Sonography of Thyroid Nodules
A "Classic Pattern" Diagnostic Approach

Carl C. Reading, MD,* J. William Charboneau, MD,* Ian D. Hay, MD, PhD,† and Thomas J. Sebo, MD‡

Abstract: This article describes an approach to some of the commonly encountered, “classic patterns,” appearances of both benign and malignant thyroid nodules that are seen in day-to-day practice. These appearances include specific nodules that commonly need fine needle aspiration (FNA)/biopsy, and other nodules that do not usually need FNA/biopsy.

Key Words: Thyroid cancer, thyroid nodule, thyroid ultrasound

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LEARNING OBJECTIVES

After reading this article and completing the posttest, the reader should be able to

• Describe which thyroid nodules need FNA/biopsy based on their pattern of ultrasound features
• Explain the classic patterns of the ultrasound appearances of typical malignant thyroid lesions
• Explain the classic patterns of the ultrasound appearances of typical benign thyroid lesions

Thyroid nodules are very common, and are found in 4% to 8% of adults by palpation, 41% by ultrasound, and 50% by pathologic examination at autopsy.1,2 In contrast, compared with the very high prevalence of nodular thyroid disease, thyroid cancer is rare. The American Cancer Society estimates that only 25,690 new cases of thyroid cancer will be diagnosed in the United States this year, which constitutes only 1% of all cancers.3 Of these patients with thyroid cancer, it is estimated that only 1460 will die of their disease this year.4 The challenge of managing thyroid nodules is to reassure the majority of patients who have benign disease and to diagnose the minority of patients who will prove to have malignant disease.

Of new cases of thyroid cancer diagnosed in the United States, most (75%–80%) are likely to be papillary thyroid cancer, whereas the remaining histologic types will consist of approximately 10% to 20% follicular, 3% to 5% medullary, and 1% to 2% anaplastic cancers.4,5 The morbidity and mortality rates of thyroid cancer increase with advancing stages of the disease and the age of the patient, but both are low compared with many other cancers.6 It is generally accepted that the overall 30-year survival for papillary carcinoma is approximately 95%.7 The majority of these patients with papillary cancer (80%–85%) is classified as “low-risk”, and is associated with 99% survival at 20 postoperative years.8

The evaluation of a thyroid nodule depends in part on its method of discovery. If a thyroid nodule is palpable, the evaluation begins with the physical examination; if the findings are of concern, the subsequent workup may include laboratory studies, radionuclide scanning, ultrasonography, and/or fine needle aspiration (FNA). If a thyroid nodule is not palpable but detected by imaging, the workup most often either ends with the decision to observe clinically, or proceeds to an FNA, depending on the level of concern based on the imaging appearance or size. Although it is possible for radiologists to simply recommend biopsy of all identified nodules, it is important to become familiar with the morphologic features associated with benign or malignant nodules so that appropriate management recommendations regarding the need for FNA can be made.9

The goal of the pattern-oriented ultrasound approach to the evaluation of both palpable and impalpable thyroid nodules is to understand and recognize the typical appearances of some of the common benign and malignant thyroid nodules and to separate those nodules that usually require FNA for further evaluation from those that usually do not.

This article presents an approach to the ultrasound evaluation of thyroid nodules that is used in our practice. It describes the classic appearances of some of the commonly encountered benign and malignant nodules that are seen in day-to-day practice. Although more than half of all thyroid nodules encountered in day-to-day practice will fit into one of the classic categories, this article is not meant to be a complete description of the ultrasound appearances of all conceivable types of thyroid nodule, as many nodules will not fall into one of these specific categories. It is likely that additional classic nodule appearances will be identified over time. Moreover, this
article is not meant to be a comprehensive review of the existing and rapidly expanding literature that is developing on this complex subject. Rather, this article describes our current understanding of the sonographic appearances of classic thyroid nodules, and offers what we believe is a practical and effective approach to deal with the large number of thyroid nodules that are encountered in the day-to-day practice of neck ultrasound. These patterns guide our approach, regardless of the size of the nodule, whether the nodule is palpable or not palpable, and whether the nodule is solitary or within a thyroid gland containing multiple nodules. Thus, in a multinodular gland, it is the characteristics of the nodule itself, not its presence in a “goiter” that dictate whether FNA/biopsy is warranted or not. If the nodule has a classic pattern that indicates a benign etiology (Patterns 4 through 8), we do not recommend further imaging, unless there is overriding clinical concern or significant, alarming change in the physical examination during routine clinical follow-up. Almost nothing in medical imaging is absolute, but the eight unique appearances described below, in our experience (which has been gained over the past two decades of practice), are highly likely to represent the pathologic entity described.

