Original Article

A Retrospective Study of Correlation of Ultrasonogram And Fine Needle Aspiration Cytology In Diagnosis of Thyroid Lesions

Komal Soni[1,*], Chetankumar M. Dharaiya[2], Hadavani Dipalben Kantibhai[1], Ina Shah[2]

[1]Department of Pathology, B. J. Medical College and Civil Hospital, Ahmedabad, Gujarat, India
[2]Department of Pathology, B. J. Medical College, Ahmedabad, Gujarat, India

***Correspondence:** Komalsoni2507@gmail.com

DOI
10.21276/apalm.3752

Article History
Received: 07-11-2025
Revised: 07-01-2026
Accepted: 13-01-2026
Published: 06-02-2026

How to cite this article
Soni K, Dharaiya CM, et al. A Retrospective Study of Correlation of Ultrasonogram And Fine Needle Aspiration Cytology In Diagnosis of Thyroid Lesions. Ann Pathol Lab Med. 2026;13(2):A73-A79.

Abstract

Background: Thyroid nodules are common in iodine-deficient regions of India and usually present as palpable swellings. Most are benign, but about 4–5% are malignant.
Materials and Methods: A retrospective analysis was conducted on 100 patients who underwent thyroid USG followed by FNAC. USG findings, FNAC findings, and relevant data were recorded from the laboratory Information system. The USG findings were compared with the FNAC results to determine the level of diagnostic concordance.
Results: In this study(n=100), according to FNAC, 94% patients had non-neoplastic lesions, 6% had neoplastic lesions comprising 2% follicular neoplasm,1% suspicious for malignancy and 3% papillary carcinoma. On USG, 87% cases were non-neoplastic, and 13% comprised 7% follicular adenoma,6% suspicious for malignancy. The correlation of USG with FNAC revealed that of the 5% cases identified as moderate to highly suspicious for malignancy on USG, 2 were diagnosed as follicular lesions on FNAC and subsequently confirmed as benign (follicular lesions) on histopathological examination (HPE). The remaining 3 cases, identified as malignant (Papillary carcinoma) on FNAC, were confirmed as malignant (Papillary carcinoma) on HPE. One case, which was diagnosed as mildly suspicious on USG, was diagnosed as suspicious for malignancy on FNAC, which was diagnosed as benign (colloid goitre) on HPE.
Conclusion: USG and FNAC are highly effective diagnostic modalities for evaluating thyroid nodules and identifying suspicious lesions. This strategy allows for more accurate exclusion of malignancy, thereby reducing the need for unnecessary surgical interventions.

Keywords: FNAC thyroid; USG thyroid; HPE; Thyroid lesions

Introduction

The thyroid gland, from the Greek words thyreos (shield) and eidos (shape), is one of the largest endocrine organs, with a remarkable potential for growth and enlargement. Diseases due to altered parenchymal function and anatomic abnormalities of this gland are among the most common endocrine disorders in humans. [1]

Thyroid lesions may have features suggestive of hyperthyroidism, hypothyroidism or may have malignant potential.[2] Thyroid swelling presents clinically with a lump in the neck and may cause cosmetic deformity, pressure symptoms over the trachea, esophagus, and major vessels.[3]

The majority (90%) of thyroid lesions are benign, as malignancy occurs in only 1 in 10 thyroid nodules.[4]

Indications for thyroid USG include evaluation for palpable thyroid lesions or suspected thyroid enlargement and workup of thyroid lesions discovered incidentally. It helps to detect a possible thyroid abnormality at an early stage and also provides differential diagnosis that results in subsequent thorough examination and timely treatment in appropriate cases. [5, 6]

FNAC provides a definite diagnosis of thyroid malignancy, with tumor type leading to appropriate surgery. Further, the remaining patients can be segregated into those who potentially require surgery or medical or endocrinological management.[7] FNAC has excellent patient acceptance and no morbidity; it is an easy, cost-effective test used in the diagnosis of thyroid lesions. [8, 9]

USG-guided FNAC of the thyroid is useful, especially in cystic and multinodular lesions harbouring malignancy. [10]

But there are limitations for both USG and FNAC in the diagnosis of thyroid malignancies, and still, there is a doubt as to which one is more efficacious.[11]

Although USG and FNAC are well-established tools for evaluating thyroid nodules, limited studies have systematically assessed their concordance using standardized reporting systems. This study uniquely correlates USG findings, classified by ACR TI-RADS, with FNAC results reported according to the TBSRTC, providing real-world data on diagnostic agreement in routine clinical practice. By analyzing discordant cases, the study highlights situations in which USG may overestimate malignancy, particularly in follicular-patterned lesions. These findings emphasise the importance. of a combined USG and FNAC approach for accurate thyroid nodule evaluation and optimised clinical management.

