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ORIGINAL ARTICLE

Sonographic criteria predictive of benign thyroid nodules useful in avoiding unnecessary ultrasound-guided fine needle aspiration

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Background/Purpose: There has been no individual ultrasound feature of having high accuracy for diagnosis of thyroid malignancy. In this study, we aimed to establish feature-oriented criteria to characterize benign thyroid nodules that do not require ultrasound (US)-guided fine needle aspiration (FNA).
Methods: We reviewed 374 patients with thyroid nodules who had undergone US-guided FNA at our institution (2005–2008). Thyroid nodules were classified into two groups: Category 1 (benign nodules that required follow-up 6–12 months later but not US-guided FNA); and Category 2 (indeterminate nodules or suspected carcinoma that required US-guided FNA). To test the validity, we reviewed 315 consecutive patients who had histologically proven thyroid carcinoma ($n = 39$) and randomly selected 40 of the 276 patients with benign nodules (2009–2010).
Results: Of 374 nodules, 354 (95%) were benign and 20 (5%) malignant. On US, 260 nodules had no calcification, no increase in vascularity, well-defined margin, and no lymphadenopathy (Category 1). Using a combination of these four features, we were able to discriminate benign from indeterminate nodules or suspected malignant nodules with a sensitivity of 73%, and specificity and positive predictive value of 100%. Validity testing revealed that none of the 39 malignant thyroid nodules had all four US features. All Category 1 nodules (2005–2008) remained benign at the 3-years follow up.

Conflicts of interest: The authors state that they have no conflict of interest.

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Conclusion: The combination of four US features of Category 1 nodules is highly predictive of benign disease, and we could avoid unnecessary US-guided FNA in 69.5% of our patients using this combined features.

Introduction

Most thyroid nodules in adults are benign; the incidence of malignancy has been reported to be 3–7%.[1–4] Some thyroid nodules can be detected at physical examination, but many are incidental findings from imaging studies. Up to 67% of thyroid nodules in adults are detected by ultrasonography.[5–10] The most frequently used method of diagnosis for thyroid nodules is ultrasound (US)-guided fine needle aspiration (FNA), which has a low rate of complications. Use of US-guided FNA has led to a considerable decrease in the number of surgical excisions and a twofold increase in the diagnosis of carcinoma.[1,3,4] Therefore, US-guided FNA has replaced blind surgical excision, thereby reducing the overall cost of medical care.[11–14] However, not every thyroid nodule detected on US is accessible to aspiration.

Some authors advocate the use of a "classic pattern" approach to evaluate malignant and benign nodules.[1,6,15] The features of a malignant nodule on US can be a solid hypoechoic mass, taller-than-wide shape, irregular shape, spiculated margin, blurred or indistinct margin, micro- and macrocalcifications, disrupted calcified rim, and intranodular vascular pattern.[6,16–24] The features of a benign nodule on US can be isoechogenicity and spongiform appearance, cystic with a colloid clot, and giraffe-like or diffusely hyperechoic pattern.[1,17] However, no single appearance or combination of features are sufficiently sensitive or specific for diagnosis of nodules imaged at different centers.[18] Also the interobserver reliability of these features is variable.

The aim of this study was to establish feature-oriented criteria to characterize benign thyroid nodules that do not require US-guided FNA.

Methods

The study protocol was approved by our institutional review board. Informed consent was waived because of the retrospective nature of this study and its limitation to the analysis of data from patients' records.

The study was divided into two parts. Between 2005 and 2008, the medical records of 538 consecutive patients with thyroid nodules who had undergone US-guided FNA at our institution were retrospectively reviewed. Patients who had incomplete US images or whose cytopathology results were inconclusive were excluded. Finally, 374 patients (298 women and 76 men; mean age, 50 years; range, 9–92 years) having complete medical records and US images were recruited.

US examinations were performed on two scanners (ATL Philips HDL 3000; Philips, Eindhoven, The Netherlands). US-guided FNA was routinely performed with a 21-gauge needle on a 10-mL syringe and at least three passes were made per nodule. For a partially cystic nodule, the fluid was aspirated with the needle directed at the solid portion of the nodule. Specimens were smeared on four slides, two fixed in 95% ethanol immediately and the other two dried in room air. All pathological results were reported by senior pathologists and the specimens were classified into benign, atypical cell, or suspicious for follicular neoplasm or papillary carcinoma.

Two senior radiologists with at least 6 years' experience performing US reviewed the thyroid US images on a picture archiving and communication system workstation. The readers were blinded to clinical and pathologic diagnosis, and reached a consensus interpretation. We evaluated the nodular content (solid or cystic; Fig. 1A and B), echogenicity (hyperechoic, isoechoic, or hypoechoic), and calcification (micro, coarse, or absent; Fig. 1C and D). Microcalcifications were too small to induce posterior acoustic shadowing from echogenic foci with posterior comet-tail artifacts (commonly seen in benign cystic or partially cystic nodules; Fig. 1B).[16,25] Nodular margin (well-defined or ill-defined; Fig. 1A and E), vascularity (increased or decreased) relative to the normal part of the thyroid tissue (Fig. 1F), and lymph node hyperplasia or lymphadenopathy (neck node with calcification or short-axis longer than 10 mm; Fig. 1G and H) were also evaluated.

Statistical analyses were performed using SPSS (SPSS version 20, Inc., Chicago, IL, USA). The patient characteristics and nodular size were analyzed by Fisher's exact test. The relative risk of malignancy was analyzed by logistic regression. Statistical significance was accepted when the corresponding $p < 0.05$. The sensitivity, specificity, positive predictive value, and negative predictive value were defined for each individual US feature in the detection of benign masses.

Significantly different US features of benign thyroid nodules were identified and used to divide thyroid nodules into two groups: Category 1 (benign nodules that required follow-up 6–12 months later but not US-guided FNA); and Category 2 (indeterminate nodules or suspected carcinoma that required US-guided FNA).

Between 2009 and 2010, there were 315 patients who had received US-guided FNA for thyroid lesions and had complete US images and medical records in our institution. To perform validity testing of the US features indicating benign disease, we reviewed the records of all consecutive patients who had histologically proven thyroid carcinoma ($n = 39$) and randomly selected 40 of 276 patients with benign nodules by including the first and second cases of proven benign thyroid nodules in each month of a 2-year period. The evaluation of clinical and histological