THYROID NODULES THAT COMMONLY NEED FINE NEEDLE ASPIRATION/BIOPSY

Classic Pattern #1

A solid, hypoechoic nodule containing discrete echogenic foci is papillary carcinoma with a high probability (Fig. 1).

Thyroid carcinomas are divided into four principal primary epithelial histologic types: papillary, follicular, medullary, and undifferentiated. Papillary carcinoma is the most common malignancy of the thyroid, comprising 75% to 80% of all new diagnoses of thyroid cancer.10,11

Most papillary carcinomas (63%–90%) are hypoechoic in echogenicity relative to thyroid parenchyma.12,13 This finding holds true even for small papillary cancers, where Papini found that 87% of nonpalpable (8–15 mm) thyroid cancers were hypoechoic.14 However, at the same time, 55% of benign nodules can be hypoechoic.12 Therefore, the presence of significant additional sonographic features is important to help discern which nodules are most likely to be malignant. The most useful additional sonographic finding that suggests malignancy is the presence of microcalcifications, which are seen as several or many discrete highly echogenic foci. Both coarse calcifications and microcalcifications may be detected in malignant nodules, with microcalcifications being more specific for thyroid cancer.15 The appearance of microcalcifications is highly specific for malignancy with a sonographic specificity of 93% to 95%.14,16 The sensitivity is lower at 29% to 59%.12,16,17 The prospective positive predictive value of these calcifications for malignancy has been reported to be 70% to 71%.15,17

Calcium deposits are frequently identified during pathologic microscopic evaluation of papillary cancer. They may be due to either psammoma bodies, or coarse granular amorphous deposits of calcification.15 Psammoma bodies are tiny calcified laminated spherules found in 40% to 61% of papillary cancers.8,18 They are thought to be due to necrotic cells, often at the tips of papillae, which form a nidus for subsequent concentric laminations of calcium. Amorphous deposits of calcification can also occur in papillary carcinoma. These irregular, coarse deposits are typically present in areas of fibrosis and degeneration.

Holz and Powers20 reported in 1958 that the x-ray finding of fine stippled calcification within a thyroid mass was characteristic of papillary thyroid carcinoma. A similar appearance has subsequently been visualized on ultrasound and has been confirmed by many other authors since this time. It is now well accepted as a worrisome finding for malignancy.16,21 These tiny calcifications usually do not cause acoustic shadowing when widely scattered, but may cause shadowing in some cases, perhaps when clustered in an aggregate.

Classic Pattern #2

A solid, hypoechoic nodule with coarse echogenic foci may represent either medullary carcinoma or papillary carcinoma (Fig. 2).

Almost all medullary cancers are hypoechoic. They tend to be well marginated sonographically, which reflects their usual gross morphologic appearance—sharply circumscribed although not encapsulated. They are usually soft, but may be firm and sclerotic. Medullary cancer is much less common than papillary cancer and accounts for 3% to 5% of all thyroid cancers. In 20% of cases it is familial and often associated with MEN-2 syndrome where it is often multicentric and bilateral. Medullary carcinoma is sporadic and usually solitary in the remaining 80% of cases. Because it originates from the C-cells of the thyroid, it is often located in the upper and mid portions of the thyroid lobes because this is where the majority of the C-cells are located.

Coarse calcifications are often seen in these tumors, and the calcifications often tend to be more discretely and centrally
located than in papillary cancers. However, because papillary cancer is much more common than medullary cancer, the finding of coarse calcifications within a hypoechoic nodule will also frequently be due to papillary cancer. Amyloid deposits are often present microscopically in medullary cancer; secondary calcification and fibrosis within the amyloid deposits may represent the origin of the sonographically visualized coarse echogenic foci. In addition, medullary cancer may rarely contain psammoma bodies, which can be another cause of visualized echogenic foci.