Aims and Objectives

To evaluate the cytological features of thyroid nodules using Fine Needle Aspiration Cytology (FNAC) and classify them according to the Bethesda System for Reporting Thyroid Cytopathology (TBSRTC).

To assess the correlation between FNAC findings and ultrasonographic (USG) observations in the diagnosis and characterisation of thyroid lesions.

Materials and Methods

This was a retrospective study conducted in the Cytopathology section of the Department of Pathology, B. J. Medical College, Ahmedabad, from January 2024 to July 2024, comprising 100 cases of thyroid swellings. USG findings, FNAC findings, and relevant data were recorded from the laboratory Information system (LIS). The results obtained were tabulated and correlated.

Inclusion Criteria

Patients presenting with clinically palpable thyroid swellings in the midline of the neck or on either side, accompanied by clinical features suggestive of thyroid pathology.

Exclusion Criteria

Cases with inadequate or non-diagnostic samples.

Patients who did not provide consent for FNAC.

Patients without prior ultrasonographic evaluation of the thyroid.

Patients with bleeding disorders, and individuals with a history of thyroid surgery, previously diagnosed thyroid malignancy, or prior treatment for thyroid lesions.

Ultrasonography

Thyroid ultrasonography was performed in the Department of Radiodiagnosis, B.J. Medical College and Civil Hospital, Ahmedabad, using a high-resolution ultrasound machine PHILIPS AFFINITY 50, with a 7.5–12 MHz linear transducer. Examinations were conducted by experienced radiologists.

Patients were positioned supine with the neck hyperextended, achieved by placing a pad under the shoulders, to facilitate optimal visualization. The superficial location of the thyroid gland allowed sonographic detection of subtle anatomical changes. The neck was scanned in sagittal, transverse, and oblique planes to comprehensively assess both lobes, the

isthmus, carotid arteries, and internal jugular veins. Imaging of the lower poles was enhanced by asking the patient to swallow, which elevated the thyroid gland. Additionally, the lateral neck and supraclavicular regions were examined for lymphadenopathy.Thyroid nodules were assessed for composition, echogenicity, margins, shape, and echogenic foci, and categorized according to the American College of Radiology Thyroid Imaging Reporting and Data System (ACR TI-RADS)

According to the ACR TI-RADS system nodules were classified as follows:

TR1: Benign

TR2: Not suspicious

TR3: Mildly suspicious

TR4: Moderately suspicious

TR5: Highly suspicious

FNAC Technique

After obtaining informed consent, the swelling was examined, and the procedure was performed under all aseptic and antiseptic precautions. Using a 22-, 23-, or 24-gauge disposable needle attached to a 10 mL disposable syringe, material was aspirated from the lesion. The procedure was repeated 2–4 times from different areas of the lesion to ensure adequate sampling. The aspirated material was smeared onto clean glass slides, and the smears were immediately fixed in fixative solution for a minimum of 20 minutes. Some smears were air-dried for May–Grünwald–Giemsa (MGG) staining. All slides were appropriately labelled, and 2–3 unstained smears were reserved for special stains if required.

Staining

Wet-fixed smears were stained using Hematoxylin and Eosin (H&E) and Papanicolaou (Pap) stains, while air-dried smears were stained with May–Grünwald–Giemsa (MGG) stain. The slides were mounted with DPX and preserved. Microscopic examination was subsequently carried out to evaluate the cytomorphological features of thyroid lesions.

Reporting

The Bethesda System for Reporting Thyroid Cytopathology (TBSRTC) – 2017 was followed for diagnostic categorization. The recommended diagnostic categories included:

Category I: Non-diagnostic / Unsatisfactory

Category II: Benign

Category III: Atypia of Undetermined Significance / Follicular Lesion of Undetermined Significance (AUS/FLUS)

Category IV: Follicular Neoplasm / Suspicious for Follicular Neoplasm

Category V: Suspicious for Malignancy

Category VI: Malignant

Statistical Analysis

Sensitivity, specificity, Youden's index, and Cohen's Kappa (κ) statistics were calculated for USG and FNAC using HPE as the gold standard. In our study, out of 100 patients, we had histopathological

Data of 15 patients. TIRADS categories III –V and Bethesda categories V–VI were considered positive.

Cases reported as AUS/FLUS (Bethesda Category III) were excluded from sensitivity, specificity, and correlation analyses due to their indeterminate nature, which precludes definitive classification as benign or malignant.

Results

A total of 100 thyroid lesion cases were studied, with a marked female predominance (86%) and a peak incidence in the 21–40 years age group (49%). The distribution of cases by age and gender is summarized in Table 1.

Table 1: Distribution of age and sex in the study group.

