Potential Clinical Utility of Peptide Receptor Radionuclide Therapy with $^{177}$Lu-DOTATATE: the sociétal impact of Atomic Energy Research in India

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Colloquium at VECC
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$^{177}$Lu-DOTA-TATE: From bench to bed!!

Was available in only 3-4 countries with prohibitively high cost (~US$40,000 per injection)

Tracer level radiochemistry

High yield, purity and stability at low \([L]/[M]\) ratio

Optimization of protocol for the preparation of therapeutic dose
PRRT in India: Factors for the Boost in Recent Years

- Two developments as a part of radiopharmaceutical research in the country’s premier atomic energy establishment BARC:

  1. The availability of $^{177}$Lu-$\text{LuCl}_3$ at a much lower cost due to indigenous production (less than one-third of commercially available material)

  and

  2. Indigenous production of a single-vial kit for the formulation of $^{99m}$Tc-HYNIC-TOC, which has played an important role in centres that do not have access to a germanium/gallium generator.

Use of BARC Indigenous production: Several sessions of successful treatment
Production of $^{177}$Lu in Research Reactor

**Direct Route**

$^{176}$Lu $\rightarrow$ $^{177}$Lu + $^{177m}$Lu

$\sigma = 2090$ b & $2.8$ b

6.65 d & 160.5 d

**Indirect Route**

$^{176}$Yb $\rightarrow$ $^{177}$Yb

$\sigma = 2.85$ b

1.9 h

$^{176}$Lu (2.6% nat, enriched)

$^{176}$Yb (12.7% nat, enriched)
Direct vs. Indirect Route

**Direct Route**
- Carrier Added $^{177}\text{Lu}$
- Large scale production
- Simple post-irradiation processing
- Cost-effective
- Specific activity: Adequate for receptor-specific therapeutic agents
- Presence of $^{177m}\text{Lu}$

**Indirect Route**
- No Carrier Added $^{177}\text{Lu}$
- Carrier
  - High specific activity
  - No $^{177m}\text{Lu}$
- Tedious post-irradiation processing
- Large scale production is difficult
- High cost of $^{177}\text{Lu}$
- Radioactive waste
177Lu-DOTA-TATE therapy in India

More than 1000 sessions of successful treatment

- Radiation Medicine Centre, BARC, Mumbai
- All India Institute of Medical Sciences, New Delhi
- Bangalore Institute of Oncology, Bangalore
- INLAKS and Budhrani Hospital, Pune
- Jaslok Hospital and Research Centre, Mumbai
- SPECT Lab, Pune
- PGIMER, Chandigarh

Courtesy: Sudipta Chakrabarty; Radiopharmaceutical Division, BARC, Mumbai
Theme 1. The range of tumors where PRRT employed

- NET of the gastroenteropancreatic and bronchial tracts
  - Pheochromocytomas
  - Paraganglioma
  - Neuroblastoma
  - Medullary thyroid carcinoma
  - Non-iodine concentrating metastasis of DTC
The goal of targeted radionuclide therapy is to selectively deliver radiation to cancer cells and/or diseased tissue with minimal toxicity to surrounding normal tissues.

The basis for successful radionuclide therapy is a theranostic approach that integrates diagnostic testing for the presence of a molecular target for which a specific treatment/drug is intended.
PRRT: the fundamental Principle

- PRRNT is based on the fact that nearly about 70% of these tumours express **somatostatin receptors (especially subtype 2)** on the **cell surface**, which constitutes an excellent therapeutic target.

- A receptor ligand (i.e. a somatostatin analogue) is bound to a radioactive isotope (normally Lu-177 or Y-90).

- Commonly used radiopharmaceuticals are Lu-177-DOTATATE and Y-90-DOTATATE.
Radioligand Used: [177 Lu-DOTA 0 ,Tyr] Octreotate

- Octreotate: differs from octreotide only in that the C-terminal threoninol is replaced with threonine.

