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“Hidden” bone metastasis from thyroid carcinoma: A clinical note

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Abstract

The ¹³¹I-iodide (¹³¹I) whole-body scan, for thyroid carcinoma is at times difficult to interpret. In a diagnostic whole body ¹³¹I scan of a patient with follicular carcinoma, a posterior skull lesion was partially hidden by overlapping facial structures. On lateral head view, the abnormality was clearly evident. SPECT/CT and MRI showed the lesion originated in the occipital bone and had enlarged into the posterior fossa. The mass was surgically removed and the patient received ¹³¹I therapy for residual tissue. The study demonstrates a pitfall in the reading of two dimensional radioiodine images which can be overcome by SPECT or lateral imaging.

Keywords

Follicular thyroid cancer; Metastatic disease; ¹³¹I-Iodide; SPECT; Radioiodine therapy

Introduction

Radioiodine imaging is a cornerstone of the evaluation and care of patients with differentiated thyroid carcinoma. Many tumors however do not concentrate radioiodine a trait rightly attributed to low functional levels of the sodium iodide symporter (NIS).^{1,2} Aggressive, poorly differentiated primary tumors, sites of metastasis and residual cancer after ¹³¹I or external radiation therapy all can have lower NIS levels and thus low radioiodine uptake and false negative scans.² A second factor causing a false negative radioiodine scan is the inherent limit in the sensitivity of gamma camera imaging. This is

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Conflict of interests

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primarily a physical limitation but as pointed out by Arnstein et al., it is related not only to the radioiodine level but also to the concentration of background activity and the depth and size of the abnormalities, a smaller volume being less well detected by cameras that have a finite resolution.³ Another factor causing false negative scans is the location of the abnormality. Those that reside adjacent to, behind or in front of normal iodine concentrating structures are easily missed particularly with two dimensional planar images and the scan being obtained in only the anterior posterior direction. In these instances SPECT/CT may be helpful in unmasking hidden abnormalities. Here, we describe a patient with follicular thyroid carcinoma who had an unusual metastasis that was initially overlooked in a ¹³¹I scan because it overlapped with normal structures.

Clinical case

The patient was a 51-year-old woman who presented with Graves hyperthyroidism three years earlier. A total thyroidectomy was performed to remove a 4 cm cold nodule after a non-diagnostic fine needle biopsy. A diagnosis of diffuse hyperplasia secondary to Graves and minimally invasive follicular carcinoma (Hurthle variant) was made. She received 100 mCi of ¹³¹I for thyroid remnant ablation.

Fifteen months before admission to NIH, a thoracic inlet tumor was discovered on CT originating from the manubrium with several pulmonary nodules. An ¹³¹I whole body scan was negative with no uptake in the upper chest mass or nodules. The patient lived in a country where measurement of serum thyroglobulin was unavailable. A biopsy of the lesion in the manubrium was deemed too risky so the patient was treated with external beam radiation on the basis that the most likely diagnosis was metastatic thyroid carcinoma. She was referred to our institution for high dose ¹³¹I therapy.

At the time of her initial physical examination, the patient was hypothyroid with a serum thyroglobulin of 61,000 ng/ml. There was a palpable supra-sternal neck mass that extended behind the manubrium. She received a scanning dose of 5 mCi of ¹³¹I and began blood and whole body counts to determine the maximal safe dose of ¹³¹I that could be administered as therapy. A whole body ¹³¹I scan was performed at 48 h and was initially read as showing a physiologic distribution of ¹³¹I without significant uptake in the lower neck mass or lung nodules. Activity in the head and face was thought to show a normal concentration in salivary glands, nose and mouth (Fig. 1A).

Further study of the ¹³¹I images suggested that a normal distribution of ¹³¹I could not totally explain the findings in the head as the activity was more intense in the posterior than the anterior image (Fig. 1A and B). A lateral scan of the head (Fig. 1C) revealed an ¹³¹I avid mass in the back of the head and SPECT/CT images (Fig. 1D) showed that it originated in the occipital skull.

