US Features of Thyroid Malignancy: Pearls and Pitfalls[1]

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LEARNING OBJECTIVES

After reading this article and taking the test, the reader will be able to:

- Describe common US features of thyroid malignancy and the value and limitations of each.
- Correlate US features with the pathologic appearance and behavior of different histologic types of thyroid malignancy.
- Recognize atypical features of thyroid malignancy and other potential diagnostic pitfalls.

TEACHING POINTS

See last page

Thyroid nodules are common and occur in up to 50% of the adult population; however, less than 7% of thyroid nodules are malignant. High-resolution ultrasonography (US) is commonly used to evaluate the thyroid gland, but US is frequently misperceived as unhelpful for identifying features that distinguish benign from malignant nodules. Microcalcifications are one of the most specific US findings of a thyroid malignancy. Other useful US features include a marked hypoechogenicity, irregular margins, and the absence of a hypoechoic halo around the nodule. Lymphadenopathy and local invasion of adjacent structures are highly specific features of thyroid malignancy but are less commonly seen. The number, size, and interval growth of nodules are nonspecific characteristics. Suspicious US features may be useful for selecting patients for fine-needle aspiration biopsy when incidental nodules are discovered and when multiple nodules are present. Common interpretative pitfalls that may lead to failure to recognize a malignancy include mistaking cystic or calcified nodal metastases for nodules in a multinodular thyroid, mistaking diffusely infiltrative thyroid carcinomas and multifocal carcinomas for benign disease, and failing to recognize microcalcifications in papillary thyroid cancer.

Introduction

Thyroid nodules are very common and may be observed at ultrasonography (US) in 50% of the adult population. Thyroid malignancy is relatively rare and is diagnosed in approximately 25,000 patients per year in the United States (1). The most common cause of benign thyroid nodules is nodular hyperplasia (2). Although less than 7% of thyroid nodules are malignant (2), it is critical that they be accurately identified. The imaging modality of choice for the investigation of thyroid nodules is high-resolution US. US is commonly misperceived as unhelpful in distinguishing between benign and malignant thyroid nodules. Although individual US features may be of

Abbreviation: FNA = fine-needle aspiration

RadioGraphics 2007; 27:847–865 • **Published online** 10.1148/rg.273065038 • **Content Codes:** HN OI US

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See the commentary by Langer following this article.

limited value, when multiple signs of thyroid malignancy appear in combination it is possible to make an accurate prediction. The nodule then may be further assessed with fine-needle aspiration (FNA).

Scintigraphy is not used routinely to assess thyroid nodules. It is primarily of use in patients with a suppressed thyroid-stimulating hormone level, in whom it allows assessment of the functional activity of a thyroid nodule and of the whole gland. A functioning, or "hot," thyroid nodule is rarely malignant, with only a few reported cases of such malignancy (3–10). Although a nonfunctioning, or "cold," nodule at scintigraphy is commonly thought to indicate an increased risk of thyroid malignancy, as many as 77% of cold thyroid nodules may be benign (4,11). Thyroid scintigraphy therefore is unhelpful for differentiating a benign nodule from a malignant one, and its utility for the routine evaluation of thyroid nodules is limited.

Pathologic Types of Thyroid Malignancy

The main pathologic types of thyroid carcinoma are papillary, follicular, medullary, and anaplastic (Fig 1). Papillary and follicular thyroid carcinomas both have an excellent prognosis, with a 20-year survival of 90%–95% and 75%, respectively (12–14). Medullary thyroid carcinoma is more aggressive, with a 10-year survival of 42%–90% (13,14). Anaplastic thyroid carcinoma has an extremely poor prognosis, with a 5-year survival of 5% (13,14). Risk factors for thyroid carcinoma include age of less than 20 years or more than 60 years, a history of neck irradiation, and a family history of thyroid cancer (14).

Thyroid lymphoma, usually of the non-Hodgkin type, is uncommon. It may occur as part of generalized lymphoma or as a primary tumor, usually in the setting of Hashimoto thyroiditis. Metastases to the thyroid are rare and usually originate from primary lung, breast, and renal cell carcinomas. Metastatic disease should be suspected when a solid thyroid nodule is found in a patient with a known nonthyroid malignancy.

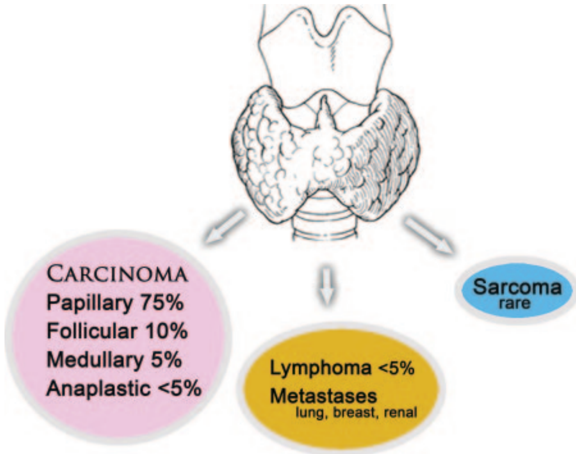


Figure 1. Drawing shows the thyroid gland and the frequency of occurrence of the different pathologic types of thyroid malignancy.

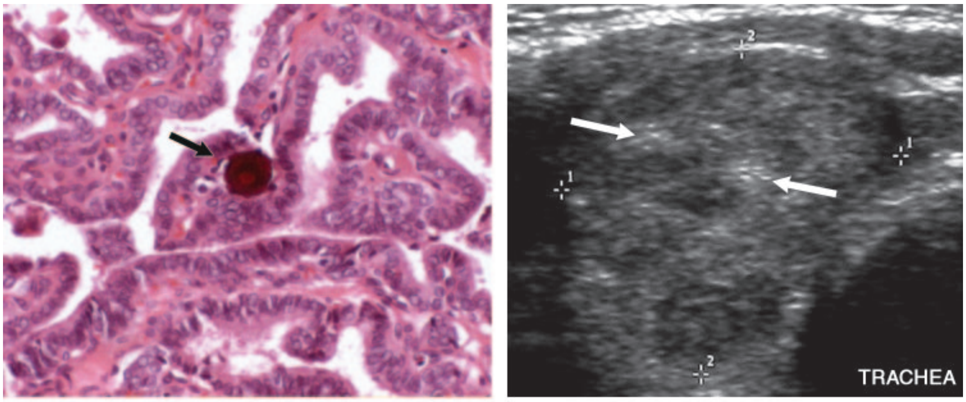
US Features Suggestive of Malignancy

Calcifications

Thyroid calcifications may occur in both benign and malignant disease. Thyroid calcifications can be classified as microcalcification, coarse calcification, or peripheral calcification. Thyroid microcalcifications are psammoma bodies, which are 10–100-μm round laminar crystalline calcific deposits (Fig 2a). They are one of the most specific features of thyroid malignancy, with a specificity of 85.8%–95% (2,15–17) and a positive predictive value of 41.8%–94.2% (1). Microcalcifications are found in 29%–59% of all primary thyroid carcinomas (2,16,18,19), most commonly in papillary thyroid carcinoma. Their occurrence has been described in follicular and anaplastic thyroid carcinomas as well as in benign conditions such as follicular adenoma and Hashimoto thyroiditis (20). At US, microcalcifications appear as punctate hyperechoic foci without acoustic shadowing (Fig 2b).

