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Original Article

Ultrasound-guided fine-needle aspiration of thyroid nodules: does the size limit its efficiency?

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Abstract: Purpose: The management criterion of thyroid nodules is to evaluate the risk of malignancy, based on cytological examinations. Ultrasound-guided fine-needle aspiration biopsy (US-FNAB) has a highly diagnostic value for thyroid nodules. The aim of this study was to compare the efficacy of US-FNAB for thyroid nodules with different sizes. Material and methods: From August 2013 to November 2013, 344patients with thyroid nodules who had undergone US-FNAB were divided into three groups, according to the largest diameter of their nodules (group A, ≤ 5.0 mm; group B, 5.1-10.0 mm; group C, > 10.0 mm). All the nodules were subsequently verified by histology or follow-up findings. The accuracy, sensitivity, specificity, positive predictive value, negative predictive value of aspiration cytology in each group was compared. Results: Among 344 thyroid nodules diagnosed by cytology, the cytology was classified as nondiagnostic or unsatisfactory for 53 (15.4%) lesions, benign for 144 (41.9%) lesions, atypia of undetermined significance or follicular lesion of undetermined significance for 20 (5.8%) lesions, follicular neoplasm or suspicious for a follicular neoplasm for 26 (7.6%) lesions, suspicious for malignancy for 36 (10.5%) lesions, malignant for 65 (18.9%) lesions. There were 243 benign and 101 malignant nodules confirmed by the pathological or follow-up ultrasound. The sensitivity, specificity, accuracy, positive predictive value, and negative predictive value were confirmed to be 87.5% (14/16), 92.5% (37/40), 91% (51/56), 82.3% (14/17), and 94.8% (37/39) in group A; 92.3% (36/39), 96.9% (94/97), 95.5% (130/136), 92.3% (36/39), and 96.9% (94/97) in group B; and 91.3% (42/46), 93.4% (99/106), 92.7% (141/152) 85.7% (42/49), and 96.1% (99/103), in group C. There were no statistical differences in accuracy, sensitivity, specificity, false positive accuracy, false negative rate of fine needle aspiration of thyroid nodules with different sizes ($P > 0.05$). Conclusion: US-FNAB has similar diagnostic efficacy to thyroid nodules with different sizes.

Keywords: US-guided fine-needle aspiration biopsy, thyroid nodules, cytopathology, thyroid carcinoma, follow-up

Introduction

High-resolution ultrasound is generally considered as the first choice for the evaluation of thyroid, and the number of detected asymptomatic, impalpable lesions in the gland rapidly increases due to its wide use [1, 2]. However, only 5%-15% of thyroid nodules are malignant [3, 4], thus it creates dilemmas in the management of the nodules: aggressive or conservative strategies? The management criterion of thyroid nodules is to evaluate the risk of malignancy, based on cytological examinations. Ultrasound-guided fine-needle aspiration biopsy (US-FNAB) is widely regarded as the preferred diagnostic tool in the evaluation of thyroid nodules with a maximal diameter larger than 1-1.5 cm and of nodules that are smaller with US features of suspicious, such as a solid hypo-echoic mass, taller-than-wide shape, irregular border, microcalcifications [5-9]. However, thyroid FNA cytology was limited by the nondiagnostic results, which have been reported to range from 6.4% to 33.6% [10, 11].

This retrospective study was carried out to evaluate whether the size can influence the efficacy of US-FNAB for thyroid nodules.

