

Pain Levels and Diagnostic Accuracy of Ultrasound-Guided Fine-Needle Aspiration Biopsy for Thyroid and Neck Masses: A Concordance Study with Definitive Pathology

Behzad Nemati Honar, Hamed Tahmasbi*

Department of General Surgery, Imam Hossein Hospital, School of Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

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ABSTRACT

Background: FNA is the standard initial assessment for thyroid nodules. This study evaluated its diagnostic accuracy against postoperative histopathology.

Methods: In this study, histopathological results were compared with FNA findings in patients referred to a private clinic. Following approval by the institutional ethics committee, 180 patients presenting to the subspecialty outpatient clinics of the hospital due to thyroid nodules were enrolled in the study. Thyroid-stimulating hormone (TSH) testing was requested for all patients. Patients with a solitary thyroid nodule underwent FNA. In patients with multiple nodules, ultrasonography was performed initially, and FNA was subsequently carried out if suspicious nodules were identified on ultrasound examination. Subsequent to the FNA procedure, all collected specimens were submitted for pathological examination. Statistical processing and data analysis were subsequently executed through the IBM SPSS Statistics software

Results: Result showed, a total of 180 patients were included in the study. Based on FNA cytology results, 90.6% of patients were classified as benign, while 9.4% were classified as malignant. also, based on the final histopathological examination, 33.3% of patients were classified as benign, while 28.9% were categorized as suspicious for malignancy. The results demonstrated a high concordance between FNA and final histopathological findings. All 14 malignant cases were correctly identified by FNA, yielding a sensitivity of 100%. However, three cases diagnosed as malignant by FNA were found to be benign on final histopathological examination. Pain scores decreased significantly 5 minutes after the procedure compared with immediately after the procedure, as measured by both the VAS and NRS ($P < 0.001$).

Conclusion: While FNA is highly sensitive (100%) for detecting thyroid malignancies, the risk of false positives necessitates careful interpretation alongside histopathology to prevent unnecessary surgeries.

Introduction

With the growing trend of population aging, the incidence and prevalence of chronic diseases are increasing [1-2]. Cancer is a chronic disease associated with a wide range of short-term and long-term complications. These complications may be physical, psychological, and social, affecting not only the

individual but also the family and society. Furthermore, due to its high prevalence, cancer affects a large number of individuals and significantly influences their quality of life [3-5]. As the most prevalent endocrine-related malignancy in females, thyroid cancer is typically characterized by an optimistic prognosis and limited recurrence. There has been a steady rise in its incidence over recent decades, a trend primarily attributed to the enhanced diagnostic capabilities of ultrasonography and

The authors declare no conflicts of interest.

*Corresponding author.

E-mail address: hamed168tahmasebi@gmail.com

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FNA cytology. Pathologically, thyroid malignancies are categorized into four distinct subtypes: papillary, follicular, medullary, and anaplastic carcinomas. PTC remains the most dominant form, representing nearly 80% of cases, followed by follicular (10%), medullary (5–10%), and the more aggressive anaplastic variant (2–5%) [6–9]. Thyroid hormone synthesis is regulated by the pituitary-derived TSH. These hormones are indispensable for the structural and functional maturation of the central nervous system, exerting a profound influence on fundamental neurodevelopmental processes, including neuronal proliferation, migration, and lineage differentiation. Even a slight reduction in thyroid hormone levels during critical developmental periods may adversely affect normal brain development. Therefore, the diagnosis and treatment of hypothyroidism are of considerable importance [10–12]. Thyroid nodules represent a prevalent clinical challenge, frequently serving as a primary reason for endocrinology consultations. While palpable nodules are detected in approximately 4–7% of the population, subclinical findings are significantly more common; autopsy data reveal that 50–60% of individuals without a history of thyroid disease harbor nodules exceeding 1 cm. These figures underscore the status of thyroid nodules as a widespread public health concern [10,13]. Among endocrine malignancies, thyroid cancer stands as the most frequent, with PTC being the predominant histological type, representing roughly 85% of all diagnoses. Beyond its histological diversity, the progression and survival of these malignancies are deeply rooted in genetic heterogeneity. Such genetic variation is a fundamental driver of tumor evolution, facilitating adaptation to environmental shifts and fostering resistance against therapeutic interventions and biological stressors [14–16]. Following only diabetes mellitus, postpartum thyroid dysfunction (PPTD) represents the most frequent endocrine abnormality encountered in women during their reproductive years. The presence of anti-thyroid antibodies in these women represents the most common autoimmune condition, with a prevalence ranging from 6% to 20%. If thyroid disorders are not adequately treated or controlled, their prognosis in pregnant women may become comparable to that of women without thyroid dysfunction. During pregnancy, the thyroid gland adapts to increased metabolic demands through alterations in thyroid hormone production and regulation of the hypothalamic–pituitary axis. Consequently, the biochemical markers of thyroid function in healthy gestations exhibit distinct reference intervals compared to those observed in the non-pregnant population [17–19].