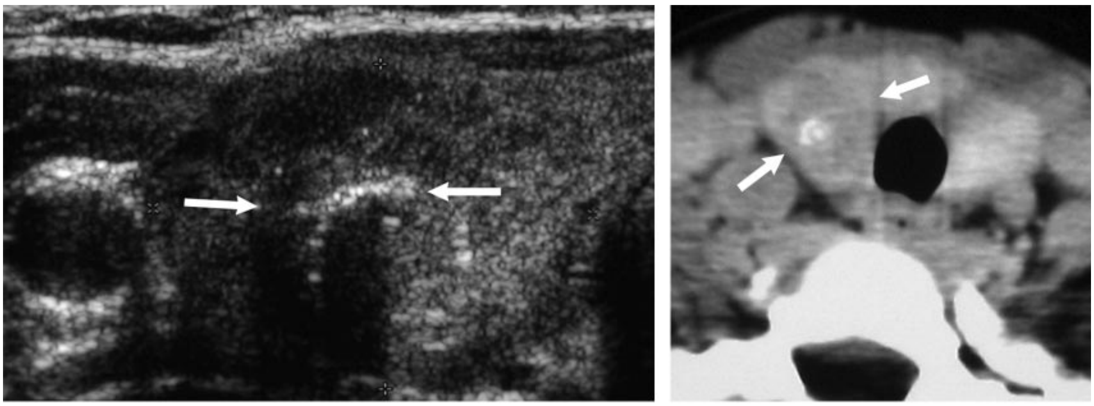
Teaching Point

Large irregularly shaped dystrophic calcifications also may occur and are secondary to tissue necrosis. They may appear as spicules, fragmented plates, or granular deposits within fibrous septa in the thyroid gland. They are commonly present in multinodular goiters; however, when found in solitary nodules, they may be associated with a malignancy rate of nearly 75% (21). Coarse calcifications may coexist with microcalcifications in papillary cancers, and they are the most common type of calcification in medullary thyroid carcinomas (14,10,22). At US, dense coarse calcifications cause posterior acoustic shadowing (Fig 3). Inspissated colloid calcifications in benign thyroid lesions may mimic microcalcifications in thyroid malignancies, but the former can be distinguished from malignant calcifications by the observation of ring-down or reverberation artifact (Fig 4) (23). Peripheral calcification is one of the patterns most commonly seen in a multinodular thyroid but also may be seen in malignancy (22).



a. b.

Figure 2. Papillary thyroid carcinoma in a 42-year-old man. **(a)** Photomicrograph (original magnification, ×400; hematoxylin-eosin stain) shows a psammoma body (arrow), a round laminar crystalline calcification. **(b)** Transverse sonogram of the right lobe of the thyroid demonstrates punctate echogenic foci without posterior acoustic shadowing, findings indicative of microcalcifications (arrows).



a. b.

Figure 3. Medullary thyroid carcinoma in a 32-year-old man. **(a)** Transverse sonogram of the right lobe of the thyroid shows a large nodule with coarse calcification and posterior acoustic shadowing (arrows). **(b)** Axial computed tomographic (CT) image shows the nodule with an internal focus of coarse calcification (arrows).

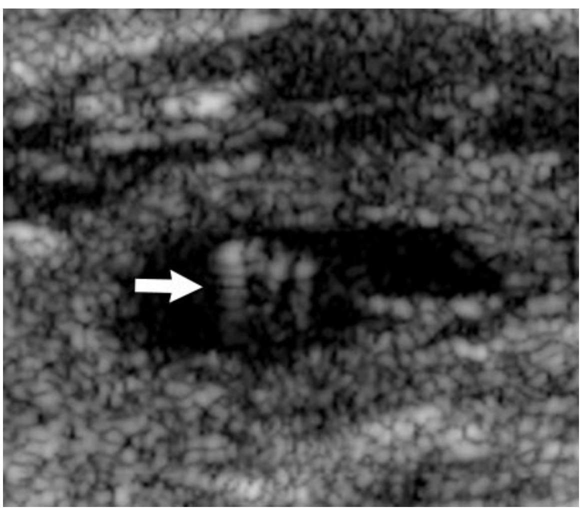


Figure 4. Benign thyroid nodule in a 51-year-old woman. Transverse sonogram of the right lobe of the thyroid shows a colloid nodule with a ring-down artifact (arrow), a finding indicative of inspissated colloid calcification.

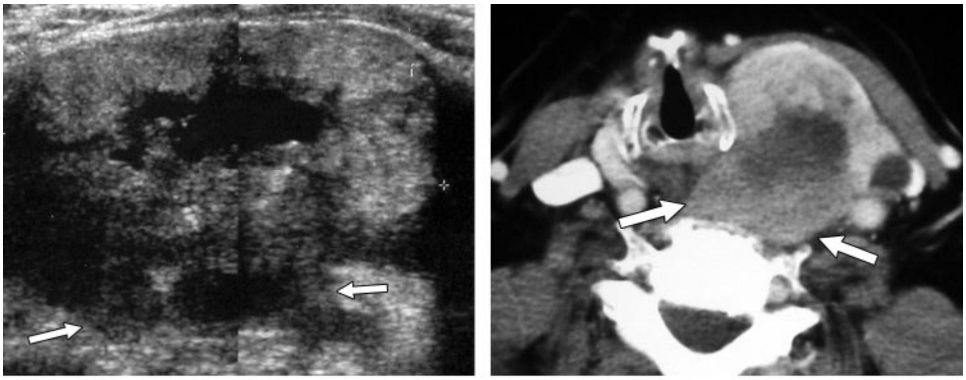


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Figure 5. Anaplastic thyroid carcinoma in an 84-year-old woman. **(a)** Transverse sonogram of the left lobe of the thyroid shows an advanced tumor with infiltrative posterior margins (arrows) and invasion of prevertebral muscle. **(b)** Axial contrast-enhanced CT image shows a large tumor that has invaded the prevertebral muscle (arrows).