Coarse, dense nodular calcification can occur in benign nodules as well as malignant ones. Calcification within benign multinodular goiter is common, and the incidence of calcification seems to increase with the duration of the goiter. This is thought to be due to dystrophic calcification. Several authors have stressed that this pattern of coarse calcification cannot be used to distinguish between malignant and benign thyroid lesions. However, in our opinion, the combination of coarse calcification within the central portion of a hypoechoic nodule is worrisome and warrants FNA.

**Classic Pattern #3**

A solid, homogeneous, egg-shaped nodule with a thin capsule indicates follicular neoplasm with a high probability (Fig. 3).

Most follicular neoplasms are solid and in 70% of cases, they are homogeneous in echogenicity. They can be isoechoic, hyperechoic, hypoechoic, or mixed. Their shape is usually oval or round and the sonographic appearance is very similar to a normal testicle. A thin hypoechoic halo is present in 80% of cases. Small focal cystic components may be present. Calcification is rare. Vascularity is usually diffusely increased throughout the nodule.

Follicular neoplasms may be due to either benign follicular adenoma or malignant follicular carcinoma. The term “neoplasm” technically simply means that the mass in question is derived from a single cell line. Some have used the term “follicular lesion” rather than follicular neoplasm, because the term neoplasm is often misinterpreted as malignant carcinoma. In our experience, most (85%) follicular neoplasms are benign adenomas. The distinction of encapsulated follicular carcinoma from follicular adenoma rests exclusively on the pathologic demonstration of capsular or vascular invasion or both. This distinction cannot be made by imaging features, and also, importantly, cannot be made by FNA or large core needle biopsy. Unfortunately, surgical excision is necessary to exclude the uncommon follicular carcinoma. The pathologist subsequently examines the gross specimen to determine if the malignant features of microscopic capsular or vascular invasion are present. If these pathologic features are not present, the lesion is considered to be a benign follicular adenoma.

Pathologically, follicular neoplasms typically have well-developed continuous capsules, a uniform internal structure, increased vascularity, sharp demarcation, and distinct structural difference from, and compression of, surrounding thyroid tissue, which correlates well with their sonographic appearance. In contrast to follicular neoplasms, benign, non-neoplastic hyperplastic nodules (also called colloid or adenomatoid nodules), which are by far the most common source of thyroid nodules, are poorly encapsulated, of variable internal structure, and often merge into the surrounding thyroid tissue. However, some benign hyperplastic nodules in nodular goiter can demonstrate and fulfill the criteria for adenoma and therefore, simulate this entity, pathologically. In theory, if molecular genetic studies are performed on the resected nodule specimens they will show that nodules in nodular goiter are usually polyclonal, whereas carcinomas and adenomas are monoclonal.
However, some nodules in nodular goiter are monoclonal as well; so, the practical utility of this analysis is unclear. Consequently, some pathologists prefer to classify these hyperplastic nodules as adenomatoid nodules or adenomatoid goiter. Therefore, it should not be surprising that in some cases the sonographic differentiation of these two entities can also be difficult.

There are several pathologic subtypes of follicular adenoma. Simple adenomas (colloid or macrofollicular) are the most common, and are composed of relatively large follicles with abundant colloid. Microfollicular lesions are comprised of less colloid and have compact follicular structures. Finally, fetal or embroyonal lesions often have little, if any, colloid or follicular architecture. Oxyphil (oncocytic, Hürthle cell) adenomas are usually regarded as variants of follicular adenomas, but are considered separate entities by some, because they may have a higher risk of malignancy and more aggressive biologic behavior than other follicular neoplasms.25

The risk of a thyroid adenoma undergoing malignant change is not well defined. There is no obvious adenoma-carcinoma sequence as has been well established in other malignancies like colon cancer.25 The larger the size of the follicular nodule, however, the greater the chance of finding malignant regions within it.

Cytologic interpretation of FNA of nodules with the classic homogeneous, egg-shaped ultrasound pattern most often will be interpreted as “suspicious”, consistent with follicular neoplasm. In most of these cases, surgical excision is recommended. Less often the cytologic interpretation will be either “negative”, consistent with benign nodule, or “positive”, consistent with papillary carcinoma. If the FNA specimen is interpreted as negative, further work-up is typically not warranted, unless there is an obvious discrepancy between the cytologic interpretation and the ultrasound findings. False-negative FNA exams, although rare, can occur. False-negative cytologic results are probably due to biopsy of the macrofollicular variety of follicular neoplasm, which does not have significant malignant potential, and therefore the cytologic designation as negative or benign is warranted.

