Original Research

DIAGNOSTIC ACCURACY OF BETHESDA SYSTEM FOR REPORTING THYROID CYTOLOGY WITH HISTOPATHOLOGICAL CORRELATION

Dr. Pushpinder Kaur[1], Dr. Akshita Rattan[2], Dr. Abhinandan Arora[3], Dr. Abhipsa Vats[4], Dr. Ombir Saini[5]

[1,2,3]Assistant Professor, Department of Pathology, Adesh Medical College and Hospital, Shahbad.

[4,5]Junior Resident, Department of Pathology, Adesh Medical College and Hospital, Shahbad.

Email ID: psohpal40@gmail.com

ABSTRACT

Background: Fine Needle Aspiration Cytology (FNAC) is a widely accepted, minimally invasive, and cost-effective diagnostic tool for evaluating thyroid nodules. The Bethesda System for Reporting Thyroid Cytopathology (TBSRTC) standardizes thyroid cytology reporting and provides an estimated risk of malignancy for each diagnostic category.

Aim: To assess the diagnostic accuracy of the Bethesda System for Reporting Thyroid Cytopathology by correlating cytological findings with histopathological diagnoses.

Materials and Methods: This retrospective cross-sectional study was conducted in the Department of Pathology, Adesh Medical College and Hospital, Shahbad. A total of 100 patients who underwent both thyroid FNAC and subsequent histopathological examination between August 2023 and September 2025 were included. FNAC findings were categorized according to TBSRTC and correlated with histopathological diagnoses. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), diagnostic accuracy, and risk of malignancy (ROM) for each Bethesda category were calculated.

Results: The majority of patients were females (78%), with the highest incidence observed in the 31–40-year age group (28%). Bethesda Category II constituted the largest proportion of cases (85%), followed by Category IV (6%), Category VI (5%), Category V (3%), and Category III (1%). No Category I cases were encountered. The risk of malignancy was 2.4% for Category II, 33.3% for Category IV, 80% for Category V, and 100% for Category VI. Cyto-histopathological correlation demonstrated 5 true-positive, 90 true-negative, and 5 false-negative cases, with no false-positive cases. FNAC showed a sensitivity of 50%, specificity of 100%, PPV of 100%, NPV of 94.7%, and overall diagnostic accuracy of 95%.

Conclusion: The Bethesda System is a reliable and effective reporting framework for thyroid cytology. FNAC demonstrated excellent specificity, high negative predictive value, and high overall diagnostic accuracy, supporting its role as a first-line investigation for thyroid nodules. Cyto-histopathological correlation remains essential for quality assurance and improving diagnostic performance, particularly in indeterminate and false-negative cases.

Keywords: Thyroid Nodule, Fine Needle Aspiration Cytology, Bethesda System, Thyroid Cytopathology, Histopathological Correlation, Diagnostic Accuracy.

INTRODUCTION

Thyroid swellings are a frequent clinical finding worldwide.[1] Fine needle aspiration cytology (FNAC) is a well-established outpatient technique that plays a key role in the initial evaluation of palpable thyroid nodules, alongside investigations such as ultrasonography (USG), thyroid function tests, and antibody levels.[2]

www.ajmrhs.com
eISSN: 2583-7761

Date of Received: 09-06-0000
Date Acceptance: 17-06-0000
Date of Publication: 16-07-000

The prevalence of palpable thyroid nodules in iodine-sufficient populations is around 4–7% in adults and 0.2–1.5% in children. With the increasing use of ultrasonography, the reported incidence of thyroid nodules has risen to 14–50%. Most thyroid lesions are benign, with fewer than 5% proving malignant.[3,4] FNAC is recognized as a safe, simple, cost-effective, and reliable method for stratifying patients with thyroid nodules.[5] Accurate cytological reporting by an experienced pathologist helps to detect malignancies requiring surgery, thereby reducing unnecessary surgical interventions and their associated complications.[6] Effective thyroid cytopathology practice relies on close coordination among pathologists, endocrinologists, radiologists, surgeons, and correlation with histopathology.[5] Previously, the absence of a standardized reporting

system led to inconsistent terminology, creating difficulties in clinical decision-making. To address this, the National Cancer Institute (NCI), Bethesda, Maryland, organized the 2007 Thyroid Fine Needle Aspiration State-of-the-Science Conference. This resulted in the development of the **Bethesda System for Reporting Thyroid Cytopathology (TBSRTC)**, which provides standardized nomenclature and guidelines. The system categorizes thyroid FNAs into six diagnostic groups: non-diagnostic/unsatisfactory, atypia of undetermined significance (AUS)/follicular lesion of undetermined significance (FLUS), follicular neoplasm/suspicious for follicular neoplasm (FN/SFN), suspicious for malignancy, and malignant. Each category is associated with a defined risk of malignancy that guides subsequent management.[7,8]