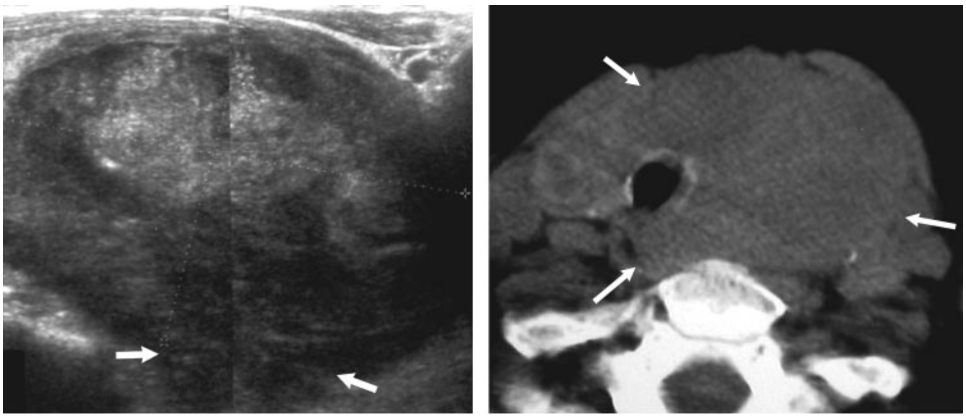

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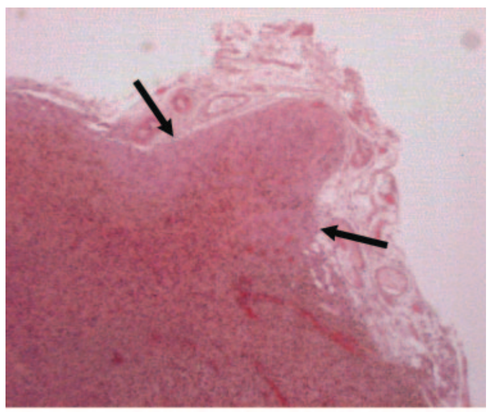
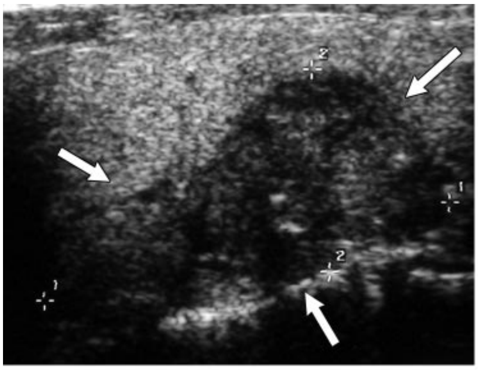
Figure 6. Infiltrative primary leiomyosarcoma of the thyroid in a 90-year-old woman. **(a)** Transverse sonogram of the left lobe of the thyroid shows a tumor (between calipers) with infiltration from the posterior tumor margin into the prevertebral space (arrows). **(b)** Axial unenhanced CT image shows the large size of the tumor and the extent of invasion (arrows). **(c)** Photomicrograph (original magnification, ×100; hematoxylin-eosin stain) shows tumor invasion beyond the capsule (arrows).



c.

Local Invasion and Lymph Node Metastases

Direct tumor invasion of adjacent soft tissue and metastases to lymph nodes are highly specific signs of thyroid malignancy (17). Extracapsular extension has been demonstrated in 36% of thyroid malignancies at histologic analysis (2). Suggestive clinical symptoms include dyspnea, hoarseness, and dysphagia, which are caused by invasion of the trachea or larynx, the recurrent laryngeal nerve, or the esophagus, respectively (13). Aggressive local invasion is common with anaplastic thyroid carcinoma, lymphoma, and sarcoma. At US, direct tumor invasion of adjacent soft tissues may appear as a subtle extension of the tumor beyond the contours of the thyroid gland or as frank invasion of adjacent structures (Figs 5, 6) (24).



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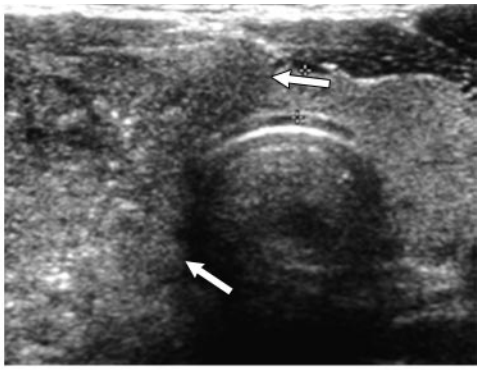

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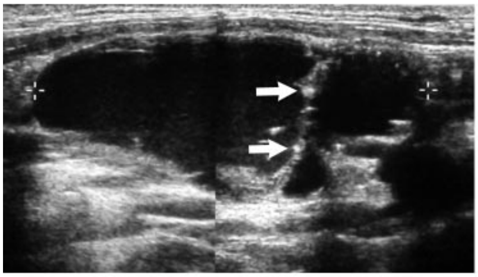

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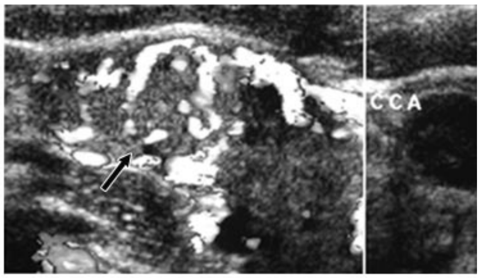

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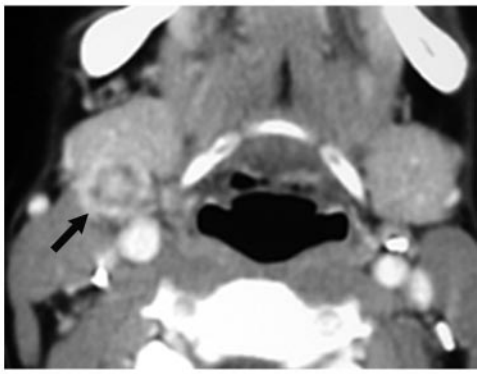

8c.

Figures 7, 8. **(7)** Papillary carcinoma and cystic lymph node metastasis in a 28-year-old woman. **(a)** Longitudinal sonogram of the right lobe of the thyroid shows an irregular hypoechoic tumor with microcalcifications. **(b)** Longitudinal sonogram of the right neck shows a cystic level 5 nodal metastasis with internal septation and foci of calcification (arrows). **(c)** Axial contrast-enhanced CT image shows the metastasis (arrow). **(8)** Papillary carcinoma and vascular lymph node metastasis in a 27-year-old woman. **(a)** Transverse sonogram shows a tumor that has infiltrated the entire right lobe of the thyroid (arrows). **(b)** Transverse sonogram of the right neck shows a level 3 lymph node metastasis with increased vascularity (arrow). **(c)** Axial contrast-enhanced CT image shows a vascular lymph node with a targetlike appearance (arrow).

