

Evaluation of the Incidence on Insufficient Cytology Results Comparing Different Ultrasound-Guided Aspiration Techniques for Thyroid Nodules

상이한 초음파 유도 흡인 기술에 따른 불충분 갑상선 세포검사 발생빈도의 비교 평가

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Purpose: We compared the incidence of insufficient thyroid cytology due to blood-stained materials or low cellularity in terms of aspiration technique, especially focusing on the degree of suction pressure and needle size.

Materials and Methods: Three experienced radiologists performed ultrasound-guided aspiration for thyroid nodules in 1174 thyroid nodules consecutively. Three different techniques were used; (A) using a 25 gauge needle with mainly capillary technique in 269 nodules; (B) using a 25 gauge needle with 3 cc syringe and minimal suction pressure in 303 nodules; (C) using a 22-23 gauge needle with 10 cc syringe and aspirator in 602 nodules. The differences of the incidence of the insufficient cytology among the three aspiration techniques and relationships of the incidence and needle size/degree of suction pressure was statistically analyzed using the Mann-Whitney U test and the chi-square test with linear-by-linear association.

Results: Overall, the difference in insufficient cytology was significant across the three aspiration technique ($p = 0.004$), and the incidence tended to increase significantly with increase of needle size and degree of suction pressure ($p < 0.001$). A pairwise comparison of aspiration techniques found significant differences ($p = 0.003$) between techniques (A) and (C), and no differences between technique (B) and (C) ($p = 0.07$) and between techniques (A) and (B) ($p = 0.10$).

Conclusion: The incidence of insufficient cytology was significantly low in the capillary technique, and it increased significantly with the increase of needle size and degree of suction pressure.

Index terms

Thyroid Nodule
Fine Needle Aspiration
Insufficient Cytology

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INTRODUCTION

Fine needle aspiration (FNA) for thyroid nodule is a standard diagnostic procedure. One major limitation of FNA is a non-diagnostic cytology result due to inadequate cytology specimen. Although FNA generally yields sufficient cytology results, there have been questions with regard to aspiration pressure and needle size. Previous studies evaluated the differences of sufficient sample rates between thick and thin needles and between the FNA with active suction (FNAS) and FNA capillary techniques

(FNAC) and the result of the comparative studies were inconclusive (1-8). In this study, we compared the incidence of insufficient cytology results according to the aspiration techniques, especially focusing on the degree of suction pressure and needle size.

MATERIALS AND METHODS

From May 2009 to December 2010, three experienced radiologists who are familiar to the ultrasound-guided aspiration, performed FNA studies consecutively in 1174 thyroid nodules from

987 patients (322 men, 665 women; mean age 52.7 years) during different time periods. The operators performed FNA studies over 5 to 17 months consecutively with or without overlapping time periods. The three radiologists used different aspiration techniques [we arbitrarily described as the technique (A), (B), and (C)], and they did not acknowledge that their FNA studies were conducted in different ways from one another. For technique (A), 25 gauge needles were used mainly with capillary technique, and the radiologist had 2 years of experience in FNA. For technique (B), 25 gauge needles with 3 cc syringe were used with intermittent minimal suction pressure, and the radiologist had 8 years of experience in FNA. For technique (C), 22-23 gauge needles with 10 cc syringe and aspirator were used for active aspiration, and the radiologist had 5 years of experience in FNA. The aspiration volume in technique (C) was usually to fill the needle hub. The aspiration volume in technique (A) and (B) was usually one third of the needle hub. Aspiration was usually conducted once or twice per nodule.

During the study period, the cytology was not reported according to the Bethesda system criteria. We retrospectively categorized cytology results as four grades: grade 1 for blood only or mostly blood cells with scant cellularity, grade 2 for scanty follicular cells with hemorrhagic background, grade 3 for insufficient results due to scanty cellularity without mention of hemorrhagic background, and grade 4 for sufficient cytology specimen. We arbitrarily assumed invasiveness of three aspiration techniques according to the needle size and degree of suction pressure, and we assigned ordinal scales as followed; technique (A) as 1, technique (B) as 2, and technique (C) as 3.

