Role of Ultrasonography in Thyroid Disease

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Thyroid nodules are very common; autopsy studies show that nearly half the population of the United States harbors thyroid nodules. However, only 4% to 8% of these nodules are palpable and detected clinically. Many more are discovered incidentally on a computed tomographic scan, magnetic resonance imaging, or ultrasound of the neck performed for an indication unrelated to thyroid disease. In recent years, there has been an explosion of investigation generated by the discovery of these incidental thyroid nodules. Despite the high prevalence of thyroid nodules in the general population, only 5% to 10% of nodules are malignant. The overwhelming majority of thyroid nodules are not true neoplasms but rather represent nodular hyperplasia (also called adenomatoid or colloid nodule). Thyroid cancer is uncommon: in 2008, there were 37,340 new cases diagnosed and 1590 patients died from the disease. Well-differentiated papillary thyroid carcinomas (PTCs) account for 75% to 90% of all thyroid cancers. It is clear from these statistics that one of the important challenges for imagers and clinicians is to identify potentially cancerous lesions and reassure the vast majority of patients harboring benign nodules.

Ultrasonography (US) is the single-most valuable imaging modality in the evaluation of the thyroid gland. Indications for thyroid US include evaluation for a palpable thyroid nodule or suspected thyroid enlargement and workup of thyroid nodules discovered incidentally. It should not be used as a screening test for the detection of nodules. In addition to nodule detection and characterization, US provides optimal guidance for fine-needle aspiration biopsy (FNAB), which, despite some limitations, remains the gold standard for the characterization of thyroid nodules.

This review discusses the US appearances of thyroid nodules, emphasizing sono- graphic features associated with potentially malignant or, at the other end of the spectrum, likely benign nodules. Diffuse thyroid abnormalities have also been reviewed. The technique of ultrasound-guided FNAB and the emerging role of elastography in characterizing thyroid nodules have also been addressed.
TECHNIQUE AND NORMAL APPEARANCE

The thyroid gland is imaged using high-frequency linear transducers, 8 to 15 MHz, depending on the thickness of the patient’s neck. Gray-scale transverse and sagittal images are recorded for each lobe. Occasionally, in large patients, additional scanning with a 6-MHz linear transducer may prove beneficial. If the thyroid gland is enlarged, a curvilinear transducer may be used for better measurements.

The normal thyroid has a homogeneous, medium gray echotexture (Fig. 1). Anatomic landmarks are best defined on transverse sections: the thyroid gland is found between the common carotid artery laterally and the trachea medially.

Measurements of any detected thyroid nodule should be performed in sagittal, transverse, and anteroposterior dimensions with electronic calipers placed outside any visible halo.

US EVALUATION OF THYROID NODULES

Once a thyroid nodule is discovered, the single-most important next step is to decide whether an FNAB should be recommended. Although this procedure is relatively noninvasive, it is desirable to limit its use for nodules that are suspicious or indeterminate to minimize unnecessary costs and anxiety to the patient. In addition, there is a documented 5% false-negative rate for FNAB.5

US CHARACTERISTICS OF THYROID NODULES: A SYSTEMATIC ANALYSIS

To encourage a rationale approach to the management of thyroid nodules detected on US, several medical societies, including the American Thyroid Association (ATA), the Society of Radiologists in Ultrasound (SRU), and the American Association of Clinical Endocrinologists (AACE), have recently published a series of guidelines.4,6,7 The US features of thyroid nodules that should be analyzed are summarized in the Consensus Statement on thyroid nodules from the SRU7 and the AACE.4 They include nodule size and content (solid, complex, or cystic). For solid thyroid nodules, the following parameters should be evaluated: nodule echotexture, shape, borders (smooth or nodular), the presence and quality of intranodular calcifications, and the presence of a perinodular halo. Table 1 compares the sensitivity, specificity, positive predictive values, and negative predictive values of each of these sonographic criteria from 6 large studies, including a large retrospective study of 849 thyroid nodules recently conducted by the