Metastases to regional cervical lymph nodes have been reported to occur in 19.4% of all thyroid malignancies (2). They are most common in papillary thyroid carcinoma and occur in up to 40% of adults and 90% of children affected by that type of malignancy (14). Medullary thyroid carcinoma also demonstrates early nodal metastases in up to 50% of patients (14). Lymph node metastases in follicular thyroid carcinoma are rare, even in highly invasive cases. Examination of the internal jugular chain of cervical lymph nodes, particularly on the ipsilateral side of a suspicious thyroid lesion, should be a routine part of US evaluations of the thyroid. US features that should arouse suspicion about lymph node metastases include a rounded bulging shape, increased size, replaced fatty hilum, irregular margins, heterogeneous echotexture, calcifications, cystic areas (Fig 7), and vascularity throughout the lymph node instead of normal central hilar vessels at Doppler imaging (Fig 8) (1,25,26).

Teaching Point

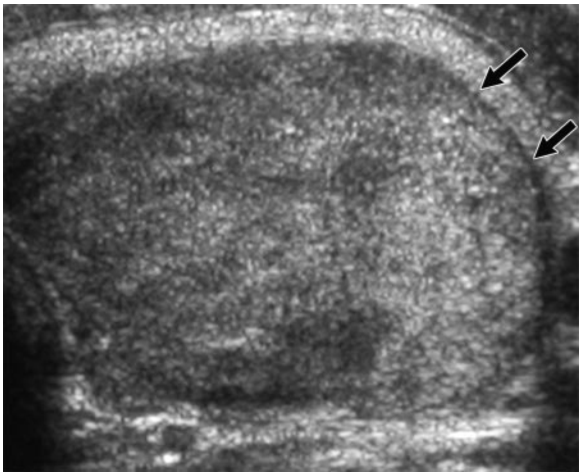

Figure 9. Follicular adenoma in a 30-year-old woman. Transverse sonogram of the left lobe of the thyroid shows a follicular adenoma with a hypoechoic halo (arrows).

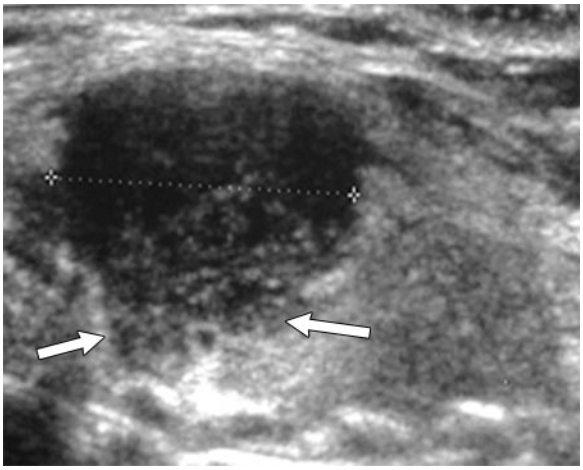

Figure 10. Papillary carcinoma in an 87-year-old man. Transverse sonogram of the thyroid isthmus shows a poorly defined tumor with marked hypoechogenicity and irregular margins (arrows) and without a hypoechoic halo.

Lymph node metastasis is a US feature that may be prognostic of thyroid carcinoma recurrence. Ito et al (27,28) showed a higher rate of local recurrence with metastases to lateral compartment lymph nodes than with only central compartment metastases identified at preoperative US in patients with microcarcinomas (6.0% vs 1.1%). The lateral compartment includes the internal jugular, spinal accessory (posterior triangle), and transverse cervical (supraclavicular) lymph node groups (nodal levels 2–5). The central compartment lies between the right and left carotid arteries and comprises the delphian or pretracheal nodes, the paratracheal nodes (lying alongside the recurrent laryngeal nerve), and the thymic and perithymic nodes located in the fatty tissue in the lower anterior part of the neck.

Margins, Contour, and Shape

The halo or hypoechoic rim around a thyroid nodule is produced by a pseudocapsule of fibrous connective tissue, a compressed thyroid parenchyma, and chronic inflammatory infiltrates (29) (Fig 9). A completely uniform halo around a nodule is highly suggestive of benignity, with a specificity of 95% (30). However, a halo is absent at US in more than half of all benign thyroid nodules (29,31). Moreover, 10%–24% of papillary thyroid carcinomas have either a complete or an incomplete halo (18,30–32).

Teaching Point

A thyroid nodule is considered ill defined when more than 50% of its border is not clearly demarcated. Furthermore, nodules can be classified according to their contours as smooth and rounded or irregular with jagged edges. An ill-defined and irregular margin in a thyroid tumor suggests malignant infiltration of adjacent thyroid parenchyma with no pseudocapsule formation (Fig 10). The reported sensitivity of ill-defined margins and irregular margins, however, ranges widely (53%–89% and 7%–97%, respectively) (17,18,30). Some papillary thyroid carcinomas may have a misleadingly well-demarcated margin at US and may be found to be encapsulated at histologic review (18). The US appearance of minimally invasive follicular carcinoma may have some features in common with that of follicular adenoma (12). The specificity of ill-defined margins is variable, with 15%–59% of benign nodules having poorly defined margins with macro- or microlobulations (2,33). Therefore, unless frank invasion beyond the capsule is demonstrated, the US appearance of the nodule margins alone is an unreliable basis for determining malignancy or benignity.

The shape of a thyroid nodule is a potentially useful US feature that has not been extensively described in the literature. Kim et al (16) found that a solid thyroid nodule that is taller than it is wide (ie, greater in its anteroposterior dimension than its transverse dimension) has a 93% specificity for malignancy. This appearance is thought to be due to a centrifugal tendency in tumor growth,

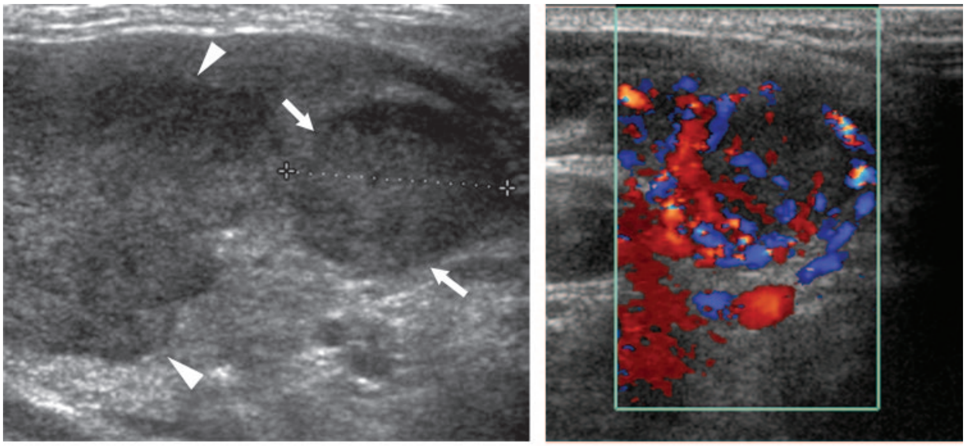

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Figure 11. Renal cell carcinoma metastases to the thyroid in a 69-year-old woman. **(a)** Longitudinal sonogram of the right lobe of the thyroid shows a round hypoechoic nodule (arrows) and an irregular-shaped hypoechoic nodule (arrowheads). **(b)** Color Doppler sonogram of the round nodule shows increased internal vascularity.