- Nine-fold increase in affinity for the SSTR 2 for [DOTA 0 ,Tyr 3 ]octreotate when compared with [DOTA 0 ,Tyr 3 ]octreotide

- Translates into 6-to 7-fold increase in affinity for their Radiolabeled counterparts and 4-5 times enhancement in the tumor uptake
Theme 2. RP employed for PRRT

• Uniformly $^{177}$Lu- from BARC: More than 90%

• In BIO: 50% BARC; 50% Imported

• In Jaslokh Hospital 4-5 patients imported Lutetium, Rest BARC Lutetium

• In certain government centres like Radiation Medicine Centre, PGIMER: 100% BARC LuCl3

• SPECT Lab Pune/ INLAKS Pune: 100% BARC LuCl3
Theme 3. Decision Making Scan Options for 177Lu-DOTATATE therapy

Somatostatin Receptor Based Imaging: Significant Advances towards Management of NET

Conventional Gamma Camera Based Planar and SPECT imaging

PET-CT Based Imaging

- $^{111}$In-Pentetotide
- $^{99m}$Tc-HYNIC-TOC
- $^{68}$Ga-DOTATOC/NOC/TATE
The indigenously formulated Lyophilized HYNIC-TOC kit: Advantages

• Lyophilized kit developed in BARC contained 33 μg of HYNIC-TOC, 10 mg of ethylenediaminodiacetic acid, 20 mg of tricine, 40 μg SnCl2, 4.5 mg of sodium phosphate dibasic and 1 mg of sodium phosphate monobasic as ingredients.

Advantages:

• Single-vial kit formulation

• Capable of providing up to four patient doses (a higher cancer patient population density per centre in India)
In this 55 year old female patient of PCT after 4 years of disease control, referred by medical oncologist for suspicion of skeletal and liver mets from Ca thyroid/unknown primary. Tg undetected. Common tumor markers normal.

Following this scan: CgA was elevated (1771.6 ng/ml). Final diagnosis: Metastatic NET

Bronchial Carcinoid with extensive liver and skeletal Mets

Gratifying Experience with Indigenous 99mTc-HYNIC-TOC
Gratifying Experience with BARC produced Indigenous $^{99m}$Tc-HYNIC-TOC

Theme 4. Decision Making Point on Scan

• The indications are tumors showing **adequate uptake** and retention of radiotracer on the basis of a pre-therapy tracer study.

• Uniform agreement: More than **Hepatic uptake** is considered adequate uptake for therapy.
Theme 5. Tumor parameter for Patient Selection

- Tumour differentiation
- Tumor Proliferation

Though well recognized among practitioners, they have not been adopted in routine practice except for 2 centres.
WHO Classification of GEP NET: the major areas of use of PRRT

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Well differentiated (neuro)endocrine tumour (WDET)</td>
<td>Neuroendocrine tumour G1</td>
</tr>
<tr>
<td>Well differentiated (neuro)endocrine carcinoma (WDEC)</td>
<td>Neuroendocrine tumour G2</td>
</tr>
<tr>
<td>Poorly differentiated (neuro)endocrine carcinoma (PDEC)</td>
<td>Neuroendocrine carcinoma G3</td>
</tr>
<tr>
<td></td>
<td>— Large cell</td>
</tr>
<tr>
<td></td>
<td>— Small cell</td>
</tr>
<tr>
<td>Mixed exocrine–endocrine carcinoma</td>
<td>Mixed adeno-neuroendocrine carcinoma</td>
</tr>
<tr>
<td>Tumour-like lesions</td>
<td>Hyperplastic and pre-neoplastic lesions</td>
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ENETs Classification of GEP NET: the major areas of use of PRRT

<table>
<thead>
<tr>
<th>Grade</th>
<th>Mitosis (10 HPF)(^a)</th>
<th>Ki-67 index (%)(^b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>&lt;2</td>
<td>(\leq 2)</td>
</tr>
<tr>
<td>G2</td>
<td>2–20</td>
<td>3–20</td>
</tr>
<tr>
<td>G3</td>
<td>&gt;20</td>
<td>&gt;20</td>
</tr>
</tbody>
</table>

\(^a\) 10 HPF — high power field = 2 mm\(^2\), at least 40 high power fields (40×).
\(^b\) MIB-1 antibody; percentage of positively stained of 2000 tumour cells.
Thoracic NET: WHO Classification

<table>
<thead>
<tr>
<th>Type</th>
<th>Differentiation grade</th>
<th>Mitosis per 2 mm² (10 HPF)</th>
<th>Other features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical carcinoid</td>
<td>Well differentiated</td>
<td>&lt;2</td>
<td>No necrosis</td>
</tr>
<tr>
<td>Atypical carcinoid</td>
<td>Well differentiated</td>
<td>2–10</td>
<td>With/without necrosis</td>
</tr>
<tr>
<td>Large cell neuroendocrine carcinoma</td>
<td>Poorly differentiated</td>
<td>11; median: 20</td>
<td>With necrosis; large cells</td>
</tr>
<tr>
<td>Small cell neuroendocrine carcinoma</td>
<td>Poorly differentiated</td>
<td>11; median: 80</td>
<td>With necrosis; small cells</td>
</tr>
</tbody>
</table>
The joint IAEA, EANM, and SNMMI practical guidance on peptide receptor radionuclide therapy (PRRNT) in neuroendocrine tumours