Infrequently, FNA of a nodule with the sonographic appearance of follicular neoplasm will be interpreted as positive for papillary carcinoma. This is usually due to a unique type of papillary carcinoma called the follicular variant of papillary cancer. This variant is often encapsulated and is composed entirely, or almost entirely, of follicles.26

Classic Pattern #4

A refractive shadow(s) from the edge of a solid lesion is worrisome for malignancy (Fig. 4).

Grossly, papillary thyroid cancer frequently contains abundant amounts of reactive fibrous connective tissue, particularly at the periphery or advancing edge of the tumor. In one series of gross specimens, fibrous connective tissue was present in 56% of papillary cancers.27 It may be that this dense fibrotic reaction at the edge of the thyroid cancer causes the sonographic refractive shadow.

Refraction occurs when sound passes from a tissue with one acoustic propagation velocity to a tissue with a faster or slower sound velocity. When the ultrasound beam intersects a boundary interface at an oblique angle there is refraction of the beam resulting in a change in the direction of the sound wave. This causes lack of transmission posterior to this site, and the critical angle refraction causes shadowing deep to the oblique interfaces. Although unproven, it may be that the refractive shadow at the margins of some thyroid cancers is due to fibrosis or encapsulation. It is important to know that refractive shadows can also occur deep to the border of predominantly cystic nodules and, in that setting, the finding is not worrisome for malignancy.

There is considerable variability in the sonographic descriptions of both the contour and margin of thyroid cancer in the existing literature. A halo, often incomplete, has been described as occurring in 15% to 30% of papillary carcinomas.17 Thyroid malignancies have been variably described as having both irregular and smooth contours, and having both poorly defined and well-defined margins.17,28,29 Pathologic studies of lesion morphology suggest that papillary cancer can cause all of these patterns. The typical papillary cancer invades into the surrounding thyroid parenchyma without a well-defined capsule. However, in 22% of cases, portions of a gross capsule or fibrous connective tissue can be detected, and there is total or complete encapsulation of papillary thyroid cancer in 4% to 16% of lesions.18,30,31

NODULES THAT DO NOT USUALLY NEED FINE NEEDLE ASPIRATION/BIOPSY

Classic Pattern #5

Small cystic nodules, with or without internal echogenic foci, indicate benign non-neoplastic nodules (Fig. 5).
Small, less than 1 cm, solitary or multiple fluid-filled nodules are most often caused by benign thyroid nodular hyperplasia with colloid filled cysts. It is doubtful that these cysts represent dilated follicles because normal follicles within the thyroid are typically about 0.2 mm in size. Normal follicles can change in size based on the functional activity of the gland but rarely are larger than several millimeters in diameter.

Often there are tiny echogenic foci with comet-tail or ring-down artifacts within the cystic nodules. Some authors have concluded that this is due to condensed colloid. In one sonographic series of 100 nodules that exhibited comet-tail artifacts, all of the nodules were benign and no malignancy was seen. The authors concluded that this artifact is seen in association with abundant colloid, and abundant colloid is usually present in benign nodules.

Most nodules of the thyroid are not true neoplasms, but are benign hyperplastic nodules. These form as a result of cycles of hyperplasia and involution of the thyroid parenchyma. The definition of the term “goiter” means enlargement of the thyroid, and it does not technically distinguish among enlargement due to solitary or multiple nodules; neoplastic, hyperplastic, or inflammatory causes; or benign or malignant etiologies. In day-to-day use, however, “goiter” is most commonly used to describe a “simple goiter” that is a non-inflammatory, non-neoplastic, diffuse, or nodular enlargement of the thyroid without hyperthyroidism (non-toxic).

The natural history of simple goiter is assumed to be a diffuse hyperplasia that later becomes nodular. The first phase of diffuse enlargement is termed parenchymous goiter. Over time excessive colloid is stored and a diffuse colloid goiter results. The nodular goiter phase develops due to repeated cycles of exacerbation and remission with resultant increasing fibrosis, nodularity, hemorrhage, cystic degeneration, and calcification. These cystic areas contain colloid or brown fluid containing blood products. Large nodules tend to compress the surrounding parenchyma and may have partially developed fibrous capsules. For the most part, these nodules are incompletely encapsulated, are poorly demarcated, and merge with the internodular tissue, which also has an altered architecture. However, in some glands, the lesions are localized and there are areas of apparently normal architecture elsewhere in the gland. This is most commonly termed nodular goiter at this phase.