Fig. 1. Normal thyroid gland. (A) Sagittal US right thyroid lobe shows a homogeneous gland with medium gray echogenicity. (B) Transverse US shows both thyroid lobes. Note the hypoechoic strap muscle anteriorly (arrows). C, common carotid artery; T, trachea.
<table>
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<tr>
<th>Study</th>
<th>Number of Nodules</th>
<th>Clinical Hypoechogenicity (%)</th>
<th>Shape Spherical/Taller Than Wide (%)</th>
<th>Spiculated Margins (%)</th>
<th>Microcalcifications (%)</th>
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<td>Sensitivity</td>
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<td>Takashima et al&lt;sup&gt;a&lt;/sup&gt;</td>
<td>259</td>
<td>P &amp; NonP</td>
<td>83</td>
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<td>Kim et al&lt;sup&gt;10,a&lt;/sup&gt;</td>
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<td>NonP</td>
<td>26.5</td>
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<td>NonP</td>
<td>87.1</td>
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<td>317</td>
<td>NonP</td>
<td>68.2</td>
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<td>P &amp; NonP</td>
<td>87.2</td>
<td>58.5</td>
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Abbreviations: NonP, nonpalpable; NPV, negative predictive value; P, palpable; PPV, positive predictive value.

<sup>a</sup> Marked hypoechogenicity.

<sup>b</sup> Clustered blurred and spiculated margins together.
Korean Society of Neuro and Head and Neck Radiology Thyroid study group. Many of the statistics listed below stem from these articles and are summarized in Table 1.9–13

**Nodule Content: Cystic Versus Solid Nodules**

Before the availability of high-resolution high-frequency transducers, the role of US was limited to distinguishing between cystic and solid nodules. Purely cystic nodules are anechoic. They are almost invariably benign and represent colloid cysts. Some colloid cysts contain echogenic foci with posterior reverberation or comet tail artifact (Fig. 2). A subset of cystic nodules shows a lacelike or honeycomb pattern of multiple small cysts separated by thin septations (Fig. 3). This pattern is strongly associated with a benign hyperplastic nodule11,14,15 and has been dubbed the “leave me alone” lesion.15 Consequently, purely cystic nodules, with or without comet tails, and cystic nodules with a honeycomb appearance do not need FNAB.14

However, many cystic thyroid nodules have a solid-appearing component. Although these complex nodules are often referred for biopsy for concern that they represent a cystic papillary cancer, their most common underlying cause is a degenerated colloid nodule (Fig. 4). Because these nodules contain avascular debris and fibrosis, they tend to yield scant or no follicular cells and are associated with a higher number of inconclusive FNAB.14,16

Careful analysis of any solid area within cystic nodules is imperative to identify the rare papillary thyroid cancer (approximately 2.5%) with a large cystic component. Hatabu and colleagues17 described the “calcified nodule within a cyst,” a sign of papillary excrescences with microcalcifications protruding into the cyst, as specific for papillary thyroid cancer (Fig. 5). Such an area should be specifically targeted during fine-needle aspiration.

**Echotexture**

The echotexture (or shade of gray) of solid nodules is another important criterion taken into consideration when analyzing nodules. The echotexture of the nodule is compared with that of the surrounding thyroid parenchyma and the strap muscle (Fig. 6). Nodules are described as isoechoic (same shade of gray as the thyroid), hypoechoic (darker than the thyroid) or markedely hypoechoic (darker than the strap muscle). Hypoechoic and very hypoechoic nodules are classified as suspicious and

**Fig. 2.** Colloid cyst with comet tail artifact in a 33-year-old woman. Sagittal US of the right thyroid lobe demonstrates a 7-mm cystic nodule (between calibers) with 2 echogenic foci with comet tail artifact (arrowhead). This is a benign lesion. Note the second purely cystic nodule (arrow).
referred for FNAB. Kim and colleagues found that 26.5% of malignant nodules were markedly hypoechoic (see Fig. 6) compared with only 5.6% of benign nodules. The underlying histology for these nodules is usually PTC, and it is postulated that the dense cellularity of PTC produces very few interfaces to the sound beam and hence the hypoechoic appearance. Follicular neoplasms, whether benign adenomas or follicular carcinomas, contain colloid, have a microfollicular structure, and usually display an echogenic or mixed echotexture. Pathologically, they are typically encapsulated and tend to be sharply demarcated from the surrounding thyroid parenchyma on US.