Well-differentiated and moderately differentiated neuroendocrine carcinomas defined as NET grade 1 or 2 according to the WHO 2010 classification (i.e. upto 20%)
Should Grade of Tracer Uptake on Somatostatin Receptor–Targeted Imaging Be the Major Determinant and Break the Barrier of Histopathologic Criteria for Determining the Suitability of Peptide Receptor Radionuclide Therapy?
26/M, Bleeding PR, anorectal polyp excision in March 2013: HPR: High grade rectal NET with MiB 1 index of 22%.

- Took 5 inj of Long acting Octreotide injections. After the 5th injection started complaining of abdominal pain and flushing.

- 68-Ga DOTATOC scan showed multiple SSTR positive lesions in liver and pre sacral nodes. Seg III, Seg IV B (SUVmax: 39.7), Seg VI and Seg VIII (SUVmax: 26.3). Presacral node at S1 (SUVmax: 45.6), 2 presacral node at 4 (SUVmax: 48.9 larger and smaller is 22.5).

- Patient was treated with 166 mCi of 177-Lu based PRRT. Follow up 68-Ga DOTATOC scan shows complete resolution of lesions in Seg III and VI (no documented lesion on CT). Other SSTR positive lesions in liver and in pre sacral area have decreased in metabolic intensity. Seg IV B (SUVmax: 24.9), Seg VIII (SUVmax: 25), Presacral node at S1 (SUVmax: 32.9), 2 presacral node at 4 (SUVmax: 5.9 larger and smaller is 16.8)

- Patient has overall reported a dramatic response with total resolution of the abdominal pain and episodes of flushing.

- Subsequently patient again received 2 more cycles of PRRT with the scan findings being now almost same with progressive decrease in the serum chromogranin A
ESMO Clinical Practice Guidelines for GEP-NETs

Treatment algorithm:

- Pancreas
  - Non-resectable/metastases
    - Functioning: Endocrine symp.
      - Cytoreductive surgery
      - Streptozotocin+5-FU/Doxorubicin (Ki-67: 5-20%)
    - Non-functioning: Endocrine symp.
      - Cytoreductive surgery
      - Everolimus
        - Sunitinib
          - Ki-67: 2-20%
      - Temozolomide
        - Ki-67: >10%
      - Carboplatin+Etoposide
        - Ki-67: >20%
      - \(^{177}\)Lu-DOTATATE
        - \(^{90}\)Y-DOTATOC
          - Ki-67: <30%
  - Resectable: R0/R1 resection
    - Recurrence
      - Endocrine symp.
        - Cytoreductive surgery
        - Somatostatin analog
          - (Ki-67: <2-10%)
    - Non-resectable/metastases
      - Somatostatin analog
        - (Ki-67: <10%)
Tumor Biology and Heterogeneity in Neuroendocrine Tumors: its correlation with Tumor Proliferation Index

Dual tracer imaging approach in assessing tumor biology and heterogeneity in neuroendocrine tumors: its correlation with tumor proliferation index and possible multifaceted implications for personalized clinical management decisions, with focus on PRRT

Sandip Basu · Bhawna Sirohi · Shailesh V. Shrikhande
59/M, postoperative case of NET of the head and body of pancreas presenting with recurrent heterogeneously enhancing paraduodenal mass with liver metastasis; The Mib1 LI was reported 1-2% and serum Cg A was 1375 ng/ml. The recurrent mass and the hepatic lesion shows high grade uptake in SRI but negligible uptake on PET-CT.

