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Thyroid nodules with suspicious ultrasound findings: the role of ultrasound-guided core needle biopsy

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ABSTRACT

The aim of this study was to evaluate the value of core needle biopsy (CNB) in the diagnosis of sonographically suspicious thyroid nodules. We retrospectively reviewed 997 patients with sonographically suspicious thyroid nodules who underwent CNB using pathological results as gold standard. In our result, the accuracy of CNB was 98.0%, and its area under the receiver operating characteristic curve was 0.981. The inconclusive result was in 22 (6.0%) of CNBs. Therefore, CNB demonstrates high rates of conclusive and accurate diagnosis in sonographically suspicious thyroid nodules, which may reduce repeat fine needle aspiration, diagnostic surgery, and unnecessary follow-up.

1. Introduction

Ultrasound (US)-guided fine needle aspiration (FNA) is an extensively used interventional procedure to help with the diagnosis of thyroid nodules, which are commonly observed in daily clinical practice [1–3]. Although FNA is a safe, accurate, and low-cost interventional procedure, inconclusive results and false-negative specimens of which often impair the diagnostic value. As reported, the inconclusive result was in 10%–33.6% of FNAs [1,4–6], and it was even in 9.9%–47.8% of repeat FNAs [7–9]. In addition, false-negative results were commonly concerned when nodules with suspicious malignant US features had benign cytological results [10]. In these situations, repeat FNA, diagnostic surgery, or follow-up was recommended, which might increase the expenses and sufferings of the patients.

US-guided core needle biopsy (CNB) is a safe and well-tolerated procedure with low incidence of complications, which enables histological diagnosis with cellular architecture [7,11–13]. Studies indicated that CNB had lower incidence of inconclusive results than FNA [7–9,11]. Although CNB is not commonly used as the first-line interventional diagnostic procedure for thyroid nodules, it has been performed as an alternative procedure to FNA, especially in nodules with previously nondiagnostic FNA results.

At our institution, the pathology department could not provide cytological reports according to the Bethesda system [14], so CNB is performed as the alternative procedure. In this case, the diagnostic performance and the feasibility of CNB for sonographically suspicious thyroid nodules were investigated in this study.

2. Materials and methods

This study was conducted in accordance with The Code of Ethics of the World Medical Association and was also approved by the institutional review board of the hospital. The requirement for informed consent was waived because this was a retrospective study.

3. Patients

From April 2009 to April 2011, 1019 thyroid nodules from 997 patients underwent US-guided CNB in our institution. Nodules with at least one of the following suspicious malignant US findings were subjected to CNB: hypoechogenicity, calcification, irregular or microlobulated margin, intranodular vascularity, and taller than wide [3,15].

Among all the CNB nodules, 369 nodules from 355 patients with final diagnosis were included in this study, containing 101 (27.4%) men (mean age, 45.6 years±12.3; age range, 14–78 years) and 254 (68.8%) women (mean age, 48.6 years±11.5; age range, 17–78 years) with a mean age of 47.7 years±11.8 (age range, 14–78 years).

For malignant nodules (n=221), the final diagnosis was based on histopathologic findings after surgical resection. For benign nodules (n=148), the final diagnosis was based on histopathologic findings after surgical resection (n=25, 16.9%) or benign findings at CNB with a stable size at follow-up (n=123, 83.1%) [2,16].

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3.1. Analysis of US findings

In this study, the US images were obtained by board-certificated sonographers using IU22 (Philips Medical System, Bothwell, WA, USA) or Logiq 9 (GE Health Care, Milwaukee, WI, USA) US system with linear high-frequency probe (5–17 MHz). US images were stored in a picture archiving and communication system and were reviewed independently using the blind method by two sonographers (Mingbo Zhang and Yun Zhou) who had more than 5 years of experience in thyroid US. If there were disagreements on the US features, final impression was made by the consensus of three sonographers, adding another expert (Faqin Lv) with more than 15 years of experience in thyroid US.

US findings for the nodules were evaluated for the following features: size, echogenicity, internal component, margin, calcification, and vascularization. Echogenicity was classified as hyperechogenicity, isoechogenicity, hypoechogenicity, or anechoic. A nodule was defined as isoechogenicity if the echogenicity was similar to that of the thyroid parenchyma, and it was classified as hypoechogenicity or hyperechogenicity if the echogenicity was less than or more than that of the thyroid parenchyma. The internal components of the nodules were classified as solid, mixed solid, or cystic. The margin was classified as well circumscribed or irregular. Calcification, when present, was categorized as microcalcification or macrocalcification. Microcalcification was defined as calcification $\leq$1 mm in diameter and was visualized as tiny punctuate hyperechoic foci, either with or without acoustic shadows. Tiny bright reflector with clear-cut comet tail artifact was considered as colloid [17]. Macrocalcification was defined as hyperechoic foci >1 mm. When a nodule had both types of calcifications (macrocalcification intermingled with microcalcification), it was designated as having microcalcifications. Vascularization was categorized as no blood flow, internal blood flow, or peripheral blood flow. Height was defined as anteroposterior diameter, and width was defined as the larger one of transversal or longitudinal diameter, based on which the height/width ratio was calculated.