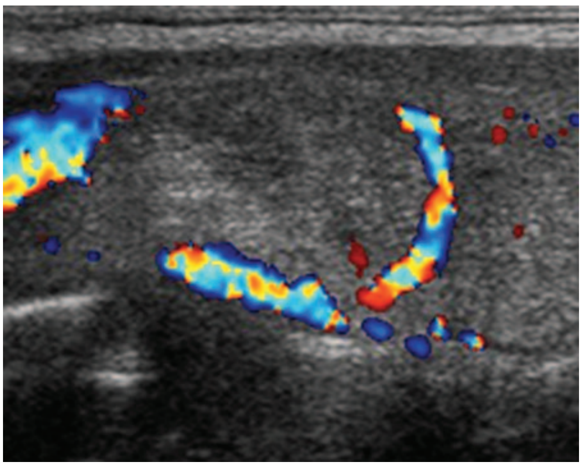


Figure 12. Follicular adenoma in a 36-year-old woman. Longitudinal color Doppler sonogram of the right lobe of the thyroid shows perinodular flow around a follicular adenoma.

which does not necessarily occur at a uniform rate in all dimensions.

Vascularity

Vascular flow within a thyroid nodule can be detected with color or power Doppler US. The most common pattern of vascularity in thyroid malignancy is marked intrinsic hypervascularity, which is defined as flow in the central part of the tumor that is greater than that in the surrounding thyroid parenchyma (Fig 11). This occurs in 69%–74% of all thyroid malignancies (2,18). However, it is not a specific sign of thyroid malignancy. Frates et al (34) showed that more than 50% of hypervascular solid thyroid lesions were benign. Perinodular flow is defined as the presence of vascularity around at least 25% of the circumference of a nodule (Fig 12). This flow pattern is more characteristic of benign thyroid lesions but also has been found in 22% of thyroid malignancies (18). In contrast, complete avascularity is a more useful sign: Chan et al (18) reported that all papillary thyroid carcinomas in their study had some intrinsic blood flow, and they concluded that a completely avascular nodule is very unlikely to be malignant.

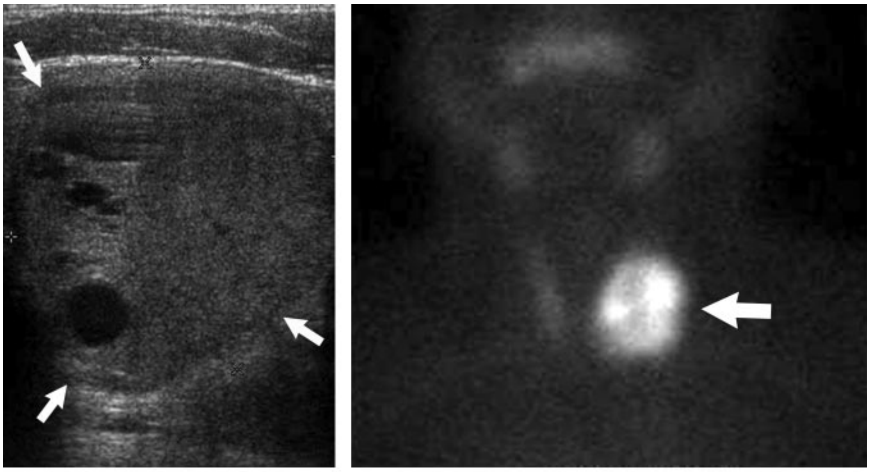
Teaching Point

The US assessment of nodule vascularity may be useful to optimize sampling at FNA in two clinical settings (1,23). First, in a multinodular thyroid, nodules with intrinsic vascularity and other features of malignancy can be targeted for biopsy, in preference to other nodules. Second, echogenic debris or hemorrhage within complex cystic nodules—a finding that otherwise might be mistaken for the solid component of the nodule—can be ignored, and solid areas with intrinsic vascularity can be targeted.

Hypoechoic Solid Nodule

Malignant nodules, both carcinoma and lymphoma, typically appear solid and hypoechoic when compared with normal thyroid parenchyma. The combination of these two US features has a sensitivity of 87% for the detection of thyroid malignancy (2) but has low specificity (15.6%–27%) and a low positive predictive value (1). This appearance is present also in 55% of benign nodules (2). When a thyroid nodule is markedly hypoechoic, with a darker appearance than that of the infrahyoid or strap muscles of the

Figure 13. B cell lymphoma of the thyroid in a 73-year-old woman with Hashimoto thyroiditis. Transverse sonogram of the left lobe of the thyroid shows a large heterogeneous mass (between calipers) with marked hypoechogenicity when compared with the strap muscles *(SM)*. A normal isthmus (arrow) also is visible. *IJV* = internal jugular vein.



a. b.

Figure 14. Large toxic follicular adenoma in a 45-year-old woman. **(a)** Transverse sonogram of the left lobe of the thyroid shows a 4.5-cm nodule (arrows) that was benign despite its size. **(b)** Coronal scintigram obtained with technetium 99m pertechnetate shows a hyperfunctioning adenoma (arrow).

neck, the specificity for detection of malignancy is increased to 94%, but the sensitivity is reduced to 12% (16) (Fig 13). Marked hypoechogenicity is very suggestive of malignancy.

Teaching Point

Nonspecific US Features

Size of Nodule

The size of a nodule is not helpful for predicting or excluding malignancy. There is a common but mistaken practice of selecting the largest nodule in a multinodular thyroid for FNA. The Society of Radiologists in Ultrasound recently recommended that the selection of a nodule for FNA in a multinodular thyroid be based primarily on US characteristics rather than nodule size (1). Papini et al (2) analyzed their experience with FNA of 402 thyroid nodules, each with a maximal diameter of 8–15 mm. Their findings showed that the selection of nodules for biopsy on the sole basis of a size of more than 1 cm would have led to the selection of 325 of the nodules for FNA, with resultant detection of 61% of thyroid cancers. If one or more of the US features of hypoechogenicity, irregular margins, or intrinsic vascularity were used, only 125 of the nodules would have been selected for FNA, but 87% of the cancers would have been detected. Although nodules with a size of more than 4 cm are slightly more likely to be malignant than are smaller nodules, it is well known that benign nodules can reach a large size (Fig 14).

