



Management of Thyroid Nodules

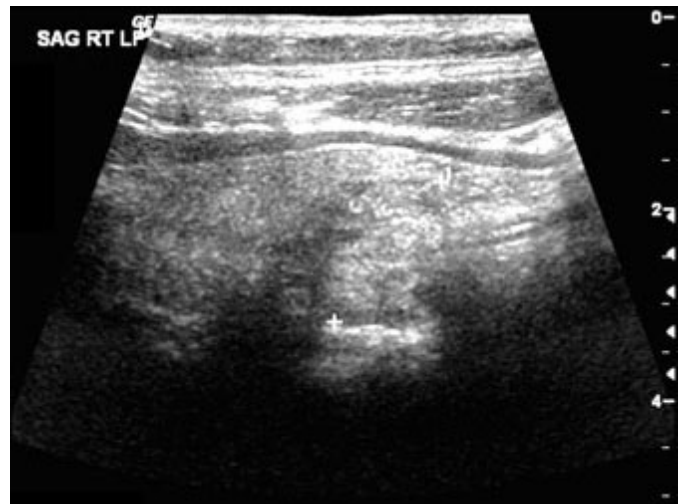
- Palpable thyroid nodules are found in 4-7% of the population
- Non-palpable thyroid nodules are found in approximately 50% of persons over 60 yrs
- The vast majority of thyroid nodules are benign (malignancy rate 2-5%)
- Ultrasound can help determine which nodules are suspicious but a biopsy is needed for a definitive diagnosis
- A low TSH followed by a ¹²³I scan may define a nodule as "hot" or functioning, and virtually always benign in which case an ultrasound may be unnecessary

The detection rate of thyroid nodules has increased dramatically because they are common incidental findings during carotid ultrasonography as well as MRI and CT images of the neck and thorax, ordered for a variety of diagnostic purposes. These nodules are typically non-palpable, asymptomatic, and medically insignificant. Nevertheless, there is a concern that they may be cancerous even though thyroid cancer is rare. Approximately 5% of solitary thyroid nodules are malignant; multinodular thyroid glands can harbor cancer, but the risk of malignancy per nodule is lower in this situation.

Although the discovery of thyroid nodules warrants attention and follow-up, there is considerable concern that the increase in the number of incidental findings may lead to unnecessary testing and treatment, adding to the cost-burden of health care and some risk for the patient. It should be noted that the prevalence of non-palpable thyroid nodules has been estimated to be in the range of 19-67% of the population, and about 50% in those over the age of 60. In comparison, only 4-7% of the populations are discovered to have thyroid nodules by palpation. Furthermore, autopsy studies indicate that the prevalence of occult (microscopic) papillary thyroid carcinoma, which rarely has any clinical significance, may exceed 10%. Unfortunately, there is no perfect answer to the need for the detection of all clinically significant cancers while avoiding unnecessary biopsy procedures and surgery.

Evaluation of Thyroid Nodules

Risk factors for thyroid cancer include age less than 20 or over 60, a history of head or neck irradiation, and a family history of thyroid cancer or familial multiple endocrine neoplasias. Thyroid function tests may be helpful. If the serum TSH is below normal, an ¹²³I scan should be performed to exclude a "hot" nodule, which are benign over 99% of the time. In this situation, a



Grey scale ultrasound image of a pathologically proven thyroid cancer demonstrates an isoechoic nodule (within calipers) with a well-defined margins and microcalcifications. This case illustrates the point that many nodules that harbor malignancy will only demonstrate one of the several features (hypoechoic, microcalcifications, poorly defined margins, etc.) associated with malignancy.

biopsy is not necessary. Because only 5% of nodules are hot, a thyroid scan should only be performed if the TSH is low. Due to the limitations in the resolution of a radionuclide scan only nodules greater than 1 cm can generally be imaged with this modality.

As a general rule, most endocrinologists recommend a FNA (Fine Needle Aspiration Biopsy) for palpable nodules larger than 1 to 1.5 cm. There is currently intense debate about whether all identified nodules over 1 (or 1.5 cm) require FNA. Some feel that only the smaller non-palpable nodules (e.g. < 1.5 cm) with suspicious characteristics (see below) need to be biopsied.

