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Original Research Article

Comparative Study of Fine Needle Aspiration Cytology and Histopathology Correlation of Various Thyroid Lesions

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Abstract

Background: Anterior neck edema in patients is a prevalent issue in clinical practice. Thyroid cancer is the most common endocrine system cancer in all age categories, including children. Fine needle aspiration cytology (FNAC) has proven to be a rapid and economical method of first diagnostic testing. As a result, it is generally acknowledged and more thyroid instances are identified early. However, because FNAC and Histopathological Examination (HPE) have different correlations, it has drawbacks. The goal of the study is to assess the diagnostic efficacy of FNAC by comparing its results with histopathological findings.

Methods: The current study was carried out from August 2025 to January 2026 at the Department of Pathology, Lord Buddha Koshi Medical College and Hospital, Saharsa, Bihar. One hundred thyroid nodule cases that had FNAC and had their postoperative specimens examined histopathologically were included in the study. Histopathological data were compared with the FNAC results.

Results: Eight of the 100 cases collected for the study were cancerous, while 92 were benign. In 89 cases, there was a correlation between the cytological and histological diagnoses. Five cases showed a partial correlation between the cytological and histological diagnosis. The FNAC diagnosis did not match the histological findings in six instances. 62.50% sensitivity, 97.83% specificity, 95% accuracy, 71.43% positive predictive value, and 96.77% negative predictive value were found by FNAC.

Conclusion: Thus, FNAC of thyroid lesions has been shown to be an easy, economical, and precise way to identify and direct the treatment of palpable thyroid lesions. As a result, we can observe that the FNAC procedure has a very good diagnostic accuracy, making it a very helpful investigation in the work-up of thyroid patients. However, histology should be the basis for the ultimate diagnosis and course of treatment.

Keywords: Accuracy, Bethesda system, FNAC, Thyroid swelling.

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Introduction

The thyroid is a gland at the front of the neck that resembles a butterfly. Neck swelling is a common clinical sign of thyroid swellings. The most prevalent endocrine system cancer that affects people of all ages, including children, is thyroid cancer, which is also the fastest-growing cancer in both men and women.[1] Thyroid nodules are found in 0.2% to 1.2% of children and 4% to 10% of adults.[2] Only 5% to 30% of thyroid nodules that are clinically detected are malignant and need surgery; the majority are nonneoplastic.[3] Clinical history and examination are frequently insufficient to diagnose these disorders; instead, radiographic and fine needle aspiration cytology testing are necessary.[4]A syringe and fine needle are used in the minimally invasive procedure of fine needle aspiration cytology to aspirate cells. The American Thyroid Association [5] and the National Comprehensive Cancer Network State have endorsed it as a first diagnostic test due to its affordability and ease of use. FNAC is currently being utilized more and more globally to prevent needless thyroid surgery.[6] Finding nodules that need surgery and benign nodules that are visible clinically, as well as lowering the total thyroidectomy rate in individuals with benign illnesses, are the main objectives of FNAC. This is economical and reduces unnecessary hospital stays

and procedures.[7] The entire process, from aspiration to smear processing, can be finished in a matter of hours. Rapid diagnosis relieves patient's anxiety and saves precious time in planning a definitive treatment.

In addition to reducing the amount of needless thyroid surgeries, FNAC has aided in the diagnosis of other benign disorders, including inflammatory, neoplastic, and infectious diseases. 8 The proportion of benign to malignant tumors removed has gone raised. It is a very useful diagnostic tool for the diagnosis and treatment of individuals with thyroid abnormalities, even though it cannot replace surgical histopathology. Thyroid swellings are currently diagnosed using a variety of ancillary assays, including thyroid antibodies, radio-nucleotide ultrasonography, and high resolution ultrasonography (USG).

Nonetheless, FNAC of the thyroid remains the most straightforward, economical test with excellent sensitivity, specificity, and diagnostic precision, particularly for cystic abnormalities.[9]

In order to link the FNAC and histological findings of different thyroid lesions, the current investigation was conducted.

