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Perioperative Diagnosis of Thyroid Lesions through Fine-Needle Aspiration: A Clinicopathological Retrospective Analysis

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Abstract

Background Thyroid lesions are a worldwide common clinical problem. Majority of thyroid nodules are benign whereas less than 5% are malignant. Fine-needle aspiration cytology (FNAC) is a commonly used method in the diagnosis of thyroid lesions with some limitations.

Aim The objective was to assess the precision of FNAC in identifying thyroid lesions.

Methods A retrospective analysis was conducted on 62 patients with thyroid lesions who underwent preoperative FNAC followed by surgical resection. Data collection took place from January 2017 to December 2022 and included demographic information such as age, gender, and chief complaint. Cytological and histopathologic diagnoses were obtained from pathology reports. The correlation between histopathological diagnosis and preoperative FNAC results was assessed for each patient in terms of sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy. The data were presented as frequencies and percentages.

Results The diagnosis by FNAC was correlated with histopathology. The analysis showed that FNAC had a sensitivity of 94%, specificity of 91%, PPV of 80%, and NPV of 97%. However, the overall accuracy in this study was determined to be 92%.

Conclusion As a tool for the preoperative diagnosis of thyroid lesions, FNAC was proved in our laboratory to be sensitive and specific with a high accuracy rate.

Keywords
- fine-needle aspiration cytology
- FNAC
- histopathology
- thyroid lesions

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ملخص المقال باللغة العربية

التشخيص ما قبل الجراحة لآفات الغدة الدرقية باستخدام الشفط بالإبرة الدقيقة: دراسة سريرية بأثر رجعي

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الخلفية: آفات الغدة الدرقية مشكلة سريرية شائعة في جميع أنحاء العالم. غالبية عقيدات الغدة الدرقية حميدة، في حين أن أقل من 5٪ منها خبيثة. يعتبر تشخيص آفات الغدة الدرقية باستخدام الشفط بالإبرة الدقيقة (FNAC) طريقة شائعة مع ما يرافقها من بعض القيود.

الهدف: الهدف هو تقييم دقة استخدام الشفط بالإبرة الدقيقة (FNAC) في تشخيص آفات الغدة الدرقية.

الطرق: تم إجراء دراسة بأثر رجعي على 62 مريضا يعانون من آفات الغدة الدرقية الذين خضعوا إلى التشخيص الأولي باستخدام الشفط بالإبرة الدقيقة قبل الجراحة (FNAC) متبوعًا بتدخل جراحي وتحليل خلوي نسيجي. تم جمع البيانات في الفترة من يناير 2017 إلى ديسمبر 2022م وتضمنت معلومات ديموغرافية مثل العمر والجنس والشكوى الرئيسية. تم الحصول على التشخيص الخلوي والنسيجي من تقارير علم الأمراض لكل مريض. تم دراسة العلاقة ما بين النتائج التي تحصل عليها قبل الجراحة عبر الشفط بالإبرة الدقيقة، وبعد الجراحة بالتشخيص النسيجي من حيث الحساسية، والنوعية، والقيمة التنبؤية الإيجابية (PPV)، والقيمة التنبؤية السلبية (NPV)، ودقة التشخيص. تم تقديم البيانات على شكل تكرارات ونسب منوية.

النتائج: أظهرت النتائج أن حساسية التحاليل باستخدام الشفط بالإبرة الدقيقة قبل الجراحة كانت 94%، والنوعية 91%، والقيمة التنبؤية الإيجابية 80%، والقيمة التنبؤية السلبية 97%. ومع ذلك، تم تحديد الدقة الإجمالية للتحاليل باستخدام الشفط بالإبرة الدقيقة قبل الجراحة في هذه الدراسة لتكون 92٪.

الاستنتاجات: ثبت في مختبرنا أن استخدام الشفط بالإبرة الدقيقة قبل الجراحة كأداة لتشخيص آفات الغدة الدرقية حساسة ومحددة وبنسبة دقة عالية.

الكلمات المفتاحية: علم الخلايا، الشفط بالإبرة الدقيقة، التشريح المرضي، آفات الغدة الدرقية.

Introduction

Thyroid lesions are a worldwide common clinical problem. The enlargement of thyroid gland, goiter, may present as small or large, single, or multinodular. It could be unilateral, or bilateral slowly growing painless swellings.[1] The causes of the thyroid lesions could be developmental, inflammatory, hyperplastic, or neoplastic,[2] and the incidence of these lesions depend upon different factors such as age, sex, diet, and radiation exposure. Thyroid enlargement is usually seen in women and elderly people[3] while low incidences were detected in males of different ages.