Shape

Moon and colleagues reported that an elongated shape as compared with a wide shape, defined as an anteroposterior to transverse ratio of 1 or greater, is highly specific (91.4%) for malignancy. These results confirmed the reports published earlier. In another series, nodules with a spherical shape (ratio of long to short axis <1.5) were found to be associated with an 18% risk of cancer. By contrast, a ratio of long to short axis greater than 2.5 was found to have a 100% negative

Fig. 3. Cystic nodule with a honeycomb pattern in a 54-year-old woman with hyperparathyroidism. Transverse US of the right thyroid lobe shows a 9-mm nodule (between calibers) with multiple small cysts separated by thin echogenic septa, a classic honeycomb pattern associated with benign hyperplastic nodules.

Fig. 4. Adenomatoid nodule presenting as a complex cystic nodule in a 49-year-old woman. (A) Transverse US of the right thyroid lobe demonstrates a 3.5-cm complex cystic nodule (between calibers). The nodule is predominantly cystic with septations and a solid appearing component (arrow). Note echogenic foci with comet tail artifact (arrowhead). (B) Transverse US of the right thyroid lobe with color Doppler shows vascularity within the solid component. The diagnosis of adenomatoid nodule was confirmed with US-guided FNAB.
predictive value for malignancy. It is speculated that cancers tend to grow across tissue planes and assume a spherical shape to maximize their oxygen supply, whereas benign lesions respect normal thyroid parenchyma.

**Borders**

Predictably, a spiculated or nodular border is associated with a higher probability of malignancy (see Fig. 6). Classically, PTC invades the surrounding thyroid tissue and is poorly encapsulated. In the series published by Moon and colleagues, 11 48.3% of thyroid cancers had spiculated margins and 32.5% had smooth borders, whereas 75.9% of benign nodules had smooth margins and only 8.2% were spiculated. These results confirm findings from previous studies. 10 Demonstration of a refractive shadow from the edge of a solid nodule is another suspicious finding that warrants fine-needle aspiration. 14

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**Fig. 5.** Cystic PTC in a 51-year-old woman who presented with right neck swelling. (A) Sagittal US of the right thyroid lobe shows a 2-cm complex cystic nodule (between calibers). There is a large solid component (arrow) with tiny echogenic foci suspicious for microcalcifications (arrowhead). The solid component was specifically targeted during the FNAB procedure. (B) Transverse US of the right thyroid lobe with color Doppler shows some vascularity (arrowheads) within the solid component. The diagnosis of PTC was confirmed with US-guided FNAB and surgery.

**Fig. 6.** Right PTC and left adenomatoid nodule in a 37-year-old woman. (A) Sagittal US of the right thyroid lobe shows a 1.6-cm markedly hypoechoic nodule (between calibers). Note that the nodule is more hypoechoic than the strap muscle (arrows) and that its borders are spiculated. The diagnosis of PTC was confirmed by FNAB. (B) Transverse US of the left thyroid lobe shows a 1-cm nodule that is nearly isoechoic to the thyroid gland (between calibers). The diagnosis of adenomatoid nodule was confirmed by fine-needle aspiration.
Perinodular Halo

Some thyroid nodules are surrounded by a distinct hypoechoic halo. Although it was initially speculated that this hypoechoic rim represents thyroid parenchyma compressed by a slow-growing and therefore presumably benign process, correlation with histology has shown that follicular adenomas and carcinomas are well encapsulated and may display a well-defined thick hypoechoic rim. In fact, adenomatous (colloid) nodules can be incompletely encapsulated or poorly demarcated from the rest of the thyroid parenchyma. Therefore, the presence of a halo is not a particularly useful sonographic criterion to suggest a benign process.

Calcifications

Calcifications are detected in almost one-third of thyroid nodules. Microcalcifications are defined as punctuate echogenic foci measuring less than 2 mm. Because of their small size, they do not produce acoustic shadowing. Microcalcifications are thought...
to represent the psammoma bodies or calcified laminated nidus that are frequently found in PTC. The presence of microcalcifications in a solid nodule has a high specificity of 91.3% to 96.3% and a positive predictive value of 74.8% for malignancy; unfortunately, the sensitivity is only 29% to 51.4% (Figs. 7 and 8).\textsuperscript{11,13}