The present study was done aimed at classifying the thyroid fine needle aspirations based on the Bethesda system for reporting thyroid cytopathology and to compare the results with histopathology wherever surgery was done.

RESEARCH AIM & OBJECTIVES

Aim

- To classify thyroid fine needle aspiration cytology (FNAC) samples according to the Bethesda System (TBSRTC) and correlate the findings with histopathology.

Objectives

- To assess the distribution of cases across different Bethesda categories.
- To determine the risk of malignancy (ROM) associated with each Bethesda category.
- To compare cytological diagnoses with final histopathology in surgically treated cases.
- To evaluate the sensitivity, specificity, and diagnostic accuracy of the Bethesda System in detecting thyroid malignancy.

MATERIAL & METHODS

1. Study Type: Retrospective Cross Sectional

a. Study Population (patient group/ age group etc.) – All patients who had undergone both histopathology and FNAC between August 2023- September 2025
b. Place of study- Department of Pathology in Adesh Medical College and Hospital, Shahabad (M)
c. Study period- 6 months (August 2023- September 2025)
d. Sample size – All patients fulfilling the above criteria.
e. Inclusion Criteria- Patients who had undergone both FNAC and histopathology between August 2023- September 2025.
f. Exclusion Criteria -Thyroidectomy specimen without previous fine needle aspiration and vice versa.
g. Data was collected retrospectively; clinical details including demographic data were taken along with cytological and histological data. Data was entered in excel sheet and evaluated to obtain the risk of malignancy in various categories. Cytohistological correlation was done to access the diagnostic accuracy of the Bethesda system for reporting thyroid cytology.
h. Randomization method (if any)- None

Statistical Analysis Plan

Data collected was analyzed using SPSS version 27.0. Qualitative data was presented as frequencies and proportions whereas quantitative data was presented as mean and standard deviation. Sensitivity, specificity, positive predictive value, negative predictive value were calculated and data correlation was done.

RESULTS

A total of 100 cases of thyroid fine needle aspiration cytology (FNAC) were included in the present study. All cases were categorized according to the Bethesda System for Reporting Thyroid Cytopathology (TBSRTC). Notably, no case was reported as non-diagnostic (Category I), indicating adequate sampling in all cases.

Table1: Distribution of Patients According To Age (N=100)

Age (in years)	Number	Percent (%)
1-10	0	0%
11-20	0	0%
21-30	8	8%
31-40	28	28%
41-50	15	15%
51-60	22	22%
61-70	20	20%
71-80	6	6%
81-90	1	1%
Total	100	100%

Table 2: Distribution of Patients According To Gender (N=100)

Gender	Number	Percent (%)
Female	78	78%
Male	22	22%
Total	100	100%

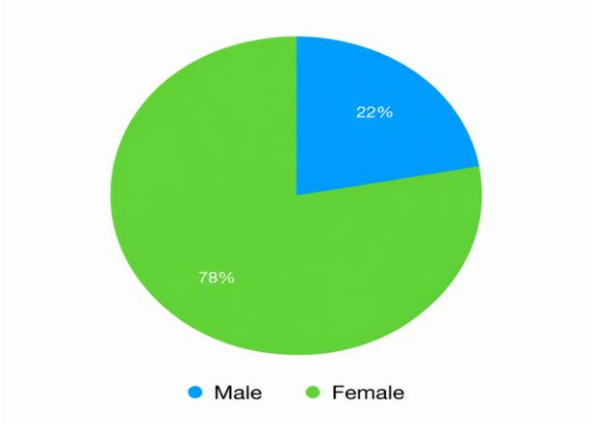

Figure No. 1: Pie Chart Showing Gender Distribution of Patients in the Study Population.