Classic Pattern #6

A nodule containing multiple cystic spaces separated by thin septations in a “honeycomb” pattern strongly indicates a benign, non-neoplastic, nodule (Fig. 6).

Fluid-filled nodules with thin internal septations are most likely benign nodules due to hyperplasia. They are heterogeneous in appearance with multiple thin internal septations or attenuated strands of thyroid tissue within the fluid. They are typically avascular with Doppler imaging.

Careful scanning with high-frequency transducers is necessary. In some cases these honeycomb cystic nodules have specular, often linear, echogenic foci that are due to the backwall interfaces of the internal cystic components. These should not be mistaken for hypoechoic solid nodules with malignant microcalcifications. The difference between these two entities rests in the recognition of the presence, or absence, of internal fluid components and the location of the echogenic foci associated with the back wall of the cystic space. This is in contrast to the solid nodule with internal microcalcifications.
to malignant nodules, which are typically solid, where the malignant coarse and micro-calcifications are located within the solid stroma of the malignant nodules.

Sometimes these benign honeycomb cystic nodules have echogenic foci with comet-tail artifacts that are seen within the fluid components. These features may only be visible transiently during real-time imaging and may not be apparent on review of static images. Therefore, careful real-time evaluation is critical.

Classic Pattern #7

A large, predominantly cystic nodule is highly likely a benign non-neoplastic nodule (Fig. 7).

In two recent studies 40% to 53% of all benign nodules contained cystic components.36,37 These cystic nodules are benign non-neoplastic hyperplastic nodules often containing a large cystic component due to degeneration with associated fibrosis and avascular internal debris.

Malignant nodules, however, rarely undergo a large amount of cystic change detected sonographically. Papillary cancers have been reported to have cystic components in 13% to 25% of cases, and the cystic component is usually very small.29,38 In our experience, it is rare for carcinomas to have a significant or large cystic component and only 2.5% of cancers have a sonographically visualized large cystic component of more than half of the volume of the tumor.39

Even if a cancer is predominantly cystic, other worrisome features such as microcalcifications are often present and careful scanning to evaluate the specific features of the solid component is important. The solid component may appear as a papillary projection into the fluid or as an irregular nodular or shaggy interface with the fluid.18 Hatabu et al40 described the sonographic findings of solid excrescences containing multiple punctuate echogenic foci protruding into the fluid, also called a “calcified nodule within a cyst” sign, and reported a 100% correlation between this sign and papillary carcinoma in a series of eight patients.

Fine needle aspiration could be performed on these cystic nodules but it would likely often be non-diagnostic due to the large amount of fluid and the small number of diagnostic follicular cells present. The nature of the fluid obtained in aspiration of both benign and malignant cystic lesions is similar in appearance. In one study of cystic thyroid nodules, bloody fluid was aspirated in 80% of malignant lesions, 88% of benign neoplastic lesions, and 78% of benign non-neoplastic lesions. Although aspiration of most cystic papillary cancers in this series yielded bloody or brown fluid, one cancer contained clear yellow fluid.38 If the appearance of the solid component is worrisome, directed aspiration of the mural nodule should be performed.

Of interest, cystic changes of papillary carcinoma are often more common and more extensive in cervical lymph node metastases than in the primary tumor; 43% to 70% of metastatic nodes from papillary carcinoma have fluid components detected sonographically.41–43 The node morphology may exhibit the opposite cystic characteristics from the primary tumor. In one study, only 20% of metastatic nodes had cystic changes when the primary tumor was predominantly cystic, but 34% of metastatic nodes had cystic changes when the primary tumor was completely solid.37

Classic Pattern #8

Innumerable tiny hypoechoic nodules in both lobes almost certainly indicate Hashimoto’s thyroiditis (Fig. 8). Of the inflammatory diseases of the thyroid, Hashimoto’s thyroiditis is the most common. Hashimoto’s thyroiditis is also the most common cause of hypothyroidism. It is an autoimmune disease where antibodies develop to both thyroglobulin (Tg) and the thyroid peroxidase (TPO) enzyme. It is four times more common in women than men, and has a prevalence of 4% of the female population.

