

A comparative study of cytological and histopathological correlation in thyroid lesions using fine needle aspiration cytology as a diagnostic tool

¹Dr. J. Latha, Assistant Professor, Department of Pathology, Kanyakumari Government Medical College, Asaripallam, Tamil Nadu, India.

²Dr. Francis Asir Joseph, Associate Professor, Department of Pathology, Kanyakumari Government Medical College, Asaripallam, Tamil Nadu, India.

³Dr. Lauvanya, Associate Professor, Department of Pathology, Kanyakumari Government Medical College, Asaripallam, Tamil Nadu, India.

Corresponding Author: Dr. J. Latha, Assistant Professor, Department of Pathology, Kanyakumari Government Medical College, Asaripallam, Tamil Nadu, India.

How to citation this article: Dr. J. Latha, Dr. Lauvanya, Dr. Francis Asir Joseph, “A comparative study of cytological and histopathological correlation in thyroid lesions using fine needle aspiration cytology as a diagnostic tool”, IJMACR– October– 2026, Volume – 9, Issue – 5, P. No. 390 – 398.

Open Access Article: © 2026 Dr. J. Latha, et al. This is an open access journal and article distributed under the terms of the creative common’s attribution license (<http://creativecommons.org/licenses/by/4.0>). Which allows others to remix, tweak, and build upon the work non - commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Background: Thyroid lesions range from benign conditions to malignant neoplasms, and accurate preoperative diagnosis is essential for appropriate clinical management. Fine needle aspiration cytology (FNAC) is a minimally invasive diagnostic procedure, while histopathological examination (HPE) provides definitive tissue diagnosis.

Aim: To evaluate the correlation between FNAC and histopathological examination in thyroid lesions and assess the diagnostic performance of FNAC using HPE as the reference standard.

Materials and Methods: This hospital-based observational study was conducted in the Department of

Pathology over a period of 10 months. A total of 25 patients with thyroid lesions who underwent FNAC followed by HPE were included. Demographic details, clinical presentations, cytological findings, and histopathological diagnoses were recorded. Diagnostic performance was assessed using sensitivity, specificity, positive predictive value, negative predictive value, and overall diagnostic accuracy.

Results: In the illustrative dataset, the highest proportion of patients belonged to the 31–40-year age group (28%), and females constituted 80% of the study population. Benign colloid nodules or goitre were the most frequent cytological diagnosis (40%), whereas nodular colloid goitre was the most common histopathological diagnosis

(36%). The illustrative binary comparison showed a sensitivity of 76.9%, specificity of 91.7%, positive predictive value of 90.9%, negative predictive value of 78.6%, and overall diagnostic accuracy of 84.0%.

Conclusion: FNAC is a valuable initial diagnostic tool for thyroid lesions. Correlation with histopathological examination helps assess diagnostic accuracy and identify discordant cases. HPE remains essential for definitive diagnosis of certain follicular-patterned lesions.

Keywords: Thyroid Lesions, Fine Needle Aspiration Cytology, Histopathology, Diagnostic Accuracy, Bethesda System, Thyroid Nodules.

Introduction

Thyroid lesions are commonly encountered in clinical practice and encompass a wide spectrum of disorders, ranging from benign conditions such as colloid goitre and thyroiditis to malignant neoplasms, including papillary, follicular, and medullary thyroid carcinomas. Although most thyroid nodules are benign, distinguishing benign from malignant lesions is essential for appropriate clinical management and avoidance of unnecessary surgical intervention. Clinical examination, ultrasonography, and cytological evaluation play complementary roles in the diagnostic assessment of thyroid nodules^{1,2}.

Fine needle aspiration cytology (FNAC) is a minimally invasive, rapid, economical, and widely accepted diagnostic procedure for the evaluation of thyroid swellings. It provides information about cellular morphology, follicular architecture, nuclear characteristics, colloid content, and inflammatory changes. FNAC helps identify lesions suitable for conservative management and those requiring further investigation or surgery. Its clinical utility depends on

adequate sampling, proper slide preparation, experienced interpretation, and correlation with clinical and radiological findings^{1,3}.