We evaluated the incidence of malignancy and analyzed whether the incidence of malignant lesions was different among the three groups by using the Kruskal-Wallis test. The difference in incidence of insufficient cytology results and the relationships

between the incidence and invasiveness of the aspiration technique among three technique groups was statistically analyzed using Pearson's chi-square test with linear-by-linear association. The pairwise incidence differences between each pair of groups was statistically analyzed using the Mann-Whitney U test and the relationships between the incidence of insufficient cytology results and invasiveness of aspiration technique among groups was analyzed by the Pearson's chi-square test with linear-by-linear association. Statistical analysis was performed using SPSS for Windows (SPSS Inc., an IBM Company, Chicago, IL, USA), and *p*-values of less than 0.05 were considered to represent statistical significance.

RESULTS

Malignant lesions were present in 15% (178/1174) of all nodules [14.9% (40/269) for group of technique (A), 15.5% (47/303) for group of technique (B), 15.1% (91/602) for group of technique (C)], and there was no significant differences in the incidence of malignant lesions between three groups. The insufficient cytology results occurred in 18.6% for the technique (A), 24.4% for the technique (B), and 29.2% for the technique (C), and detailed results are summarized in Table 1. Overall, the difference in incidence of the insufficient cytology results was significant among the three aspiration techniques (*p* = 0.004), and the incidence of insufficient cytology results tended to increase significantly with the increase of needle size and degree of suction pressure (linear-by-linear association, *p* < 0.001). By comparing the two aspiration techniques, the difference was significant (*p* = 0.003) between technique (A) and (C), and not significant between technique (B) and (C) (*p* = 0.07) or between technique (A) and (B) (*p* = 0.10). The proportional tendency between the incidence of insufficient results and needle size/degree of suction pressure was statistically

Table 1. Results of Cytology Specimen According to the Aspiration Technique

Technique	Results of Cytology				Total
	Grade 1	Grade 2	Grade 3	Grade 4	
A (25 G, FNAC)	9	17	24	219	269
B (25 G, FNAS)	17	14	43	229	303
C (22-23 G, FNAS)	56	43	77	426	602
Total	82	74	144	874	1174

Note.—Grade 1 for blood only or mostly blood cells with scant cellularity, Grade 2 for scanty follicular cells with hemorrhagic background, Grade 3 for insufficient results due to scanty cellularity without mention of hemorrhagic background, Grade 4 for sufficient cytology specimen. FNAC = fine needle aspiration capillary technique, FNAS = fine needle aspiration with active suction

significant between technique (A) and (C) (linear-by-linear association, $p < 0.001$), technique (B) and (C) ($p = 0.02$).

DISCUSSION

In our study, FNAC with a smaller fine needle yielded better results in terms of sufficient cytology specimen. Cytology adequacy is important for accurate diagnosis of thyroid nodule. There have been controversial results about the needle sizes and aspiration techniques for adequate cytology specimen in thyroid nodules, and the previous results were summarized in Table 2. Previous comparative studies have shown no significant differences between FNAC and FNAS (1, 2). However, there have been one-sided results favoring FNAC (3, 4) or FNAS (7). Similarly in the aspiration technique, there have been no prominent differences in results on needle sizes (5, 6, 9), or one-sided results favoring smaller needles (3, 7) or larger needles (8). In summary, although sufficient volume of aspiration may be obtained by using larger needles and active suction, it may not guarantee adequacy of cytology specimen and may be more easily obscured by red blood cells (5, 6).

In our study, a mixed combination of the aspiration techniques and needle sizes could be compared fortuitously, and FNAC resulted in better cytology adequacy. The volume of aspiration in FNAC was relatively smaller than the volume of FNAS within our study. Although it may seem peculiar that the smaller volume of aspiration could result in better cytology adequacy, we interpret our results in terms of needle sizes and degrees of suction. Generally, we can see several vessel structures in thyroid nodules on a color Doppler study. In our opinion, although the difference of needle size was about 0.2 mm in our study, large sized needles may be more likely to puncture or penetrate the vessel structure. One of the criteria of needle withdrawal during FNA is the vol-

ume of aspiration. If we combined large needle sizes with active suction, we may have a large volume of aspiration rapidly, but the chance of blood-stained materials occupying the volume may be increased and the incidence of insufficient cytology may increase. From the patient's perspective, a thinner needle with capillary technique may cause the least discomfort such as pain and bleeding within the thyroid gland. In addition, although the chances are extremely low, the possibility of needle tract seeding during FNA may be smaller in finer needles and FNAC (10).