The sonographic appearance of Hashimoto’s thyroiditis is often one of innumerable small hypoechoic nodules. The


FIGURE 8. Classic Pattern #8. Hashimoto’s thyroiditis: Longitudinal sonogram shows multiple tiny hypoechoic solid nodules (arrow) and coarse echogenic bands (arrowhead).
nodules range in size from 1 to 6 mm, are of similar hypoechoic appearance, and occur bilaterally. Coarse hyperechoic septations or bands may be present. The internal blood flow of the parenchyma of the gland may be increased, normal, or decreased.

Grossly, the gland is typically symmetrically enlarged and contains visible discrete nodules. Microscopically, there is diffuse infiltration of the thyroid parenchyma by lymphoplasmacytic infiltrates, which form lymphoid follicles, and varying amounts of fibrosis, which account for the sonographic nodular and hyperechoic band features.

When these typical sonographic features are present, the positive predictive value of sonography in the diagnosis of Hashimoto’s thyroiditis was 95% in one series. It was also of interest in this series that 75% of the patients had no known diagnosis of thyroiditis before the ultrasound examination. In clinical practice, this diagnosis is often made by the ultrasound examination without clinical suspicion. The diagnosis of Hashimoto’s thyroiditis is usually confirmed by serologic tests, including anti-Tg and anti-TPO antibodies, rather than FNA.

**DISCUSSION**

A wide variety of pathologic conditions, including neoplastic, hyperplastic, and inflammatory diseases can all cause nodular enlargement of the thyroid. All of these conditions can have a spectrum of appearances that can overlap with one another. Fortunately, in our experience, there are some appearances that strongly indicate the underlying pathologic nature of the lesion. This classic pattern approach to thyroid nodule evaluation has allowed us to avoid unnecessary and costly workup including additional imaging, FNA, and surgical removal. In medicine, every decision to either stop a workup or pursue with further workup is based on a balance of perspectives and clinical judgment. For example, mammographers will frequently diagnose a benign fibroadenoma of the breast based on its imaging features. This diagnosis is highly probable but not absolutely certain without surgical removal and pathologic study (ie, the imaging diagnosis is highly likely but not certain). In addition, the perspectives must include not only the cost of missing a cancer but also the cost of aggressively managing a mass that is not cancer.

What would occur, for example, if ultrasound criteria were not used to determine the likelihood of a thyroid nodule being benign or malignant? In this circumstance, FNA/biopsy would likely always be the next step after a nodule was detected. Whereas FNA is the “gold standard” for nodule diagnosis, it is clearly an imperfect technique for many reasons. First, the results are non-diagnostic in approximately 15% to 20% of cases. Second, there is a false negative rate of approximately 3% to 5%. Third, there is wide variability in interpretative skill regarding cytopathology of the thyroid nodule. Unfortunately, in less experienced centers, the report of “follicular cells are present, cannot exclude follicular neoplasm” occurs more frequently than in centers with greater interpretative experience. This report commonly leads to the need for surgical excision. Given these considerations, it is estimated that approximately 18% of all patients who have an FNA ultimately come to surgery for nodule excision based on positive, suspicious, or non-diagnostic results, and that most of these nodules are benign. Of these patients who have surgery it is estimated that only 15% to 32% have cancer. Therefore, the majority of patients who come to surgery for thyroid nodule excision will have had an operation for clinically insignificant benign nodular disease.

It is also important to consider a perspective on the epidemic of nodular thyroid disease as seen by ultrasound imaging and the potential cost of the FNA/biopsy workup of these nodules. For discussion purposes, assume that 1 million people of the current 293 million population of the United States undergo a thyroid ultrasound examination. Because we know that the prevalence of one or more thyroid nodules detected by high-frequency ultrasound is approximately 40%, then 400,000 people will have one or more thyroid nodules detected by ultrasound imaging. Assuming a cost of approximately $1500 for a US-guided FNA and cytologic analysis, $600 million could theoretically be spent to exclude or detect thyroid cancer in this group. Importantly, approximately 18%, or 72,000 operations could occur at a cost of nearly $20,000 each, for an additional cost of $1.44 billion. Finally, approximately 5%, or nearly 3600 operated patients could experience significant morbidity as a result of surgery including hoarseness, hypoparathyroidism, and long-lasting pain. Clearly, this type of aggressive management of thyroid nodules would entail massive expenditure of health care dollars and would have a potentially very negative clinical impact. The use of ultrasound screening for thyroid cancer would likely exacerbate such a scenario by significantly increasing the number of patients undergoing FNA/biopsy and unneeded surgery. In fact, the Institute of Medicine recently recommended against ultrasound screening, even for patients who may be at higher risk for thyroid cancer than the normal population—those who have been exposed to I-131 fallout from nuclear bomb testing, which occurred during 1950 to 1960.