Thyroid lesions are either neoplastic or nonneoplastic.[4] Nonneoplastic multinodular goiter is the most common cause of thyroid enlargement followed by malignant thyroid tumors.[5] Thyroid cancer is a relatively infrequent malignancy, representing only 1.5% of all cancers.[6] However, it is the most common endocrine cancer accounting for 92% of all endocrine malignancies.[5] Papillary carcinoma is the most widely recognized thyroid cancer followed by follicular carcinoma, medullary carcinoma, anaplastic carcinoma, and lymphoma.[7] Very rarely the thyroid gland can also be the site of metastasis of other malignancies. However, renal cell carcinoma is the most common metastasizing tumor to thyroid.[8] Thyroid cancer is reported to be female predominant while male patients have more aggressive behaviors and worse prognosis compared with female.[9] The increased incidence of thyroid carcinoma permits the increase in gathering of more information about its demographic and clinical profile. Fine-needle aspiration (FNA) is a commonly used method for the preoperative assessment of thyroid nodules. FNA provides a clue for the suitable surgical treatment to reduce the number of unnecessary surgical procedures for thyroid nodules. However, false-negative results are not rare and limitation include an inadequate specimen and overlapping of diagnostic histopathological features.[10,11] In this study, the clinicopathological features of 62 patients who had FNA cytology (FNAC) for a thyroid swelling followed by surgical resection were examined and analyzed to detect the accuracy of FNAC in the diagnosis of thyroid lesions in our patients.

Methods

This is a retrospective study of thyroid specimens collected from Tiba Histopathology Laboratory in Benghazi, Libya from January 2017 to December 2022. A total of 62 patients presented with thyroid enlargement, who underwent any type of thyroid operation (i.e., hemithyroidectomy, subtotal thyroidectomy, or total thyroidectomy) and had a preoperative FNAC data were included in this study. Demographic data including patients' age, gender, chief complaint, and the cytological and histopathologic diagnosis were collected from the pathology reports. FNAC was done by using a 22-G needle attached to a 20-mL disposable plastic syringe and aspirator with hand-free techniques. Specimens were studied by routine paraffin processing and hematoxylin and eosin stain. The histopathological diagnosis was correlated with the preoperative FNAC result for each patient and the data were represented by frequencies and percentages. The following equations were used to calculate sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy[12]:

$$\text{- Sensitivity (true positive rate)} = \frac{True positive(TP)}{True positive(TP)+False negative(FN)}$$

$$\text{- Specificity (true negative rate)} = \frac{True negative(TN)}{True negative(TN)+False positive(FP)}$$

$$\text{- PPV} = \frac{True positive(TP)}{True positive(TP)+False positive(FP)}$$

$$\text{- NPV} = \frac{True negative(TN)}{True negative(TN)+False negative(FN)}$$

$$\text{- Total accuracy} = \frac{True positive(TP)+True negative(TN)}{Total number of cases}$$

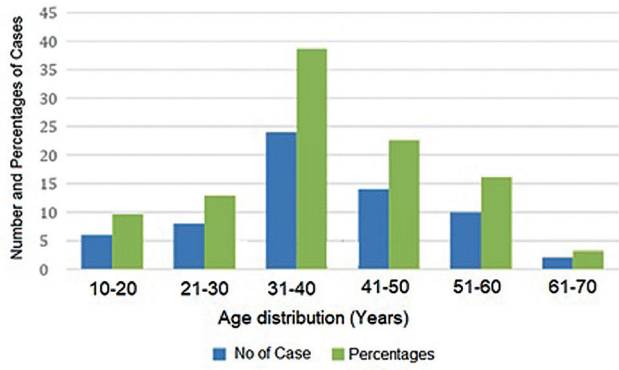

Fig. 1 Distribution of ages within the population under study.

Table 1 Presentations and chief complaints

Presentation	Number	Percentages
Swelling	38	61.3
Swelling and compression symptoms	22	35.4
enlarged cervical lymph nodes	2	3.2
Total	62	100

Results

Among a total of 62 patients, 80.6% of patients were females (50 patients) whereas 19.4% were males (12 patients), with female-to-male ratio of 4.2:1. The mean age in years of the study population was 40.99 ± 11.0. The age distribution of patients was between 14 and 70 years. The highest number of patients was seen in the age group of 31 to 40 years (►**Fig. 1**).

►**Table 1** shows that among the total of 62 patients, 38 patients (61.3%) were presented with a swelling in the anterior part of the neck either suddenly discovered or gradually increased in size. Another 22 patients (35.4%), besides the swelling, also had some compression symptoms, like discomfort in swallowing. Two patients (3.2%) had enlarged cervical lymph nodes due to metastatic primary thyroid carcinoma.