We have encountered some limitations in this study. First, we did not consider nodule characteristics such as vascularity, echogenicity, and size of the nodules. The imaging characteristics such as echogenicity, vascularity, and size may affect the adequacy of cytology specimen. Heterogeneous echoic nodule, cystic portions > 50%, and sizes less than 5 mm or larger than 10 mm were all related to the inadequate cytology results (9, 11). In our study, the operator performed FNA studies consecutively and independently, and the incidences of malignancy among three groups were not statistically different. Therefore, we think that the imaging characteristics of the nodules may not be significantly different between the three groups. Second, the cytology results might not be consistent because specimens were read by several pathologists during the study, and cytology reports were not made by the standardized form such as the Bethesda system.

In conclusion, the incidence of insufficient cytology result was significantly different according to aspiration technique, and it was least in the capillary technique. The incidence of insufficient cytology result tended to increase significantly with increase of needle size and degree of suction pressure.

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Table 2. Summary of the Comparative Studies between FNAS and FNAC

References	Insufficient Cytology Results		p-Value
	FNAS (%)	FNAC (%)	
Haddadi-Nezhad et al. (2)*	4.62	4.69	NS
Tublin et al. (1)	11	13	NS
Degirmenci et al. (3)	50.60	23.10	$p < 0.01$
Romitelli et al. (4)	16.30	5.80	$p < 0.05$
de Meer et al. (7)	34.80	59.20	$p < 0.01$

Note. — *Haddadi-Nezhad (2003) compared the qualitative score of cytology specimen.

FNAC = fine needle aspiration with capillary technique, FNAS = fine needle aspiration with active suction

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상이한 초음파 유도 흡인 기술에 따른 불충분 갑상선 세포검사 발생빈도의 비교 평가

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목적: 갑상선 결절의 세침흡인검사에서 흡인 압력의 정도와 바늘 크기가 서로 다른 3가지 검사방법에 따른 불충분 병리 결과의 발생빈도를 조사하고자 하였다.

대상과 방법: 3명의 경험이 풍부한 영상의학과 의사가 1174개의 갑상선 결절에서 연속적으로 초음파 유도하 세침흡인검사를 다음의 세 가지 방법으로 각각 시행하였다; (A) 269개의 결절은 25 게이지 바늘로 모세관 기법을 이용, (B) 303개의 결절은 25 게이지 바늘과 3 cc 주사기로 최소한의 흡인 압력을 이용, (C) 602개의 결절은 22-23 게이지 바늘, 10 cc 주사기와 흡인기를 이용해 세침흡인검사를 시행하였다. 세 가지 상이한 방법에서 생긴 불충분 세포검사결과의 발생빈도가 차이가 있는지를 통계적으로 분석하였다.

결과: 전반적으로, 불충분 세포검사결과의 발생빈도의 차이는 세 흡인 방법에 따라 의미 있는 차이를 보였고($p = 0.004$), 바늘 크기와 흡인 압력이 증가할수록 그 발생빈도가 증가하는 경향을 보였다($p < 0.001$). 세침흡인방법들의 쌍별 비교에서는 방법 (A)와 (C)에서는 의미 있는 차이를 보였으나($p = 0.003$), 방법 (B)와 (C)($p = 0.07$) 및 방법 (A)와 (B)($p = 0.10$) 사이에는 의미 있는 차이는 없었다.

결론: 불충분한 세포검사결과의 발생빈도는 모세관 기법에서 유의하게 낮았고, 바늘 크기와 흡인 압력의 정도가 증가함에 따라 유의하게 증가하는 경향을 보였다.

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