Materials and methods

We retrospectively reviewed 344 thyroid nodules which had undergone US-FNAB from

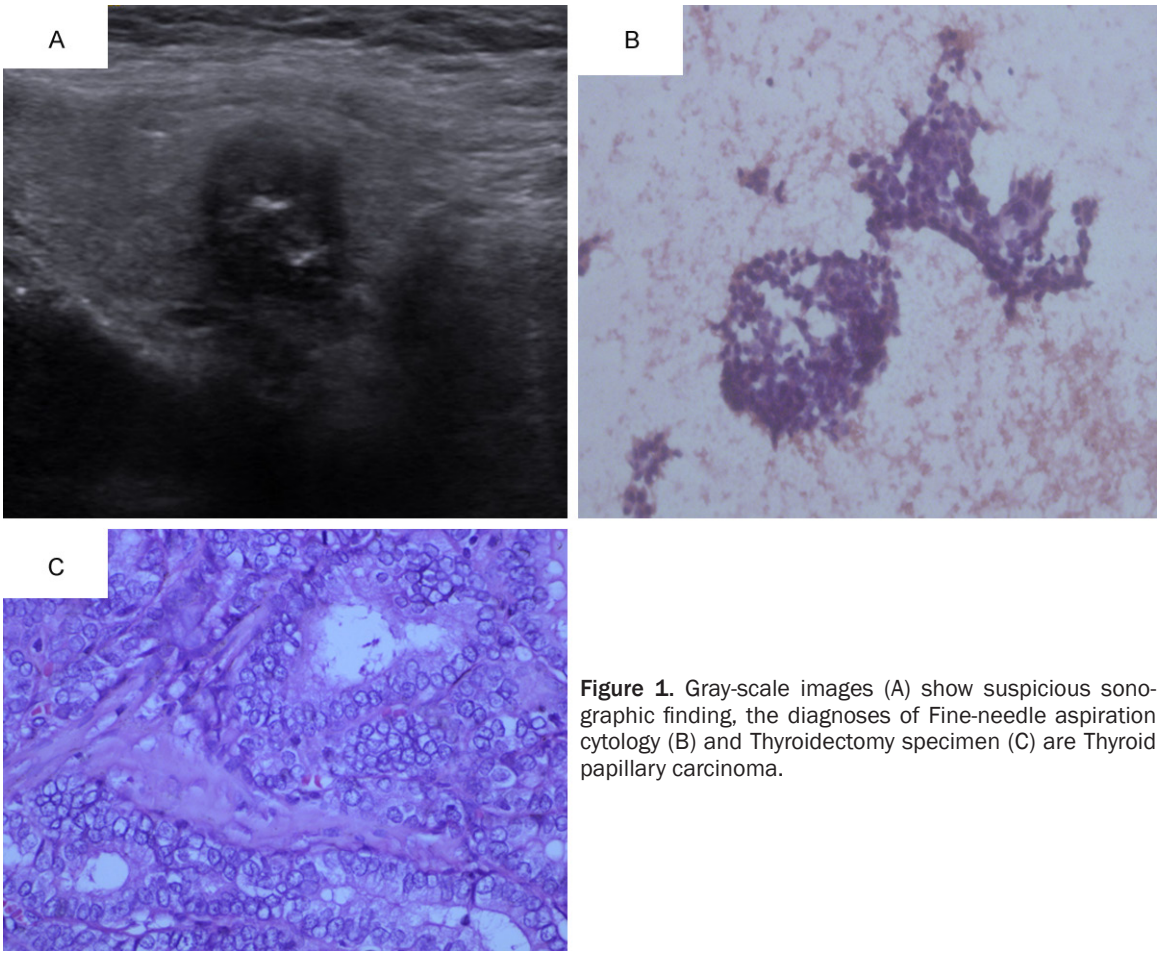

Figure 1. Gray-scale images (A) show suspicious sonographic finding, the diagnoses of Fine-needle aspiration cytology (B) and Thyroidectomy specimen (C) are Thyroid papillary carcinoma.

August 2013 to November 2013 in our hospital. The protocol was approved by the local Ethics Committees and written informed consent was obtained from all the patients. The inclusion criteria for US-FNAB evaluation of the thyroid nodules were as following: I) with suspicious sonographic findings included solid hypoechoic mass, taller-than-wide shape, irregular border, and micro-calcifications; II) nodules with high risk for malignancy: patients with history of thyroid malignancy or family history of thyroid cancer; III) nodules with increasing size during follow up.

Nodules were divided into three groups according to the largest diameter: group A, ≤ 5.0 mm; group B, 5.1-10.0 mm; group C, > 10.0 mm.