FNAC analysis revealed that 42 patients (67.7%) had benign lesions (►**Table 2**), among them 34 patients had colloid goiter and 8 patients had Hashimoto's thyroiditis. Eight patients showed suspicious follicular lesions with atypia suggestive of malignant changes. Twelve patients had malignant lesions, 10 patients had papillary carcinoma, while 2 patients had anaplastic carcinoma. No cases of follicular carcinoma or medullary carcinoma were found (►**Table 2**).

Histopathological analysis revealed that 40 patients (64.5%) had benign lesions (►**Table 3**), among them 32 patients had colloid goiter and 8 patients had Hashimoto's thyroiditis. Twenty-two patients had malignant lesions, 13 patients had papillary carcinoma, while 2 patients had anaplastic carcinoma, 6 patients had follicular carcinoma, and 1 patient had medullary carcinoma (►**Table 3**).

The results of FNAC were compared with their corresponding histopathological diagnoses in all cases (►**Table 4**). After surgical intervention, out of the 34 colloid

Table 2 Distribution of cases based on FNAC findings

Type of lesion (number, %)	Subtype	Number	Percentages
Benign lesions (42; 67.7%)	Colloid goiter	34	54.8
	Hashimoto's thyroiditis	8	12.9
Suspicious follicular lesions (8; 12.9%)		8	12.9
Malignant lesions (12; 19.3%)	Papillary carcinoma	10	16.1
	Anaplastic carcinoma	2	3.2
	Follicular carcinoma	0	0
	Medullary carcinoma	0	0

Abbreviation: FNAC, fine-needle aspiration cytology.

Table 3 Distribution of cases based on histopathological findings

Type of lesion (number, %)	Subtype	Number	Percentages
Benign lesions (40; 64.5%)	Colloid goiter	32	51.6
	Hashimoto's thyroiditis	8	12.9
Malignant lesions (22; 35.5%)	Papillary carcinoma	13	21
	Anaplastic carcinoma	2	3.2
	Follicular carcinoma	6	9.6
	Medullary carcinoma	1	1.6

Table 4 Cytological diagnosis of cases and the corresponding pathologic results

Cytological diagnosis	Number	Pathological diagnosis	Number (%)[a]
Benign (colloid goiter)	34	Colloid goiter Adenoma Papillary carcinoma	29 (85.3) 4 (11.8) 1 (2.9)
Benign (Hashimoto's thyroiditis)	8	Hashimoto's thyroiditis	8 (100)
Suspicious	8	Benign (2 follicular adenoma, and 1 colloid goiter)	3 (37.5)
		Malignant (papillary carcinoma)	5 (62.5)
Malignant (papillary carcinoma)	10	Papillary carcinoma Colloid goiter	7 (70) 2 (20)
Malignant (medullary carcinoma)	0	Medullary carcinoma	1 (10)
Malignant (anaplastic carcinoma)	2	Anaplastic carcinoma	2 (100)

[a]From the total of the cytological diagnosis.

Table 5 Summary of cytology results, predictive value, and diagnostic accuracy of FNAC compared with final diagnosis

Cytological diagnosis	Final diagnosis		Percentages
	Benign	Neoplastic	
Benign, 42	41 (TN)	1 (FN)	97 (TN)
Suspicious, 8	3 (FP)	5 (TP)	62.5 (TP)
Malignant, 12	2 (FP)	10 (TP)	83.3 (TP)
Sensitivity			94
Specificity			91
Positive predictive value			80
Negative predictive value			97.6
Total accuracy			92

Abbreviations: FN, false negative; FNAC, fine-needle aspiration cytology; FP, false positive; TN, true negative; TP, true positive.

goiter cases, 29 cases (85.3%) were confirmed to be as colloid goiter, 4 cases (11.8%) were confirmed as follicular adenoma, and 1 case (2.9%) was diagnosed as papillary carcinoma. All the 8 cases (100%) which were diagnosed as Hashimoto's thyroiditis by FNAC were confirmed as Hashimoto's thyroiditis by histopathological analysis. Out of 8 cases that were diagnosed as suspicious follicular lesions, 2 (25%) were follicular adenoma, 1 was hyperplastic colloid goiter (12.5%), and 5 (62.5%) were papillary carcinoma. Of the 10 cases which were suspicious for papillary carcinoma, 7 cases (70%) were confirmed as papillary carcinoma after surgical resection, 1 case (10%) was proved to be medullary carcinoma, and 2 cases (20%) were confirmed as nodular colloid goiter. The pathologic diagnosis of anaplastic carcinoma was concordant with the cytological one in 2 cases (100%) (►**Table 4**).

