The effect of surgical office-based thyroid ultrasound on clinical decision making

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An important diagnostic tool for the evaluation of thyroid disease, thyroid ultrasound has recently become available for use in surgical offices. The purpose of this report is to determine the lesional sensitivity of office-based thyroid ultrasound and its impact on clinical decision making. Surgical office-based thyroid ultrasound was performed on 49 consecutive patients who presented with thyroid disease. Indications for sonography included a solitary palpable nodule ($n = 32$), multiple palpable nodules ($n = 3$), diffuse enlargement ($n = 5$), or other hormonal or radiologic abnormalities ($n = 9$). Thyroid ultrasound demonstrated 104 lesions compared with 38 lesions found on physical examination ($P < 0.0001$). In the subpopulation who underwent scintigraphy ($n = 10$), 24 nodules were identified by ultrasound and only 10 nodules were iden-

tified by scan ($P < 0.01$). Overall, office-based thyroid ultrasound impacted the clinical management of 40 patients (80%): in 16 patients, thyroid ultrasound was the only modality that demonstrated a multinodular condition, thus contributing to a decision to avoid surgery; 19 patients had ultrasound-guided fine-needle aspiration of vaguely palpable or nonpalpable lesions; and 5 patients underwent ultrasound-guided cyst aspiration and follow-up. Office-based thyroid ultrasound performed by surgeons is a highly accurate imaging modality that identified significantly more lesions than physical examination or scintigraphy. Clinical management was affected through the identification of a multinodular process or through facilitation of accurate image-guided biopsy.

The evaluation of thyroid disease continues to change with recent advances in thyroid imaging and cytological analysis. Ultrasound was first used to study the thyroid gland in 1967, primarily to distinguish solid lesions from cystic lesions (1). In 1987, Rizzatto discussed the use of ultrasound-guided fine-needle aspiration (FNA) biopsy for diagnosing thyroid nodules (2). Hatada reported a higher accuracy (68%) and lower inadequate sample rate (17%) for ultrasound-guided FNA compared with standard FNA (accuracy, 48%; inadequate sample, 30%) (3). Ultrasound has become the primary imaging modality in the assessment of thyroid disease and has proven to be especially useful in identifying patients with a solitary nodule. In a recent study, Brander demonstrated that 31% of patients with a single thyroid mass on physical examination have a multinodular process on ultrasound (4). A multinodular process demonstrated by ultrasound suggests a benign process and allows for nonoperative management, especially when supported by benign cytology.

Ultrasound examination is painless, requires no radiation exposure, and is easily performed after proper training. The real-time nature of ultrasound allows for accurate image-guided biopsies or aspirations. Ultrasound has become routine in the practice of cardiologists, urologists, gastroenterologists, and gynecologists. More recently, surgeons have used ultrasound for blunt abdominal trauma, intraoperative guidance, and breast disease.

Introducing ultrasound into surgical office practice has been facilitated by refinements in computer-enhanced ultrasonographic imaging and more affordable ultrasound units. When ultrasound is performed as a part of the surgeon's physical examination, the management of thyroid disease is streamlined. This prospective

study seeks to examine how surgical office-based thyroid ultrasound impacts the diagnosis and management of thyroid disease.

METHODS

From December 1997 to August 1998, surgical office-based thyroid ultrasound was performed on 49 consecutive patients who presented with thyroid disease. Data were collected prospectively to examine the lesional analysis of ultrasound and its impact on treatment management. The patient group included 42 women and 7 men, with a median age of 54 (range, 17 to 88 years). All patients were examined with a Seimens Sonoline ultrasound system (Koeln, Germany) with a 7.5-MHz probe. Ultrasound technique was standardized to include transverse and longitudinal images of both lobes of the thyroid gland as well as the adjacent structures in the neck. All nodules were measured in 3 planes, and hard copy images were created to document nodule location and orientation. Thyroid nodules were characterized by number, location, and echogenicity.

FNA biopsy, when indicated, was performed under ultrasound guidance to ensure accurate sampling. Biopsy was performed with a 25-gauge needle and a 5-mL disposable syringe under local anesthesia. Sterile gel was used as the coupling agent, and the needle was inserted along a path within the scanning plane so that the nodule and the needle were continuously visualized. When the needle reached the target, aspiration biopsy

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was performed with an in-and-out movement while suction was applied. Suction was released before the needle was removed from the nodule. The collected material was expelled onto glass slides, fixed immediately by a trained cytotechnologist, and placed into a cytolyte solution for centrifugation and examination of a pellet. Samples were interpreted by a cytopathologist as benign, follicular, malignant, or inadequate.