However, in general, smaller malignancies have a more favorable prognosis than do larger lesions. Pellegriti et al (35) reported that there were no deaths in a group of 299 patients with surgically treated papillary thyroid carcinomas smaller than 15 mm within a follow-up period of 3.8 years.

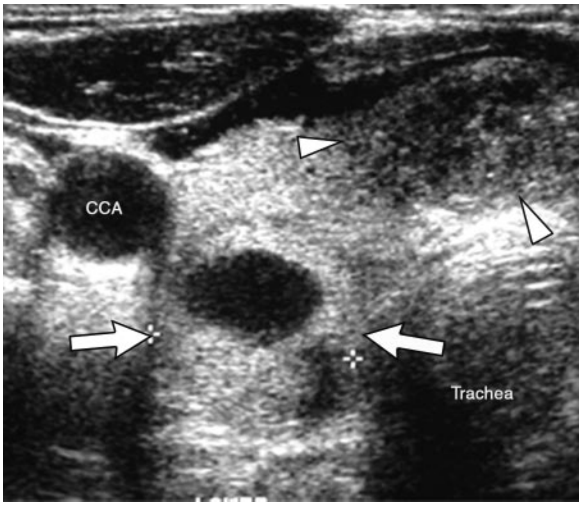


Figure 15. Papillary carcinoma and cystic lymph node metastasis in a 44-year-old woman with a multinodular thyroid. Transverse sonogram of the right lobe of the thyroid shows a hypoechoic carcinoma in the isthmus, with microcalcifications and absence of a halo (arrowheads). The right lobe of the thyroid is displaced anteriorly by a large, partially cystic, level 6 (paratracheal) nodal metastasis (arrows), which appears to be within the thyroid and which was mistaken for a benign thyroid nodule. Because several solid benign nodules were present, the initial diagnosis was benign multinodular thyroid. The cystic nodal metastasis was confirmed at surgery. *CCA* = common carotid artery.

Number of Nodules

Although most patients with nodular hyperplasia have multiple thyroid nodules and some patients with thyroid carcinoma have solitary nodules, the presence of multiple nodules should never be dismissed as a sign of benignity. The risk of malignancy in a thyroid with multiple nodules is comparable to that with a solitary nodule. In a study of 68 consecutive biopsy-proved cases of papillary thyroid carcinoma, 48% of the cancers were found in multinodular thyroids (23). In another series, a malignancy was found in 18 (9.2%) of 195 thyroids with a solitary nodule and in 13 (6.3%) of 207 multinodular thyroids (2). Follicular thyroid carcinoma frequently is found in a multinodular thyroid, and papillary thyroid carcinoma is multifocal in 20% of cases (12).

In a patient with multiple thyroid nodules, one or more nodules may be selected for biopsy. The nodule or nodules are selected for FNA on the basis of the clinical assessment, the presence of suspicious US features, and the patient's risk factors. FNA is not likely to be necessary in a diffusely enlarged gland with multiple nodules of similar and benign US appearance and without intervening normal parenchyma (1). Indications for thyroidectomy in patients with a multinodular thyroid include hyperthyroidism, local compression symptoms, cosmesis, and concern about malignancy (36). If there is a history of significant radiation exposure, total thyroidectomy should be considered despite a benign result at FNA biopsy, as there is a high incidence of malignancy in patients with such a history (37–39). There is no indication for surgery in an uncomplicated multinodular thyroid.

Interval Growth of a Nodule

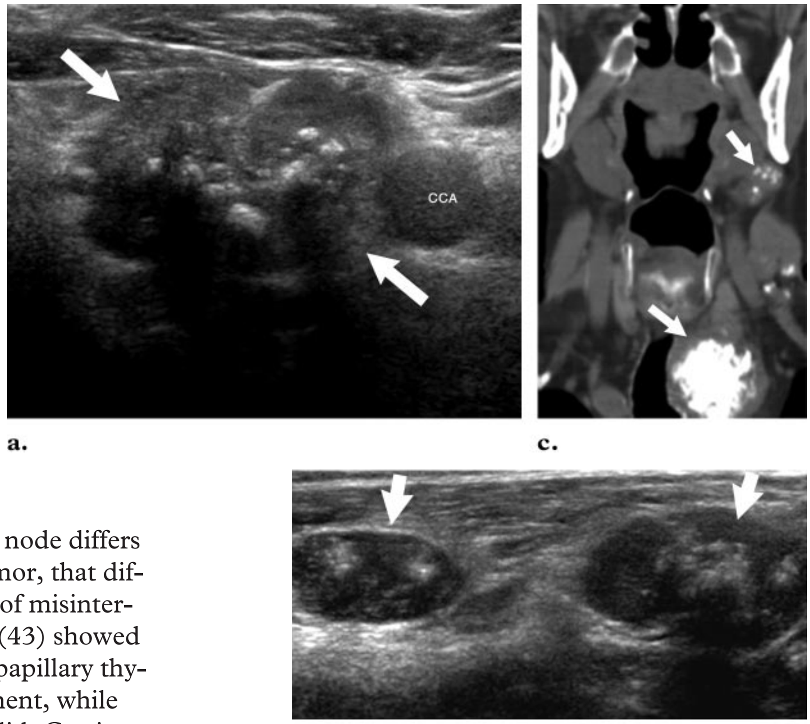
In general, interval growth of a thyroid nodule is a poor indicator of malignancy. Benign thyroid nodules may change in size and appearance over time, with the potential to either enlarge or decrease in size (40,41). Approximately 90% of nodules undergo a 15% or greater increase in volume over 5 years; nodules that are predominantly cystic are less likely to enlarge than are solid nodules (42). Given this expectation of growth, it is difficult to determine which benign-appearing nodules and previously biopsied nodules may require FNA. The exception is clinically detectable rapid interval growth, which most commonly occurs in anaplastic thyroid carcinoma but also may occur in lymphoma, sarcoma, and, occasionally, high-grade carcinoma. Anaplastic thyroid carcinoma often is manifested as a painful, enlarging neck mass with features of local invasion.

