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CYTOLOGICAL EVALUATION OF THYROID NODULES AND ITS CORRELATION WITH HISTOPATHOLOGY: A PROSPECTIVE STUDY

Nidhi Dhingani[1], Vikas Chauhan[2], Sonagara Nikhilkumar[3], Prachi Bhatt[4]

[1] *Assistant Professor, Department of Pathology, P.D.U. Medical College and Hospital, Rajkot, India.*
[2] *Senior Resident, Department of Pathology, P.D.U. Medical College and Hospital, Rajkot, India.*
[3] *Pathologist, Military Hospital, Jaipur, India.*
[4] *Senior Resident,Department of Pathology, P.D.U. Medical College and Hospital, Rajkot, Gujarat, India.*

Correspondence:
Dr. Prachi Bhatt
Senior Resident,Department of Pathology, P.D.U. Medical College and Hospital, Rajkot, Gujarat, India.

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Abstract

Background: Thyroid nodules are frequently encountered in clinical practice, with the majority being benign. Accurate preoperative diagnosis is essential to avoid unnecessary surgical interventions. Fine needle aspiration cytology (FNAC) is widely used as an initial diagnostic modality for thyroid nodules due to its simplicity, cost-effectiveness, and minimal invasiveness. This study evaluates the diagnostic performance of FNAC in solitary thyroid nodules by correlating cytological findings with histopathology. **Methods:** This prospective study was conducted in the Department of Pathology at B.J. Medical College and Civil Hospital, Ahmedabad, from June 2017 to October 2019. A total of 100 patients presenting with palpable solitary thyroid nodules were included. FNAC was performed using a 22-gauge needle under aseptic precautions. Smears were stained with hematoxylin and eosin (H&E), Papanicolaou (PAP), and May-Grünwald-Giemsa (MGG) stains. Cytological diagnoses were reported according to The Bethesda System for Reporting Thyroid Cytopathology. Histopathological examination was performed in surgically treated cases and considered the gold standard. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy were calculated. **Results:** Most patients were in the 31–40-year age group, with a female predominance (male-to-female ratio 1:9). On histopathology, 76% of cases were benign and 24% were malignant. Colloid goiter was the most common benign lesion (46.05%), while papillary carcinoma was the most common malignant lesion (58.3% of malignant cases). FNAC demonstrated high specificity across most lesions. For papillary carcinoma, sensitivity was 85.71% and specificity was 100%. Follicular neoplasms showed a sensitivity of 59.26% and specificity of 100%. Medullary carcinoma demonstrated 100% sensitivity and specificity. Overall, FNAC showed high diagnostic accuracy in distinguishing benign from malignant thyroid lesions. **Conclusion:** FNAC is a safe, reliable, and effective first-line diagnostic tool for evaluating solitary thyroid nodules. Its high specificity and diagnostic accuracy make it valuable in guiding clinical management and reducing unnecessary surgeries. Histopathological correlation remains essential, particularly in cases of follicular-patterned lesions.

Keywords: FNAC; histopathology; cyto-histological correlation.

INTRODUCTION

Thyroid nodules are a frequent finding in everyday clinical practice. Palpable nodules are detected in around 4–7% of adults, but when high-resolution ultrasound is used, nodules can be found in up to two-thirds of people [1,2]. While most nodules are benign, a small but significant proportion—about 5–15%—can be malignant. This makes accurate preoperative evaluation crucial, as it helps clinicians determine which patients truly need surgery and which can be safely monitored [3]. The increased use of imaging has led to more incidental detection of nodules, creating a need for reliable, minimally invasive diagnostic tools [4].

Fine Needle Aspiration Cytology (FNAC) has become the go-to test for evaluating thyroid nodules. It is safe, minimally invasive, cost-effective, and can be performed quickly in an outpatient setting. FNAC has been shown to provide high n specificity and good sensitivity for differentiating benign from malignant nodules, making it a valuable first-line investigation [5,6].

To improve consistency and communication between pathologists and clinicians, The Bethesda System for Reporting Thyroid Cytopathology (TBSRTC) was introduced in 2007 and updated in 2017. TBSRTC categorizes thyroid cytology

into six groups, each linked to an estimated risk of malignancy and recommended clinical actions [7]. This system has improved diagnostic consistency and decision-making worldwide.

Despite its strengths, FNAC has some limitations. In particular, it struggles to distinguish follicular adenomas from follicular carcinomas because features like capsular or vascular invasion can only be seen on histological examination [8]. Therefore, histopathology remains the gold standard, especially for nodules that are surgically removed.