The 2-tailed paired Student's *t* test was used to evaluate the statistical significance of the data; calculations were performed using StatView software (SAS Institute, Cary, NC).

RESULTS

There were 5 different indications for surgical referral in the patient group: solitary palpable nodule (66%), hormonal abnormalities (14%), diffuse thyroid enlargement (10%), multiple thyroid nodules (6%), or radiologic evidence of tracheal compression (4%). Physical examination identified 14 patients with solitary thyroid nodules, 18 patients with vaguely palpable lesions, and 3 patients with multiple thyroid nodules. Diffuse thyroid enlargement was noted in 5 patients, and no masses were identified in 9 patients. Of the 49 patients in this study, ultrasound identified a multinodular process in 20 patients and a solitary nodule in 20 patients. Five patients were noted to have cystic lesions.

Ultrasound examination of the thyroid gland identified more nodules than physical examination (104 vs 38, $P < 0.0001$). In the subpopulation of patients who had thyroid scintigraphy performed ($n = 10$), ultrasound also identified more nodules than scintigraphy (24 vs 10, $P < 0.01$).

FNA biopsy was performed on 27 patients; ultrasound guidance was used to ensure proper needle placement. Cytological analysis revealed follicular cells ($n = 9$), malignant or suspicious cells ($n = 5$), benign cells ($n = 10$), or nondiagnostic cells ($n = 3$).

Overall, surgical office-based thyroid ultrasound impacted the clinical management of 40 patients (80%). In 16 of these patients, thyroid ultrasound was the only modality that demonstrated a multinodular condition, thus contributing to a decision to avoid surgery. Five patients underwent ultrasound-guided cyst aspiration and follow-up. Ultrasound facilitated FNA biopsy of vaguely palpable or nonpalpable lesions in 19 patients. Thyroid exploration was avoided in 10 patients on the basis of benign FNA cytology obtained via ultrasound guidance.

Indications for thyroid resection included malignant or suspicious cytology ($n = 14$), toxic nodule ($n = 3$), indeterminate cytology ($n = 1$), and mass effect of an enlarged thyroid ($n = 1$). Thyroid resection was performed on 19 patients (12 lobectomies and 7 total thyroidectomies). Pathologic analysis revealed a malignancy in 7 (37%) resected thyroid glands (Table).

DISCUSSION

Ultrasound is an excellent complement to the surgeon's physical examination and facilitates determination of nodule size, number, and echogenicity. Ultrasound can be used to evaluate potential cervical lymphadenopathy, recurrent laryngeal nerve invasion, and adjacent neck structures. In our experience, ultrasound identifies significantly more thyroid lesions than either physical examination or scintigraphy.

Table. Pathology of 19 resected thyroid glands

Pathological diagnosis	Number (%)
Follicular adenoma	8 (42%)
Papillary carcinoma	4 (21%)
Multinodular goiter	2 (11%)
Follicular carcinoma	2 (11%)
Metastatic breast carcinoma	1 (5%)
Nodular hyperplasia	1 (5%)
Hashimoto's thyroiditis	1 (5%)

Ultrasound has emerged as the preferred modality for imaging the thyroid. The excellent resolution of ultrasound and accessibility of the thyroid gland enable the identification of foci as small as 3 mm (5). The development of biopsy guide devices for ultrasound transducers has also facilitated improved accuracy and reduced sampling error. With the combination of an experienced aspirator and cytopathologist, the accuracy of cytologic diagnosis of thyroid lesions approaches 95% (6). Recent technological advancements have expanded the usefulness of ultrasound by allowing physicians to accurately obtain tissue in the office.

The evaluation, treatment, and follow-up of multinodular vs single-nodule disease of the thyroid are significantly different. Early differentiation of the 2 processes allows for more efficient management. In this study, ultrasound proved to be the most accurate modality for differentiating a solitary thyroid nodule from a multinodular process. In 16 patients, ultrasound was the only modality that demonstrated multinodularity. FNA of a dominant nodule in the setting of a multinodular thyroid can provide further evidence of a benign process, since 5% to 10% of patients with multinodular disease may have thyroid carcinoma. Ultrasound can also be used in the surveillance of multinodular or cystic disease of the thyroid. Patients can then be selected for surgery if an existing nodule changes size or echostucture (7).