Age Group (Years)	No. of Cases in Males (%)	No. of Cases in Females (%)	Total No. of Cases (%)
0–20	1 (1%)	6 (6%)	7 (7%)
21–40	9 (9%)	40 (40%)	49 (49%)
41–60	3 (3%)	28 (28%)	31 (31%)
61–80	1 (1%)	12 (12%)	13 (13%)
Total	14 (14%)	86 (86%)	100 (100%)

On FNAC, non-neoplastic lesions constituted 94% of cases, most commonly colloid goitre (32%), followed by nodular goitre (22%), benign follicular lesions (19%), Thyroiditis (17%), and Grave's disease (1%). 3% cases were diagnosed with AUS/FLUS. Neoplastic lesions accounted for 6%, including papillary carcinoma (3%) and follicular neoplasm (2%) and suspicious for malignancy (1%), as shown in Table 2.

Table 2: Distribution of thyroid lesions according to FNAC diagnosis (Bethesda category).

Cytological diagnosis	Bethesda category	No. of cases (%)
Lymphocytic thyroiditis	II	10(10%)
Granulomatous thyroiditis	II	2(2%)
Hashimoto thyroiditis	II	5(5%)
Colloid goitre	II	32(32%)
Nodular goitre	II	22(22%)
Benign follicular lesion	II	19(19%)
Graves' disease	II	1(1%)
AUS/FLUS	III	3(3%)
Non-neoplastic lesion: Total		94(94%)
Follicular neoplasm	IV	2(2%)
Suspicious for malignancy	V	1(1%)
Papillary carcinoma	VI	3(3%)
Neoplastic lesion: Total		6(6%)

Ultrasonography revealed predominantly benign lesions (88%), with colloid goitre (28%) and multinodular goitre (27%) being the most frequent findings, followed by Thyroiditis (14%), Benign nodules (13%), and colloid cysts (5%). Neoplastic lesions accounted for 13%, including follicular adenoma (7%), suspicious cases were 6% including 1% mildly suspicious,3% moderately suspicious and 2 % highly suspicious, as shown in Table 3.

Table 3: Distribution of thyroid lesions according to USG diagnosis.

Lesion type	USG diagnosis	No. of cases
Nonneoplastic lesion		
Benign	Benign nodule	13(13%)
	Colloid goitre	28(28%)
	Multinodular goitre	27(27%)
	Colloidal cyst	5(5%)
Inflammatory	Thyroiditis	14(14%)
Neoplastic lesion		
Benign	Follicular adenoma	7%
Suspicious for malignancy	Mildly suspicious	1(1%)
	Moderately suspicious	3(3%)
	Highly suspicious	2(2%)
Total		100(100%)

HPE was available for 15 out of 100 patients who underwent surgery for suspicion of malignancy, discordant findings between USG and FNAC, confirmed malignancy or large thyroid swelling or goitre. These surgically treated cases formed the basis for statistical analysis.

Correlation between USG and FNAC showed that out of 100, 5 cases were identified as moderate and highly suspicious for malignancy on USG, 2 cases were diagnosed as follicular lesions on FNAC and subsequently confirmed as benign (follicular lesions) on HPE. The remaining 3 cases, identified as malignant (Papillary carcinoma) on FNAC, were confirmed

as malignant (Papillary carcinoma) on HPE. One case, which was diagnosed as mildly suspicious on USG, was diagnosed as suspicious for malignancy on FNAC, which was diagnosed as benign (colloid goitre) on HPE, as shown in Table 4.

Table 4: Correlation of USG and FNAC diagnosis.

Diagnosis	USG		FNAC		
	Inflammatory	Non inflammatory	Benign	Suspicious for malignancy	Malignant
Inflammatory	14	17	-	-	-
Non inflammatory	80	-	79	1	-
Mildly Suspicious	1	-	-	-	-
Suspicious for malignancy					
Moderately Suspicious	3	-	-	-	3
Severely Suspicious	2	-	-	-	-

In the present study, USG exhibited a sensitivity of 75% and specificity of 72.7% in the detection of thyroid malignancy, yielding a diagnostic accuracy of 73.3%. A Youden's Index of 0.48 indicates that USG has moderate overall diagnostic effectiveness, and Cohen's Kappa (κ)= 0.41 indicates moderate concordance with HPE outcomes.

FNAC demonstrated superior specificity (90.9%) with comparable sensitivity (75%). A Youden's Index of 0.66 indicates that FNAC has good diagnostic effectiveness, and Cohen's Kappa (κ)= 0.67 indicates substantial agreement with HPE, corroborating its status as a highly reliable diagnostic modality.

The higher Youden's Index and Cohen's Kappa (κ)for FNAC emphasize its greater discriminative power in identifying malignant versus benign nodules compared to USG. These findings emphasize the importance of USG as an effective screening tool, whereas FNAC remains the definitive cytological standard.