Coarse larger calcifications are caused by areas of degeneration and necrosis within thyroid nodules. On US, these calcifications appear as echogenic foci associated with distal acoustic shadowing. These larger calcifications are found in both benign and malignant nodules, particularly in long-standing goiter and in medullary thyroid cancer (MTC). Thus the presence of coarse calcifications within a hypoechoic solid nodule warrants FNAB.\textsuperscript{14}

**Vascularity**

Color or power Doppler US provides useful additional information in the characterization of solid nodules by depicting nodular vascularity. It is postulated that malignant nodules are more likely to have disorganized internal vascularity and generally thyroid cancers tend to be hypervascular compared with the adjacent thyroid parenchyma (Fig. 9). Papini and colleagues\textsuperscript{13} defined an intranodular vascular pattern on color Doppler US as most suspicious, with sensitivity of 74.2% and specificity of 80.8%. Benign nodules tend to be avascular or demonstrate only perinodular vascularity. It has also been postulated that power Doppler may be useful because it measures the amplitude of the Doppler signal rather than the mean velocity and is thus more sensitive to slow flow that may be present in small vessels.\textsuperscript{21} However, Frates and colleagues\textsuperscript{22} found that 14% of malignant nodules were iso- or hypovascular to the rest of the gland (see Fig. 7). We have observed that benign nodules may harbor internal vascularity and thus believe that the gray-scale appearance of nodules is more helpful than their internal vascularity in predicting malignancy.

**ULTRASOUND DIAGNOSIS OF THYROID NODULES: SUMMARY, CONTROVERSIES, AND CHALLENGES**

In spite of the invaluable contribution of thyroid US in the assessment of thyroid nodules, there are many challenges, pitfalls, and controversies that need to be considered.

**Multiple Suspicious Sonographic Findings**

As shown in Table 1, individual sonographic signs are only moderately sensitive and specific for predicting malignancy in solid thyroid nodules, as there can be significant

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![Fig. 9. Vascular MTC in a 36-year-old man with a family history of medullary cancer. (A) Sagittal US of the right thyroid lobe shows a hypoechoic nodule (arrow) with a coarse central calcification (arrowhead). (B) Sagittal US of the right thyroid lobe with color Doppler shows a hypervascular hypoechoic nodule (arrow). The diagnosis of MTC was confirmed by FNAB of an adjacent node.](image-url)
overlap with benign processes because almost 70% of histologically proved benign nodules may exhibit 1 suspicious sonographic sign. However, malignant nodules tend to harbor multiple suspicious findings, for example, a mean of 2.6 abnormalities in the study by Kim and colleagues and the additional presence of microcalcifications in a solid hypoechoic nodule that increased the odds ratio of this nodule being malignant from 6.5 to 13.1 in the series published by Nam-Goong and colleagues.

**Does Number Matter?**

Even in patients referred for a palpable lesion, US can detect additional nodules in 45% of cases. However, the prevalence of thyroid cancer is similar in patients with solitary nodules or multinodular thyroid: in a large population of 1985 patients with single or multiple nodules greater than 1 cm, the prevalence of thyroid cancer was 14.8% in the solitary nodule group and 14.9% in the multinodular group.

**Too Small to Biopsy?**

There is no correlation between the size of a thyroid nodule and the risk of underlying cancer. The prevalence of thyroid cancer is similar in palpable and nonpalpable nodules, including incidentally discovered nodules measuring 10 mm or less. However, it is unclear whether diagnosis of micro-PTC affects life expectancy or whether microcarcinomas as defined by a size smaller than 1 cm is less aggressive. In a series published by Nam-Goong and colleagues, 69% of patients with incidental PTC had extrathyroidal extension of the tumor or nodal metastases (see Fig. 7). Both the ATA and the SRU recommend further workup of nodules greater than 1 cm and careful analysis of the US characteristics listed earlier before formulating a decision to perform FNAB. The AACE/Associazione Medici Endocrinologi (AME) guidelines argue against an arbitrary cut off number to avoid missing very small but potentially aggressive tumors. Ultimately, the decision should be individualized, taking into consideration the age of the patient and the presence of comorbidity and risk factors for thyroid cancer, such as a positive family history, multiple endocrine neoplasia type 2 syndrome, or previous head and neck irradiation.