The risk of cancer and patients' concerns have increased the need for accurate diagnosis and identification of thyroid nodules. Therefore, distinguishing benign from malignant nodules is essential

for appropriate patient selection for surgery. FNA is widely considered the gold standard for the initial diagnostic workup of thyroid nodules, serving as the recommended primary intervention. Its use reduces the need for additional imaging studies and thyroidectomy procedures, thereby decreasing healthcare costs [20–23]. FNA is a cost-effective procedure that can be performed in an outpatient setting under local anesthesia with minimal expense. Moreover, in cases where lymphoma is clinically suspected, accurate identification of the cause of lymphadenopathy is of particular importance, and FNA has been shown to be a successful diagnostic method for lymphoma [24–25].

Aim

This study was conducted to evaluate the concordance between fine-needle aspiration cytology findings and definitive surgical histopathological findings in patients with thyroid nodules.

Methods

In this study, histopathological results were compared with FNA findings in patients referred to a private clinic. Following approval by the institutional ethics committee, 180 patients presenting to the subspecialty outpatient clinics of the hospital due to thyroid nodules were enrolled in the study. Thyroid-stimulating hormone (TSH) testing was requested for all patients.

Patients who consented to participate in the study and had clinical manifestations of solitary or multiple thyroid nodules were included. Patients who were unwilling to continue participation at any stage of the study or those who returned for repeat surgery or additional diagnostic procedures were excluded.

The data collection instruments consisted of a demographic information form (including age, sex, educational level, and occupation) and a checklist. The checklist included the pathologist's report (benign findings, presence or absence of atypical lesions, follicular neoplasm, suspicious for malignancy, and malignant findings) and cytology results (benign or malignant). The checklist was developed based on the published study by Jafari et al [20]. No local anesthesia was used during ultrasound-guided FNAB. Discomfort was assessed immediately and 5 minutes post-procedure via the 100-mm Visual Analogue Scale (VAS), 0–10 Numeric Rating Scale (NRS), and Verbal Rating Scale (VRS). In patients with multiple nodules, ultrasonography was performed initially, and FNA was subsequently carried out if suspicious nodules were identified on ultrasound examination. Following FNA, all specimens were sent to the pathologist, and the obtained results were recorded in the researcher-designed checklist. Ethical considerations included obtaining written informed consent from patients or their legal

guardians, ensuring that no additional costs were imposed on participants, and providing all study-related procedures free of charge. Statistical processing was executed using IBM SPSS Statistics software, version 18.

Results

A total of 180 participants met the inclusion criteria for this study. The demographic profile revealed a slight female predominance (52.2%), with a mean cohort age of 58.2 ± 12.6 years. Regarding educational attainment, the most frequent level reported was a high school diploma, accounting for 41.1% of the sample (Table 1).

According to the findings, based on FNA cytology results, 90.6% of patients were classified as benign, while 9.4% were classified as malignant (Table 2).

According to the findings, based on the final histopathological examination, 33.3% of patients were classified as benign, while 28.9% were categorized as suspicious for malignancy (Table 3).

The results demonstrated a high concordance between FNA and final histopathological findings. All 14 malignant cases were correctly identified by FNA, yielding a sensitivity of 100%.

However, three cases diagnosed as malignant by FNA were found to be benign on final histopathological examination (Table 4).

Pain scores decreased significantly 5 minutes after the procedure compared with immediately after the procedure, as measured by both the Visual Analogue Scale (VAS) and Numeric Rating Scale (NRS) ($P < 0.001$; Table 5).