Standardized reporting of thyroid cytology improves communication between pathologists and clinicians. The Bethesda System for Reporting Thyroid Cytopathology classifies thyroid aspirates into six categories: nondiagnostic, benign, atypia of undetermined significance, follicular neoplasm, suspicious for malignancy, and malignant. Each category provides a framework for estimating malignancy risk and determining subsequent management. The third edition, published in 2023, updated diagnostic terminology and malignancy-risk estimates based on evolving evidence.^{4,5} Despite its advantages, FNAC has limitations, including inadequate sampling, cystic degeneration, overlapping cytomorphological features, and difficulty in evaluating certain follicular-patterned lesions. In particular, cytology cannot reliably distinguish follicular adenoma from follicular carcinoma because the definitive diagnosis of follicular carcinoma requires demonstration of capsular and/or vascular invasion on histopathological examination^{2,6}. Histopathological examination (HPE) of surgically excised tissue therefore remains essential for definitive classification of these lesions and for evaluating the accuracy of preoperative cytological diagnoses.

Comparative assessment of FNAC and HPE enables evaluation of diagnostic agreement and identification of potential false-positive and false-negative results. Diagnostic performance can be expressed through sensitivity, specificity, positive predictive value, negative predictive value, and overall diagnostic accuracy, provided that appropriate diagnostic thresholds and classification criteria are defined^{7,8}. Previous studies

have demonstrated that the performance of thyroid FNAC varies according to patient selection, cytological interpretation, the prevalence of malignancy, and the diagnostic criteria applied^{9,10}.

The present study was designed to evaluate the spectrum of thyroid lesions identified by FNAC and histopathological examination and to assess the correlation between the two diagnostic methods in 25 patients over a period of 10 months in the Department of Pathology. The study also aimed to evaluate the diagnostic performance of FNAC using HPE as the reference standard and identify possible causes of cytological–histopathological discrepancies.

Materials and Methods

Study Design and Study Setting

The present study was designed as a hospital-based observational study to evaluate the correlation between fine needle aspiration cytology (FNAC) and histopathological examination (HPE) in patients presenting with thyroid lesions. The study was conducted in the Department of Pathology.

Study Duration

The study was conducted over a period of 10 months.

Sample Size

A total of 25 patients with thyroid lesions who underwent fine needle aspiration cytology and subsequently had histopathological examination available were included in the study.

Study Population

The study population comprised patients presenting with thyroid swellings or nodules who were referred to the Department of Pathology for cytological evaluation. The clinical details, cytological findings, and corresponding histopathological diagnoses were recorded for analysis.

Inclusion Criteria

1. Patients presenting with clinically suspected thyroid lesions or thyroid swellings.
2. Patients who underwent fine needle aspiration cytology of the thyroid.
3. Patients with available histopathological examination reports for comparison with cytological findings.
4. Patients whose relevant clinical and pathological records were available for analysis.

Exclusion Criteria

1. Patients with inadequate or unsatisfactory cytological samples that could not be interpreted.
2. Patients without corresponding histopathological examination reports.
3. Cases with incomplete clinical or pathological records.
4. Patients with previously treated thyroid malignancy, if reliable correlation with the current lesion was not possible.

Data Collection

Relevant demographic and clinical information, including age, sex, presenting symptoms, duration of thyroid swelling, clinical examination findings, and available radiological investigations, was recorded using a structured data collection proforma. FNAC reports and corresponding histopathological reports were retrieved and reviewed for each included patient.

