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Original Research Article

Cytological–Histopathological Correlation in Thyroid Lesions: A Tertiary Care Centre Experience

Roushan Kumar[1], Md Zeeshan Haider[2], Shashi Ranjan Roy[3], Dilip Kumar[4]

[1]Tutor, Department of Pathology, Patna Medical College and Hospital, Patna, Bihar, India
[2]Tutor, Department of Pathology, Patna Medical College and Hospital, Patna, Bihar, India
[3]Tutor, Department of Pathology, Patna Medical College and Hospital, Patna, Bihar, India
[4]Professor, Department of Pathology, Patna Medical College and Hospital, Patna, Bihar, India

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Corresponding Author: Roushan Kumar
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Abstract:

Background: Fine-needle aspiration cytology (FNAC) is an essential diagnostic tool for evaluating thyroid nodules. However, its accuracy varies across different lesion types, especially those with follicular patterns. This study assessed the diagnostic performance of FNAC by correlating cytological findings with histopathological examination in patients presenting with thyroid lesions at a tertiary care centre.

Methods: This retrospective observational study was undertaken in the Department of Pathology at PMCH, Patna, spanning the period from January to October 2025. A total of 60 patients who underwent FNAC followed by thyroidectomy or biopsy were included. FNAC smears were reported using The Bethesda System for Reporting Thyroid Cytopathology (TBSRTC). Final histopathological diagnoses were correlated with cytology and diagnostic indices were calculated.

Results: Of the 60 patients, females predominated (83.3%), with a mean age of 41.2 years. Distribution of Bethesda categories was: I—2 (3.3%), II—30 (50%), III—8 (13.3%), IV—6 (10%), V—6 (10%), and VI—8 (13.3%). Histopathology revealed 40 benign and 20 malignant lesions. Cytology–histopathology concordance was observed in 54 cases (90%). Considering Bethesda V and VI as cytology-positive, FNAC showed a sensitivity of 75.0%, specificity of 97.5%, PPV of 93.7%, NPV of 88.6%, and overall diagnostic accuracy of 90%.

Conclusion: FNAC demonstrated high specificity and diagnostic accuracy for thyroid lesions in this centre. Indeterminate categories, particularly Bethesda III and IV, contributed to most discordant cases, reinforcing the importance of multidisciplinary evaluation in such scenarios.

Keywords: Thyroid Nodule, FNAC, Bethesda System, Histopathology, Diagnostic Accuracy.

Introduction

Thyroid swellings are a common clinical finding and continue to be an important reason for outpatient consultations in endocrinology and surgery [1]. Their increasing detection in recent years is largely due to better access to imaging and greater health awareness among the general population [2]. Although most thyroid nodules do not indicate malignancy, identifying the smaller fraction that does carry malignant potential remains essential for appropriate management. Early and accurate distinction between benign and malignant lesions helps avoid unnecessary surgery in benign conditions while ensuring timely intervention for cancers. For this purpose, fine-needle aspiration cytology (FNAC) has become an indispensable part of the initial diagnostic workup [3].

FNAC is widely preferred because it is simple, low-cost, and well-tolerated, and it provides rapid preliminary information. To promote consistency and improve communication between cytopathologists and clinicians, the Bethesda System for Reporting Thyroid Cytopathology (TBSRTC) was introduced [4]. This classification system categorizes thyroid cytology findings into six diagnostic tiers, each linked to specific malignancy risks and corresponding management recommendations. While the system has improved clarity and decision-making, a degree of uncertainty persists in some categories, particularly those involving follicular-patterned lesions. These categories often require additional investigations or histopathological confirmation, as cytology alone cannot assess features such as capsular or vascular invasion [5,6].

Given that histopathology is the definitive diagnostic method, correlating cytology with postoperative tissue findings is crucial for evaluating the performance of FNAC. Such correlation helps

determine how often cytology predicts the correct diagnosis and also highlights the reasons for diagnostic disagreement, whether related to sampling limitations, intrinsic morphological overlap, or interpretational challenges. Regular assessment of FNAC performance at the institutional level also serves as a valuable quality check, ensuring that reporting practices remain accurate and aligned with current standards [7].

Patna Medical College and Hospital manage a large number of patients with thyroid disorders, reflecting the disease burden in this region. The diversity of cases seen here provides an opportunity to assess the reliability of FNAC in routine clinical practice. This study was undertaken to compare cytological diagnoses, classified according to TBSRTC, with corresponding histopathological findings in patients who underwent thyroidectomy or biopsy. By evaluating diagnostic concordance and calculating standard accuracy measures, the study aims to provide clarity on the strengths and limitations of FNAC in this population and to support more informed clinical decision-making for patients presenting with thyroid lesions [8].