Discussion

Thyroid nodules are among the most common endocrine abnormalities encountered in clinical practice. While the majority are benign, a small but clinically significant subset may harbour malignancy, making accurate differentiation essential to guide management and avoid unnecessary surgical interventions. In this context, ultrasonography (USG) and fine-needle aspiration cytology (FNAC) serve as complementary diagnostic tools, providing valuable anatomical and cytomorphological information.

In the present study of 100 patients with thyroid swellings, most cases occurred in the 21–40-year age group, with a marked female predominance (female-to-male ratio 6:1). This distribution is consistent with prior reports by Bhatia et al. [12]and Gupta et al. [13], who noted higher prevalence in women, likely due to hormonal influences and autoimmune predisposition.

FNAC revealed that non-neoplastic lesions accounted for 94% of cases, with colloid goitre being the most frequent, followed by nodular goitre and thyroiditis. Neoplastic lesions constituted only 6% of cases, in accordance with global data indicating malignancy in fewer than 10% of thyroid nodules.[14] These observations align with earlier studies by Guhamallick et al. [15] and Nandedkar et al. [16], highlighting colloid goitre as the predominant pathology in iodine-deficient regions of India.

Ultrasonography classified 93% of nodules as non-neoplastic and 7% as neoplastic. These observations align with earlier studies by Patel NR et al. [11].

In a similar prospective study conducted by Battina et al., FNAC findings revealed follicular hyperplasia in 30% of patients, follicular neoplasia, in 46%, thyroiditis in 8% and papillary carcinoma in 15% of cases. On USG, 51% were diagnosed with nodular goitre, 10% had cystic nodules, 14% were diagnosed with thyroiditis, and 25% showed features suggestive of malignant nodular goitre.[17]

Despite being a widely accessible, non-invasive, and sensitive imaging modality, USG has limited specificity for distinguishing benign from malignant lesions, as some benign nodules, particularly follicular adenomas, may mimic malignancy sonographically. In this study, USG overdiagnosed malignancy in two cases, later confirmed as benign follicular lesions on FNAC and HPE. Both nodules exhibited suspicious USG features, including marked hypoechogenicity, irregular margins, and punctate echogenic foci, leading to their categorization as malignant on USG. However, HPE revealed benign follicular lesions, highlighting the overlap of sonographic features between malignant/follicular lesions and emphasizing the need for combined USG–FNAC correlation. Similar diagnostic limitations have been reported by Hegedüs[18] and Frates et al. [19], underscoring the need for cytological confirmation prior to surgical intervention.

FNAC demonstrated higher diagnostic accuracy (86.7%) than USG (73.3%), consistent with findings by Handa et al. [20] and Bagga and Mahajan[21], who reported FNAC accuracy rates of 92–97% in differentiating benign from malignant nodules.

The use of The Bethesda System for Reporting Thyroid Cytopathology (TBSRTC) further standardizes interpretation, enhances reproducibility, and improves clinician–pathologist communication.

Bethesda Category III (AUS/FLUS) is widely recognized as an ambiguous and heterogeneous diagnostic category with variable malignancy risk, potentially leading to inconsistent interpretations across institutions; this characteristic makes its inclusion in strict USG–FNAC–HPE correlation analyses problematic, and therefore AUS/FLUS cases were excluded from the main statistical correlation.[22]

The clinical implications are noteworthy. The false-positive rates associated with USG highlight its limitations as a standalone diagnostic instrument. Integration of FNAC with USG assessment facilitates precise risk stratification of thyroid nodules, enhancing diagnostic confidence. These data substantiate the current recommendations delineated in the American Thyroid Association (ATA) guidelines and TIRADS-based protocols, which advocate cytological evaluation of nodules exhibiting suspicious sonographic features. Adherence to such evidence-based frameworks can refine clinical decision-making, minimize unnecessary surgical interventions, and optimize patient outcomes in the management of thyroid nodular disease.

Conclusion

The present study highlights that fine-needle aspiration cytology (FNAC), when interpreted alongside ultrasonographic (USG) findings, markedly improves diagnostic accuracy in the evaluation of thyroid lesions. FNAC is particularly essential in cases with suspicious USG features, as it allows for precise lesion classification and informs appropriate clinical management. Sole reliance on USG may result in diagnostic inaccuracies and potentially unnecessary surgical interventions. Accordingly, a combined diagnostic approach utilizing both USG and FNAC is strongly recommended to optimize the assessment and management of thyroid nodules.

Acknowledgements: I extend my gratitude to my mentors, peers and laboratory team for their support and assistance during this study.

Funding: None

Competing Interests: No conflict of interest

Statement of Ethical Approval for the study: Ethical approval was obtained from the college's ethical committee.

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