TOTAL DISCORDANCE: SOMATOSTATIN RECEPTOR EXPRESSION AND TUMOR GLYCOLYSIS
60/M, presented with 11x9x11 cm heterogeneous mass arising from pancreatic body and tail with liver metastases; Mib1 Index of the primary: 4%. A partial concordance was observed between SRI and FDG-PET/CT both in the primary and at the metastatic lesions. Both intrallesional (in the primary) and interlesional heterogeneity (amongst the hepatic metastases) is well observed in the images with regard to FDG avidity and positivity. Received 2#: 215 and 181 mCi 177Lu-DOTATATE in 2 sittings ; CgA: 4775-2770

Somatostatin Receptor Imaging

18F-FDG PET CT
44/M, 6.1x6.3x4 cm highly vascular mass in the uncinate process of pancreas with duodenal and SMA infiltration on ceCT. HPR: Poorly differentiated NE Ca; Mib1 Index >30 %: Total concordance of SOMATOSTATIN RECEPTOR EXPRESSION AND TUMOR GLYCOLYSIS.

Somatostatin Receptor Imaging

18F-FDG PET CT
61/M, Post Whipple’s (Primary- Head and Proximal Body of Pancreas); Biopsy- Poorly diff NE Ca; MiB1---20%; FDG-PET/CT: Total Discordance; CgA: 125.01→93.47; with excellent symptomatic response

**Somatostatin Receptor Imaging**

**18F-FDG PET CT**

Sunil Walke
53/M, Primary Head and uncinate process with bilobar hepatic mets; **Mib 1- 6-8%**. 
*Near-total Discordance;* Referred following disease progression with sandostatin and 
ChemoRx. 3# PRRT---191/211/183 mCi; CgA---8105----> 4180---->5330; 
Symptomatic response- Resolution of diarrhoea and weight gain.

**Somatostatin Receptor Imaging**

**18F-FDG PET CT**
54/M, diagnosed case of NET of pancreas (on biopsy MiB 1 LI was reported 2%, serum Chromogranin A- 4365 ng/ml). The patient had extensive hepatic metastases as noted in the SRI and FDG-PET/CT. Both primary and hepatic metastases were heterogeneously FDG avid, with high SUVs. The patient responded poorly to PRRT and demonstrated progressive disease. A dual tracer imaging was a correct predictor of tumor aggressiveness, though the MiB1 LI was reportedly low.
The possible clinical implications of dual-tracer molecular imaging vis-a-vis the tumor proliferation index: will the former take the upper hand for prognosis and guiding individualized therapy?

- [a] Assessing disease biology on a continuous scale at intermediate Mib1 (Ki-67) indices

- [b] Assessing intra- and interlesional heterogeneity in metastatic lesions

- [c] Discordance between molecular imaging and tumor proliferation index of the primary

- [d] Treatment decision-making in Mib1 (Ki-67) LI between 20 and 30 %: can the dual-tracer approach help in individualization?

Theme 6. Renal Parameter as cut-off for Patient Selection

- **Megalin/cubilin**: The two tandem endocytic receptors are co-localized in the proximal renal tubule

- Nephrotoxicity of radiolabeled somatostatin analogues such as octreotide is due to ultrafiltration and reuptake by proximal tubular cells

- Most consultants follow, Serum creatinine ≤1.5 mg/dl

- No obvious uniformity on 99mTc-DTPA–GFR, but restriction followed below 60 ml/min
Theme 7. Renal protection: Amino acid Preparation and Schemes

• The protocol is quite similar amongst the centres: (a) coinfusion of basic amino acids (Lys-Arg) and (b) Gelatin-based plasma expander Gelofusine.

• The amino acid preparation used is Aminoven or Hermin.

• Amino acid protective schemes: Single day regimen.

• Amino acid infusion usually started 30 min before administration of the radiopeptide.
Theme 8. Patient Preparation: Somatostatin analogue withdrawal

• Withdrawal periods of 4–6 weeks for long-acting release formulations

• At least 24 h for short-acting formulations

- Prophylactic anti-emetics are used by every centre: Ondansetron is the anti-emetic of choice.

- In our centre as well as some others, Dexamethasone is regularly added. We had only one patient complaining of vomiting in more than 500 therapies. (Combined dexamethasone and ondansetron is more effective in reducing severe nausea and vomiting than ondansetron alone)
Theme 10. Dose Determination and Schedule

- Administered activity (Fixed Dose): 5.55–7.4 GBq (150–200 mCi)
- Number of cycles: 3-5
- Time interval between cycles: 12 weeks
- Dose Fractionation: A better Choice??
Theme 11. Dose Reduction Considered??

