University of Washington
Radiology Board Review 2015

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Disclosures: None

- Thyroid
- Parathyroid
- Bone
3/24/2015

41 year old male complaining of
30 lbs weight loss over 9
months
Neck pain, odynophagia
Intermittent diplopia
Restlessness, excessive
sweating, fine tremors
TSH: 0.01 (NL:0.27-4.20)

Diffuse homogeneous uptake in
an enlarged gland: Graves
disease

- 5 hours I-131 uptake: 55%
- 24 hour I-131 uptake: 70%
- Estimated thyroid weight: 80g

- Thyroid uptake and scan is Performed for
differential diagnosis of thyrotoxicosis:
  - Thyroid uptake:
    - I-131, I-123
  - Thyroid scan:
    - Tc-99m, I-123

- Two most common causes of
thyrotoxicosis:
  - Graves disease
  - Thyroiditis
• Uptake value would be able to differentiate the two major causes of hyperthyroidism.

• Graves disease:
  – Thyroid uptake is elevated

• Thyroiditis:
  – Uptake is decreased

• RAIU% is also used for calculation of I-131 therapy dose for Graves’ disease

Dose calculation:

\[
\text{Thyroid weight (g)} \times \frac{(100-180 \text{ uCi/g})}{24 \text{ hour uptake %}}
\]

\[
(80 \times 0.150) \div 70\% = 17.14 \text{ mCi}
\]
• Radiopharmaceuticals used:
  – Tc-99m 3-5 mCi, imaging in 20-30 minutes (thyroid scan)
  – I-131 15 uCi for thyroid uptake
  – I-123 200-300 uCi, 2-6 hour (thyroid scan, uptake)
  – I-131 3-5 mCi for thyroid cancer survey
  – I-123 400-500 uCi for thyroid cancer survey
  – I-131 for treatment. Dose depends on indication.
18 year old male with clinical hyperthyroidism and suppressed TSH

63 year old male with Hyperthyroidism.

"Toxic" nodule within the left thyroid lobe with suppression of the remainder of the gland. Nodule may have had some degeneration as well, given some heterogeneity of appearance.
• **Toxic nodule:**
  – Focal intense uptake in neck
  – The remainder of the gland is suppressed.
  – No significant salivary gland uptake.
  – Toxic Nodular Disease

Toxic nodules are more resistant to therapy with radioiodine than Graves disease. The reason is unclear, but it may be that I-131 thyroid residence time in the nodule(s) is reduced, leading to a lower retained dose. The administered I-131 therapeutic dose is often increased by 50% over what would be prescribed for Graves disease. An empirical dose of 20 to 25 mCi is also often used.

Ziessman, Harvey A.; O’Malley, Janis P.; Thrall, James H. (2013-04-12). *Nuclear Medicine: The Requisites*. 4 and 24 thyroid uptake values of 28.3% and 51.1%, respectively. Findings are most consistent with a toxic multi nodular goiter.
• **Multi nodular goiter**
  – Heterogeneous uptake in a nodular gland.
  – Background thyroid is not suppressed.
  – Risk of malignancy in case of dominant cold nodule is < 5%. Should be worked up (US/ FNA).
  – Radioiodine treats hyperthyroidism, but may not be cyto-reductive.
  – Surgery is a better option for reducing mass effect.

Young gentleman with symptoms of hyperthyroidism

4 hour uptake: 3.9%, 24 hour uptake 12%

Thyroiditis, Autoimmune disease characterized by elevated thyroid peroxidase antibodies and thyroglobulin antibodies
– Decreased 24 hour uptake → Thyroiditis (no scan is required)

• Thyroid scan only (no uptake required):
  – Looking for ectopic thyroid tissue
  – Equivocal US findings of a nodule (cold nodule)

Ectopic (lingual) thyroid
• Pertechnetate (stomach uptake is present as well), intravenous administration.
• There is no thyroid tissue in the normal anatomic bed. Increased tracer uptake is seen in sublingual region.
• Findings consistent with lingual thyroid.
• 1. Dyshormonogenesis (an uncommon cause of congenital hypothyroidism, the most common abnormality is absent or insufficient thyroid peroxidase enzyme.)
• 2. Transient hypothyroidism due to maternal blocking antibodies
• Photopenia in the right lobe of thyroid gland (cold nodule)
• Differential diagnosis of a cold nodule includes thyroid cancer, simple cyst, colloid cyst, thyroiditis, hemorrhage, necrosis, and amyloid
• 15-20% likelihood of thyroid cancer
• In a multinodular goiter, cold nodule has 5% chance of malignancy.
• Radio-ablation reduces local recurrence and allows follow up with thyroglobulin measurement and whole body thyroid cancer survey.