Materials and Methods

Study Design and Setting: This study, designed as a retrospective observational analysis, was carried out in the Pathology Department of Patna Medical College and Hospital, Patna.

Study Duration: January 1, 2025 to October 31, 2025.

Sample Size: The study included 60 patients who had thyroid FNAC performed and subsequently underwent histopathological evaluation.

Inclusion Criteria

- Patients with clinically suspected thyroid lesions.
- FNAC performed and reported using TBSRTC.
- Availability of corresponding thyroidectomy or biopsy specimens.
- Complete clinical and pathological records.

Exclusion Criteria

- FNAC without subsequent histopathology.
- Poorly stained or non-representative smears (Bethesda I noted but analyzed separately).
- Incomplete demographic or clinical data.

Procedure: FNAC was performed under aseptic precautions using 23–25G needles. The cytology smears were processed using both Giemsa and Papanicolaou staining techniques. Cytology was categorized into Bethesda classes I–VI.

Histopathological evaluation was carried out on formalin-fixed, paraffin-embedded tissue sections stained with hematoxylin and eosin. Cytology–histopathology correlation was done based on benign vs malignant nature.

Statistical Analysis: Bethesda categories V and VI were classified as malignant for analytical purposes. Sensitivity, specificity, positive and negative predictive values, and overall diagnostic accuracy were computed using conventional statistical formulas.

Results

1. **Demographic Characteristics:** A total of 60 patients who underwent FNAC followed by histopathological examination were included in the study. Thyroid disorders were predominantly seen in females, who accounted for 83.3% (n=50) of the cases, while males comprised 16.7% (n=10). The age of patients ranged from 18 to 72 years, with a mean age of 41.2 years. Most cases were clustered in the 31–50 years age group.
2. **Cytological Findings (Bethesda System):** FNAC smears were classified using the Bethesda categories. Benign lesions (Bethesda II) formed the largest group with 30 cases (50%). Indeterminate categories accounted for 23.3% of cases (Bethesda III—8 cases; Bethesda IV—6 cases). Categories suspicious or diagnostic of malignancy (Bethesda V and VI) constituted 14 cases (23.3%). Non-diagnostic smears (Bethesda I) were seen in 2 cases.

Table 1: Distribution of FNAC Findings According to Bethesda System

Bethesda Category	Number of Cases (n=60)	Percentage
I — Non-diagnostic	2	3.3%
II — Benign	30	50.0%
III — AUS/FLUS	8	13.3%
IV — Follicular neoplasm	6	10.0%
V — Suspicious for malignancy	6	10.0%
VI — Malignant	8	13.3%

3. **Histopathological Diagnosis:** On histopathological examination, benign lesions were more common (n=40; 66.7%) while

malignant lesions accounted for 20 cases (33.3%). Colloid goitre and nodular hyperplasia together formed the largest benign category (46.7%). Papillary thyroid carcinoma was the most frequent malignancy, observed in 16 cases.

Table 2: Distribution of Histopathological Diagnoses

Histopathological Diagnosis	Number of Cases	Percentage
Colloid goitre / Nodular hyperplasia	28	46.7%
Thyroiditis	6	10.0%
Follicular adenoma	6	10.0%
Papillary thyroid carcinoma	16	26.7%
Follicular carcinoma	3	5.0%
Medullary carcinoma	1	1.7%

4. **Cytology–Histopathology Correlation:** Cytology categories Bethesda V and VI were considered positive for malignancy. Out of 16 cytology-positive cases, 15 were confirmed malignant on histopathology (true positives), and 1 benign case was reported as suspicious on cytology (false positive). Among the cytology-negative group, 5 malignant cases were missed (false negatives), while 39 showed concordant benign results.

Overall, 54 out of 60 cases showed agreement between FNAC and histopathology, yielding a concordance rate of 90%.

Table 3: FNAC vs. Histopathology (2×2 Table)

	Malignant (HPE)	Benign (HPE)	Total
Cytology Positive (Bethesda V–VI)	15 (TP)	1 (FP)	16
Cytology Negative (Bethesda I–IV)	5 (FN)	39 (TN)	44
Total	20	40	60

5. **Diagnostic Index of FNAC:** Using histopathology as the gold standard, FNAC demonstrated:

- **Sensitivity:** 75.0%
- **Specificity:** 97.5%
- **Positive Predictive Value:** 93.7%
- **Negative Predictive Value:** 88.6%
- **Overall Accuracy:** 90.0%

These results highlight FNAC's strong ability to rule in malignancy (high specificity), while some malignant lesions were placed in indeterminate or benign cytology categories, explaining the moderate sensitivity.