**The Special Case of Follicular Neoplasms**

The suspicious sonographic appearances described earlier are usually associated with PTC, which represent approximately 70% of all thyroid malignancies. However, follicular neoplasms, which are less common, often do not exhibit classic malignant sonographic features. When comparing PTC with follicular carcinomas, Jeh and colleagues found that 65.2% of follicular cancers were isoechic to the thyroid parenchyma, 72.7% were oval, and 86.6% had a thin or thick hypoechoic rim. None of the cancers had microcalcifications. Benign follicular adenomas demonstrate similar sonographic findings on gray-scale US. Because a solid, homogeneous oval nodule with a hypoechoic capsule may represent a follicular neoplasm, such a lesion should be referred for fine-needle aspiration (Fig. 10). Although some have suggested that follicular carcinomas may exhibit more internal vascularity as compared with follicular adenomas, there is considerable overlap and it is not possible to differentiate the two radiographically or based on cytologic specimen (see Fig. 10). Hürtthle cell neoplasms are considered to be a variant of follicular cell neoplasms by some investigators, although more recent molecular analyses suggest that they are likely a distinct group of tumors. Their sonographic appearance is similar to that of follicular neoplasms. The follicular variant of PTC, which represents 9% to 22% of PTC, may have a sonographic appearance similar to follicular neoplasms (Fig. 11).
Medullary Thyroid Cancer

MTC arises from the calcitonin-secreting C cells and account for approximately 5% of thyroid malignancies. There is a familial form of medullary cancer, and it also affects patients with multiple endocrine neoplasia type II. On US, the appearance of MTC is difficult to differentiate from PTC; most present as a hypoechoic nodule. When calcifications are present, they tend to be coarse and centrally located and may be related to underlying fibrosis and amyloid deposits (see Fig. 9). However, MTC can mimic

Fig. 10. Follicular neoplasm in a 38-year-old woman. (A) Sagittal US of the left thyroid lobe shows an isoechoic solid nodule with well-defined borders and a hypoechoic rim (arrows). This appearance is suggestive of a follicular neoplasm and should prompt recommendation for FNAB. (B) Transverse US of the left thyroid lobe confirms the findings. (C) Sagittal US of the left thyroid lobe with color Doppler shows increased vascularity in the nodule. Fine-needle aspiration yielded the diagnosis of “suspicious for a follicular neoplasm.” Final pathology after surgical removal was follicular adenoma.

ULTRASOUND APPEARANCE OF RARE THYROID MALIGNANCES

Medullary Thyroid Cancer

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Fig. 11. Follicular variant of PTC in a 47-year-old woman with a history of hyperparathyroidism. (A) Transverse US of the right thyroid lobe shows a well-defined oval nodule (arrow). The nodule is hypoechoic to the thyroid gland but less hypoechoic than the strap muscle (arrowhead). (B) Sagittal US of the right thyroid lobe shows that the nodule has a hypoechoic halo (arrows). The diagnosis of papillary thyroid cancer, follicular variant was made after surgical removal.
the far more common PTC with internal microcalcifications or appear as a solid non-calcified mass.

**Anaplastic Thyroid Cancer**

Anaplastic thyroid cancer accounts for 2% of all thyroid cancers, usually affects elderly patients, and is the most aggressive and lethal form of thyroid cancer, with a 5-year mortality of more than 95%. It often presents as a large hypoechoic mass, and invasion of adjacent muscles or the trachea is not uncommon.

**Lymphoma and Metastases**

Non-Hodgkin lymphoma represents approximately 4% of thyroid cancers and is often associated with Hashimoto thyroiditis. Patients typically present with an enlarging neck mass. On US, it appears as a large hypoechoic, often relatively homogeneous and vascular mass (Fig. 12). Metastases to the thyroid gland are uncommon, with melanoma, breast carcinoma, and renal cell carcinoma being the most common primary tumors.

**US EVALUATION OF DIFFUSE THYROID DISEASES**

In the evaluation of diffuse thyroid abnormalities, the role of US is generally limited to differentiating multinodular thyroid from other diffuse processes affecting the gland. However, some of these conditions, particularly Hashimoto thyroiditis can be mistaken for nodular diseases by novice imagers.