Ultrasound Imaging

Ultrasound imaging can detect nodules as small as 2 mm and it is useful for determining the number of thyroid nodules and measuring their size. It can also differentiate simple cysts, which are unlikely to be malignant. Radiologists have defined ultrasound characteristics that make a nodule more likely to be malignant. These have been particularly useful in deciding which non-palpable nodules between 0.8 and

1.5 cm might require biopsy. These characteristics include a hypoechoic nodule with one of the following: microcalcifications, central blood flow, or irregular border. Although one or more of these features in a nodule increase the chance for malignancy, small nodules that have these characteristics still only prove to be malignant 22% of the time.

Thyroid Ultrasonography	
Useful Applications	<ul style="list-style-type: none"> To supplement physical examination of patients with thyroid nodular disease To screen patients with a history of head or neck irradiation To differentiate solid and cystic nodules To follow up patients with benign nodules To look for recurrence of cancer in patients who have had surgery To guide fine needle aspiration biopsy of small solid, partially cystic, or non-palpable nodules
Limitations	<ul style="list-style-type: none"> Cannot unequivocally rule out cancer (sensitivity 87-94%) Attenuation of sound waves in deeper tissues makes evaluation of large goiters difficult Passage of sound waves blocked by calcific deposits in thyroid and bone – Substernal portions of thyroid not visualized

Sensitivity, Specificity and Predictive Value of Ultrasound Imaging of Non-Palpable Thyroid Nodules				
	Hypoechoic	Hypoechoic and Blurred Margins	Hypoechoic and Intranodular Vascularization	Hypoechoic and Microcalcifications
Sensitivity	87%	74%	61%	26%
Specificity	48%	88%	86%	96%
Predictive Value	11%	39%	26%	36%

Data from Papini et al., 2002

Fine Needle Aspiration Biopsy

Fine needle aspiration (FNA) biopsy provides the most direct and specific information about a thyroid nodule. If the nodule is palpable, image guidance is unnecessary. However, FNA biopsy is more successful if guided by ultrasound when nodules are small, partly cystic, or nonpalpable. FNA biopsy is performed on an outpatient basis and is a low risk procedure, usually requiring no sedation and only local anesthesia. It is not precluded by anticoagulant or aspirin therapy. The most likely complication is local discomfort.

FNA results can be classified as *a*) non-diagnostic, in which case the biopsy should be repeated; *b*) benign, usually a macrofollicular pattern in which case the nodule can be followed; *c*) malignant; most commonly a papillary thyroid carcinoma and occasionally a

medullary thyroid carcinoma, in which case surgery is necessary; or *d*) suspicious, often called a follicular neoplasm, which usually has a microfollicular pattern or abundant oxyphil (Hurthle) cells, in which case surgery is necessary to decide if a nodule is benign or malignant.

The suspicious category is a reflection of our inability to diagnose follicular carcinomas by FNA. The distinction between a benign microfollicular adenoma and a follicular carcinoma (or a benign oxyphil cell tumor or a malignant one) requires surgery. A suspicious biopsy (follicular neoplasm) will be found in 10 to 20% of biopsies. Ten to twenty percent of these (higher in men and in larger nodules) will ultimately prove to be malignant.

Scheduling

Ultrasound examination of patients with thyroid nodules may be performed at Mass General West Imaging in Waltham, Mass General Imaging in Chelsea, or at the main MGH campus. Appointments can be scheduled by calling 4-XRAY (617-724-9729) or through the web-based Radiology Order Entry system, <http://mghroe/>.

Ultrasound-guided FNA biopsy is performed on the main campus only and can be scheduled by calling Interventional Radiology (617-726-8386). FNA biopsies are also performed in the Thyroid Unit and by the Cytology FNA service.

Further Information

For further questions on thyroid ultrasound, please call [Joseph Simeone, M.D.](#), Radiologist, Abdominal Imaging and Intervention Division, at 617-726-3091.

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References

Blum, M. (2004) *Use of ultrasonography in thyroid disease* Up-to-Date Online <http://uptodateonline.com/application/topic.asp?file=thyroid/22414>

Hegedus, L. (2004) *The Thyroid Nodule*. N Engl J Med **351**: 1764-1771

Kane, RA. (2003) *Ultrasound of the thyroid and parathyroid glands: Controversies in the diagnosis of thyroid cancer*. Ultrasound Q. **19**:177-178

Mandel, SJ (2004) *A 64-year-old woman with a thyroid nodule*. JAMA **292**: 2632-2642

Papini, E, Guglielmi, R, Bianchini, A, Crescenzi, A, *et al.* (2002) *Risk of malignancy in nonpalpable thyroid nodules: predictive value of ultrasound and color-Doppler features*. J Clin Endocrinol Metab **87**: 1941-1946

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