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Comparative Application of 5 mL Syringe and 22G PTC Needles in Thyroid Nodule Fine-Needle Aspiration

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Abstract: This study aims to compare the differences in sampling satisfaction rates between 5 mL syringe and 22G percutaneous transhepatic cholangiography (PTC) needles in fine-needle aspiration (FNA) to provide economical and reasonable needle selection. From January 2021 to March 2022, 187 patients with thyroid nodules (a total of 200 nodules) who underwent ultrasound-guided FNA were punctured using 22G PTC and 5 mL syringe needles once for each nodule, and the sample was sent for pathological examination. The sample satisfaction rate of the two methods was statistically analyzed, and factors affecting the sample satisfaction rate were determined. Results demonstrated that the overall sample satisfaction rates of 5 mL syringes and 22G PTC needles were 83% and 85% (P>0.05), respectively. The satisfaction rates of the two specimens were 92.6% and 91.1% (P>0.05) among 136 nodules with poor blood supply. For 64 nodules with rich blood supply, the satisfaction rate of both specimens was significantly lower than that of the nodule with poor blood supply (P<0.05), and that of the 5 mL syringe needle was significantly lower than that of the latter (62.5% *vs.* 71.8%, P<0.05). The results suggest that satisfactory sampling results can be obtained using either a 5 mL syringe or 22G PTC needles. The 22G PTC needle is more likely to yield FNA results if the nodule is rich in blood supply.

Key words: thyroid nodule; ultrasound examination; fine-needle aspiration biopsy
CLC number: R 445.1

0 Introduction

Ultrasound-guided fine-needle aspiration (US-FNA) is one of the most convenient, accurate, and effective clinical modalities to detect the nature of thyroid nodules. Although the use of FNA is widespread, the proportion of patients who cannot obtain diagnostic results owing to unsatisfactory specimens in clinical practice is approximately 28.7%[1]. Many factors affect FNA results, including operator experience, needle selection, and nodule characteristics. Recently, several studies recommend the use of specialized thyroid FNA biopsy

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needles. However, FNA biopsy needle is not hard and sharp enough, require well trained technique and is too expensive. In contrast, the 5 mL syringe needle is quite economical, with tough and sharp needles, easy to operate, having broad clinical applications. The differences in the value of thyroid nodule cytology between the two needles are worth assessing to provide more reference for clinical thyroid FNA.

1 Material and Methods

This prospective study was performed in the Department of Ultrasound at the Xiangyang Central Hospital, Affiliated Hospital of Hubei University of Arts and Science. The local ethics committee of the hospital approved the study, and written informed consent was obtained from all participants.

1.1 Research Objects

A total of 187 patients (a total of 200 nodules) between 18 to 75 years undergoing FNA were recruited consecutively at Xiangyang Central Hospital, Affiliated Hospital of Hubei University of Arts and Sciences from January 2021 to March 2022. This study included 83 men and 104 women, with an average age of (43.5 ±12.5) years. FNA is performed on nodules with one of the following ultrasound signs, including hypoechoic, solid, irregular or lobed shape, microcalcification, and aspect ratio ⩾1 [2, 3]. Patients with cystic or predominantly cystic solid nodules, coagulopathy, mental disorders, and inability to cooperate were excluded.

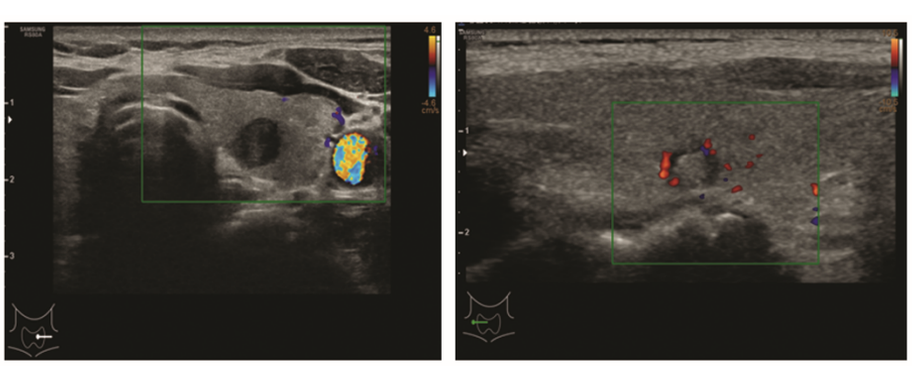
1.2 Instruments and Methods

1) Main instruments: Samsung Rs80A ultrasonic diagnostic instrument, L3-12A linear array probe. The thyroid FNA biopsy needle was a 22G percutaneous transhepatic cholangiography (PTC) needle (outer diameter 0.7 mm) and 5 mL syringe (outer diameter 0.7 mm).