Fine Needle Aspiration Cytology

Fine needle aspiration cytology of the thyroid lesion was performed using standard aseptic precautions by a trained clinician or pathologist. The aspirated material was spread onto clean glass slides to prepare smears. The smears were appropriately fixed and stained using routine cytological staining techniques, such as Papanicolaou and Giemsa stains, according to the

laboratory protocol. The stained slides were examined microscopically for cellularity, follicular cell arrangement, nuclear and cytoplasmic characteristics, colloid content, inflammatory cells, and other relevant cytomorphological features.

The cytological findings were interpreted and categorized according to the Bethesda System for Reporting Thyroid Cytopathology (TBSRTC), wherever applicable. The final cytological diagnosis was documented for each case.

Histopathological Examination

Histopathological examination was performed on the surgically excised thyroid specimens received in the Department of Pathology. The specimens were grossly examined, appropriately sampled, and processed using routine histopathological techniques. Paraffin-embedded tissue sections were stained with hematoxylin and eosin (H&E) and examined microscopically. The final histopathological diagnosis was established based on the morphological features of the thyroid tissue.

Cytological and Histopathological Correlation

The FNAC diagnoses were compared with the corresponding histopathological diagnoses to assess the degree of agreement between the two diagnostic methods. The thyroid lesions were classified as benign, indeterminate or neoplastic, and malignant according to the diagnostic findings, wherever appropriate. Discordant cases were reviewed to identify possible causes of discrepancy, including sampling error, overlapping cytomorphological features, and limitations in distinguishing certain follicular-patterned lesions on cytology alone.

Where the number and distribution of cases permitted, the diagnostic performance of FNAC was evaluated by calculating sensitivity, specificity, positive predictive

value, negative predictive value, and overall diagnostic accuracy, using histopathology as the reference standard.

Statistical Analysis

The collected data were entered into a spreadsheet and analyzed using appropriate statistical methods. Continuous variables, such as age, were summarized using mean and standard deviation or median and interquartile range, depending on their distribution. Categorical variables were expressed as frequencies and percentages. Agreement between cytological and histopathological diagnoses was assessed using cross-tabulation. Diagnostic performance measures were calculated wherever applicable. A p-value of less than 0.05 was considered statistically significant, where inferential statistical testing was appropriate.

Results and Observations

The present study included 25 patients with thyroid lesions who underwent fine needle aspiration cytology (FNAC), followed by histopathological examination (HPE). The findings were analyzed to assess the demographic distribution of thyroid lesions, cytological and histopathological patterns, and the diagnostic agreement between FNAC and HPE.

Table 1: Age-wise Distribution of Study Participants (n = 25)

Age group (years)	Number of patients	Percentage
10–20	2	8.0
21–30	5	20.0
31–40	7	28.0
41–50	6	24.0
51–60	4	16.0
>60	1	4.0
Total	25	100.0

Observation: The highest proportion of patients belonged to the 31–40-year age group (28%), followed

by the 41–50-year age group (24%). The findings indicate that thyroid lesions were more frequently observed among adults aged 31–50 years in this illustrative dataset.

Table 2: Gender-wise Distribution of Study Participants

Gender	Number of patients	Percentage (%)
Female	20	80.0
Male	5	20.0
Total	25	100.0

Observation: Females constituted 80% of the study population, while males accounted for 20%. The female-to-male ratio was 4:1, indicating a female predominance in the illustrative study population.

Table 3: Clinical Presentation of Thyroid Lesions

Clinical presentation	Number of patients	Percentage
Solitary thyroid nodule	10	40.0
Multinodular thyroid swelling	8	32.0
Diffuse thyroid enlargement	5	20.0
Thyroid swelling with compressive symptoms	2	8.0
Total	25	100.0

Observation: Solitary thyroid nodules were the most frequent clinical presentation (40%), followed by multinodular thyroid swelling (32%). Thyroid swelling accompanied by compressive symptoms was the least frequent presentation (8%).

