Imaging Thyroid Disease
Updates, Imaging Approach, and Management Pearls

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KEYWORDS

• Thyroid cancer • Incidental thyroid nodule • Ultrasonography • Radioactive iodine scan • CT • MR imaging • Hyperthyroidism

KEY POINTS

- Thyroid cancer is the fastest increasing cancer in the United States. An exponential increase in incidence of thyroid cancer has been partly attributed to an increased work-up of incidentally detected thyroid nodules on imaging, especially ultrasonography and computed tomography (CT).
- A categorization method has been proposed for guiding the evaluation of incidental thyroid nodules detected on CT, MR imaging, or PET/CT. The method is a 3-tiered system and is based on the patient's age, nodule size, and suspicious imaging findings.
- The most common cause of hyperthyroidism is Graves disease, followed by toxic adenoma, toxic multinodular goiter, and subacute thyroiditis.
- Most patients do not have preoperative imaging with CT or MR imaging because ultrasonography adequately evaluates the primary tumor and nodal disease. CT or MR imaging is only performed in some cases of advanced local invasion to guide operative approach or decide whether surgery is possible.
- Ultrasonography of the neck is the first imaging investigation for suspected thyroid cancer recurrence. If the ultrasonography is negative and the histology is differentiated thyroid cancer, the next investigation should be radioiodine whole-body scintigraphy.

INTRODUCTION

There are many disorders that can occur in the thyroid gland, ranging from benign to malignant entities. Diseases in the thyroid can be subclinical or present with symptoms from structural or functional abnormalities. Imaging of the thyroid gland can also be complex because it includes different modalities such as ultrasonography, computed tomography (CT), MR imaging, and nuclear scintigraphy. Hence, expertise in the thyroid spans the subspecialties of neuroradiology, nuclear medicine, and body imaging. It is important for general radiologists and subspecialty radiologists to

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understand key aims of imaging and treatment in order to provide helpful information to help guide management.

This article focuses on 5 common problems of the thyroid that require special consideration with regard to optimizing imaging strategies in a multidisciplinary and collaborative platform. These problems are the incidental thyroid nodule (ITN), preoperative evaluation of goiter, hyperthyroidism, invasive thyroid cancer, and recurrent thyroid cancer. For each problem, essential facts, interesting updates, optimal imaging approach, and management pearls are reviewed.

PROBLEM 1. THE INCIDENTAL THYROID NODULE DETECTED ON COMPUTED TOMOGRAPHY

A 51-year-old woman has an incidental 10-mm thyroid nodule on CT of the cervical spine performed for trauma. She has no personal or family history of thyroid disease. Should this nodule receive further work-up?

Essential Facts and Updates

ITNs on imaging are common, seen in 16% to 18% of CT scans that cover the neck.[1–4] Although ultrasonography has greater resolution than CT, several recent studies show that CT is the most common modality responsible for detection of asymptomatic thyroid nodules because CT is performed more commonly than ultrasonography.[5–7] The rate of incidental thyroid findings on CT increases with age with a prevalence of ITN in one-third of patients more than 65 years of age.[1] ITNs are also twice as common in women.[1]

The decision to work up an ITN is driven by the possibility that the nodule may be malignant, but the malignancy rate is as low as 1.2% according to a large population-based case-control study.[8] In addition, most thyroid cancers are indolent in behavior.[4,9,10] Most patients with small thyroid cancers die with rather than from the thyroid cancer.[4,9] In addition, the work-up of ITN detected on imaging has been partly attributed to an exponential increase in thyroid cancer incidence with little change in mortality.[10,11] Since 1975, the incidence of thyroid cancer has nearly tripled, from 4.9 to 14.3 per 100,000 individuals.[11]

Imaging Recommendations and Findings

Components of work-up

If work-up is necessary after an ITN is detected on CT or MR imaging, the next investigation is ultrasonography. Ultrasonography has higher spatial resolution and allows better characterization of nodules. Many sonographic signs of thyroid cancer have been evaluated in the literature.[12] In the largest retrospective study to date, the only useful sonographic signs of malignancy were microcalcifications, solid composition, and size greater than 2 cm (odds ratios of 8.1, 4.0, and 3.6, respectively).[8]

Which incidental thyroid nodule to select for work-up?

Most ITNs on CT and MR imaging do not have reliable signs of malignancy, which has resulted in highly variable reporting practices.[13] A categorization method has recently been proposed for guiding the evaluation of ITN detected on CT, MR imaging, or PET/CT.[1,5,14] The method is a 3-tiered system and is based on patient's age, nodule size, and suspicious imaging findings (**Table 1**). Two retrospective studies found that the 3-tiered system had the potential to reduce radiographic and endocrinologic work-up without missing malignancies in the respective cohorts. Compared with an academic institution's clinical practice without specific guidelines, there was a 35% reduction in ITN work-up with the 3-tiered system.[5] Compared with a 1 cm size cut-off, there was a 46% reduction in ITN work-up with the 3-tiered system.[1]

Tip

Signs of focal fluorodeoxyglucose (FDG) activity and corresponding thyroid nodule on CT is worrisome for thyroid cancer (**Fig. 1**). The rate of malignancy in ITNs with focal FDG uptake in a euthyroid patient ranges between 26% and 50%, with an overall incidence of 33% in one systematic review.[15–19]

Management Pearls

The decision to perform subsequent evaluation of ITN with ultrasonography can lead to fine-needle aspiration (FNA) in a large number of patients with asymptomatic, benign disease. Ultrasonography criteria for FNA are different for various societies, resulting in highly variable practices among radiologists and clinicians.[13,20–23] Smith-Bindman and colleagues[8] recently found that an approach to FNA of thyroid nodules with 2 or more of 3 ultrasonography findings (size>2 cm, entirely solid composition, and microcalcifications) reduced unnecessary biopsies while maintaining a low risk of missed cancers (0.5%).

It is also valuable to appreciate that evaluation does not end with an FNA in one-third of