Table 3: Distribution of Patients According To Neoplastic and Non- Neoplastic Lesions (N=100)

Type	Number	Percent (%)
Non -Neoplastic	85	85%
Neoplastic	15	15%
Total	100	100%

Table 4: Distribution of Patients According To Bethesda System (N=100)

Categories	Number	Percent (%)
Category I	0	0%
Category II	85	85%
Category III	1	1%
Category IV	6	6%
Category V	3	3%
Category VI	5	5%
Total	100	100%

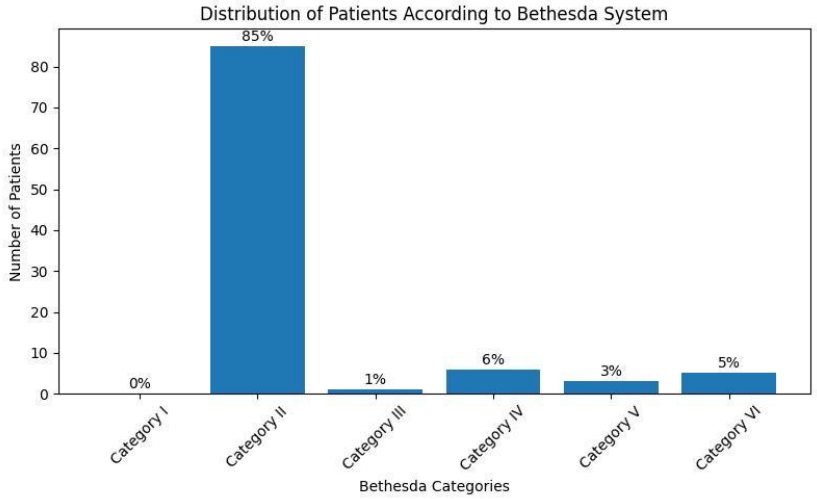

Figure No 2: Histogram Showing Distribution of Patients Across Different Bethesda Categories.

Table 5: Malignancy Rate of Each Bethesda Category

Bethesda Category	Malignancy Rate
I	0%
II	2.4%
III	1%
IV	33.3%
V	80%
VI	100%

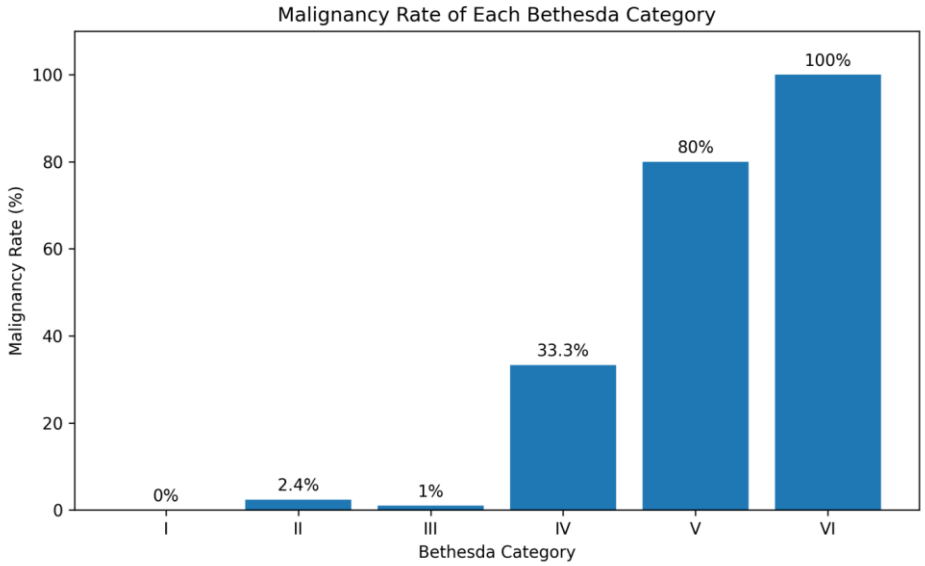

Figure No. 3: Histogram Depicting Malignancy Rates Associated with Each Bethesda Category

Table 6: Correlation of Bethesda System with Histopathology (N=100)

Bethesda system	Histopathology		Total
	Carcinoma	Benign	
Carcinoma	5 (TP)	0 (FP)	5
Benign	5(FN)	90(TN)	95
TOTAL	10	90	100