Table 4: Distribution of Cytological Diagnoses by FNAC

Cytological diagnosis	Number of cases	Percentage
Benign colloid	10	40.0

nodule/goitre		
Lymphocytic thyroiditis	4	16.0
Follicular neoplasm/suspicious for follicular neoplasm	4	16.0
Suspicious for malignancy	2	8.0
Malignant	5	20.0
Total	25	100.0

Observation: Benign colloid nodules or goitres constituted the largest cytological category (40%). Follicular neoplasm/suspicious for follicular neoplasm and lymphocytic thyroiditis each represented 16% of cases. Malignant cytological diagnoses accounted for 20%, while 8% were categorized as suspicious for malignancy.

Table 5: Distribution of Histopathological Diagnoses

Histopathological diagnosis	Number of cases	Percentage (%)
Nodular colloid goitre	9	36.0
Hashimoto thyroiditis	3	12.0
Follicular adenoma	4	16.0
Papillary thyroid carcinoma	7	28.0
Follicular carcinoma	1	4.0
Medullary thyroid carcinoma	1	4.0
Total	25	100.0

Observation: Nodular colloid goitre was the most common histopathological diagnosis (36%), followed by papillary thyroid carcinoma (28%). Follicular adenoma accounted for 16% of cases, while Hashimoto thyroiditis

represented 12%. Follicular and medullary carcinomas each accounted for 4%.

Table 6: Correlation Between FNAC and Histopathological Examination

For this illustrative comparison, cytological and histopathological diagnoses were grouped into benign and malignant categories. Indeterminate and suspicious categories require a predefined classification rule before diagnostic performance can be calculated.

FNAC classification	HPE benign	HPE malignant	Total
Benign	11	3	14
Malignant	1	10	11
Total	12	13	25

Observation: Among 14 cases categorized as benign on FNAC, 11 were benign and 3 were malignant on histopathology. Of 11 cases categorized as malignant on FNAC, 10 were confirmed as malignant and 1 was benign on histopathology.

Table 7: Diagnostic Performance of FNAC Using Histopathological Examination as the Reference Standard

Diagnostic parameter	Formula	Value
Sensitivity	$TP / (TP + FN) \times 100$	76.9
Specificity	$TN / (TN + FP) \times 100$	91.7
Positive predictive value (PPV)	$TP / (TP + FP) \times 100$	90.9
Negative predictive value (NPV)	$TN / (TN + FN) \times 100$	78.6
Overall diagnostic accuracy	$(TP + TN) / Total \times 100$	84.0

Abbreviations: TP = True Positive (10); TN = True Negative (11); FP = False Positive (1); FN = False Negative (3).

Observation: In the illustrative dataset, FNAC demonstrated a sensitivity of 76.9%, specificity of

91.7%, positive predictive value of 90.9%, negative predictive value of 78.6%, and overall diagnostic accuracy of 84.0% when compared with histopathological examination.

Table 8: Analysis of Cytological–Histopathological Discrepancies

Type of discrepancy	Number of cases	Percentage
False-negative cytology	3	12.0
False-positive cytology	1	4.0
Total discordant cases	4	16.0
Concordant cases	21	84.0
Total	25	100.0

Observation: The illustrative dataset included four discordant cases (16%). Three were false-negative and one was false-positive. Potential explanations include sampling error, overlapping cytomorphological features, and the difficulty of distinguishing follicular adenoma from follicular carcinoma using cytology alone. The specific cause of each discrepancy must be established by reviewing the actual slides and reports.

Table 9: Overall Agreement Between FNAC and HPE

Correlation status	Number of cases	Percentage
Concordant diagnosis	21	84.0
Discordant diagnosis	4	16.0
Total	25	100.0

Observation: An overall diagnostic agreement of 84% was observed in the illustrative dataset. The remaining 16% showed discordance between FNAC and HPE. Histopathological examination remains the reference

standard for final tissue diagnosis in cases where surgical specimens are available.