- Low white blood cell and platelet counts.
- Massive bone marrow invasion and/or
- Impaired renal function
35/F, duodenal NET (MiB1 labeling index 20%) with liver metastasis (involving left lobe) and history of radiofrequency ablation of the liver metastasis and external radiotherapy six months previously, was referred for exploring the feasibility of PRRT.
FDG-PET/CT: partial concordance/discordance with somatostain receptor based imaging
At 3 month post-therapy assessment, there was substantial symptomatic improvement with better health related quality of life. The serum chromogranin A level reduced from 1135 ng/ml to 786.70 ng/ml; 99mTc-HYNIC-TOC scintigraphy demonstrated stable disease.
RMC-TMC SCHEDULE OF TARGETED THERAPY WITH [(177)Lu] DOTA-OCTREOTATE .....we started on a regular basis from 2011

- [(177)Lu] DOTA-OCTREOTATE Rx schedule in non-MIBG week.

- We usually space our thyroid cancer patients in such a way that 5-6 patients are treated on a single day (usually on Wednesdays) and 5-6 patients on next day; they are discharged after an overnight stay and metastatic thyroid cancer patients are admitted on subsequent day.

- One sitting of 177Lu-DOTATATE Rx costs a total of 15,000 INR (300 USD)
In the last 3 ½ years, over 500 therapies administered in around 200 patients), in 2013, the number reached 163.

46 evaluable patients: Trend similar to what have been reported in literature

Symptomatic response and better quality of life (>80%) --→ (Who had undergone more than 3 therapies) Biochemical response (60%) --→ Objective response in those: 1/3rd (1 reported death)

No obvious acute or delayed renal and haematological toxicity in any patient.
Example of Objective Tumor Response is in around 1/3rd

Posttherapeutic $^{177}$Lu-DOTATATE scan: 1$^{st}$ cycle

Posttherapeutic $^{177}$Lu-DOTATATE scan: 2$^{nd}$ cycle
53/F, diagnosed as a case of atypical carcinoid of lung (MiB1 index of 6-10%), MiB1 index of 6-10%. Multiple SSTR positive lesions in liver, both lungs, multiple rib & right sided pelvis. received 3 cycles of chemotherapy with cisplatin and etoposide. Reported a dramatic decrease in symptoms which includes decrease in abdominal pain and frequency of diarrhea. Also patient reports weight gain and overall improvement in general condition. Received 2 # of PRRT and being worked up for the 3rd.

### Timing of Test

<table>
<thead>
<tr>
<th></th>
<th>Ser CgA (ng/ml)</th>
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<tr>
<td>Before 1st PRRT</td>
<td>496.7</td>
</tr>
<tr>
<td>After 1st PRRT and before 2nd PRRT</td>
<td>243.1</td>
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</table>
I-131 therapy for thyroid cancer, that has been the cornerstone of management of the disease for more than 50 years, is based upon the Na+/I- symporter pump, an integral membrane protein residing in the basolateral membrane of thyroid epithelial cells, symports two sodium ions for every iodide ion.....20-40 fold in the thyroid gland compared to its plasma concentration.
Metastatic Thyroid Carcinoma in Pregnancy

35/F, primigravida hailing from a humble and rural background, presented with acute paraplegia at the last trimester of pregnancy and never presented with any complaints related to thyroid carcinoma.

Our advice was sought for from the Department of Gynecology and Obstetrics of a neighbouring teaching hospital where the patient was diagnosed to harbor thyroid carcinoma following MRI of the spine with guided biopsy.

Metastatic Thyroid Carcinoma in Pregnancy: Multiple Medical and Radiation Protection issues

• Presentation with acute paraparesis and the poor general condition of the patient

• Precious first pregnancy of the patient

• The need for making aware the obstetricians, involved in the patient management, of the requirement of strict abstinence of iodine containing medications and substances (particularly in this case where a cesarean section was being planned for the patient).

• The timing and sequence of total thyroidectomy and cesarean section

Metastatic Thyroid Carcinoma in Pregnancy: Multiple Medical and Radiation Protection issues

• Postnatal care of the newborn immediately following birth and the subsequent period, as the mother required radioiodine therapy at the earliest convenience for treating the skeletal metastases

• Isolation issues between mother and the newborn in the immediate post I-131 therapy period following discharge from the isolation ward including provision of artificial feeding of the newborn.....a strong family support
FDG-PET: MULTIPLE DISEASED NODES IN LOWER NECK, CONFIRMED AFTER EXCISION. In our preliminary data of 57 patients, this group of surgically amenable disease is around 25% of patients. In these patients this modality makes an impact in patient management.