• Baseline Thyroglobulin, and thyroid cancer survey are done prior to treatment.

• Whole body scan is obtained 7-10 days post treatment.

• Post treatment scan is more likely to reveal occult metastases due to much higher dose compared with cancer survey.
• Papillary carcinoma is the most common thyroid cancer (80%).
• Other types include follicular (second most common), medullary, anaplastic, primary lymphoma, and primary sarcoma.
• Distant metastases are more common with follicular carcinoma than papillary, frequent sites being lungs and bones.
• Brain and liver metastases are less frequent.

26 year old male with renal stones and hypercalcemia
— Focal increased uptake in the lower pole of the left lobe of thyroid gland, which persists on the 1 and 2 hour images.
— Findings could represent a parathyroid adenoma. Differential includes thyroid adenoma, and thyroid carcinoma.
- Heterogeneous solid nodule measuring 3.4 x 3.6 x 4.5 cm
- Mid/lower pole of the left thyroid lobe.
- This lesion demonstrates internal vascularity.
- No evidence of internal micro calcifications or coarse calcifications.
- Suspicious lymphadenopathy: none
Cold nodule corresponding to the previous finding. Biopsy proven follicular thyroid cancer.

- Surgery (total thyroidectomy)
- Pre-therapy scan, I-123 or I-131 (thyroid cancer survey)
  - Withdrawal
  - rTSH stimulation
- I-131 treatment
- Post therapy scan (7-10 days)
- Follow-up scan
17 year old lady, I-131 whole body scan, thyroid cancer survey

198 mCi I-131 for treatment. Post therapy scan
I-123 whole body scan with rTSH for thyroid cancer survey

Post therapy scan

37 year old lady with papillary thyroid cancer. S/P thyroidectomy and 150 mCi I131 ablation
6 days later

Retained I-131 activity in the uterus from menses

Post surgery and ablation follow up due to high thyroglobulin levels
I-123 whole body imaging
FDG PET-CT can be used in cases of negative iodine scan

13 year old with history of left parotid adenocarcinoma
Hypertrophic osteoarthropathy (HOA) is a clinical syndrome of clubbing of the fingers and toes, enlargement of the extremities, and painful, swollen joints. HOA is characterized by symmetric periostitis involving the radius and fibula and, to a lesser extent, the femur, humerus, metacarpals, and metatarsals.
1. Foci of increased uptake anterolateral 7th + 8th left ribs
2. Diffusely increased uptake along posterolateral left ribs.
3. Cortical uptake involving bilateral femurs and tibiae with a "tram-track" appearance.

Companion case
45 year old gentleman

Courtesy of Laura Nason M.D
In radiolabeled WBC scan
68 year old lady with LVAD, bacteremia and back pain
T6-T7 discitis

- Combination of.....
  - Bone scintigraphy, followed by
  - labeled leukocytes, and
  - Tc-99m SC marrow scintigraphy
- .....Offers 90% accuracy.

http://radiographics.rsna.org/content/21/5/1229.full
Pagetic bone has intensely increased uptake in the active phase. Bone scan can show the extent of disease, and can be used for follow up.
55 year old lady s/p traumatic L thumb partial amputation 6 months ago

Despite resolution of surgical injury, chronic pain in L hand/forearm, worse with use

L hand feels “hot, numb, and stiff,” with “mottled, red” color changes extending to mid forearm

On the left, there is increase in blood flow, interstitial phase (blood pool), and delayed uptake (periarticular)
66 year old gentleman

67 year old lady with hypercalcemia, history of breast cancer
70-year-old gentleman who underwent community screening and was diagnosed with hepatitis B, which was followed by an ultrasound which demonstrated a large liver mass. Pathology report, liver, right, extended lobe hepatectomy: Hepatocellular carcinoma, 21.0 cm, 50% necrotic.

49 year old lady, ESRD on dialysis, bilateral knee and ankle pain for 6 months. R/O enthesopathy.
53 year old lady with history of breast cancer

Bone metastases
Left arm is larger, there is mild and diffuse increased activity in left arm
Glove sign in right forearm due to intra-arterial injection (retention of activity in soft tissues of hand and forearm.)

Thank you!