US-FNA cytology procedure

Before US-FNAB, all patients routinely underwent serial US examinations, which were performed by one of three experienced operator. US-FNAB was performed by one of three radiologists using a 9-14MHz linear array transducer (Logiq E9; GE Healthcare) and a 23-gauge, 15 cm long needle. The sample was obtained by the needle moving up and down for a few seconds only by movement of the wrist of the operator, mounted immediately onto a glass slide and placed in 95% alcohol solution.

Cytopathological examinations

The Bethesda System for Reporting Thyroid Cytopathology was used as the criteria of standard sample adequacy in our study: the sample was defined as nondiagnostic if it did not have more than 6 groupings of at least 10 thyroid follicular cells each [12].

Follow-up after FNA cytology

In our study, all the nodules that the cytological findings were malignant, suspicious for malignancy, or indeterminate were recommended to

Table 1. Result of FNAB

Cytology	Group A	Group B	Group C
I	10 (17.8%)	17 (12.5%)	24 (15.8%)
II	22 (39.3%)	58 (42.6%)	61 (40.1%)
III	3 (5.3%)	12 (8.8%)	11 (7.2%)
IV	4 (7.1%)	10 (7.4%)	7 (4.6%)
V	6 (10.7%)	16 (11.7%)	18 (11.8%)
VI	11 (19.6%)	23 (16.9%)	31 (20.4%)
Total	56	136	152

Note: The Bethesda System for Reporting Thyroid Cytopathology. I, Non-diagnostic or unsatisfactory. II, Benign III, Atypia of undetermined significance or follicular lesion of undetermined significance. IV, Follicular neoplasm or suspicious for a follicular neoplasm. V, Suspicious for malignancy. VI, Malignant.

Table 2. Results of surgery or clinical diagnosis

Results of cytology	Final results	
	Malignant	Benign
Group A		
Malignant	14	3
Benign	2	37
Group B		
Malignant	36	3
Benign	3	94
Group C		
Malignant	42	7
Benign	4	99

operation, while follow-up FNAB cytology or follow-up ultrasound for those with benign or nondiagnostic cytology. Nodules showed no change on follow-up ultrasound after more than one year, were included in the benign group [13].

Statistical analysis

Results were compared with post-operative diagnoses and clinical follow-up findings. For each tested variable, such as the sensitivity, specificity, positive predictive values (PPV) and negative predictive values (NPV) of US-FNAB, SPSS 20.0 was used for statistical analysis using the chi-square test, $P < 0.05$ was considered statistically significant.

Results

344 patients with a mean age ± standard deviation, 49.8 ± 12.4 years, including 264 women and 80 men, were enrolled in the study. The final diagnoses based on pathology from surgery (n = 171), repeated FNAB cytology (n = 14) or follow-up of over a year (n = 159), and there were 243 benign, 101 malignant in total. Of 56 thyroid nodules diagnosed by cytology in group A, the cytology was classified as nondiagnostic or unsatisfactory for 10 (10/56, 17.8%) lesions, benign for 22 (22/56, 39.3%) lesions, atypia of undetermined significance or follicular lesion of undetermined significance for 3 (3/56, 5.3%) lesions, follicular neoplasm or suspicious for a follicular neoplasm for 4 (4/56, 7.1%) lesions, suspicious for malignancy for 6 (6/56, 10.7%) lesions, malignant for 11 (11/56, 19.6%) lesions. The corresponding numbers were 17 (17/136, 12.5%), 58 (58/136, 42.6%), 12 (12/136, 8.8%), 10 (10/136, 7.4%), 16 (16/136, 11.7%), 23 (23/136, 16.9%), respectively, in group B; and 24 (24/152, 15.8%), 61 (61/152, 40.1%), 11 (11/152, 7.2%), 7 (7/152, 4.6%), 18 (18/152, 11.8%), and 31 (31/152, 20.4%) respectively, in group C (**Figure 1**). There were no significant differences in the adequacy of US-FNAB among groups A, B and C (chi-square test, all $P > 0.05$, **Table 1**). In the benign cytological results of group A, two nodules (2/56, 3.6%) turned out to be malignant even though the cytology findings were benign, three nodules (3/56, 5.4%) turned out to be benign for which the cytology findings were suspicious for malignancy. Three (3/136, 2.2%) and four (4/152, 2.6%) nodules turned out to be malignant even though the cytology findings were benign in group B and C, while three (3/136, 2.2%) and seven (7/152, 4.6%) nodules turned out to be benign for which the cytology findings were suspicious for malignancy, respectively (**Table 2**).