Basu et al, WJNM, Jan 2004 Vol 1 (Suppl)
Follicular carcinoma thyroid with pulmonary mets:

Tg: >800ng/ml

Non-iodine concentrating Thyroid Cancer: extensive FDG uptake

Basu et al, WJNM, Jan 2004 Vol 1 (Suppl)
Somatostatin Receptor Imaging in Non-$^{131}$I-Avid Metastatic Differentiated Thyroid Carcinoma for Determining the Feasibility of Peptide Receptor Radionuclide Therapy With $^{177}$Lu-DOTATATE: Low Fraction of Patients Suitable for Peptide Receptor Radionuclide Therapy and Evidence of Chromogranin A Level–Positive Neuroendocrine Differentiation


METHODS: In this research study, 19 patients diagnosed with differentiated thyroid carcinoma with non-iodine-concentrating metastasis with elevated serum thyroglobulin levels, attending thyroid outpatient department for follow-up, underwent Ga-DOTATATE PET-CT/Tc-HYNIC-TOC scan for the evaluation of positivity of somatostatin receptor (SSTR). Based on the visual grading, SSTR-positive lesions were graded into 4 categories (grades I-IV) in comparison with the hepatic uptake on the scan. Patients with grades III and IV uptake in lesions (equal to or more than hepatic uptake on scan) were scheduled for Lu-DOTATATE administration. Posttherapy Lu-DOTATATE scan was undertaken during discharge from the isolation ward.
Somatostatin Receptor Imaging in Non-$^{131}$I-Avid Metastatic Differentiated Thyroid Carcinoma for Determining the Feasibility of Peptide Receptor Radionuclide Therapy With $^{177}$Lu-DOTATATE: Low Fraction of Patients Suitable for Peptide Receptor Radionuclide Therapy and Evidence of Chromogranin A Level–Positive Neuroendocrine Differentiation


RESULTS: Of the 19 patients studied, 12 patients (63%) showed SSTR-positive lesion expression demonstrating uptake ranging from grade I-IV, and 7 patients (37%) did not demonstrate any tracer uptake. On a lesion-specific analysis, of the total 57 metastatic lesions, 4 lesions (7%) demonstrated grade I tracer uptake, 18 lesions (31%) grade II (less than liver), 2 lesions (3.5%) grade III (equal to liver uptake), and 1 lesion showed grade IV uptake (more than liver). Interestingly, an elevated serum chromogranin A level was documented in 3 of the patients with grades III and IV tumor uptake. A comparison of Ga-DOTATATE PET-CT and Tc-HYNIC-TOC in 4 patients who underwent both the scans demonstrated no significant differences in the tracer concentration in the metastatic lesions in any of the patients on visual grading. Based on the criterion of high tracer uptake and the patient consent, finally 2 of 3 patients were treated with Lu-DOTATATE. On follow-up after 3 months, a significant fall in serum thyroglobulin level was noted in one of the patients, and the other patient was
GRADE I
Tc-99m HYNIC TOC positive
Rt. supraclavicular lymph node (arrow); [site of injection seen on medial aspect of right forearm], in a case of follicular variant of papillary carcinoma of thyroid

GRADE II
Tc-99m HYNIC TOC positive Lt. level III cervical lymph node (arrow) and both the lungs (Rt>Lt); in a case of papillary carcinoma of thyroid

GRADE III
Heterogeneous grade III uptake on Tc-99m HYNIC TOC in bilateral lung parenchyma with focal grade II tracer uptake in left level III cervical lymph node (arrow) and mediastinal lymph node in a case of differentiated papillary carcinoma of thyroid

GRADE IV
Tc-99m HYNIC TOC positive right fibular lesion (arrow) in a case of poorly differentiated carcinoma of thyroid

PRRT in Thyroglobulin elevation but negative iodine scintigraphy: the TENIS syndrome
PRRT in Thyroglobulin elevation but negative iodine scintigraphy: the *TENIS syndrome*

56 year old female of DTC with elevated Tg (On Thyroxine suppressi
on Tg was 63.64 ng/ml, Biopsy of the fibular lesion: Poorly Differentia
ted thyroid Ca
58/M, Diff PCT in 2007, stimulated Tg > 250 ng/ml, no abnormality in I-131 scan
PRRT Set-up: Acknowledgement to the Team and the referring Gastroenterologists
Thank You