Table 1- Baseline Demographic and Clinical Profiles of the Study Population

Variable	n	%
Total patients	180	100
Gender		
Female	94	52.2
Male	86	47.8
Age	Mean (SD)	58.2 (12.6)
Educational level		
Illiterate	19	10.6
Primary school	65	36.1
High school diploma	74	41.1
University education	22	12.2

Table 2- FNA Cytology Findings in Patients

FNA Result	n	%
Benign	163	90.6
Malignant	17	9.4
Total	180	100

Table 3- Final Histopathological Findings

Pathology Result	n	%
Benign	60	33.3
Atypical / Atypical Lesion	26	14.4
Follicular Neoplasm	28	15.6
Suspicious for Malignancy	52	28.9
Malignant	14	7.8
Total	180	100

Table 4- Concordance Between FNA and Final Histopathological Findings

FNA	Benign/Atypical/etc.	Malignant	Total
Benign	163	0	163
Malignant	3	14	17
Total	166	14	180

Table 5- Patient-Reported Pain Scores Immediately and 5 Minutes Post-Procedure

Pain Assessment Instrument	Immediate post-procedure	5 Minutes Post-Procedure	P value
Visual Analogue Scale (mm)	29.3 (22.1)	10.8 (4.4)	< 0.001
Numeric Rating Scale (0–10)	3.4 (2.1)	0.9 (0.5)	< 0.001

Discussion

Among the diverse array of endocrine-related neoplasms, thyroid cancer stands as the most prevalent malignancy globally. It is predicted that by 2040, thyroid cancer will become the fourth most common cancer among individuals aged 20–49 years. Although this malignancy generally has a favorable prognosis, metastasis occurs in a subset of patients, leading to a reduction in the five-year survival rate [26–28].

According to the findings based on the final histopathological results, 33.3% of patients were classified in the benign group, while 28.9% were categorized as suspicious for malignancy. In the study conducted by Jafari et al. in Hamadan, 115 patients referred for fine-needle aspiration (FNA) were evaluated. The results showed that 84.35% of the patients were female, the mean age was 40 years, 46.1% had nodules in the left lobe, 15.7% had bilateral nodules, and 0.9% had nodules located in the isthmus. Furthermore, 40.86% of pathological specimens were diagnosed as benign, whereas 59.14% were reported as malignant [20].

In the cross-sectional retrospective study conducted by Bahar et al., 2,002 patients were evaluated. Among all patients, histopathological examination results following thyroidectomy were available for 217 cases. Of these, 153 cases were reported as benign and 64 cases as malignant.

Additionally, among the 123 cases that had been reported as benign on cytology, 8 cases were subsequently identified as malignant on histopathological examination. The sensitivity and specificity of fine-needle aspiration biopsy for detecting malignant thyroid nodules were calculated as 81.2% and 75.1%, respectively [29].

According to the present findings, based on FNA cytology results, 90.6% of patients were classified in the benign group and 9.4% in the malignant group. In the study conducted by Siadati et al. in Babol, cytological findings from 225 patients aged 11 to 77 years were evaluated. Among the 225 cytological samples, 127 were reported as benign, 47 as suspicious, 27 as malignant, and 24 as inadequate. Final pathological diagnosis revealed benign lesions in 150 patients and malignant lesions in 75 patients [30].

In a regional study performed by Gharib et al. in Gorgan, the clinical profiles of 102 patients were analyzed. The cohort's mean age was reported as 41 years, with participants spanning a broad chronological range from 18 to 76 years. The findings indicated that in 45.1% of patients, the lesion was confined to the right thyroid lobe, whereas in 28.4% of patients, both thyroid lobes were involved. Furthermore, 30.4% of patients were classified as benign, 13% were categorized as suspicious for follicular malignancy, and 33.6% were diagnosed with papillary cell carcinoma [31].

In the study by Nikbaksh et al., 450 patients aged 22–51 years were evaluated. According to the findings, 36.66% of the patients underwent total thyroidectomy. Benign lesions were identified in 54.88% of patients, whereas malignant lesions were reported in 45.11% [32].

Conclusion

FNA, with a sensitivity of 100%, is a highly effective diagnostic tool for avoiding missed cases of thyroid malignancy. However, the occurrence of false-positive cytological results highlights the need for careful interpretation of FNA findings and indicates that clinical decision-making should not rely solely on cytological assessment without considering the final histopathological findings to prevent unnecessary surgical interventions.

Ethics approval and consent to participate

Ethical approval for this study was obtained only after clearance and approval from the Ethics Committee of Shahid Beheshti University of Medical Sciences (IR.SBMU.MSP.REC.1401.024).

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