Pitfalls in the Diagnosis of Malignancy

Cystic or Calcified Lymph Node Metastases

Abnormal lymph nodes adjacent to the thyroid gland may be mistaken for benign nodules in a multinodular thyroid, especially if the nodes are cystic (Fig 15) or calcified (Fig 16). When the US

Figure 16. Medullary thyroid carcinoma and calcified nodal metastases in a 57-year-old man. **(a)** Transverse sonogram shows a lymph node metastasis with coarse calcifications (arrows) immediately inferior to the left lobe of the thyroid. The metastasis was mistaken for a benign calcified hyperplastic thyroid nodule. Several truly benign thyroid nodules also were found at US, and these findings led to an incorrect diagnosis of multinodular thyroid. *CCA* = common carotid artery. **(b)** Sagittal sonogram obtained at follow-up US shows two other calcified lymph node metastases (arrows) on the left side, at level 2. **(c)** Coronal unenhanced CT image shows the calcified nodal metastases in both locations (arrows).



a. c. b.

appearance of the metastatic lymph node differs from that of the primary thyroid tumor, that difference may increase the likelihood of misinterpretation (Figs 7, 15). Kessler et al (43) showed that 70% of metastatic nodes from papillary thyroid carcinoma had a cystic component, while most of the primary tumors were solid. Cystic metastatic nodes are more common in younger patients. Helpful US features suggestive of an extrathyroidal location of a lymph node mass are an incomplete rim of thyroid parenchyma around the mass, and lack of movement of the mass with the thyroid gland during swallowing. Cystic lymph node metastases may be differentiated from benign cystic thyroid nodules by carefully assessing sonograms for the presence of a thickened outer wall, internal echoes, internal nodularity, and septation.

Cystic Variant of Papillary Carcinoma

A cystic component occurs in 13%–26% of all thyroid malignancies (18,31), but a predominant cystic appearance is uncommon. Chan et al (18) showed that three of 50 papillary thyroid carcinomas had this predominant cystic appearance, which may be mistaken for cystic change in a hyperplastic nodule. However, a careful US assessment will demonstrate solid components with vascularity (18), solid excrescences protruding into the cyst, or microcalcifications (44), which will help differentiate a papillary carcinoma from a benign cystic hyperplastic nodule (Figs 17, 18).

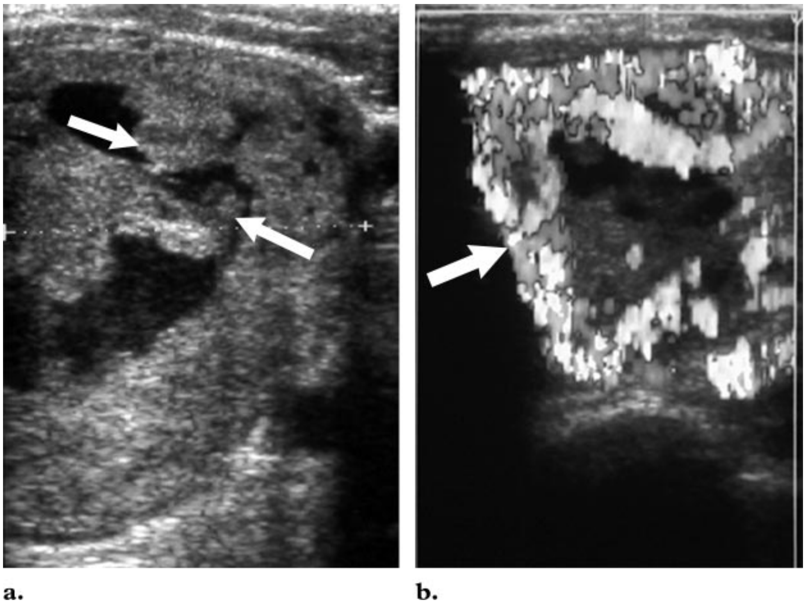


Figure 17. Hürthle cell (follicular) carcinoma in a 60-year-old woman. **(a)** Transverse sonogram of the left lobe of the thyroid shows a partially cystic tumor with solid internal projections (arrows) and thick walls. **(b)** Color Doppler sonogram (shown in black and white) depicts increased vascularity in the solid parts of the tumor (arrow).

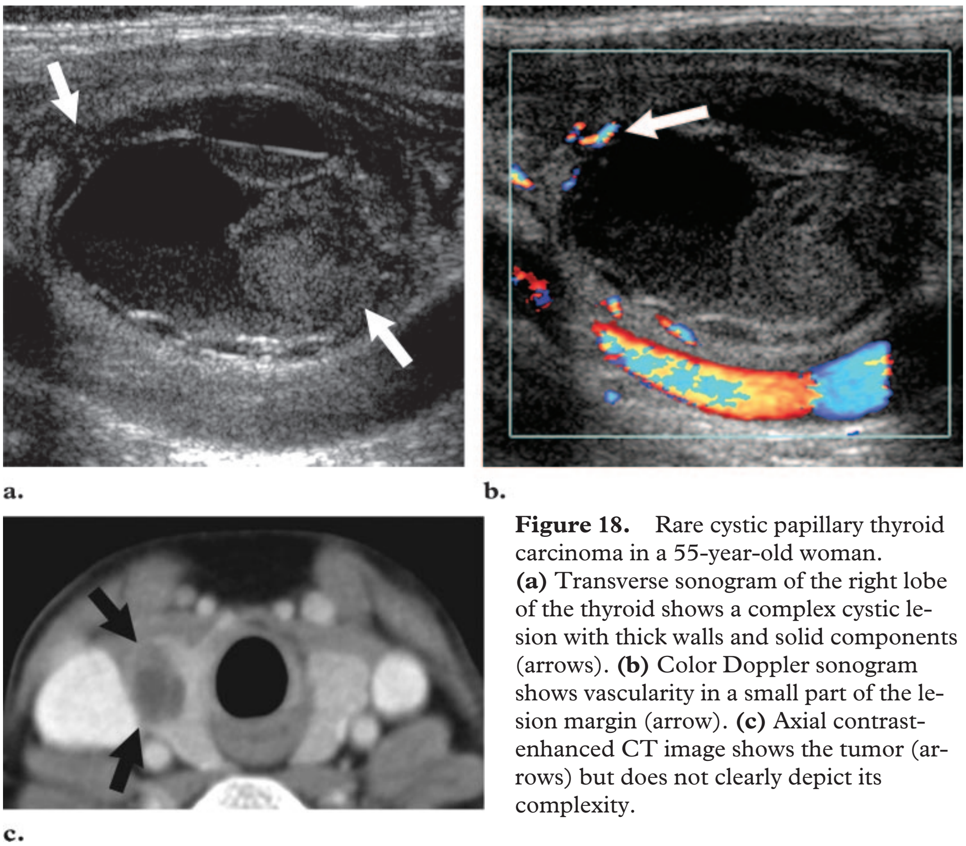
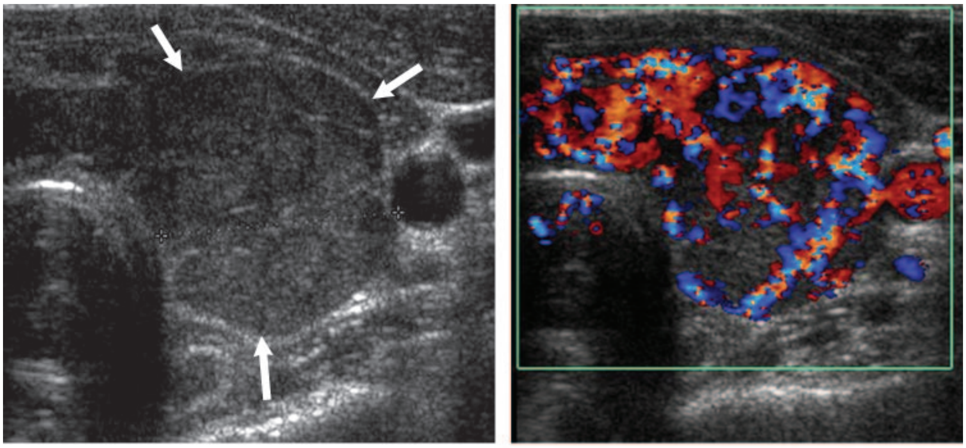