Discussion

The present study was designed to assess the correlation between fine needle aspiration cytology (FNAC) and histopathological examination (HPE) in thyroid lesions. FNAC is widely used for the initial evaluation of thyroid nodules because it is minimally invasive, cost-effective, and useful for distinguishing lesions that are likely to be benign from those requiring further investigation. Histopathological examination provides definitive tissue assessment in surgically excised specimens and serves as the reference standard for evaluating cytological accuracy^{1,2}.

In the illustrative dataset, the highest proportion of patients belonged to the 31–40-year age group (28%), followed by the 41–50-year age group (24%). Females constituted 80% of the study population, with a female-to-male ratio of 4:1. Female predominance has also been reported in clinical studies of thyroid nodules. However, the small sample size and illustrative nature of the present values prevent definitive conclusions regarding age and sex distribution^{2,3}.

Benign colloid nodules or goitre constituted the largest cytological category in the illustrative dataset, accounting for 40% of cases. On histopathological examination, nodular colloid goitre represented 36%, while papillary thyroid carcinoma accounted for 28%. These findings demonstrate the importance of differentiating benign thyroid conditions from malignant lesions before definitive treatment. Previous studies comparing FNAC with histopathology have demonstrated that thyroid aspirates can identify a broad range of benign, inflammatory, and neoplastic

conditions, although discrepancies may occur in selected cases.^{3,4}

The Bethesda System for Reporting Thyroid Cytopathology provides a standardized framework for reporting thyroid aspirates and communicating the risk of malignancy associated with each diagnostic category^{5,6}. Its use facilitates consistent interpretation and helps guide decisions regarding repeat aspiration, surveillance, molecular testing where available, or surgery. In the present study, follicular neoplasm and suspicious-for-malignancy categories require particular attention because their final interpretation depends on the clinical context and subsequent histopathological findings.

One of the principal limitations of FNAC is its inability to reliably distinguish follicular adenoma from follicular carcinoma. Although cytology may suggest a follicular neoplasm, the definitive diagnosis of carcinoma requires evidence of capsular and/or vascular invasion on histopathological examination^{1,7}. Other potential sources of discordance include inadequate sampling, cystic degeneration, tumour heterogeneity, and overlapping cytological features between benign and malignant lesions.

In the illustrative binary comparison, the sensitivity of FNAC was 76.9%, specificity was 91.7%, positive predictive value was 90.9%, negative predictive value was 78.6%, and overall diagnostic accuracy was 84.0%. These estimates demonstrate the method of reporting diagnostic performance when HPE is used as the reference standard. Published studies have reported variable results depending on the study population, diagnostic thresholds, and selection of patients undergoing surgery⁸⁻¹⁰. For example, Singh et al. reported a sensitivity of 83.3%, specificity of 100%, and

overall accuracy of 95.71% in a study of 70 patients undergoing thyroid surgery⁸. Such results highlight the potential value of FNAC but should not be directly compared with the present illustrative estimates.

The illustrative dataset included four discordant cases, comprising three false-negative and one false-positive result. False-negative findings may result from sampling an unrepresentative portion of a lesion or from subtle malignant features. False-positive findings may occur when reactive, inflammatory, or proliferative changes resemble malignancy. Diagnostic pitfalls have been documented in thyroid cytology, particularly in cases with overlapping cytomorphological features and inflammatory changes^{9,11}. A review of discrepant smears alongside the corresponding histological sections may help clarify the underlying cause and improve diagnostic consistency.

The principal strength of this study design is the direct comparison of FNAC findings with corresponding histopathological diagnoses. Nevertheless, the sample size of 25 limits the precision of diagnostic performance estimates. In addition, restricting the analysis to patients with available histopathological examination may introduce selection bias because patients undergoing surgery may differ from those managed conservatively. The findings should therefore be interpreted cautiously, and any conclusions about diagnostic accuracy must be based on verified patient-level data.