The sensitivity, specificity, accuracy, positive predictive value, and negative predictive value were confirmed to be 87.5% (14/16), 92.5% (37/40), 91% (51/56), 82.3% (14/17), and 94.8% (37/39) in group A; 92.3% (36/39), 96.9% (94/97), 95.5% (130/136), 92.3% (36/39), and 96.9% (94/97) in group B; and 91.3% (42/46), 93.4% (99/106), 92.7% (141/152) 85.7% (42/49), and 96.1% (99/103), in group C (**Table 3**). There were no significant differences in the sensitivity, the specificity, the positive predictive value, the negative predictive value, and the accuracy of US-FNAB among groups A, B and C (chi-square test, all $P > 0.05$).

Table 3. Sensitivity, specificity, accuracy, PPV and NPV calculated according to FNAB

	Group A (≤ 5 mm)	Group B (6-10 mm)	Group C (> 10 mm)	*P* value
Sensitivity	87.5% (14/16)	92.3% (36/39)	91.3% (42/46)	> 0.05
Specificity	92.5% (37/40)	96.9% (94/97)	93.4% (99/106)	> 0.05
Accuracy	91% (51/56)	95.5% (130/136)	92.7% (141/152)	> 0.05
PPV	82.3% (14/17)	92.3% (36/39)	85.7% (42/49)	> 0.05
NPV	94.8% (37/39)	96.9% (94/97)	96.1% (99/103)	> 0.05

PPV, Positive predictive value; NPV, negative predictive value.

Discussion

Regardless of the nodule size, malignancy is found in approximately 5% of thyroid nodules [14]. Since the use of US-guided FNAB in the management of thyroid nodules, there has been a decline in the number of surgery to exclude the nodule malignancy. However, it is still controversial for thyroid nodules smaller than 10 mm evaluated on US-FNAB. The American Thyroid Association (ATA) guidelines proposed that only nodules larger than 10 mm in diameter were more usefully evaluated by US-FNAB [14], and some researchers considered that the sensitivity was lower in the nodules smaller than 5 mm compared with other nodule size [11, 15].

The present study revealed that there were no statistically significant differences in sensitivity for nodules with different sizes. There were 56 nodules less than 5 mm in diameter, and 10 (17.8%) yielded unsatisfactory results. Of the 136 nodules larger than 5 mm but smaller than 10 mm, 17 yielded unsatisfactory results (12.5%), and the nondiagnostic in third cohorts of our study was 24 (15.8%). The size of the nodule did not appear to influence the inadequacy of the aspirated material in our study; the findings of our study are in agreement with the studies by Kim et al. and Nam-Goong et al. [16, 17]. The specificity, accuracy, positive predictive value, and negative predictive value of our study were also similar to the present study [18]. In the procedure of FNAB of the thyroid, there were no severe complications in our study, except for one man with dizziness that might be related to changes in position.

There were several limitations in our study. First, the time of follow-up was only one year; however, it might be not enough to confirm the natures of the thyroid nodules, which would lead to overestimated diagnostic ability of US-FNAB to some extend. Second, our study was not a large-scale study thus future studies with more patients were mandatory.

In conclusion, although nondiagnostic results were observed in the process of US-FNAB, it is a useful technique to evaluate the thyroid nodules, even in the nodules less than 5 mm in maximum diameter. US-FNAB has similar diagnostic efficacy to thyroid nodules with different sizes.

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Disclosure of conflict of interest

None.

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