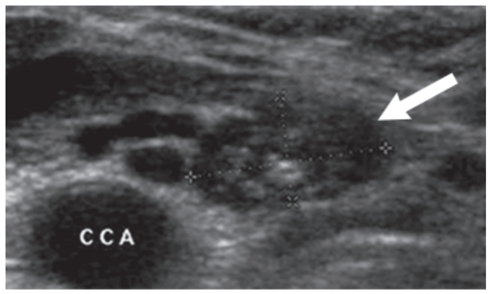
Figure 18. Rare cystic papillary thyroid carcinoma in a 55-year-old woman. **(a)** Transverse sonogram of the right lobe of the thyroid shows a complex cystic lesion with thick walls and solid components (arrows). **(b)** Color Doppler sonogram shows vascularity in a small part of the lesion margin (arrow). **(c)** Axial contrast-enhanced CT image shows the tumor (arrows) but does not clearly depict its complexity.

RadioGraphics

Figure 19. Diffuse follicular variant of papillary thyroid carcinoma in a 37-year-old woman with thyrotoxicosis mistaken for Graves disease. **(a)** Transverse sonogram of the left lobe of the thyroid shows a heterogeneously hypoechoic enlarged thyroid (arrows) with no residual normal thyroid tissue. **(b)** Color Doppler image shows diffuse increased parenchymal vascularity. **(c)** Transverse sonogram of the right neck shows a lymph node metastasis inferior to the right lobe of the thyroid (arrow) with coarse calcification. This finding aroused suspicion about the possible presence of a primary thyroid carcinoma. Histopathologic analysis of the surgical specimen showed replacement of the thyroid gland by a diffuse follicular variant of papillary thyroid carcinoma. *CCA* = common carotid artery.



a. b.



c.

Diffusely Infiltrative Hypervascular Tumor

US characteristics of autoimmune diseases such as Graves disease or chronic lymphocytic (Hashimoto) thyroiditis include enlargement of the thyroid with reduced echogenicity, heterogeneity, and hypervascularity, particularly in Graves disease (14). Diffusely infiltrative papillary or follicular thyroid carcinoma may have all these features and therefore may be mistaken for autoimmune thyroid disease (Fig 19). Patients may even present with misleading thyrotoxicosis. Coexisting autoimmune thyroid disease and thyroid cancer also may present a trap at image interpretation. The frequency of such occurrences may indicate that autoimmune thyroid disease is a risk factor for thyroid malignancy (13,45–48). US features that are suggestive of malignancy include irregular or nodular enlargement of the thyroid gland, sparing from the infiltrative process in parts of the gland, and nodal metastases.

Biopsy of Incidental Thyroid Nodules

Palpable thyroid nodules should be investigated with FNA on the basis of thyroid function test results, clinical presentation, US features, and risk factors. The management of asymptomatic thyroid nodules detected at US is controversial. There is a dilemma between the needs to avoid burdening health care providers with overinvestigation of benign nodules and, at the same time, to avoid adversely affecting the survival of patients with carcinoma by delaying the diagnosis. The work-up of incidental thyroid nodules must be considered against the high prevalence of benign thyroid nodules, the low incidence of thyroid carcinoma, and the low rate of mortality from small thyroid carcinomas. Consensus guidelines set by the Society of Radiologists in Ultrasound (1) are based on the size of the nodule and suspicious US characteristics. FNA is recommended for the following: microcalcifications in a nodule with a diameter of 1 cm or greater; coarse calcification or a solid nodule with a size of 1.5 cm or greater; and a mixed cystic and solid nodule with a size of 2 cm or greater. These size limitations for each category are based on consideration of the excessive number of biopsies of small nodules and the likelihood that treatment of microcarcinomas (<1 cm) does not improve life expectancy (35). The presence of abnormal lymph nodes suggestive of metastatic disease overrides these recommendations.

Conclusions

US is valuable for identifying many malignant or potentially malignant thyroid nodules. Although there is some overlap between the US appearance of benign nodules and that of malignant nodules, certain US features are helpful in differentiating between the two. These features include microcalcifications, local invasion, lymph node metastases, a nodule that is taller than it is wide, and markedly reduced echogenicity. Other features, such as the absence of a halo, ill-defined irregular margins, solid composition, and vascularity, are less specific but may be useful ancillary signs. Apart from local extrathyroidal invasion, none of these features is individually pathognomonic of malignancy. However, in combination, these features may lead to a diagnosis of malignancy and may direct attention to other suspicious nodules in need of further investigation. Potential diagnostic pitfalls include routinely dismissing small nodules, assuming that multiple nodules are most likely benign, mistaking carcinomas for cystic hyperplastic nodules and Graves disease, and mistaking adjacent nodal metastases for benign thyroid nodules.

Acknowledgments: The authors acknowledge Luke F. Chen, MBBS, FRACP, Oliver F. Hennessy, FRCR, FRANZCR, and Christopher T. Holden, MBBS, FRANZCR, for their assistance with preparation of the education exhibit and manuscript.

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US Features of Thyroid Malignancy: Pearls and Pitfalls

Jenny K. Hoang, MD et al

RadioGraphics 2007; 27:847–865 • **Published online** 10.1148/rg.273065038 • **Content Codes:** HN OI US

Page 848
Thyroid microcalcifications are psammoma bodies, which are 10–100-μm round laminar crystalline calcific deposits. They are one of the most specific features of thyroid malignancy, with a specificity of 85.8%–95% and a positive predictive value of 41.8%–94.2%.

Page 851
US features that should arouse suspicion about lymph node metastases include a rounded bulging shape, increased size, replaced fatty hilum, irregular margins, heterogeneous echotexture, calcifications, cystic areas, and vascularity throughout the lymph node instead of normal central hilar vessels at Doppler imaging.

Page 852
A completely uniform halo around a nodule is highly suggestive of benignity, with a specificity of 95%.

Page 853
Chan et al (18) reported that all papillary thyroid carcinomas in their study had some intrinsic blood flow, and they concluded that a completely avascular nodule is very unlikely to be malignant.

Page 854
Marked hypoechogenicity is very suggestive of malignancy.

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