Discussion

The findings of this study demonstrate that FNAC continues to perform well as a diagnostic tool when its results are directly correlated with histopathological examination. The high concordance of 90% observed in the present series reflects consistent smear preparation, appropriate sample selection, and experienced cytological interpretation at our centre. Such a level of agreement has been reported by several established institutions, suggesting that FNAC retains strong clinical utility when applied in a structured manner. The predominance of correctly identified benign nodules in this study also emphasizes the reliability of FNAC in ruling out malignancy in the majority of patients who present with solitary or multiple thyroid swellings [9,10].

A key observation was the distribution pattern of confirmed malignancies, with papillary carcinoma forming the largest subgroup. This aligns with the recognized trend that papillary carcinoma often exhibits distinctive nuclear features, making it more straightforward to identify on cytology compared with other thyroid malignancies. The relatively smaller number of follicular carcinoma cases explains why most false-negative results arose from follicular-patterned lesions [11]. These lesions remain difficult to classify accurately because cytology cannot assess capsular or vascular invasion. The presence of follicular adenoma, follicular carcinoma, and the follicular variant of papillary carcinoma within the same morphological spectrum accounts for the diagnostic challenges encountered, especially in the Bethesda III and IV categories [12].

The performance metrics obtained—particularly the specificity of 97.5%—underscore the strength of FNAC in confirming malignancy when cytological atypia is evident. High specificity reduces the likelihood of unnecessary surgeries, which is important in a setting where healthcare access and patient resources vary significantly. The fact that only a single case was falsely categorized as malignant indicates that overt nuclear features were likely present in the smear but not predictive of invasive behavior on histology. Such cases may arise from reactive atypia or degenerative changes, reinforcing the need for caution when evaluating

smears that show borderline atypical findings [13,14].

The moderate sensitivity of 75% seen in the study is consistent with the practical limitations posed by sampling errors. Although ultrasound guidance improves yield, some nodules, particularly those with cystic degeneration or heterogeneous composition, may not provide sufficient diagnostic material in a single pass. The five false-negative cases in this series highlight the importance of clinical and radiological correlation. When discordance occurs, especially in nodules that appear suspicious on imaging, repeat FNAC or proceeding to diagnostic lobectomy may be justified. Multidisciplinary case review plays an essential role in resolving such ambiguities and in preventing delays in management [15,16].

Interpreting the diagnostic behavior of the indeterminate Bethesda categories within our study population sheds further light on their complexity. A proportion of Bethesda III and IV cases turned out to be benign on histology, while others showed malignancy, demonstrating the heterogeneous nature of these categories. The variable outcomes reiterate that cytology alone cannot provide definitive guidance for all patients in these groups. Careful follow-up and individualized decision-making are necessary, and emerging methods such as elastography or ancillary molecular markers, although not utilized here due to resource constraints, could contribute to improved risk stratification in the future [17].

The histopathological profile observed in this study also reflects the regional clinical spectrum. The high proportion of colloid goitre and nodular hyperplasia indicates a pattern commonly seen in regions where long-standing benign thyroid enlargement is prevalent. The presence of thyroiditis in several cases may have contributed to subtle cytological atypia in a few smears, although most were accurately classified as benign. This reinforces that clinical context and ultrasonographic features remain indispensable companions to cytological interpretation, particularly for lesions showing inflammatory or degenerative changes [18].

Despite the overall strong performance of FNAC in this study, its limitations must be considered when interpreting results. The retrospective design restricts assessment of procedural variables such as needle passes, on-site adequacy evaluation, or ultrasound guidance, all of which could influence overall sensitivity. Furthermore, the study represents a single-centre experience, and although the sample size is adequate for internal audit, wider regional studies would provide more comprehensive insights. Nevertheless, the findings offer valuable evidence that FNAC, when interpreted within a structured reporting framework and supported by clinical and imaging inputs, remains a dependable and efficient diagnostic tool. Continued correlation meetings and internal audits will further enhance diagnostic consistency, ensuring that cytology remains an integral component of thyroid nodule evaluation at our institution.

Conclusion

FNAC using the Bethesda System offers high specificity and diagnostic accuracy in differentiating benign from malignant thyroid lesions. While it performs exceptionally well in identifying papillary carcinoma, indeterminate categories continue to challenge cytopathologists. Multidisciplinary assessment, repeat FNAC, and adjunct molecular testing—where available—can help improve diagnostic confidence.

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