**Hashimoto Thyroiditis**

Hashimoto thyroiditis, an autoimmune inflammatory condition, affects 4% of women and is the most common cause of hypothyroidism in the United States. Antibodies to thyroglobulin and to thyroid peroxidase develop and cause gradual thyroid failure. The sonographic appearance of the affected gland reflects the underlying histopathologic changes of diffuse infiltration of the thyroid parenchyma with lymphocytes and fibrosis. The thyroid parenchyma is heterogeneous, peppered with innumerable small hypoechoic nodules measuring a few millimeters and separated by echogenic septae. Depending on the stage and duration of the disease, the thyroid may be normal in size, enlarged, or small and vascularity can also be variable. This characteristic sonographic appearance has a 95% positive predictive value for Hashimoto thyroiditis.

![Fig. 12. B-cell lymphoma in a 67-year-old man presenting with a rapidly enlarging neck mass. Transverse US of the thyroid gland shows that the gland is markedly enlarged with hypoechoic parenchyma. The diagnosis of B-cell lymphoma was made by FNAB.](image-url)
thyroiditis and should not be confused with a multinodular thyroid (Fig. 13). The diagnosis is usually confirmed by measuring the levels of serum antithyroglobulin and anti-thyroid peroxidase antibodies.

However, there are some challenges associated with Hashimoto thyroiditis. Because of the underlying heterogeneity of the thyroid parenchyma, it is more difficult to characterize discrete nodules in these patients. It is, however, imperative to be vigilant and carefully assess any discrete nodules in patients with Hashimoto thyroiditis, particularly women, because of an apparent increased incidence of PTC and lymphoma.

**Graves Disease**

The diagnosis of Graves disease is based on clinical and laboratory abnormalities, and the role of US is limited to the detection of associated nodules. It is important to carefully evaluate any nodule in these patients, as recent studies seem to indicate an increased incidence of thyroid cancer in patients with Graves disease. In a multicenter study of 557 patients with the disease, 3.8% had PTC.

**ULTRASOUND-GUIDED THYROID FINE-NEEDLE ASPIRATION BIOPSY**

FNAB of the thyroid plays a crucial role in the characterization of suspicious or indeterminate thyroid nodules. Traditionally, FNAB of a thyroid nodule was performed by palpation; however, FNAB of thyroid nodules is now increasingly being performed with US guidance. Carmeci and colleagues found that the rate of obtaining a non-diagnostic sample was decreased to 7% when using US guidance as compared with 16% when using the palpation technique. The following advantages justify the current shift toward US guidance.

1. Nodules discovered incidentally on imaging are often nonpalpable and can only be accessed with US.
2. Even in palpable nodules, it may be beneficial to target specific areas; this is particularly important in partially cystic nodules, in which case it is critical to biopsy the solid component to improve diagnostic yield.
3. In large solid nodules, US guidance ensures that different areas of the nodule are sampled.
4. The accuracy of US-guided FNAB reported in the literature varies from 85% to 94%.

![Fig. 13. Hashimoto thyroiditis in a 38-year-old woman with history of hypothyroidism. Sagittal US of the right thyroid lobe demonstrates a heterogeneous echotexture of the right lobe with innumerable hypoechoic nodules separated by echogenic septa.](image)
Technique

Several techniques of US guidance and tissue sampling are used in standard practice. Once the appropriate nodule is identified, some operators use the freehand technique, whereby the US transducer is placed over the nodule and the needle is inserted next to the transducer, whereas others use a fixed needle guide attached to the transducer to introduce the needle (needle guide technique). Once the needle is inserted, the stylet is removed and the needle is moved rapidly within the target. Typically, 7 to 10 incursions are made till a flash of bloody fluid is seen within the needle hub.

In addition to the various techniques used for needle insertion, 2 aspiration techniques can be used. In the capillary method, no suction is applied and the sample is obtained by capillary action. Theoretically, this method minimizes trauma to the tissue and may decrease contamination by blood, especially if the nodule is very vascular. Some operators favor the suction technique, applying 3 to 5 mL of suction via a syringe attached to the FNAB needle. This method may be slightly more cumbersome and allow slightly less control over needle motion but may yield more cells if the nodule is fibrotic. A recent study compared both techniques in 180 samples and found no statistically significant difference in diagnostic accuracy between the 2 methods.36

At our institution, we favor the needle guide technique and capillary sampling method. We use a 25-gauge 9-cm long needle and infiltrate the skin with 1% buffered lidocaine before FNAB to minimize any patient discomfort, anticipating that a minimum of 3 samples will be required from each site. A trained cytopathologist or cytopathology technician is always available on-site to evaluate the adequacy of the sample at the time of biopsy.

