have decreased tracer localization to the spleen) or production of somatostatin by the tumor itself, may lower tumor detectability.
   b. Absence of somatostatin receptor subtype 2 (sst2), variable tumor differentiation and receptor expression also influences tumor detectability. This is a consideration especially with insulinomas and medullary thyroid carcinomas.
   c. Low target-to-background ratio; small liver metastases of neuroendocrine tumors may appear isointense relative to surrounding normal liver. Correlation with anatomic imaging,
SPECT/CT, or subtraction scintigraphy with sulfur colloid may be considered in such cases.

X. RADIATION SAFETY IN IMAGING

Nuclear medicine physicians, medical physicists, and technologists have a responsibility to minimize radiation dose to individual patients, to staff, and to society as a whole, while maintaining the necessary diagnostic image quality. This concept is known as —as low as reasonably achievable (ALARA).

Policies should be in place to vary examination protocols to take into account patient body habitus, such as height and/or weight, body mass index or width. The dose reduction devices that are available on imaging equipment should be active; if not, manual techniques should be used to moderate the exposure while maintaining the necessary diagnostic image quality. For example:

A. Medical personnel should be instructed in the proper care of patients after radiopharmaceutical administration and in the proper disposal of radioactive biological waste.

B. Adverse reactions associated with radiopharmaceutical administration should be reported to the Society of Nuclear Medicine/USP Drug Problem Reporting Program.

C. In general, precautions taken to avoid the biological hazards from patient excreta is more than sufficient to avoid the often much smaller radiation hazard.

D. Instructions should be provided on methods of minimizing radiation exposure to the patient’s family and to the general public, where appropriate.

E. Weight and size tolerances of equipment should be observed when imaging large patients.

F. In general, there is no scientific or regulatory reason why a pregnant nurse cannot provide routine care to a patient who has had a diagnostic imaging study. The risk of caring for a patient receiving therapy is small; however, it may be prudent not to assign pregnant nurses to care for these patients.

Radiation Dosimetry: Adults*

<table>
<thead>
<tr>
<th>Radiopharmaceutical</th>
<th>Administered Activity MBq (mCi)</th>
<th>(organ receiving the largest dose) mGy/MBq (rad/mCi)</th>
<th>Effective Dose mSv/MBq (rem/mCi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>111In-pentetreotide</td>
<td>222 (6)</td>
<td>Spleen 0.57 (2.1)</td>
<td>0.054 (0.20)</td>
</tr>
</tbody>
</table>

*Adapted from ICRP 106 (37).
Radiation Dosimetry: Children 15 years-old

<table>
<thead>
<tr>
<th>Radiopharmaceutical</th>
<th>Weight-adjusted Administered Activity MBq/kg (mCi/kg)</th>
<th>(organ receiving the largest dose) mGy/MBq (rad/mCi)</th>
<th>Effective Dose mSv/MBq (rem/mCi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$^{111}$In-pentetreotide</td>
<td>5 (0.14)</td>
<td>Spleen 0.79 (2.9)</td>
<td>0.071 (0.26)</td>
</tr>
</tbody>
</table>

*Adapted from ICRP 106 (37).

Radiation Dosimetry: Children 5 years-old *

<table>
<thead>
<tr>
<th>Radiopharmaceutical</th>
<th>Weight-Adjusted Administered Activity MBq/kg (mCi/kg)</th>
<th>(organ receiving the largest dose) mGy/MBq (rad/mCi)</th>
<th>Effective Dose mSv/MBq (rem/mCi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$^{111}$In-pentetreotide</td>
<td>5 (0.14)</td>
<td>Spleen 1.8 (6.7)</td>
<td>0.16 (0.59)</td>
</tr>
</tbody>
</table>

*Adapted from ICRP 106 (37).

The Pregnant or Potentially Pregnant Patient

Dose estimates to the fetus were provided by Russell et al. (38). No information about possible placental crossover of this compound was available.

<table>
<thead>
<tr>
<th>Stage of Gestation</th>
<th>Fetal Dose mGy/MBq (rad/mCi)</th>
<th>Fetal Dose mGy (rad)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early</td>
<td>0.082 (0.30)</td>
<td>18 (1.8)</td>
</tr>
<tr>
<td>3 months</td>
<td>0.060 (0.22)</td>
<td>13 (0.13)</td>
</tr>
<tr>
<td>6 months</td>
<td>0.035 (0.13)</td>
<td>7.8 (0.78)</td>
</tr>
<tr>
<td>9 months</td>
<td>0.031 (0.11)</td>
<td>6.9 (0.69)</td>
</tr>
</tbody>
</table>

The Breastfeeding Patient

ICRP Publication 106, Appendix D suggests that no interruption of breastfeeding is needed for $^{111}$In-pentetreotide.

XI. ISSUES REQUIRING FURTHER CLARIFICATION

A. Since $^{111}$In-pentetreotide elimination in patients with impaired renal function has not been studied, possible dosage adjustment in these patients needs to be clarified.
B. The role of $^{111}$In-pentetreotide scintigraphy in breast carcinoma, renal cell carcinoma, Hodgkin’s and non-Hodgkin’s lymphoma and other tumors (see section III), as well as in the evaluation and management of some granulomatous and autoimmune processes (e.g. activity of sarcoidosis, response of Graves’ ophthalmopathy to steroids, etc) is yet to be determined.

C. Recent studies have suggested that imaging with $^{111}$In-pentetreotide and $^{18}$F-FDG PET may be complementary, and that abnormalities on either imaging modality predict a worse outcome in patients with neuroendocrine tumors. Further work is needed (34, 35).

D. Neuroendocrine tumor imaging utilizing conjugates of octreotide labeled with positron-emitting radionuclides may have improved sensitivity when compared with $^{111}$In-pentetreotide; this issue requires further study (36).

XII. ACKNOWLEDGEMENTS

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XIV. BOARD OF DIRECTORS APPROVAL DATES

Version 1.0 February 11, 2001