The Relationships of the Type of Needle and the Flushing of the Needle with the Satisfactory Rate of Thyroid Nodule Fine Needle Biopsy

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Abstract: **Objective**: To explore the factors that affect the satisfactory rate of fine needle aspiration biospy(FBAB)sampling of thyroid nodules and the effects of different needle types and needle flushing methods on the satisfactory rate of FNAB sampling. **Methods**: The clinical data of 190 patients with thyroid nodules (200 nodules in total) who underwent FNAB from June 2020 to December 2020 were analyzed. The relationship of the satisfaction rate of sampling with the type of puncture needle and the flushing method of the puncture needle was analyzed. **Results**: In 200 thyroid nodules, we found that the nondiagnostic rate (37%) with a larger needle (22G) was lower than that with a smaller needle (25G) (55%), and the difference was statistically significant ($P < 0.05$). In the analysis of the comparison of the satisfaction rate of the flushing of the puncture needle, it was found that the nondiagnostic rate of the flushing method was lower (24%) than that of the nonflushing method (68%), with a statistically significant difference (< 0.05). In the randomized test according to the size of the puncture needle and the flushing method, the nondiagnostic rates of the four groups (25G needle with flushing group, 25G needle without flushing group, 22G needle with flushing group and 22G needle without flushing group) were 34%, 76%, 14% and 60%, respectively. Moreover, there was no significant change in the diagnosis rate of benign and malignant lesions in the obtained samples ($p=0.912$). **Conclusion**: In fine-needle biopsy of thyroid nodules, a larger needle should be used in combination with the flushing method to reduce the nondiagnostic rate and improve the pathological diagnosis rate.

Keywords: Thyroid Nodules; Fine Needle Biopsy; Needle Flushing

Introduction

Thyroid nodules are common thyroid diseases, with a prevalence of 4-7%. Malignant nodules account for approximately 5 ~ 15% of the total number of thyroid nodules [1]. It is the primary purpose of thyroid nodule diagnosis to identify benign and malignant thyroid nodules, which can not only reduce the economic and mental burden of patients but also be particularly important for disease treatment and prognosis. At present, fine needle aspiration biopsy (FNAB) is considered the most convenient, safe and effective method to detect benign and malignant thyroid nodules [2]. However, when using FNAB as a clinical examination means, misdiagnosis and missed diagnosis are inevitable [3]. It is reported in the literature that approximately 1/5 of thyroid nodules cannot be clearly diagnosed by pathology [4]. It is considered that dissatisfaction with specimens is the most common reason for the low positive rate. At present, some studies have found that the diameter and type of puncture needle are the factors affecting the dissatisfaction of nodule puncture specimens [5-6], and some studies have reported that the flushing of the puncture needle may have an impact on the satisfaction rate of puncture specimens [7]. This study combines these two factors to analyze whether they have an impact on the nondiagnostic rate of specimens.

Methods

A total of 190 patients with thyroid nodules who underwent FNAB in our department from June 2020 to December 2020 were enrolled, with a total of 200 nodules. All patients were informed before the operation and signed informed consent to undergo FNAB. We randomly divided the patients into four groups according to the use of different sizes of puncture needles and whether the puncture needles were rinsed: the group using 25G needles with flushing, the group using 25G needles without flushing, the group using 22G needles with flushing, and the group using 22G needles without flushing. Inclusion criteria: We first used ti-rads (ACR ti-rads) published by the American Society of Radiology in 2017 for classification. According to the ACR ti-rads guidelines, nodules that were rated above TR3 with a size reaching the puncture index were all included in this study. Exclusion criteria: nodules rated as TR2 or below and nonthyroid origin nodules.