Indicators	Percentage
Sensitivity= TP/(TP+FN)	50%
Specificity= TN/(TN+FP)	100%
Positive Predictive Value= TP/(TP+FP)	100%
Negative Predictive Value= TN/(TN+FN)	94.7%
Diagnostic accuracy= TN+TP/(TP+FN+TN+FP)	95%

The majority of patients were in the age group of 31–40 years (28%) followed by 51–60 years (22%) and 61–70 years (20%). Very few cases were seen in extreme age groups (Table 1)

A female predominance was observed in the present study constituting 78% and males 22% of the study population (Table 2)

On categorization into neoplastic and non-neoplastic lesions, 85% of cases were non-neoplastic while only 15% were neoplastic, indicating a higher prevalence of benign thyroid conditions. (Table 3)

The majority of cases were categorized as Bethesda Category II (Benign) comprising 85% of cases. Category III (AUS/FLUS) accounted for 1% of cases. Category IV (Follicular neoplasm/suspicious for follicular neoplasm) constituted 6% of cases. Category V (Suspicious for malignancy) and Category VI (Malignant) comprised 3% and 5% of cases respectively. (Table 4)

The risk of malignancy (ROM) was found to be highest in Category VI (100%), followed by Category V (80%) and Category IV (33.3%). Category II showed a low ROM of 2.4%, 1% malignancy was observed in Category III in this study. (Table 5)

Cyto-histological correlation revealed that out of 100 cases, 5 were true positives, 90 were true negatives, and 5 were false negatives. No false positive cases were identified. The diagnostic performance of FNAC showed a sensitivity of 50%, specificity of 100%, positive predictive value (PPV) of 100%, and negative predictive value (NPV) of 94.7%, diagnostic accuracy 95% indicating excellent specificity and high overall diagnostic reliability. (Table 6).

Table 7. Out of the Total Cases, 95 Cases Were Concordant and 5 Cases Were Discordant.

S. No	Cytological Diagnosis	Histopathological Diagnosis
1	Lymphocytic Thyroiditis	Non- Hodgkin's lymphoma
2	Atypia of undetermined significance	Multinodular goitre with incidental Papillary Microcarcinoma
3	Suspicious For Follicular Neoplasm	Follicular Carcinoma
4	Suspicious for Follicular Neoplasm	Follicular variant of papillary carcinoma
5	Suspicious for Follicular Neoplasm	Papillary Carcinoma

DISCUSSION

Fine needle aspiration cytology (FNAC) has emerged as a highly reliable, minimally invasive, and cost-effective diagnostic modality for the evaluation of thyroid nodules. Its diagnostic accuracy and clinical utility have been significantly enhanced by the introduction of the Bethesda System for Reporting Thyroid Cytopathology (TBSRTC), which provides a uniform reporting framework along with an implied risk of malignancy (ROM) for each category. The introduction of the Bethesda System for Reporting Thyroid Cytopathology (TBSRTC) has further standardized reporting and provided implied risk of malignancy for each category, thereby improving clinical management decisions.

In our study, the common age group with thyroid nodule was in the third and fourth decade with female preponderance, similar observation was noted in the study of Shiksha et al. and Sahana SN et al.[9,10]

In the present study, the majority of cases (85%) were categorized as Bethesda Category II (Benign), which is higher compared to Sahana et al. (66.3%), Nandedkar et al. (82.6%), Neethu et al. (82%), and Shiksha et al. (83.2%).[10-12,9] This variation may be attributed to differences in patient population and a higher prevalence of non-neoplastic lesions in our cohort. Similar trends have been reported across multiple studies, confirming that benign lesions constitute the majority of thyroid FNAC diagnoses.[13] The absence of Category I cases in the present study indicates excellent sampling adequacy. In contrast, Sahana et al. reported 7.9% and Shiksha et al. reported 3.4% of non-diagnostic cases.[10,9] Adequate sampling is a key factor in improving diagnostic yield and reducing repeat procedures.[14]

Category III (AUS/FLUS) constituted only 1% of cases in the present study, which is lower than that reported by Sahana et al. (5.9%) and Neethu et al. (2.4%).[10,12] The malignancy risk in this category could not be reliably assessed due to the small number of cases. However, Bongiovanni et al. reported a risk ranging from 5–15%, reflecting its indeterminate nature.[13]

