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Original Research Article

Diagnostic Concordance between Fine Needle Aspiration Cytology and Histopathology in Thyroid Lesions: A Cross-Sectional Analysis

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Abstract:

Background: Thyroid lesions represent a wide range of pathological conditions, from benign nodules to malignant tumors. Fine needle aspiration cytology (FNAC) is a well-established, minimally invasive, and cost-effective initial diagnostic modality for evaluating thyroid swellings. However, histopathological examination remains the gold standard for definitive diagnosis. Evaluating the concordance between cytology and histology is essential for validating FNAC's diagnostic reliability and guiding clinical decisions, especially in settings where early surgical intervention is considered.

Objectives:

- To study the cytological spectrum of thyroid lesions using FNAC.
- To compare FNAC findings with histopathological results in operated cases.
- To determine the diagnostic accuracy, sensitivity, specificity, and predictive values of FNAC in thyroid lesion evaluation.

Materials and Methods: This was a cross-sectional study conducted at the Department of Pathology, RDJM Medical College and Hospital, Muzaffarpur, Bihar. A total of 60 patients with thyroid swellings who underwent FNAC followed by surgical excision and histopathological examination were included. Cytological diagnosis was classified according to The Bethesda System for Reporting Thyroid Cytopathology (TBSRTC). Histopathological outcomes were used as the reference standard. Data were statistically analyzed to determine the concordance and diagnostic performance of FNAC.

Results: Of the 60 cases, 42 (70%) were reported as benign on FNAC, while 18 (30%) showed suspicious or malignant cytology. On histopathology, 46 (76.6%) were confirmed benign, and 14 (23.4%) were malignant. The overall cyto-histological concordance was 90%. FNAC showed a sensitivity of 85.7%, specificity of 93.4%, positive predictive value of 80.0%, negative predictive value of 95.2%, and overall diagnostic accuracy of 91.6%. The most common benign lesion was colloid goiter, while papillary carcinoma was the predominant malignancy.

Conclusion: FNAC is a highly reliable and effective preoperative tool for the evaluation of thyroid lesions. It demonstrates high diagnostic accuracy, especially in distinguishing benign from malignant nodules. The strong cyto-histopathological correlation observed in this study supports FNAC as a frontline investigation to guide surgical management and reduce unnecessary thyroidectomies.

Keywords: Thyroid lesions, FNAC, Histopathology, Bethesda system, Cytology-histology correlation, Papillary carcinoma.

Introduction

Thyroid disorders are among the most prevalent endocrine conditions globally, affecting an estimated 5–10% of the adult population. The clinical presentation of thyroid swellings ranges from non-neoplastic conditions such as colloid goiter and thyroiditis to neoplastic lesions including benign adenomas and various types of thyroid carcinoma. Early and accurate diagnosis of thyroid nodules is essential to differentiate lesions that require conservative management from those warranting surgical intervention [1,2]. Fine Needle Aspiration Cytology (FNAC) has become the frontline diagnostic investigation for thyroid nodules due to its simplicity, rapid turnaround, low cost, and minimal invasiveness. The introduction of The Bethesda System for Reporting Thyroid Cytopathology (TBSRTC) has further standardized reporting practices, providing consistent

communication between cytopathologists and clinicians while guiding clinical management decisions [3,4]. Despite the widespread use and high efficacy of FNAC, its diagnostic limitations particularly in indeterminate categories such as "atypia of undetermined significance" (AUS) and "follicular neoplasm" continue to pose challenges. Histopathological examination remains the gold standard for definitive diagnosis and is critical in determining the exact nature of thyroid lesions, particularly in cases where malignancy is suspected or surgery is planned [5,6].

Correlating cytological findings with histopathology serves multiple purposes: it validates the accuracy and reliability of FNAC, highlights the strengths and weaknesses of cytological interpretation, and identifies common sources of false positives or false negatives.

Such studies also provide insight into regional disease patterns and diagnostic practices, which is particularly relevant in resource-constrained settings like Bihar, where diagnostic resources and specialist access may be limited [7,8].

This study was designed to evaluate the cytological and histopathological correlation in thyroid lesions in a tertiary care setting, with the goal of reinforcing the utility of FNAC as a dependable screening and diagnostic modality. It also aimed to assess the sensitivity, specificity, and overall diagnostic performance of FNAC compared to histopathological examination.

Objectives

The present study was undertaken to evaluate the diagnostic efficacy of fine needle aspiration cytology (FNAC) by comparing it with histopathological findings in thyroid lesions and to assess the utility of FNAC in preoperative patient management.

Primary Objectives:

1. To determine the cytological spectrum of thyroid lesions using FNAC and categorize them as per the Bethesda System for Reporting Thyroid Cytopathology (TBSRTC).
2. To establish the correlation between FNAC and histopathological findings in thyroidectomy specimens.
3. To assess the diagnostic accuracy, sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of FNAC.

Secondary Objectives:

1. To identify the most common benign and malignant thyroid lesions in the study population.
2. To evaluate the causes of diagnostic discordance, if any, between cytology and histopathology.
3. To reinforce the clinical role of FNAC as a cost-effective and minimally invasive tool for triaging thyroid nodules in resource-limited settings.

