

Short Communication

Patterns of Indications and Findings of Radionuclide Thyroid Scintigraphy: The Chris Hani Baragwanath Academic Hospital Experience: Johannesburg, South Africa

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Abstract

Thyroid scintigraphy is an essential modality in nuclear medicine, requiring a contribution for both diagnosis and treatment. Worldwide, nodular thyroid disease is common. Most nodules are symptomatic and benign, however some are malignant. Fine needle aspiration (FNA) biopsy should be the cornerstone of the evaluation of thyroid nodules. Radionuclide scans should be used as adjunctive tests and should not be performed until after determination of thyroid function and results of cytology are available. The most common indication for thyroid imaging is in a patient with thyrotoxicosis. Thyrotoxicosis has multiple etiologies, manifestations, and potential therapies. Appropriate treatment requires an accurate diagnosis and is influenced by coexisting medical conditions as well as patient preference.

INTRODUCTION

Thyroid scintigraphy is based on the concept of thyroid hormone synthesis that is, trapping of iodide or iodide analogues (ie, Technetium pertechnetate) [1]. In the case of radioactive iodine, there is eventual incorporation into thyroid hormone synthesis within the thyroid follicle [1]. The radioactive iodine (^{123}I) and technetium ($^{99\text{m}}\text{Tc}$) constitute the radionuclides used in the imaging of the thyroid gland [2].

Thyroid scintigraphy is a reflection of the physiological functional state of the gland [1]. Scintigraphy, therefore, provides information that anatomical imaging (ie, ultrasound, computed tomography, magnetic resonance imaging) lacks [1].

AIM

Our aim of this retrospective study was to evaluate the indications for thyroid scintigraphy in our clinical environment, and to look at the common findings on scintigraphy.

METHODOLOGY

A retrospective audit of all patients referred to our department

for thyroid scintigraphy was done. We included all $^{99\text{m}}\text{Tc}$ scans undertaken from January 2013 to December 2014.

RESULTS

We had a total of 202 patients that had thyroid pertechnetate scans. The vast majority were female patients (81%) versus 19% of male patients. The age ranges of the patients were 16 to 82 years (mean 48 +/- 15.66). The thyroid function test (TSH) was suppressed in 71% of patients and normal in 22%, while 7% of patients had no blood results. The majority of the patients who were referred were for the evaluation of clinically confirmed Graves' disease (60%). The other indications were for the evaluation of a nodule in a patient with toxicosis (13%), multinodular goiter (MNG) (14%), goiter (10%), thyroiditis (2%) and suspected carcinoma (1%). With regard to the findings on scan, 56% of patients had a diffuse toxic goiter of Graves' disease, 16% euthyroid multinodular goiter, and the rest had other diagnoses, including toxic MNG (7%), normal thyroid gland (7%) and nodular goiter (7%), thyroiditis (5%), and toxic adenoma (2%). Of the patients with Graves' disease, radioactive iodine ablation was requested in 44% and ablation was given in 43% of patients.

DISCUSSION

Goiter is a common disease in areas with moderate iodine-deficiency, with a prevalence of about 30% for either goiter, thyroid nodules or both [3]. Thyroid scintigraphy is a nuclear medicine procedure that produces a visual display of functional thyroid tissue that is based on the uptake of various radionuclides by thyroid tissue. Technetium-99m pertechnetate and iodine is trapped by the thyroid gland, like iodides, but $^{99m}\text{TcO}_4^-$ is not organified. It is released over time as unaltered pertechnetate ion ($^{99m}\text{TcO}_4^-$). ^{99m}Tc is more frequently used due to it being less expensive, more readily available and it requires less patient time due to same day imaging and therefore the shorter waiting time for the report. It also has the advantage of a lower absorbed dose to the thyroid and therefore permits the administration of higher doses and allows more rapid imaging of the gland [2].

We do thyroid pertechnetate imaging on a daily basis as we have availability of ^{99m}Tc from a Molybdenum (^{99}Mo) generator. In our environment, the majority of patients that are referred for thyroid scintigraphy are female (81%). Patients of all ages are referred, with a mean age of 48 years. The majority of patients (71%) present with biochemical evidence of hyperthyroidism and most are referred to us for the confirmation of suspected Graves' disease (60%), (Figure 1).

It is important to distinguish between hyperthyroidism associated with increased iodine uptake (Graves' disease, toxic nodular goiter), and hyperthyroidism associated with low iodine uptake (thyroiditis), because the treatment is different between the pathologies. The necessity for thyroid scintigraphy in all cases of thyrotoxicosis is debated, as thyrotoxic patient with diffuse goiter is suggestive of Graves' disease [1]. The diagnosis of Graves' disease usually can be made on clinical and laboratory data. A thyroid scan and an uptake study can be helpful in confirming Graves' disease when hyperthyroidism presents without clinical signs suggestive of Graves' disease [4]. Most clinicians would request a radioactive iodine uptake (RAIU) determination and thyroid scintigraphy as a pre-therapeutic measurement in anticipation of radioiodine therapy [5]. In addition, thyroid

scintigraphy will indicate the presence of a solitary "cold" nodule within the diffuse toxic goiter, which usually requires further work-up to exclude malignancy [5].