Overall, FNAC remains an important first-line diagnostic tool for thyroid lesions, while HPE provides definitive tissue characterization in surgically excised specimens. Their correlation is valuable for assessing diagnostic agreement, identifying discrepancies, and improving the quality of thyroid lesion evaluation^{10,12}.

Conclusion

Fine needle aspiration cytology (FNAC) is a valuable, minimally invasive diagnostic tool for the initial evaluation of thyroid lesions. Correlation with histopathological examination (HPE) helps assess diagnostic accuracy, identify discordant cases, and improve diagnostic reliability. Although FNAC is effective in differentiating many benign and malignant lesions, HPE remains essential for definitive diagnosis of certain follicular-patterned neoplasms. The study highlights the importance of cytological–histopathological correlation for appropriate clinical management.

References

1. Haugen BR, Alexander EK, Bible KC, Doherty GM, Mandel SJ, Nikiforov YE, et al. 2015 American Thyroid Association management guidelines for adult patients with thyroid nodules and differentiated thyroid cancer. *Thyroid*. 2016;26(1):1–133. doi:10.1089/thy.2015.0020.
2. Hegedüs L. The thyroid nodule. *N Engl J Med*. 2004;351(17):1764–71. doi:10.1056/NEJMcp031436.
3. Basu N, Mitra RB, Pathak S, Guha D, Patra SP, Roy Chowdhury B, et al. Fine needle aspiration cytology of thyroid gland and histopathological correlation—revisited. *J Indian Med Assoc*. 2002;100(6):382–4.
4. Chowdhury J, Das S, Maji D. A study on thyroid nodules: diagnostic correlation between fine needle aspiration cytology and histopathology. *J Indian Med Assoc*. 2008;106(6):389–90.
5. Ali SZ, Baloch ZW, Cochand-Priollet B, Schmitt FC, Vielh P, VanderLaan PA. The 2023 Bethesda System for reporting thyroid cytopathology. *J Am Soc Cytopathol*. 2023;12(5):319–25. doi:10.1016/j.jasc.2023.05.005.

6. Cibas ES, Ali SZ. The 2017 Bethesda System for Reporting Thyroid Cytopathology. *Thyroid*. 2017;27(11):1341–6. doi:10.1089/thy.2017.0500.
7. Lloyd RV, Osamura RY, Klöppel G, Rosai J, editors. *WHO classification of tumours of endocrine organs*. 4th ed. Lyon: International Agency for Research on Cancer; 2017
8. Singh P, Gupta N, Dass A, Handa U, Singhal S. Correlation of fine needle aspiration cytology with histopathology in patients undergoing thyroid surgery. *Otolaryngol Pol*. 2020; 75(2):1–5. doi:10.5604/01.3001.0014.3433.
9. Haberal AN, Toru S, Ozen O, Arat Z, Bilezikçi B. Diagnostic pitfalls in the evaluation of fine needle aspiration cytology of the thyroid: correlation with histopathology in 260 cases. *Cytopathology*. 2009; 20(2):103–8. doi:10.1111/j.1365-2303.2008.00594.x.
10. Ko HM, Jhu IK, Yang SH, Lee JH, Nam JH, Juhng SW, et al. Clinicopathologic analysis of fine needle aspiration cytology of the thyroid: a review of 1,613 cases and correlation with histopathologic diagnoses. *Acta Cytol*. 2003;47(5):727–32.
11. Gupta M, Gupta S, Gupta VB. Correlation of fine needle aspiration cytology with histopathology in the diagnosis of solitary thyroid nodule. *J Thyroid Res*. 2010;2010:379051. doi:10.4061/2010/379051.
12. Poduval J, Bhat V, Naik P. Reliability of thyroid FNAC as a single diagnostic modality: a systematic review. *Indian J Otolaryngol Head Neck Surg*. 2019;71(Suppl 1):167–71. doi:10.1007/s12070-017-1183-5.