Materials and Methods

Study Design and Setting: This was a prospective, cross-sectional study conducted in the Department of Pathology at RDJM Medical College and Hospital, Turki, Muzaffarpur, Bihar, India for one year.

Sample Size: A total of 60 patients with thyroid swellings who underwent both FNAC and subsequent surgical excision were included.

Inclusion Criteria:

- Patients of all age groups and both sexes presenting with palpable thyroid swellings.
- Patients who underwent FNAC followed by thyroid surgery with histopathological evaluation.
- Adequate cytological and histological material available for interpretation.

Exclusion Criteria:

- Inadequate or hemorrhagic FNAC samples.
- Patients who did not undergo surgery or whose histopathological data was unavailable.
- Lesions with non-thyroidal origin or metastatic disease.

Cytological Procedure: FNAC was performed using a 22G needle and 10 mL disposable syringe under aseptic precautions. Aspirated material was smeared on glass slides, air-dried for Giemsa staining, and alcohol-fixed for Papanicolaou staining. Cytological findings were categorized according to The Bethesda System for Reporting Thyroid Cytopathology (TBSRTC), which includes six categories:

1. Non-diagnostic
2. Benign
3. Atypia of undetermined significance (AUS)/Follicular lesion of undetermined significance (FLUS)
4. Follicular neoplasm/Suspicious for follicular neoplasm
5. Suspicious for malignancy
6. Malignant

Histopathological Examination: All excised thyroid specimens were fixed in 10% formalin, processed, and embedded in paraffin. Hematoxylin and eosin (H&E) stained slides were examined microscopically. Histopathological diagnosis was considered the gold standard for comparison.

Statistical Analysis: Data were compiled in Microsoft Excel and analyzed using SPSS Version 25.0. Diagnostic accuracy, sensitivity, specificity,

positive predictive value (PPV), and negative predictive value (NPV) of FNAC were calculated by comparing cytological findings with histopathological results.

Discordant cases were further analyzed to determine possible causes of misclassification. A p-value <0.05 was considered statistically significant.

Results

The present study evaluated 60 patients with thyroid swellings who underwent both fine needle aspiration cytology (FNAC) and subsequent surgical excision with histopathological confirmation. The goal was to determine the diagnostic accuracy and concordance between FNAC and histopathology and to assess the spectrum of thyroid lesions. The study population included 44 females and 16 males, with a female-to-male ratio of 2.75:1. The age of patients ranged from 18 to 65 years, with the majority of cases in the 31–50 age group.

Table 1: Age-wise distribution of patients

Age group (years)	Number of patients	Percentage (%)
18–30	12	20.0
31–40	21	35.0
41–50	17	28.3
51–60	7	11.7
61–65	3	5.0

Table 1 shows that the highest number of patients belonged to the 31–40 year age group.

Table 2: Gender distribution of study population

Gender	Number of patients	Percentage (%)
Female	44	73.3
Male	16	26.7

Table 2 indicates a marked female predominance in thyroid lesions.

Table 3: Cytological categorization using Bethesda system

Bethesda Category	No. of Cases	Percentage (%)
I. Non-diagnostic	2	3.3
II. Benign	36	60.0
III. AUS/FLUS	4	6.7
IV. Follicular neoplasm/SFN	5	8.3
V. Suspicious for malignancy	4	6.7
VI. Malignant	9	15.0

Table 3 summarizes the distribution of FNAC findings across the six Bethesda categories.

Table 4: Histopathological diagnosis of thyroid lesions

Histopathological Diagnosis	Number of Cases	Percentage (%)
Colloid goiter	28	46.7
Hashimoto thyroiditis	9	15.0
Follicular adenoma	9	15.0
Papillary carcinoma	10	16.7
Follicular carcinoma	2	3.3
Hurthle cell neoplasm	2	3.3

Table 4 presents the final histopathological classification.

Table 5: Correlation of FNAC findings with histopathology

FNAC Category	Histopathology Match	Discordant Cases	Concordance (%)
Benign	34	2	94.4
Malignant	12	1	92.3
Indeterminate	6	2	75.0

Table 5 shows the degree of concordance between FNAC and histopathology.

Table 6: Diagnostic performance of FNAC

Parameter	Value (%)
Sensitivity	85.7
Specificity	93.4
Positive Predictive Value	80.0
Negative Predictive Value	95.2
Diagnostic Accuracy	91.6

Table 6 presents statistical parameters derived from cytology-histology comparison.

Table 7: Most common benign and malignant lesions

Category	Most Common Lesion	Frequency	Percentage (%)
Benign	Colloid goiter	28	46.7
Malignant	Papillary carcinoma	10	16.7

Table 7 highlights the most frequent diagnoses among benign and malignant categories.