2) Ultrasound examination: First, a two-dimensional ultrasound examination was performed to observe the boundary, shape, internal echo, and calcification of thyroid nodules. To observe the blood flow in and around the lesion, a color Doppler ultrasound was conducted. The excessive compression affecting the blood flow signal was avoided by placing the probe lightly above the nodule as far as possible. The low-speed scale was used to observe the low-speed blood flow signal in and around the lesion.

3) Blood flow classification of thyroid nodules: The richness of the blood flow signal of thyroid nodules requiring puncture was evaluated and graded using the Alder semi-quantitative classification method. The criteria were as follows: Level 0: No blood flow signal; Level 1: 1-2 punctate or short rod blood flow signals; Level 2: 3-4 punctate blood flow signals or a clear long strip of blood flow signals; Level 3: More than 5 punctate blood flow signals, more than 2 long strip blood flow signals or reticular blood flow signals. Level 0 and level 1 were classified as nodules with poor blood supply, while level 2 and level 3 were classified as nodules with rich blood supply (Fig. 1(a) and (b)).

4) Ultrasound-guided FNA: Patients were positioned supine, routine disinfection was carried out, and towels were placed. 5 mL syringe and 22G PTC needles were used to puncture the same nodules 10-15 times without negative pressure, and the samples were quickly smeared and labeled. Two experienced Ultrasound interventional physicians performed the puncture procedures, and the smears were diagnosed by two pathologists with more than 5 years of experience in thyroid pathology analysis.



(a) (b)

Fig. 1 Blood flow classification of thyroid nodules

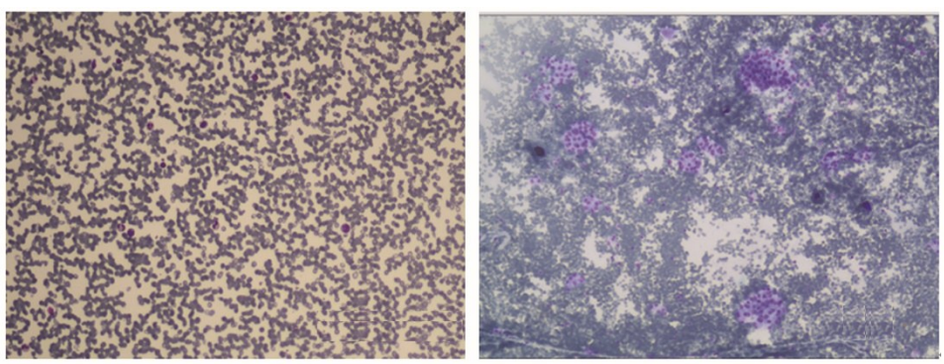
(a) The nodule with poor blood supply (Alder level 0); (b) The nodule with rich blood supply (Alder level 2)

5) Determination of thyroid cytology results: According to the Bethesda classification, cytology results were divided into six categories[4]: unsatisfactory or undiagnosable lesions, benign, indeterminate or atypical lesions, follicular tumors, suspected malignancy, and malignancy. The last five categories were classified as satisfactory.

Specimen satisfaction criteria: at least six follicular cell masses in a single smear, at least 10 cells in each cell mass with relatively intact cell morphology, any number of significant atypical cells, a large number of inflammatory cells, or easily recognizable colloid under the microscope, and no minimum number of follicular cells (Fig. 2(a) and (b)).

6) Statistical methods

Statistical analyses were performed with SPSS 25.0 statistical software. Continuous variables were expressed as the mean±standard deviation or median (interquartile range), and the count data were statistically described by frequency (percentage). The Chi-square test was used for statistical analysis in this study, and $P<0.05$ was considered statistically significant.



(a) (b)

Fig. 2 The puncture cytology results which are divided into satisfactory and unsatisfactory groups

(a) Unsatisfactory result with only blood cells at 10× magnification (Wright's stain); (b) Satisfactory result with more than six clusters of follicular epithelial cells with more than 10 cells in each cluster at 10× magnification (Wright's stain)

2 Results

2.1 Statistics of the Satisfaction Rate of US-FNA Puncture Specimens with Two Kinds of Puncture Needles

Among 200 cases of thyroid nodules, 170 (85%) were satisfied, 30 (15%) were not satisfied, the satisfaction rate of the 22G PTC puncture needle group was 85%, and that of the 5 mL syringe needle puncture group was 83%, with no statistical significance between the two groups ($P>0.05$). There were no complications such as bleeding and pain during FNA.