►**Table 5** shows that out of the 42 cases cytologically diagnosed as benign, 41 cases (97.6%; true negative "TN,") were confirmed to be nonneoplastic by histopathology and 1 case (2.4%; false negative "FN") was diagnosed as papillary carcinoma. As regard the suspicious cases, 5 cases (62.5%; true positive "TP") were confirmed to be malignant and only 3 cases (37.3%) were false positive "FP" as they proved to be benign lesions. Among the 12 malignant cases, 8 cases were confirmed to be neoplastic carcinoma (83.3%; "TP"), while only 2 cases (16.6%; "FP") were proved to be benign colloid goiter by histopathology. Therefore, in general, 83.3% of malignant cases were correctly diagnosed by the FNAC. Thus, FNAC achieved a sensitivity of 94%, specificity of 91%, PPV of 80%, NPV of 97.6%, and a total accuracy of 92% (►**Table 5**).

Discussion

FNAC is an essential tool in diagnosis of thyroid swellings; it is simple and easy to perform with rare complications. Numerous studies have shown that FNAC is an accurate and cost-effective test for diagnosing thyroid swellings compared with other methods.[13] This study aimed to determine if FNAC would yield similar results in our clinic. In this retrospective study, 62 cases with thyroid swelling were used to compare the FNAC results with the histopathological diagnosis after surgical resection of the lesion.

Since age and sex of the patients have an important impact on the type of any thyroid lesion, this study considered analyzing the age and sex of the patients. The age of patients ranged from 14 to 70 years, with a median of 40 years. Our findings were comparable with the study performed by Srirangaprasad et al.[14] Regarding the age, there

was a female predominance giving a female-to-male ratio of 4.2:1. This was also comparable with other studies.[15,16]

This study revealed that the most common clinical presentation was the presence of gradually progressive swelling in the front of the neck as seen in 70% of cases. Moreover, 30% of patients showed other compression symptoms, such as difficulty in swallowing, and only two patients presented with cervical lymphadenopathy due to metastatic lesion. These results confirm the results reported by Kurele et al,[17] where the main complaint of the patients was neck swelling and few numbers of cases showed compression symptoms.

FNAC results showed that 42 patients had benign lesions, 8 patients showed suspicious follicular lesion, and 12 patients had malignant lesions; with no cases of follicular carcinoma or medullary carcinoma. When the results of FNAC were compared with their corresponding histopathological diagnoses, 32 cases were confirmed to be as colloid goiter out of the 34 diagnosed by FNAC and 2 cases were confirmed as follicular adenoma. Note that 100% true positive results were seen in the 8 cases of Hashimoto's thyroiditis as all were confirmed as Hashimoto's thyroiditis by histopathological analysis. In regard to malignant lesions, out of 8 cases that were diagnosed as suspicious follicular lesions, 2 were false positive and turned to be follicular adenomas, 1 was hyperplastic colloid goiter, and 5 were papillary carcinoma. Of the 10 cases which were suspicious for papillary carcinoma by FNAC, 7 cases were confirmed as papillary carcinoma after surgical resection, 1 case was proved to be medullary carcinoma, and 2 cases were confirmed as nodular colloid goiter. The pathologic diagnosis of anaplastic carcinoma was concordant with the cytologic one in two cases. The comparison between FNAC and cytological diagnosis in this study was equivalent with some researches such as Kurele et al[17]; however, there was minor variation with similar studies such as Sharma et al[18] where both benign and malignant lesions were seen in 50% of cases, this may relate to the size of the samples or the geographic distribution as thyroid lesions are affected by the environments.

In this study, FNAC achieved a sensitivity of 94%, specificity of 91%, PPV of 80%, NPV of 97.6%, and a total accuracy of 92%. This was comparable to other studies with sensitivity and specificity ranges between 70 and 100%[12,19] and comparable NPV of 96.7%.[20] The PPV and the total accuracy were similar to other studies comparing FNAC results with histological diagnosis and were between 80 and 100%.[12,19]

Conclusion

The results of this study are consistent with many published data and demonstrate that FNAC is a sensitive, specific, and an accurate diagnostic tool for the evaluation of patients with thyroid swellings. FNAC helps to reduce the cost of care and avoid unnecessary surgery. Due to the risk of false negative results it is important that patients with benign cytological findings be followed up regularly.

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Conflict of Interest
None declared.

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