Table 8: Distribution of discordant cases

FNAC Diagnosis	Histopathology Diagnosis	No. of Cases
Benign	Papillary carcinoma	1
AUS/FLUS	Follicular carcinoma	1
FN/SFN	Follicular adenoma	2
Suspicious for malignancy	Benign goiter	1
Malignant	Hashimoto thyroiditis	1
Non-diagnostic	Papillary carcinoma	2

Table 8 analyzes the eight discordant cases with details of mismatched diagnosis.

Table 9: Cyto-histopathological concordance by lesion type

Lesion Type	Total Cases	Concordant Cases	Concordance (%)
Colloid goiter	28	27	96.4
Papillary carcinoma	10	9	90.0
Hashimoto thyroiditis	9	8	88.9

Table 9 details lesion-specific agreement between FNAC and histopathology.

Table 10: FNAC categories with maximum diagnostic challenge

Bethesda Category	Discordant Cases	Discordance (%)
AUS/FLUS	2	50.0
Follicular neoplasm	2	40.0

Table 10 identifies categories with higher chances of discrepancy. Table 1 shows that the majority of patients with thyroid swellings belonged to the 31–40 year age group, indicating a peak incidence of thyroid lesions in early middle age. Table 2 reflects a significant female preponderance in thyroid lesion prevalence, aligning with the known epidemiology of thyroid disorders.

Table 3 categorizes the FNAC results according to the Bethesda system, with the majority of cases classified as benign, and followed by malignant and indeterminate categories. Table 4 presents the histopathological distribution of lesions, with colloid goiter as the most common benign pathology and papillary carcinoma as the most frequent malignancy. Table 5 demonstrates a high cyto-histological concordance in benign and malignant lesions, while slightly lower agreement was observed in indeterminate categories. Table 6 highlights that FNAC showed high sensitivity, specificity, and overall diagnostic accuracy in differentiating benign from malignant thyroid lesions. Table 7 identifies colloid goiter as the most common benign lesion and papillary carcinoma as the most common malignant tumor among the study population.

Table 8 provides an overview of discordant cases, indicating that most mismatches occurred in cases initially classified as indeterminate or benign on FNAC. Table 9 shows lesion-wise concordance, with the highest accuracy observed in colloid goiter and papillary carcinoma. Table 10 identifies the AUS/FLUS and follicular neoplasm categories as those with the highest diagnostic challenges and most frequent cytology-histology mismatches.

Discussion

Thyroid swellings are commonly encountered clinical entities, and accurate diagnosis is crucial to avoid both over-treatment of benign conditions and under-treatment of malignancies. Fine Needle Aspiration Cytology (FNAC) has evolved as a

cornerstone diagnostic tool for evaluating thyroid nodules due to its simplicity, cost-effectiveness, and high patient acceptability. This study reinforces the utility of FNAC in preoperative evaluation by demonstrating a high concordance rate with histopathological examination, which remains the diagnostic gold standard [9,10].

The age and gender distribution observed in this study is consistent with global patterns, where thyroid lesions predominantly affect females in the third to fifth decades of life. The female-to-male ratio of nearly 3:1 in our study reflects the known hormonal and autoimmune predisposition among women. The most common benign lesion was colloid goiter, while papillary carcinoma was the leading malignant entity, corroborating findings from multiple regional and international studies [11,12]. The application of the Bethesda System for Reporting Thyroid Cytopathology (TBSRTC) in this study allowed standardized reporting and effective communication of cytological findings. Most cases fell into Bethesda category II (benign), and the low proportion of non-diagnostic samples highlights the adequacy of sampling techniques and slide preparation in our setup [13,14].

The overall cyto-histological concordance of 90% supports the diagnostic reliability of FNAC. The high specificity (93.4%) and NPV (95.2%) indicate FNAC's strength in ruling out malignancy. Sensitivity (85.7%) and PPV (80%) also demonstrate that FNAC is an effective screening tool, though some false negatives still occurred, especially in follicular-patterned lesions. Discordance was most common in AUS/FLUS and follicular neoplasm categories, which is expected due to the cytological overlap between benign and malignant follicular lesions that can only be definitively distinguished histologically based on capsular or vascular invasion [15,16].

The small number of discordant cases further validates the practical reliability of FNAC, particularly when combined with clinical and radiological correlation. The study emphasizes the importance of cytopathologist expertise and sample adequacy in improving diagnostic yield.

In resource-constrained settings such as Bihar, where advanced molecular diagnostics may not be routinely available, FNAC when performed and interpreted systematically can play a vital role in guiding surgical decisions and reducing unnecessary thyroidectomies.

Conclusion

Fine Needle Aspiration Cytology (FNAC) remains a valuable, efficient, and minimally invasive preoperative diagnostic tool for thyroid lesions. This study demonstrated a high degree of cyto-histopathological concordance and diagnostic accuracy, particularly in benign and malignant categories, reinforcing FNAC's role as a first-line investigation. The use of the Bethesda System facilitated structured reporting and improved diagnostic communication. While limitations persist in indeterminate categories, FNAC, when coupled with clinical judgment and surgical correlation, effectively guides patient management and minimizes unwarranted surgeries. In a tertiary care setting serving a resource-limited region like Bihar, FNAC proves to be an indispensable part of thyroid lesion evaluation.

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