Before ultrasound screening for thyroid cancer is implemented, its efficacy must be proven in an evidence-based manner, probably through the use of randomized controlled trials. Screening tests are deemed to be efficacious if four criteria are met:

1. The cancer must be fairly common.
2. The new test must reveal disease earlier than the customary way.
3. The cancer must have an effective treatment.
4. The value of detecting the cancer at this earlier time outweighs the risks and costs generated by screening.

This fourth criterion is likely not to be met in the setting of sonographic screening for thyroid cancer. If the screening test reveals non-lethal cancers, it can cause unnecessary anxiety of the patient, and can lead to treatments that are not needed and may be costly and harmful without producing any benefit.

Historically, most papillary cancers are palpable when detected; however, with the advent of high-resolution ultrasound many small cancers are now being incidentally detected. Papillary microcarcinoma is classified by the World Health Organization (WHO) as “tumors 1.0 cm or less in diameter”. The prevalence of small papillary carcinomas in systematic
autopsy studies where the thyroids have been sectioned semi-
serially has varied between 1% and 36%. This is partic-
ularly common in Scandinavian countries and in Finland, where
occult papillary cancer was found in 36% of autopsies, and has
been called a “normal” finding by some. These occult can-
cers have been found to be multifocal in 30%, and surpris-
ingly show regional lymph node spread in 30%, and distant metas-
tases in 1% to 3%. Fortunately, cervical lymph node metas-
tases, while common, is not life threatening in most patients.
These occult papillary cancers carry a very low risk for
mortality—0% in two series, and 1% in another series.11,61,62

Such data suggest that almost all occult papillary carcinomas
of the thyroid remain undiscovered during life and do not
contribute to mortality, with death in these individuals usually
resulting from other causes unrelated to thyroid cancer.

Is there value in discovering a papillary thyroid carci-
noma at a smaller size or earlier stage? In the current literature
on papillary thyroid cancer (PTC), by far the commonest form
of endocrine malignancy, there is almost no data that can
convincingly prove a life-saving advantage from early diagnosis.6
Although tumor size is important in relation to prognosis in
PTC, the recent TNM and AJCC classification, recognizing
the unimportance of a 1-cm cut-off, has increased the size
upper limit of a T1 tumor to 2 cm. Large studies of PTC
followed for up to 60 postoperative years have demonstrated
that the most significant “step-up” in cause-specific mortality
occurs when a PTC tumor size is 4 cm or more.6,53,66 This
suggests that concern about missing early or occult PTC is
misplaced, and that pursuing a US-guided FNA/biopsy diagnosis
in every nonpalpable thyroid nodule greater than 1 cm is
likely to be impractical and most often unnecessary.67

In a recent editorial devoted to the problem of the thyroid inci-
dentaloma, which he described as “the ignorant in pursuit of
the impalpable,” Topliss emphasized that “screening programs
for early cancers (lung, breast, prostate, and neuroblastoma)
have not demonstrated a mortality difference between screened
and unscreened populations despite detecting more disease at
an earlier stage”. In considering a US-guided FNA in a
patient with solid hypoechoic lesion, Topliss concluded that
“gaining informed consent should entail discussion of the
uncertainties involved and it is still a rational decision to
observe (and not biopsy) impalpable thyroid nodules”.68

For our practice, the “classic pattern” approach to the
sonographic evaluation of thyroid nodules allows an effective
and practical method for nodule evaluation. Using this
approach, most patients with clinically significant cancers
go on to appropriate further investigations, but, much more
importantly, most of the patients who have benign lesions can
thereby avoid a costly, and potentially harmful, further workup.
Follow-up imaging in these patients (Patterns 4 through 8) is
not necessary, except in the unusual circumstance when some-
thing occurs to raise new clinical concern.

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