Materials and Methods

The current study was carried out from August 2025 to January 2026 in the Department of Pathology at Lord Buddha Koshi Medical College and Hospital in Saharsa, Bihar. The study included one hundred individuals who were referred from the departments of surgery, medicine, and ENT and had a history of thyroid enlargement.

According to the proforma, each patient had a thorough clinical evaluation. The thyroid gland was carefully palpated to determine the exact location for thyroid tissue aspiration. The patient was given a brief description of the operation before the thyroid was aspirated while they were either sitting or supine and had their necks extended to highlight the thyroid enlargement. A 21-gauge needle with syringe was introduced into the lesion under aseptic precautions, and rapid to-and-fro movements were carried out. After the material was gathered in the needle under negative pressure, the negative pressure was released, the needle with the syringe holder was taken out, the material was spread out over a clean, labeled slide, and streaks were made.

Smears were stained with hematoxylin and eosin (H & E) after being wet fixed in 95% ethyl alcohol. Every time fluid was extracted, it was aspirated and centrifuged.

The sediment was used to create smears, which were then stained using the previously mentioned stain. Following surgery, the specimens were preserved with 10% formalin, subjected to a thorough gross examination, and sections were cut from representative locations for paraffin sections and H&E staining. Light microscopy was used to examine the sections.

Wherever possible, cytological diagnosis was connected with histology, and Galen and Gambino's methodology was used to determine the effectiveness of FNAC.[10]

Results

A total of 100 cases of thyroid nodules that underwent FNAC and had their corresponding post-operative specimens treated to HPE were included in this study.

Patients in the study ranged in age from 18 to 77. The majority of the cases were concentrated in the 18–40 age range. The age groups of 21–40 and 41–60 years old had the highest concentration of non-neoplastic lesions. The bimodal peak of the neoplastic lesions occurs between the ages of 21 and 40, followed by 61 and 80.(Table 1)

Table 1: Distribution of patients according to age

Age in years	Non-neoplastic	Neoplastic	Total
0-20	7	2	9
21-40	39	4	43
41-60	36	0	36
61-80	10	2	12
Total			100

Majority of the patients were females. Out of total of 100 patients, 79 were female and the rest 21 were male.(Table 2)

Table 2: Distribution of patients according to gender

Gender	No. of cases	Percentage
Male	21	21%
Female	79	79%
Total	100	100%

Out of the 100 cases taken for the purpose of the study, 92 were benign whereas 8 were malignant. (Table 3)

The benign lesions consisted majority of multinodular goitre-57 cases, (Figure 1) Hashimoto's cases-10, hyperplastic nodules-7 cases, follicular adenoma-19 cases and thyroglossal cyst- 2 cases.

Among the 8 malignant lesions, 5 were papillary carcinoma of the thyroid gland, one was follicular carcinoma, one was medullary carcinoma and one was anaplastic thyroid carcinoma.

Table 3: Distribution of benign and malignant thyroid lesions

Category	No. of cases	Percentage
Benign	92	92%
Malignant	8	8%
Total	100	100%

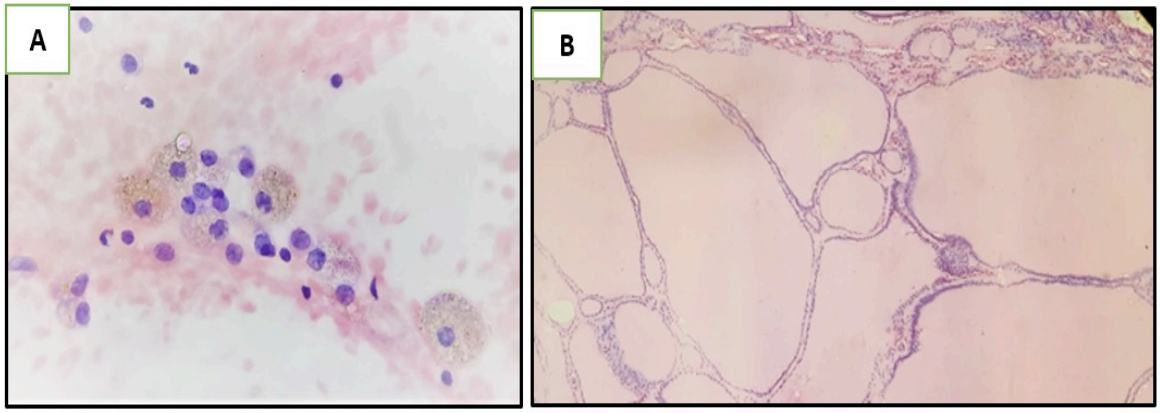

Fig. 1: A): Photomicrograph of Colloid Goiter with cystic change-(H & E stain, 40x); B): Photomicrograph showing multi-nodular goiter on histopathology- (H & E stain, 40x)