NEW HORIZONS: ELASTOGRAPHY AND THE ROLE OF PREOPERATIVE NECK US IN PATIENTS WITH THYROID CANCER

In recent years, 2 additional techniques have emerged in the armamentarium of evaluating thyroid nodules and their utility is currently being debated in the literature.

Role of Preoperative Neck US in Patients with Thyroid Cancer

The value of neck US in the detection of local recurrences and cervical nodal metastases after total thyroidectomy for well-differentiated thyroid cancer is well established. Although PTC is a relatively indolent malignancy, it is associated with a relatively high incidence of local recurrences occurring in 30% of patients after initial thyroidectomy. In an attempt to diminish the risk of cervical metastases, several additions to standard thyroidectomy have been proposed, including central compartment nodal dissection and lateral neck dissection in patients with biopsy-proven cervical node metastases at the time of initial diagnosis. Thus, preoperative neck US has a role in surgical planning, as was documented in 6% of patients in the series by Kouvaraki and colleagues.37 In addition, patients with positive nodes at the time of initial surgery are at higher risk of recurrences in the future.38 Patients with MTC have an even higher incidence of nodal metastases at the time of diagnosis, reported to reach 32% to 80%.39 Based on these data, the ATA has recommended preoperative neck US in patients with MTC in its most recent guidelines.40

The sonographic appearance of suspicious cervical nodes include a lack of the normal echogenic hilum, a round shape, the presence of intranodular microcalcification or cystic areas, and increased vascularity by color Doppler (Fig. 14).41
Elastography

Ultrasound elastography is used to evaluate tissue stiffness noninvasively. As a steady pressure is applied to the thyroid gland, the degree of deformity of the underlying tissue is measured. This technique takes advantage of the fact that malignant nodules tend to be harder than benign nodules and thus deform less compared with the surrounding normal thyroid parenchyma (Fig. 15). Two recent studies have shown a statistically significant higher tissue stiffness index in malignant nodules as compared with normal tissue and benign nodules, with a sensitivity of approximately 88% and specificity of 77.5% to 90%. Applications of this technique may be limited to papillary thyroid cancer, which was the primary tumor evaluated in the prior studies; thus, the findings may not be applicable to other thyroid tumor types. Another limitation to this technique is that it is operator dependent and requires operator expertise. Larger studies are warranted before elastography can be routinely included in the evaluation of thyroid nodules.

Fig. 14. Lateral compartment nodal metastases in a 64-year-old patient with a suspicious thyroid nodule. (A) Transverse US of the left thyroid lobe shows a large hypoechoic mass (arrows). The mass is taller than is wide, has nodular borders, and thus is highly suspicious for malignancy. (B) Transverse US of the left neck, level III shows 3 round heterogeneous nodes without a fatty hilum. FNAB of the thyroid nodule and one of the nodes yielded cells diagnostic for medullary thyroid carcinoma.

Fig. 15. Papillary cancer evaluated with elastography in a 56-year-old woman. Transverse US of the left thyroid lobe shows a hypoechoic nodule. Elastography shows that the nodule displays predominantly a blue shade indicating that it is stiffer than the surrounding normal thyroid. FNAB of the thyroid nodule yielded cells diagnostic for papillary thyroid cancer.
SUMMARY

US remains the optimal imaging modality for the detection and characterization of thyroid nodules. Careful analysis of key sonographic features as described earlier allow for more appropriate selection of indeterminate or suspicious nodules that should be referred for FNAB. US is also being increasingly used to guide FNAB, as it has been shown to improve diagnostic yield and is indispensable when obtaining biopsies of an increasing number of nodules which are subcentimeter in size.

The larger question remains, however, as to whether the exhaustive workup of incidentally detected thyroid nodules leading to the diagnosis and treatment of asymptomatic micropapillary thyroid cancers ultimately affects survival and justifies the costs and associated potential risks. With regards to thyroid incidentaloma, it is unclear if we have moved beyond, in the words of Dr Topliss, “the ignorant in the pursuit of the impalpable.”

REFERENCES