2.2 Satisfaction Rate of Puncture Specimens with Different Puncture Needles for Thyroid Nodules of Different Blood Supply Types

Among the 200 cases of thyroid nodules, 136 were classified as grade 0 and 1 according to the Alder semi-quantitative classification, which was classified as nodules with poor blood supply. The specimen satisfaction rates of the 22G PTC and 5 mL syringe needles were 91.1% and 92.6%, respectively, and the difference was not significant ($P>0.05$). The other 64 nodules were classified as grade 2 and 3, which were rich in blood supply. The specimen satisfaction rate of the 22G PTC needle was significantly higher than that of a 5 mL syringe needle (71.8% *vs.* 62.5%), and the difference was significant ($P<0.05$). Among the nodules with a 22G PTC needle,the satisfaction rates of the nodules with poor and rich blood supply were 91.1% and 71.8%, respectively, with a significant difference ($P<0.05$). Among the nodules with a 5 mL syringe needle, the satisfaction rates of the poor and rich nodules were 92.6% and 62.5%, respectively, and the difference was significant ($P<0.05$).

3 Discussion

The US-FNA is currently recognized as one of the preferred methods for preoperative determination of the nature of thyroid nodules worldwide owing to its high sensitivity and specificity, minimally invasive technique, easy operation, and economic characteristics[5, 6]. How-

ever, some studies have shown that 2%-20% of thyroid US-FNA samples cannot give a definitive diagnosis, and the operation process is easily affected by nodule size, blood supply status, puncture technique, and puncture needle specification, resulting in insufficient sample size, unsatisfactory sampling, or puncture failure [7,8].

Currently, most hospitals in China use special PTC cytology puncture biopsy needles for thyroid US-FNA, while some primary hospitals still use a 5 mL common syringe owing to its low price and easy patient acceptability. In this study, a 22G PTC (with an external diameter of 0.7 mm) and 5 mL syringe needles (with an external diameter of 0.7 mm) were used to puncture the same nodules. The overall satisfaction rates of puncture specimens were 85% and 83%, respectively, with no significant difference (P>0.05). This indicates that both the 22G PTC and 5 mL syringe needles can meet the current US-FNA.

Blood interference has been reported as the main cause of unsatisfactory smear in several studies. Considering that the type of blood supply to the nodules may affect the satisfaction rate of puncture specimens, Zhang *et al*[9] found that thyroid nodules with rich blood supply are often unsatisfied due to excessive blood cells in the smear. Xia *et al*[10] believed that the different blood supply types of thyroid nodules did not affect the satisfaction rate of specimens. However, the aforementioned scholars generally divided the types of blood supply to the thyroid nodules into the rich and low blood flows or only divided them based on the blood flow distribution of nodules into central, peripheral, and no blood flow distributions. The determination of this type of blood supply is commonly influenced by subjective factors and poor reproducibility. According to the Alder semi-quantitative grading method, thyroid nodules were divided into two groups: the poor and rich blood supply groups. The overall satisfaction rate for specimens was 92.6% and 71.8%, respectively. The satisfaction rates of nodules with poor and rich blood supply for 22G PTC puncture needle were 91.1% and 71.8%, respectively. The satisfaction rates for nodules with poor and rich blood supply with a 5 mL syringe needle were 92.6% and 62.5%, respectively, and the differences between the two groups were statistically significant (P<0.05). The difficulty in obtaining satisfactory specimens for rich blood supply nodes may be related to easy bleeding during the piercing process[11] because the needle extracted blood cells more easily. Negative pressure was not used in the puncture operation in this study. For some rich blood supply nodules, the author believes that more blood components are present at the tail of the needle when the needle tip enters the nodule, even if negative pressure is not used, resulting in unsatisfactory specimens.

The specimen satisfaction rates of 22G PTC and 5 mL syringe needles were 71.8% and 62.5%, respectively, in 64 cases of nodules with rich blood supply, and the difference was statistically significant (P<0.05), which may be due to the differences in the structure and design of the two types of needles. Because it can target lesions before pulling out the needle core, a PTC needle can reduce non-nodular cells in the needle path and blood clot disruption. However, for a 5 mL syringe needle without a needle core, blood easily enters needles to form blood clots and jam the needle, or blood may even wash away or dilute follicular epithelial cells, affecting the puncture specimen satisfaction rate. The specimen satisfaction rates of 22G PTC and 5 mL syringe needles were 91.1% and 92.6%, respectively, among 136 cases of poor blood supply nodules, and the difference was not statistically significant (P>0.05), possibly because the blood supply of nodules was not rich, and the bleeding during puncture was relatively less. Therefore, there was no difference in the satisfaction rates of the two types of puncture needles. We discovered in this study that a 5 mL syringe needle has an advantage over a PTC needle when puncturing nodules with greater hardness, because it is sharp and strong. However, the needle of a 5 mL syringe needle is only 3.2 cm long, so doctors must rely on their experience and design a reasonable puncture path to obtain satisfactory sampling.

4 Conclusion

When performing FNA for thyroid nodules, a PTC needle has its unique advantages for nodules with rich blood supply. For poor blood supply nodules, both 5 mL syringe and PTC needle can be chosen. However, a 5 mL syringe is economic, which is worth promoting in primary hospitals.

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