All punctures were performed by the same interventional radiologist with technical experience (more than 5 years). The puncture process was as follows: the patient reclined on his or her back, Betadine iodine solution ®) was applied on the skin over the nodule, and a 22G or 25G needle was connected with a specimen aspirator (CYTOMAT) for puncture. Under the guidance of ultrasound, the puncture successfully entered the nodule and began to aspirate samples. Three to five back-and-forth suctioning motions were performed in different directions, and then the sample was injected into a solution containing 10 ml of normal saline by a puncture needle without repeated flushing. Then, Papanicolaou technology was used to stain the cells.

In patients in the flushing group, in addition to the described process, the puncture needle was injected into a solution containing 10 ml of normal saline for 5-10 repeated flushes. Then, Papanicolaou technology was used to stain the cells.

The cytological and pathological classification of thyroid nodules referred to the Bethesda system classification standard, and the diagnosis of thyroid nodules by cell smear was divided into I ~ VI: class I, the samples are unsatisfactory or the samples cannot be used for pathological diagnosis; class II, considered benign lesions; class III, atypical cell lesions with ambiguous meaning or follicular lesions with ambiguous meaning (AUS/flu); and class IV, follicular tumors or suspected follicular tumors. Class I is regarded as unsatisfactory for needle aspiration cytology samples, and classes II to VI are regarded as satisfactory for needle aspiration cytology samples.

SPSS 22.0 statistical software was used to analyze and process the data. The measurement data are expressed as the means ± standard deviations ($x \pm s$). The chi square test was used for the comparison of the count data, and the four grid table method was used for the comparison between and within the measurement data groups. $P < 0.05$ indicates significance.

Results

A total of 200 thyroid nodules were included in this study. Table 1 shows the basic characteristics of the patients studied. We found that there was no significant difference in age, sex, TSH, plasma concentration of free T3 or free T4, thyroid nodule grade or nodule size.

In different study groups (Table 2), we found that the nondiagnostic rates of the four groups of samples were 14%, 36%, 60% and 74%. The sample nondiagnostic rate of the group using 25G needle without flushing was the highest(74%). Moreover, it was found that the group using a thicker needle, 22G, plus flushing had the lowest nondiagnostic rate of 14%. There was a significant difference ($P < 0.05$). Among the groups using different sizes of puncture needles(Table 4), the nondiagnostic rates of 22G and 25G puncture needles were 37% and 55%, respectively, and there was a significant difference ($p=0.01$). In the comparison of the flushing method(Table 5), the nondiagnostic rates of the group using puncture needle flushing and the group without flushing were 24% and 68%, respectively, which were significantly different ($p<0.05$). Among the groups with pathological diagnosis(Table 3), the malignant diagnosis rate was 4 - 10%, which was not statistically significant. This indicates that the use of different sizes of puncture needles and lavage or not had no effect on

the differentiation of tumor properties.

Table 1 Demographic characteristics of the selected patients

Case(s)	200
Age (year)	47.28± 17.03
Sex	Male-69 Female-131
TSH level (normal range: 0.5 to 5.0 mIU/L)	2.89±1.2
Free T3 (normal range: 0.9-2.8 nmol/L)	1.96 ± 0.59
Free T4 (normal range: 0.7-1.53 ng/dL)	1.14 ± 0.41
ACR TI-RADS classification	
TR3	137
TR4	49
TR5	14
The size of nodule(cm)	3.54 ± 1.23 cm

Table 2 Comparison of basic data of each group

	25G with needle flushing group	25G without needle flushing group	22G with needle flushing	22G without needle flushing	P value
Case(s)	50	50	50	50	
Age (years)	48.62±17.62	47.80±17.19	44.74±15.67	47.96±17.56	0.727
Sex	F-39, M-11	F-38, M-12	F-33, M-17	F-30, M-20	0.163
TSH level(mIU/L)	2.92±1.27	3.01±1.30	2.99±1.11	2.63±1.1	0.398
Free T3 (nmol/L)	2±0.57	1.93±0.55	1.95±0.59	1.96±0.66	0.951
Free T4 (ng/dL)	1.14±0.4	1.19±0.43	1.07±0.46	1.16±0.43	0.557
ACR TI-RADS classification					0.881
TR3	33	35	33	36	
TR4	13	12	13	11	
TR5	4	3	4	3	
The size of lesion(cm)	3.62±1.29	3.61±1.37	3.34±1.14	3.59±1.14	0.527