In this study among the 100 cases taken for study, in 89 cases the cytological and histopathological diagnosis correlated with each-other. There were 5 cases where the cytological diagnosis partially correlated to the histopathological diagnosis. These included cases where the FNAC slides showed goiter but missed the thyroiditis along with it. This is a well-known drawback of the FNAC procedure.In six cases the FNAC diagnosis did not correlated with histopathological diagnosis.(Table 4) These included 3 cases where the FNAC found only cyst fluid but on histopathology they turned out to be multinodular goiter.(Figures 2 and 3) In one case of medullary carcinoma on FNAC, diagnosis of goiter was given. One case of goiter turned out to be adenomatoid nodule.(Figure 4) The FNAC also failed to diagnose follicular variant of papillary carcinoma.

Table 4: Correlation of cytological and histopathological diagnosis of patient

Correlation	No. of cases	Percentage
Completely correlating	89	89%
Partially correlating	5	5%
Not correlating	6	6%
Total	100	100%

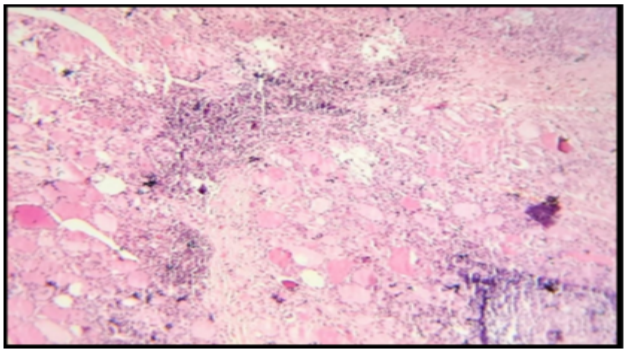

Fig. 2: Photomicrograph of smear showing only cyst macrophages-(H & E stain,40x)

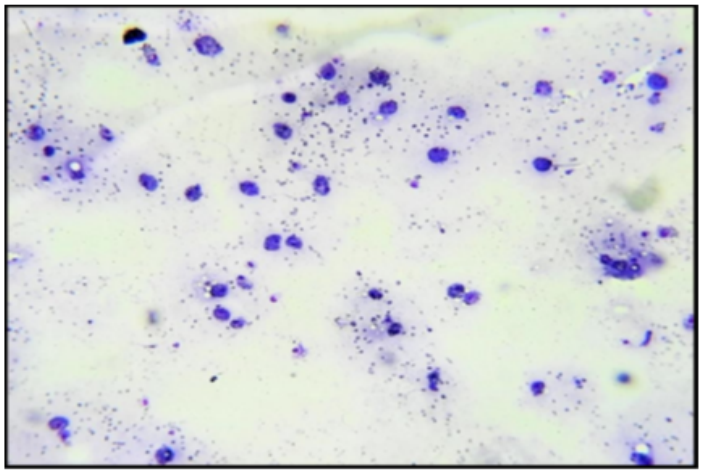

Fig. 3: Photomicrograph of smear showing only cyst macrophages-(MGG, 40x)