3.2. US-guided CNB procedures

US-guided CNB procedures were performed by experienced interventional sonographers using Bard Magnum biopsy instrument with double-action spring-activated 18-gauge needle (Bard Medical Division, Covington, GA, USA). HI VISION Preirus (Hitachi Medical Corporation, Mitaka-shi, Tokyo, Japan) US system with high-frequency linear probe (6–12 MHz) was used for the guidance. After induction of local anesthesia with 1% lidocaine, the core needle was inserted following the direction of the guideline. Color Doppler was used for evaluation of the vessels along with the guidance to avoid hemorrhage. After the needle tip was advanced into the edge of the nodule, the distance of fire was measured to minimize the injury of vessels, and the stylet and cutting cannula of the needle were sequentially fired. Fig. 1 shows the procedure of US-guided CNB. Effective compression of at least 30 min should be applied to the puncture site immediately after the biopsy in order to prevent hematoma.

3.3. Analysis of CNB results

At our institution, a board-certificated pathologist routinely examined the CNB and thyroidectomy specimens, which were reviewed by a chief pathologist with more than 10 years of experience in thyroid pathological examination. If there were more than two nodules, the doctor who performed the US-guided CNB or thyroidectomy would carry out radiology–pathology correlation to ensure the concordance.

Given that the diagnostic criteria for thyroid CNB have not been standardized, the CNB findings were categorized into the same six categories as the Bethesda system, which was used for the analysis of FNA cytology [14,16]. The nondiagnostic CNB results included the absence of any identifiable follicular thyroid tissue, the presence of normal thyroid gland, and tissues containing only few follicular cells that were insufficient for diagnosis. The benign CNB findings included colloid nodules, nodular hyperplasia, and lymphocytic thyroiditis. The atypia/follicular lesion of undetermined significance (AUS/FLUS) CNB findings included nodules in which some atypical cells were present but were not diagnostic of malignancy or suspicion for malignancy. Nodules with histological features favoring follicular neoplasm were categorized as follicular neoplasm (FN) or suspicious for follicular neoplasm (SFN). The suspicious for malignancy CNB finding was designated when the specimen exhibited atypia, but there was

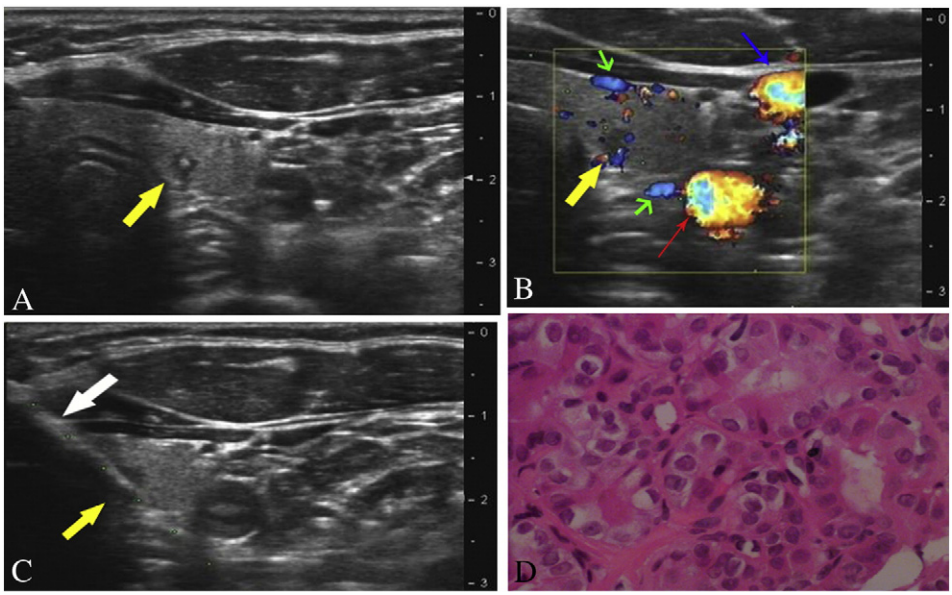

Fig. 1. The US-guided CNB procedure. (A) A 45-year-old female patient had a 3.1-mm×3.4-mm left lobe thyroid nodule with sonographic characteristics of taller than wide, hypoechoic, solid, irregular, and calcification (yellow arrow). (B) Color Doppler indicated the common carotid artery (red arrow), internal jugular vein (blue arrow), and small vessels around the nodule (yellow arrow). The biopsy guideline passed through the site of the nodule with no significant visible vessels along the track. (C) The cutting track (white arrow) went through the nodular center (yellow arrow) without damage to the surrounding tissues. (D) The pathological result was micropapillary carcinoma (hematoxylin and eosin staining, magnified 400 times).