Table 3 Comparison of nondiagnostic rate and nodule results after puncture in each group

	25G with needle flushing group	25G without needle flushing group	22G with needle flushing group	22G without needle flushing group	P value
Nondiagnostic(cases)	17 (34%)	38 (76%)	7 (14%)	30 (60%)	0.000
Benign	30 (60%)	10 (20%)	38 (76%)	13 (26%)	0.912
Malignant	3 (6%)	2 (4%)	5 (10%)	2 (4%)	0.912

Table 4 Comparison of the nondiagnostic rate of puncture needles with different sizes

	22G needle group	25G needle group	P value

Nondiagnostic(cases)	37(37%)	55(55%)	0.01

Table 5 Comparison of nondiagnostic rates between the groups with and without flushing puncture needles

	Needle flushing group	No needle flushing group	P value
Nondiagnostic(cases)	24 (24%)	68 (68%)	0.00

Discussion

Thyroid cancer is the most common malignant tumor of the endocrine system in the clinical setting [8]. Although high-frequency ultrasound is the first choice for screening thyroid nodules and differentiating benign and malignant thyroid nodules, it can only give a clear diagnosis of benign and malignant thyroid nodules. Puncture biopsy has become an inspection technique to further judge the benign and malignant nature of nodules. However, due to the associated tissue damage, relatively weak controllability, and strict requirements for puncture target nodules, puncture biopsy has limited clinical application. In contrast, as a minimally invasive and relatively controllable inspection method, fine-needle puncture can be performed on an outpatient basis. Moreover, the sensitivity and specificity of ultrasound-guided FNAB in the diagnosis of thyroid cancer can be as high as 98% and 100%, respectively [9].

To improve the diagnostic efficiency of puncture cytology specimens, the Bethesda reporting system was proposed by the American Cancer Institute in 2007 [10]. It is reported in the literature that according to the Bethesda report system classification that if FNAB puncture results are undiagnosed or unsatisfactory, approximately 4% of nodules may still be malignant tumors [11]. Therefore, improving the satisfaction rate of cytological specimens with diagnostic significance is of great significance to the clinical diagnosis and treatment of thyroid nodules. Obtaining satisfactory cytological specimens is not only a prerequisite for reducing false negative diagnoses of FNAB in thyroid nodules but can also significantly increase the sensitivity and specificity of FNAB [12-13].

In this study, we found that the nondiagnostic rates of using 22G and 25G puncture needles were 37% and 55%, respectively. The difference was statistically significant (p-0.01). The diameter of the 22G needle is larger than that of the 25G needle, so the 22G fine needle has more tissue cells than the 25G needle, less interference of blood cells, and more sufficient tissue cells for smear. It is easier to obtain a better sample successful rate for 22G fine needles than 25G fine needles when puncturing thyroid nodules. The nondiagnostic rates of the samples in the different groups with and without flushing the puncture needle were 24% and 68%, respectively. When the puncture needle enters the nodule to suck up cells, some of the cells will remain in the puncture needle. When flushing repeatedly, the cells remaining in the puncture needle can be washed into the test tube to increase the number of cell samples and improve the probability of diagnosis, increasing sensitivity and specificity. Therefore, in the group using 22G needles with rinsing, the sample nondiagnostic rate was the lowest(14%). Therefore, this study indicates that the use of a larger puncture needle with flushing can improve the sample satisfaction rate of fine-needle puncture and increase the pathological diagnosis rate.

There are some limitations in this study. The number of specimens in this study was small (200 cases), and this study was a single-center study. More research is needed in the future.

Conflicts of interest

The authors declare that they have no conflicts of interest.

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