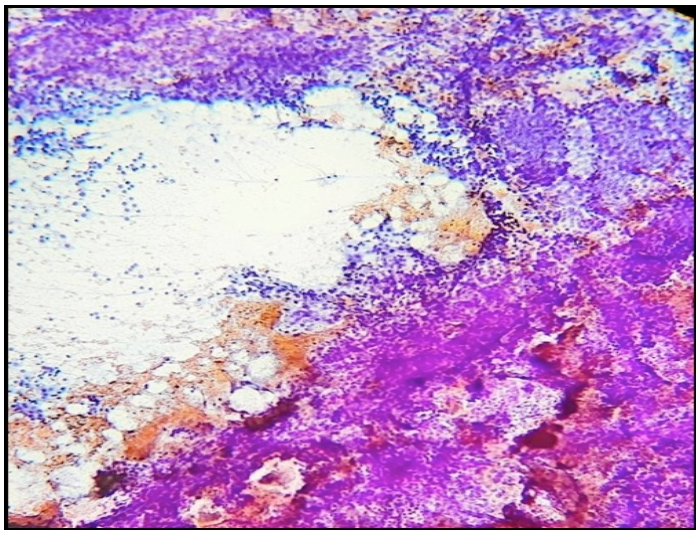

Fig. 4: Photomicrograph showing Adenomatoid Nodule on Histopathology-(H & E stain,10x)

Overall, present study shows 62.50% sensitivity, 97.83% specificity and 95% accuracy. Thus, we can see that the diagnostic accuracy of FNAC procedure is very high making it a very useful investigation in the work-up of thyroid patient. In our study, negative predictive value was 71.43% and positive predictive value was 96.77%.The thyroid lesions were categorized based on FNAC findings in the six Bethesda categories of reporting the thyroid lesions. Using the Bethesda system for reporting the thyroid lesions is very effective as it provides uniform terms of reporting across all the hospitals. Also, it provides risk assessment for benign tumor turning into malignant.(Table 5)

Table 5: Categorization of thyroid lesions according to the Bethesda category

Diagnostic Category	No. of cases	Percentage
I-Non-diagnostic or unsatisfactory	4	4%
II-Benign	76	76%
III- Atypia of Undetermined Significance (AUS)/Follicular Lesion of Undetermined Significance (FLUS)	2	2%
IV-Follicular Neoplasm /Suspicious for a Follicular Neoplasm	14	14%
V-Suspicious for malignancy	1	1%
VI-Malignant	3	3%
Total	100	100%

Table 6: Correlation between FNAC and HPE

	Histopathology- Positive	Histopathology- Negative
Cytology/FNAC- Positive	5	2
Cytology/FNAC- Negative	3	90

Table 7: Statistical values of FNAC-HPE

Statistic	Value	95% CI
Sensitivity	62.50%	24.49% to 91.48%
Specificity	97.83%	92.37% to 91.48%
Positive Likelihood Ratio	28.75	6.60 to 125.31
Negative Likelihood Ratio	0.38	0.16 to 0.94
Disease prevalence	8.00%	3.52% to 15.16%
Positive Predictive Value (PPV)	71.43%	36.45% to 91.59%
Negative Predictive Value (NPV)	96.77%	92.46% to 98.66%
Accuracy	95.00%	88.72% to 98.36%

Discussion

By classifying the patients based on the Bethesda categories used to assess the thyroid lesions, the current study looked at the cytological features of thyroid lesions and decided how to treat these patients.

Additionally, there was a correlation between these individuals' histological and cytological results.

Patients in the current study ranged in age from 18 to 77. The age range of 20 to 40 years old accounts for the majority of the cases. The current study's age distribution was also contrasted with studies by Roy PK et al. [11] and Vargis RK et al. [12]. According to Babu SBK et al. [13], the majority of patients were in the 30–45 age range.

Female made up the majority of patients with thyroid lesions. Of the 100 cases, 21 were male and 79 were female. This results in a 1:3.7 male to female ratio for the current study. Research by Gupta M et al. [14] and Naveen Kumar C et al. [15] revealed similar results. 69.73% of patients in a study by Rout K et al. [16] were female, which is comparable to our study's finding that 79% of patients were female.

Ninety-two of the 100 cases were benign or non-neoplastic. There were just eight occurrences that were neoplastic or malignant. 57 nodular colloid goiters, 10 Hashimoto thyroiditis, 2 thyroglossal cysts, 16 follicular adenomas, and 7 hyperplastic nodules were among the non-neoplastic cases. Five papillary carcinomas, one follicular neoplasm, one medullary carcinoma, and one anaplastic thyroid tumor were among the eight neoplastic lesions.