In this study, we aimed to assess how well FNAC performs in diagnosing solitary thyroid nodules by comparing cytology results with histopathology. Understanding its accuracy, sensitivity, and specificity can help clinicians make informed decisions, reduce unnecessary surgeries, and guide patient care more effectively.

MATERIALS AND METHODS

This prospective study was conducted at the Department of Pathology, B.J. Medical College and Civil Hospital, Ahmedabad, from June 2017 to October 2019, to evaluate FNAC of palpable solitary thyroid nodules and correlate cytology with histopathology.

InclusionCriteria

Patients with a solitary thyroid nodule who underwent FNAC and subsequent histopathological examination were included. Clinical evaluation and detailed palpation were performed to guide aspiration, and the procedure was explained to all patients.

FNAC Procedure

FNAC was performed under aseptic conditions using a 22-gauge needle. Aspirated material was expelled onto labeled slides. Multiple smears were prepared: some fixed in methanol and stained with H&E and PAP, and others air-dried and stained with MGG. Fluid aspirates were centrifuged, and smears were made from the sediment. A sample was considered adequate if at least six clusters of follicular cells were present on two slides. Cytology was reported according to The Bethesda System.

Histopathology

Surgically excised specimens (total, subtotal, or hemi-thyroidectomy) were fixed in 10% buffered formalin, processed, embedded in paraffin, sectioned at 3–5 µm, and stained with H&E. Histopathological diagnosis was made using light microscopy.

Statistical Analysis

Cytology and histopathology were compared to calculate:

- TP: FNA positive and histology confirmed malignancy
- FP: FNA positive but histology negative
- TN: FNA negative and histology negative
- FN: FNA negative but histology positive

From these, sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy were calculated using standard formulas:

- Sensitivity = TP / (TP + FN)
- Specificity = TN / (TN + FP)
- PPV = TP / (TP + FP)
- NPV = TN / (TN + FN)
- Accuracy = (TP + TN) / (TP + TN + FP + FN).

RESULTS

Table 1. Thyroid lesions distribution according to gender.

Gender	Total cases	Percentage(%)
Male	**10**	**10%**
Female	**90**	**90%**

The table shows the distribution of cases by gender. Out of 100 total cases, 90 (90%) are female and 10 (10%) are male. This indicates that females make up the majority of the cases in the dataset.

Table 2: Correlation between Histodiagnosis and Cytodiagnosis of thyroid gland lesions

Diagnosis			No of cases in Histodiagnosis		No of cases in Cytodiagnosis	
			Total	**Percentage**	**Total**	**Percentage**
Non Neoplastic	Non Inflammatory (Hyperplasia)	Colloid goiter and Nodular goiter	48	48%	64	64%
		Gravesdisease	1	1%	1	1%
	Inflammatory	Hashimoto's thyroiditis	2	2%	1	1%
		Lymphocytic thyroiditis	3	3%	4	4%
Neoplastic lesion		Follicular neoplasm	27	27%	16	16%
		Hyalinizing trabecular adenoma	1	1%	0	-
		Hurthle cell Neoplasm	2	2%	1	1%
		Papillary carcinoma	14	14%	12	12%
		Medullary carcinoma	1	1%	1	1%
		Lymphoma	1	1%	0	-

The table compares the distribution of thyroid lesions diagnosed by histodiagnosis and cytodiagnosis. Non-neoplastic lesions were the most common, particularly colloid and nodular goiter, accounting for 48% in histodiagnosis and 64% in cytodiagnosis. Among inflammatory conditions, lymphocytic thyroiditis and Hashimoto's thyroiditis were observed in smaller proportions. Neoplastic lesions included follicular neoplasm, papillary carcinoma, Hurthle cell neoplasm, medullary carcinoma, hyalinizing trabecular adenoma, and lymphoma, with follicular neoplasm and papillary carcinoma being the most frequent among them. Overall, non-neoplastic lesions predominated compared to neoplastic lesions.