Patients with solitary nodules identified by ultrasound are appropriate candidates for FNA analysis. Obtaining an accurate FNA is often difficult in patients with unfavorable cervical anatomy or with small lesions. In our experience, ultrasound facilitated FNA of vaguely palpable or nonpalpable thyroid nodules in 19 patients. Accurate biopsy of these lesions would have been impossible without ultrasound guidance. Numerous reports indicate that the introduction of thyroid FNA increases the yield of carcinoma from 14% to as much as 30% at the time of thyroidectomy (8). In our review, 37% of thyroid resections yielded a diagnosis of carcinoma. Pathological differentiation of follicular lesions requires careful sectioning of the entire lesion to identify vascular or capsular invasion to diagnose malignancy. By considering the follicular adenomas with the malignancies, the yield is improved to 78.9%. Improved patient selection with surgical office-based thyroid ultrasound reduces exposure to operative morbidity, such as recurrent laryngeal nerve and parathyroid injury.

Incorporation of ultrasound into the surgeon's diagnostic armamentarium leads to streamlined evaluation of thyroid disease. A surgeon who can examine, image, diagnose, and treat a thyroid mass improves continuity of care and reduces the time and expense required for evaluation.

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Invited commentaries

Dr. Gogel and colleagues are correct in their assessment of the value of thyroid ultrasound for diagnosis of thyroid masses and for guidance of percutaneous needle biopsy of thyroid masses. The study makes a significant contribution by emphasizing the importance of ultrasound in the modern management of thyroid masses.

Because ultrasound can demonstrate both normal thyroid anatomy and pathologic conditions with great clarity, the technique has become increasingly important in the diagnostic evaluation of many thyroid conditions. Sonographically guided percutaneous needle biopsy of thyroid masses has become an important technique in the management of many thyroid masses, and continuous real-time visualization of the needle is crucial for biopsy of small lesions.

However, the practice of radiology by nonradiology physicians raises serious questions concerning utilization, costs, and quality. Hillman et al showed that nonradiologist physicians who performed their own sonographic and radiographic studies performed 2 to 8 times as many imaging examinations as physicians who referred their patients to radiologists (1). Studies have also shown that actual reimbursements paid to nonradiologists tend to be higher than those paid to radiologists (2, 3).

The quality of the ultrasound examinations performed by radiologists compared with those performed by nonradiologists is an extremely important consideration, and this is dependent, at least partially, on the training and experience of the personnel performing the examination. Most imaging outside of hospitals is now done by self-referring nonradiologists who have never been formally trained in radiology. Many of these examinations are of inferior technical quality, and clinically significant misinterpretations occur in a significant number of cases. It has been proposed that payments for imaging examinations performed in private offices by nonradiologist physicians should be restricted or eliminated unless the physicians have been fully and formally trained to perform those examinations (3). A large preferred provider organization in Michigan requires nonradiologists performing ultrasound examinations to have accreditation by a national accrediting body such as the American College of Radiology or

the American Institute for Ultrasound in Medicine. In the interest of quality patient care, all physicians performing imaging examinations and image-guided interventions should be required to meet standards mandated by formal accreditation programs. The federal Mammography Quality Standards Act of 1992 is an example of what can be accomplished by national requirements (4).

A study on clinical decision making comparing surgical office-based thyroid ultrasound with radiology office-based thyroid ultrasound would be informative and useful. Finally, greater involvement by radiologists and other physicians in outcomes studies and other types of health services research is needed, and these are clearly new frontiers and challenges for all physicians (1).

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Recent Medicare reductions in the reimbursement of practice expenses have had an adverse impact on the ability of practicing physicians and surgeons to make capital investments in new technology. In "The effect of surgical office-based thyroid ultrasound on clinical decision making," Dr. Gogel and colleagues present an interesting and timely study. Thyroid ultrasonography was used in a surgical office setting to assess an unselected array of thyroid pathology in 49 patients. The authors state that ultrasound impacted the clinical management in 80%