Diagnostic CT (Fig. 2A) and MRI imaging (Fig. 2B) showed that the mass appeared extra-dural without invasion of the brain; however, there was compression of the cerebellum and displacement of the superior sagittal sinus to the right. The mass measured 5.5 cm AP × 6.9 cm transverse × 8 cm craniocaudal and extended to the foramen magnum with resulting mass effect on the posterior fossa structures, cerebellar tonsils and brainstem. The

neurologic examination was normal. Although the patient admitted experiencing mild fleeting pain in the back of her head for over one year, she had not told her doctor because she felt it was just a headache. The mass was palpable externally.

The intended ^{131}I therapy was canceled due to concern that therapy may potentially result in inflammation and dangerous swelling of the tumor leading to a neurological catastrophe. Thyroid hormone was reinstituted and when a near euthyroid state was achieved, neurosurgery was performed. The tumor, adherent to the dura was resected en-bloc with an estimated blood loss of 6 l. One week after surgery while euthyroid the serum thyroglobulin was 21,000 ng/ml. The patient had an uneventful postoperative course and returned three months later for ^{131}I therapy to treat known residual disease at the surgical margins of resection. The pathologic diagnosis of the skull tumor was follicular thyroid carcinoma. The patient was referred for possible enrollment in a tyrosine kinase inhibitor trial for iodine negative metastatic disease.

Discussion

Distant metastases from differentiated thyroid cancer are seen in a 6.7% of patients while metastases from follicular thyroid cancer occur in 21%.⁴ Among the patients with metastatic follicular thyroid cancer, 20% of metastases occur in bones,⁵ but metastases to the skull are rare.⁶ In this patient, a metastatic lesion in the posterior skull was “hidden” in the diagnostic ^{131}I scan by overlapping nose, and mouth activity. The normal patterns of radioiodine uptake in the nose, mouth, and salivary (parotid and submandibular) glands have been described and although there may be some differences due to pre-existing abnormalities and variation in uptake, the usual pattern includes focal nose and linear buccal mucosa activity.⁷ In the present case, the clue to the abnormality was the more intense activity in the posterior image whereas nose, mouth and salivary glands are located anteriorly with their activity being more prominent and often only visible in the anterior image. As originally reviewed, this patient’s study was in fact a “false” false negative. Thus, the normal distribution of the ^{131}I in the head compartment, as seen in our case, may result in false negative evaluation.⁸

Simple anterior/posterior planar radioiodine imaging is commonly used for most evaluations of thyroid cancer patients. There are, however, subtle pitfalls in the evaluation of two dimensional radioiodine images where depth of activity is inferred and overlapping structures can be confusing. When there is doubt about the planar image interpretation, lateral images may be obtained or SPECT or SPECT/CT used. A number of studies have now reported the usefulness of ^{131}I SPECT/CT particularly in the follow-up of patients for metastatic thyroid cancer. With an accuracy reaching 95%,⁹ SPECT/CT is a useful complement to planar imaging.¹⁰ When SPECT or SPECT/CT is not available, standard lateral views from planar radioiodine imaging should be considered in all patients with positive findings where the location of the abnormality may be in question. Lateral images of the head, neck and chest are also indicated in patients with advanced stage disease to prevent an abnormality from being undetected. In this case a simple lateral image of the head followed by SPECT/CT imaging revealed the nature of the problem and prevented a tragic outcome.

In conclusion, this patient's radioiodine image is an example of an abnormality that was partially hidden by overlapping normal structures causing it to be overlooked in the initial evaluation. Although this abnormality was suspected on re-evaluation of the original scan, lateral images and SPECT imaging gave key information that led to the diagnosis.

Acknowledgments

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Fig. 1.

(A) Anterior image of the head in an ^{131}I whole body scan performed at 48 h. Activity in the nose and mouth area (arrow) was initially interpreted as normal. (B) Posterior image of the head from the same study as Fig. 1 (48 h) showing intense activity on the same level as the nose, mouth, and nasopharynx. Visual clues that indicate this activity is posterior include the increase intensity in the posterior image and better definition of the finding in this view. (C) Lateral (oblique) image of the head obtained at 72 h, after re-evaluation of the 48 h images, showed an intense mass of activity in the posterior head. (D) Sagittal section of ^{131}I SPECT/CT (fused image) at 72 h showed a large intense mass in the posterior skull.

Fig. 2.

(A) Axial section of CT from SPECT/CT demonstrates that the tumor originated in the occipital skull with displacement and disruption of the inner and outer tables. (B) Sagittal section of an MRI shows the extent of the posterior fossa tumor which compresses the cerebellum.