In the current study, the overall ratio of non-neoplastic to neoplastic diseases is 1:11.5. The results of the current investigation were similar to those of studies by Kumar HC et al. [17], Gangadhara KS et al. [18], and Handa U et al.[19]

Five cases of thyroid papillary carcinoma were included in the current study. FNAC properly identified three (60%) of these cases as conventional papillary cancer. In one instance, papillary cancer was discovered in a cystic lesion; nevertheless, the sample was overlooked, resulting in a mistaken diagnosis of colloid goiter. Hurtle cell neoplasm was diagnosed in one case of papillary carcinoma thyroid due to focal hurtle cell alteration. These results differed from those of research by Naveen Kumar C et al. [15], GagnetenCB et al. [20], and Gupta M. et al. [14] because their sample sizes were too small for a precise evaluation.Out of 2 cases of Follicular neoplasm, 1 case turned out to be follicular carcinoma on histopathology with a diagnostic accuracy of 50%. The diagnostic accuracy of FNAC in diagnosing Follicular neoplasm in the present study is comparable to the Silverman JF et al[21] and Hall TL et al study.[22]

The medullary carcinoma was diagnosed on histopathology and was reported as colloid goiter on FNAC. One case of anaplastic thyroid carcinoma was categorized as suspicious for malignancy Bethesda category IV on FNAC. dFNACgnosis of thyroid lesions.

The present study showed sensitivity of 62.50%, specificity of 97.83% and diagnostic accuracy of present study of 95%. Therefore, probability of having malignant disease following positive FNAC results for malignancy i.e., PPV was 71.43%. Therefore, probability of not having malignant disease following negative FNAC results for malignancy i.e., NPV was 96.77%.

On comparison with other studies the present study showed sensitivity of 62.50% which was comparable with study conducted by Ahmed MT et al study.[23] Same was

demonstrated as 73.91% in a study by Reddy MR et al.[24] The highest sensitivity was reported in the study conducted by Handa U et al[19] showing 97%. The present studyshowed specificity of 97.83% which was comparable with study conducted by Gangadhara KS et al.18 Our findings can be compared with observation of Kumar HC et al[17] who reported specificity of FNAC was 87.5%. The highest specificity reported in the studies mentioned was in a study conducted by Babu SBK et al[13] showing 100%. Srilekha Bodepudi et al[25] evaluated thyroid swelling in 93 cases and in their study FNAC demonstrated a sensitivity of 82.35%, and a specificity of 95.18%.

In our study the accuracy of FNAC in detection of the thyroid lesions was found to be 95%. It is well compared with the study done by Babu SBK,[13] in which the accuracy was reported as 94%, and another study done by Abdullahi IM et al[26] the accuracy was 94.9%. The diagnostic accuracy of Correlation between FNAC diagnosis and final HPE diagnosis was 91.66% in a study by Gangadhara KS et al.[18]

The current study's PPV of 71.43% was consistent with research by Srilekha Bodepudi et al. [25] and Gangadhara KS et al. [18]. The NPV in our study was 96.77%, which was comparable to research by Babu SBK et al. [13] and Gangadhara KS et al. [18].

The PPV and NPV of FNAC in the identification of thyroid lesions were shown to be 80% and 73%, respectively, in a research by Reddy MR [24].

Conclusion

Thus, it has been demonstrated that fine needle aspiration cytology of thyroid lesions provides an easy, economical, and precise way to identify and direct the treatment of palpable thyroid lesions. The technique can correctly identify non-neoplastic thyroid disorders and lower the quantity of needless thyroid surgery. Furthermore, it is an easy process with no steep learning curve. The test is inexpensive since the materials needed for it are readily available.

The test's accuracy depends on a number of factors, including the test-taker's skill, the type of edema, the smears' preparation, and the knowledge and experience of the person evaluating the results. The process has excellent sensitivity, specificity, and diagnostic accuracy. For the purpose of diagnosing thyroid lesions and guiding the treatment of individuals with thyroid nodules, this makes it an appropriate initial examination.

Therefore, even though HPE is the final and confirmatory diagnostic procedure, FNAC is still the preferred preliminary, tried-and-true method.

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