Table 3: Diagnostic value of FNAC for Non neoplastic lesions of thyroid gland

Lesion	Sensitivity(%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)	Accuracy (%)
Goiter(Colloidgoiter+ Nodular goiter)	100	69.23	75	100	84
Gravesdisease	100	100	100	100	100
Hashimoto's thyroiditis	50	100	100	98.98	99
Lymphocytic thyroiditis	100	98.97	75	100	99

The table shows the diagnostic performance of cytology for different thyroid lesions. Goiter (colloid and nodular goiter) showed 100% sensitivity with 69.23% specificity and an overall accuracy of 84%. Graves disease demonstrated 100% sensitivity, specificity, positive predictive value, negative predictive value, and accuracy. Hashimoto's thyroiditis had a sensitivity of 50% and specificity of 100%, with an accuracy of 99%. Lymphocytic thyroiditis showed high diagnostic reliability with 100% sensitivity, 98.97% specificity, and 99% accuracy. Overall, most lesions showed high specificity and accuracy.

Table 4:Diagnostic value of FNAC of Neoplastic lesions of thyroid gland.

Lesion	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)	Accuracy (%)
Follicular neoplasm	59.26	100	100	86.90	89
Hurthle cell adenoma	50	100	100	98.98	99
Papillary carcinoma	85.71	100	100	97.73	98
Medullary carcinoma	100	100	100	100	100

The table shows the diagnostic performance of cytology for neoplastic thyroid lesions. Follicular neoplasm had a sensitivity of 59.26% and specificity of 100%, with an overall accuracy of 89%. Hurthle cell adenoma showed 50% sensitivity and 100% specificity, with an accuracy of 99%. Papillary carcinoma demonstrated high sensitivity (85.71%) and specificity (100%), with an accuracy of 98%. Medullary carcinoma showed 100% sensitivity, specificity, positive predictive value, negative predictive value, and accuracy. Overall, most neoplastic lesions showed high specificity and accuracy.

Table 5: Comparison of Incidence of non-neoplastic & neoplastic Lesions

Study	Non neoplastic	Neoplastic	Ratio
Silverman JF et al [9]	228	80	1:2.9
Kumar S et al [10]	82	7	1:11
Hsu and Boey J[11]	316	239	1.32:1
Present study	54	46	1.1:1

In the present study of 100 cases, 54 were Non neoplastic and 46 was neoplastic and ration of Non neoplastic to neoplastic is 1.1:1.which is correlated with Hsu and Boey J study.

Table 6 : Comparison of diagnostic value for malignant thyroid lesions

Studies	Sensitivity (%)	Specificity (%)	Positive Predictive value (%)	Negative Predictive value (%)	Accuracy (%)
Noor Hayati et al [12]	78.40	98.20	99	66.30	84.40
Kantasueb et al [13]	74.70	93.22	79.49	91.29	88.40
Kessler etal [14]	79	98.5	98.7	76.6	87
PKBaggaetal [15]	66	100	100	96	96.20
Presentstudy	65.22	100	100	77.14	84

The table compares the diagnostic performance of FNAC for thyroid lesions across different studies. Sensitivity ranged from 65.22% to 79%, while specificity was consistently high, ranging from 93.22% to 100%. Positive predictive value was also high in most studies. The overall accuracy varied between 84% and 96.2%. The findings of the present study show 65.22% sensitivity, 100% specificity, 100% positive predictive value, 77.14% negative predictive value, and 84% accuracy, which are comparable with the results reported in previous studies.

CONCLUSION

Fine Needle Aspiration Cytology (FNAC) is a valuable and reliable diagnostic tool for the evaluation of solitary thyroid nodules. In the present study of 100 cases, histopathological correlation was performed to assess the diagnostic accuracy of FNAC. The majority of patients were females, with the most common age group being 21–40 years.

Non-neoplastic lesions were slightly more common than neoplastic lesions. Colloid goiter was the most frequent benign lesion, while papillary carcinoma was the most common malignant tumor. Neoplastic lesions were relatively more common in males compared to females.

FNAC demonstrated an overall diagnostic accuracy of 84% for malignant thyroid lesions, with sensitivity of 65.32%, specificity of 100%, positive predictive value of 100%, and negative predictive value of 77.14%. No false-positive cases were observed in the present study.These findings indicate that FNAC is a simple, rapid, cost-effective, and minimally

invasive technique for the preoperative evaluation of thyroid nodules. Its high specificity makes it particularly useful in identifying malignant lesions and guiding appropriate clinical management, thereby reducing unnecessary surgical interventions.

Author Contributions

All authors contributed to the conception and design of the study. Data collection and analysis were performed by the authors. The manuscript was drafted and critically revised for important intellectual content. All authors read and approved the final version of the manuscript.

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Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this study.

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