- The indications for thyroid scintigraphic imaging include: To locate ectopic thyroid tissue, ie. lingual thyroid
- To correlate the general structure of the gland with function, especially in differentiating Graves' disease from toxic nodular goiter. This distinction is important in determining the therapeutic radioactive iodine dose.
- To determine the function of a palpable nodule
- To assist in the evaluation of congenital hypothyroidism or organification defects
- To determine if a cervical or mediastinal mass is thyroidal tissue
- To differentiate among other causes of thyrotoxicosis, ie. Thyroiditis [2]

The role of thyroid scintigraphy in thyroid nodular disease is limited, as ultrasound (U/S) is preferred to assess for any suspicious features that would suggest non-benign pathology and guide fine needle aspiration ± biopsy (FNAB) [2]. When a solitary thyroid nodule is detected by physical examination of the neck, U/S and FNA usually is obtained to determine if the nodule is malignant [4]. U/S with survey of the cervical lymph nodes should be performed in all patients with known or suspected thyroid nodules [6]. Ultrasound may be of value in distinguishing between a benign cystic abnormality and a solid lesion, which may harbor a neoplasm. U/S is not useful in differentiating malignant from benign solid nodules [2]. The sensitivity of scintigraphy in the diagnosis of thyroid cancer is very low, and is not recommended as diagnostic tool [6]. Imaging is reserved for those cases in which it is not certain if there is a nodule or if a palpable nodule is actually in the thyroid [4]. Generally, only nodules > 1 cm should be evaluated, since they have a greater potential to be clinically significant cancers. Nodules < 1 cm that would require further evaluation are due to clinical symptoms or associated neck lymphadenopathy [6]. With the discovery of a thyroid nodule > 1 cm in any diameter, a serum TSH level should be obtained. If the serum TSH is subnormal, a radionuclide thyroid scan should be obtained to document whether the nodule is hyperfunctioning, isofunctioning, or non-functioning [6]. Imaging is based on the premise that functioning ("hot") nodules are unlikely to be malignant, whereas nonfunctioning ("cold") nodules may harbor cancer in a small proportion (10%) of patients. Some literature has shown that the reported percentage of thyroid cancer in solitary cold nodules is up to 20% [2]. At the present time, the most important criterion for FNAB is nodule size. Nodules 1.0 to 1.5 cm generally are not subjected to FNAB because cancers of this size, termed "microcarcinomas," are associated with a good prognosis [7].

Graves' disease (GD) is one of the most common autoimmune diseases. It affects around 5% of the population and accounts for 50-80% of cases of hyperthyroidism [8]. Although toxic nodular goiter is less common than GD, its prevalence increases with age and in the presence of iodine deficiency [9]. Therefore, toxic nodular goiter may actually be more common than GD in older

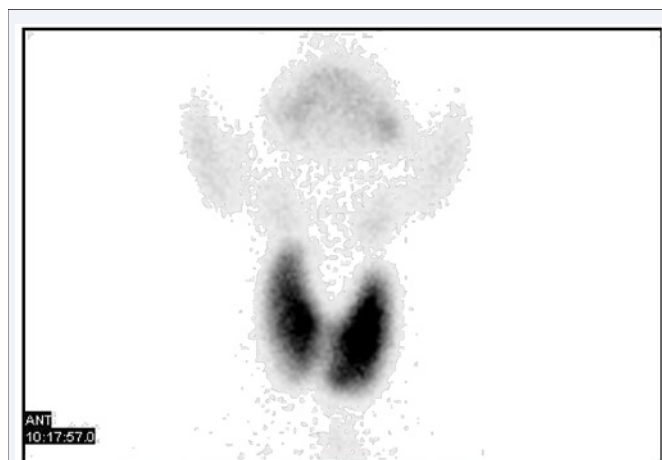


Figure 1 Graves' disease. Scintigraphy demonstrates that the thyroid is enlarged. Activity throughout the gland is increased relative to the background due to both increased stimulation and function of the gland. The TSH was suppressed at the time.

patients from regions of iodine deficiency [9]. Imaging with ^{99m}Tc or iodide requires no prior preparation of the patient. Exclusion of pregnancy and lactation is routine. A history of recent medication or iodinated contrast medium is advisable. The thyroid is imaged 20 minutes after the intravenous administration of 5-10mCi (185-370MBq) of ^{99m}Tc . A scintillation camera equipped with parallel or pinhole is used, although a pinhole collimator is preferred for nodular thyroid disease [10]. The gamma camera setting is placed on the 140keV photo peak of ^{99m}Tc -pertechnetate, with a 10% window. Anterior, left and right anterior oblique images are obtained for 100 000 to 300 000 counts (or 5 minutes) each, with the patient supine and the neck extended. The oblique images are essential for the identification of laterally and posteriorly placed nodules that might be missed with anterior imaging [2]. A 2cm lead marker is placed at the sternal notch to assess the size of the thyroid gland. The position of the palpable nodules under investigation should be documented as it aids in accurate correlation of the physical and scintigraphic findings.

For most patients, I-131 therapy is recognized as the simplest, safest, and most effective form of therapy, except for those who are pregnant or lactating or who have severe Graves' ophthalmopathy [2]. Alternatively, some endocrinologists prefer anti-thyroid drugs, particularly in patients with normal-sized glands or less severe disease [5].

In our study, the 1% of patients that did not receive ablation had a cold nodule seen on scintigraphy and required correlation with sonar to exclude sonographically worrisome features of malignancy that would require histological characterization.

CONCLUSION

Thyroid imaging is an important investigation for the scintigraphic assessment of the thyroid gland. Although being only trapped without organification, ^{99m}Tc is routinely used in our clinical setting due to its physical characteristics and readily availability. The most common clinical indication in our environment is to confirm Graves' disease.

The radionuclide scan does not offer additional advantages in differentiating benign from malignant lesions. The current role of nuclear scintigraphy in thyroid diagnosis is adjunctive rather

than as a first-line diagnostic test. Currently, FNA biopsy is the recommended initial diagnostic tool in the evaluation of thyroid nodules [11].

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