Whole Body I-131 Patterns of Uptake Unrelated to Thyroid Cancer: Apropos of 4 cases

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Normal thyroid tissue remnants and residual or metastatic foci of well-differentiated thyroid cancer have the unique ability to concentrate, organify, and store 131-I. The I-131 whole body scan provides a depiction of those tissues that can be treated with therapeutic doses of I-131. It may also reveal foci of 131-I uptake related to artifacts, anatomic and physiological variants, and nonthyroidal diseases (See Table 1 in the “Teaching Points”).
Case 1. Clinical background. Patients A and B are 48-year old and 11-year old female patients who underwent total thyroid thyroidectomy and lymph node dissection of the central neck compartment for a locally invasive papillary thyroid cancer (pT3N1a). They both received adjuvant therapy with 100 mCi of I-131. Their post therapy scans are shown.
Both patients have high focal uptake in the thyroid bed probably related to thyroid remnants.

There is faint and ill-defined uptake in the mediastinum of patient A, whereas in patient B there is well-defined mediastinal uptake (open arrows). In both cases, the uptake is located immediately above the cardiac outline in the prevascular space as shown by a CT scan in both cases.
CT scan (Patient A). The thymus triangular mass with straight borders in the anterior mediastinum located anterior to the proximal ascending aorta, pulmonary outflow tract and the superior vena cava. The thymus on CT scan has attenuation lower than muscle because of the fatty infiltration.
Discussion Case 1

I-131 uptake in the thymus of young patients with differentiated thyroid cancer is a well-known physiologic event.

The recent identification of the sodium-iodine symporter gene expression in extra thyroidal tissue, including the thymus, has provided indirect evidence of the mechanism of uptake.

Contrary to common teaching, the thymus does not involute after birth but grows reaching its largest size at puberty.
Discussion Case 1

With advancing age, the thyroid is replaced by fibro-fatty tissues and decreases in size and weight but does not disappear.

The thymus only rarely is a metastatic site for differentiated thyroid carcinoma.

Clinicians must be aware that mediastinal uptake of radiiodine occurs in thymus, especially in younger patients but may occur in patients of all ages as the thymus persists in most adults.
Case 2. Clinical background. 45-year old female who underwent total thyroidectomy and lymph node dissection of the central compartment for a locally invasive papillary thyroid cancer with tumor involvement in 3 out of 7 central lymph nodes and no extranodular extension (T3N1a). She received adjuvant therapy with 100 mCi of I-131. Unremarkable I-131 diagnostic scanning and neck ultrasound obtained one year suggested successful ablation but serum thyroglobulin levels remained > 10 ng/ml after LT4 withdrawal (TSH > 30 mUI/ml).
An empirical dose ("shot in the dark") of 100 mCi of I-131 was administered.

Abnormal liver uptake with no visible residual thyroid tissue or functioning metastases was observed.
Discussion Case 2

- There is no consensus in the literature about the transport compounds into which radioiodine is incorporated to get metabolized in the liver.
- Liver uptake of varying degrees is seen even when all other indicators such as the WBS and Tg suggest that ablation has been successful and no thyroxine producing tissue remains.
- The liver itself does not express the NIS gene.
- The gradually increasing uptake over time after administration of the RAI suggests that the uptake is related to the progressive binding of I-131 mostly to thyroxine.
Discussion Case 2

- This may be related to a possible exchange of I-131 with the I-127 in circulating thyroxine.
- Because of the long half-life of LT4, even the most hypothyroid patients may have some circulating thyroxine: it may be reasonable to expect that the more I-131 administered for ablation or follow-up, the more in vivo labeling will occur.
Case 3. Clinical background. 60 year-old male who underwent total thyroidectomy and lymph node dissection of the central compartment for a locally invasive papillary thyroid cancer (T3N1a). He received adjuvant therapy with 100 mCi of I-131 and his post therapy scan was unremarkable except for expected residual uptake in the thyroid bed. One year after the adjuvant therapy a diagnostic scan revealed no residual uptake in the thyroid bed and a neck ultrasound was unremarkable. Nevertheless, his serum thyroglobulin was > 10 ng/ml after LT4 withdrawal (TSH > 30 mUI/ml). Empiric therapy with 100 mCi of I-131 was administered and a new post therapy scan was obtained.
Post therapy scan. Administered activity, 100 mCi.

Bone marrow uptake is clearly visible in the lower limbs at 8 days, slowly fading after 10 days. There is lingering liver uptake at 12 days.
Discussion Case 3

The bilateral and symmetric distribution limited to the lower extremities makes metastatic disease very unlikely.

Bone marrow expansion is unlikely because no bone marrow activity is visualized in the axial skeleton or proximal arms.

Bohnen et al published on a similar case occurring in a runner. They speculated that the uptake could be explained by the patient’s physical activity.

To date, we have no explanation for our patient’s findings.
Case 4. Clinical background. 47-year old female patient with papillary thyroid cancer and recently diagnosed rheumatoid arthritis. At the time of I-131 therapy she was under treatment with methotrexate, prednisolone and etanercept. She complained of weakness and muscle pain, particularly in the left gluteus were etanercept was being injected. She had elevated acute-phase response markers (erythrocyte sedimentation rate [ESR], C-reactive protein [CRP]).
Case 4. Abnormal I-131 uptake in skeletal muscles, particularly in the left gluteus.

Notice abnormal foci of uptake in the right neck, related to lymph node involvement.

Also, there is I-131 contamination in her pony-tail.
It has been shown in different trials that reactions at the injection site are the most common adverse events reported by patients who were receiving Etanercept. This can explain the painful inflammation in our patient’s left gluteus.

Discussion (II)

- Steroid myopathy may be more frequent with the use of fluorinated steroids, such as dexamethasone or triamcinolone, than with non-fluorinated ones, such as prednisone or hydrocortisone.
- The chronic form occurs after prolonged use of corticosteroids and has a more insidious course.
- The acute form is less common, is associated with rhabdomyolysis and occurs abruptly while the patient is receiving high-dose corticosteroids. This can explain the generalize muscle uptake in our patient.

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Teaching Points

Table 1. Causes of I-131 Unrelated to Thyroid Cancer

- Choroid plexus salivary glands, gastric mucosa, urinary tract; contamination by physiological sections.
- Ectopic gastric mucosa, other gastrointestinal abnormalities,
- urinary tract abnormalities, mammary abnormalities.
- Serous cavities and cysts.
- Inflammation and infection.
- Nonthyroidal neoplasms.
- Unexplained causes.
References


References