Category IV lesions accounted for 6% of cases in the present study, which is comparable to Sahana et al. (9.9%) and Nandedkar et al. (9.07%).[10,11] The observed malignancy rate of 33.3% is slightly higher than the Bethesda recommended range (15–30%). This category remains diagnostically challenging due to the inability of FNAC to distinguish follicular adenoma from carcinoma without histological evidence of capsular or vascular invasion.[14]

Categories V and VI showed high malignancy rates of 80% and 100%, respectively, which are consistent with findings reported by Sahana et al.[10] and other studies (Table 8). These categories demonstrate strong cyto-histopathological correlation and highlight the high predictive value of FNAC in detecting malignancy.[15]

Table 8: Comparison of Frequencies of Different Bethesda Categories in Various Studies.

Bethesda Category	Present Study (%)	Sahana Et Al.[10]	Nandedkar Et Al.[11]	Neethu Et Al.[12]	Shiksha Et Al.[9]	Mishra Et Al.[16]
Category I	0%	7.9%	4.2%	4%	3.4%	5.4%
Category II	85%	66.3%	82.6%	82%	83.2%	84.2%
Category III	1%	5.9%	0.8%	2.4%	0%	1.9%
Category IV	6%	9.9%	9.07%	5.4%	9.09%	3.4%
Category V	3%	5.0%	1.1%	1.7%	2.09%	1.0%
Category VI	5%	5.0%	1.9%	4.5%	2.09%	4.0%

In the present study, cyto-histological concordance was achieved in 95 cases and the discordant cases of cyto-histology were 5 cases. The false negative were 5% cases. The false negative FNAC results may occur due to error in sampling or misinterpretation of cytology; these are of great concern because it indicates the potential to miss malignant lesions.[17] The rate of failure to diagnose cancer could be attributed to the failure of aspiration from precise location. False negative cytology results may cause delay in treatment and hence adversely affects the outcome in patient with thyroid cancer.[18]

The sensitivity of FNAC in the present study was 50%, which is comparable to Sahana et al. (60%), Neethu et al. (52%) and Pandey et al. (57.1%).[10,12,19] The specificity (100%) observed in our study is higher than most published studies, including Neethu et al. (97%) and Yang et al. (83.3%).[12,20] The high specificity and PPV (100%) indicate that FNAC is highly reliable in confirming malignancy.

The relatively lower sensitivity in our study can be attributed to false negative cases, which may arise due to sampling error, cystic degeneration, or missing focal malignancies such as papillary microcarcinoma. Similar discordant cases have been reported by Sahana et al. and Bamanikar et al., emphasizing the importance of adequate sampling and careful interpretation.[10,21]

Overall, the findings of the present study reaffirm that FNAC, when used within the Bethesda framework, is a highly effective diagnostic tool. It provides excellent specificity and plays a crucial role in guiding clinical management while minimizing unnecessary surgical interventions.[14,15]

CONCLUSION

FNAC is a simple, safe, minimally invasive, and highly specific diagnostic tool for the evaluation of thyroid lesions. The use of the Bethesda System significantly enhances diagnostic accuracy and provides effective risk stratification.

The present study demonstrates that FNAC has excellent specificity and high negative predictive value, making it highly reliable in ruling out malignancy. Although sensitivity is relatively lower due to occasional false negatives, FNAC remains an indispensable first-line investigation.

Integration of FNAC with clinical, radiological, and, where necessary, ultrasound-guided sampling can further improve diagnostic accuracy and patient management.

REFERENCES

1. Choudhury S, Deshpande AH, Gargade CB. The Bethesda system for reporting thyroid FNAC: A cytohistological correlation in a newly established institute. Indian J Pathol Oncol. 2018;5(4):650-5.
2. Kosam S, Mire V. Thyroid Cytopathology Reporting According to Bethesda System with Histopathological Correlation. Int J Pharm Clin Res. 2023;15(11):139-44.
3. Gharib H. Fine-needle aspiration biopsy of thyroid nodules: advantages, limitations, and effect. Mayo Clin Proc. 1994; 69(1):44–49.
4. Ezzat S, Sarti DA, Cain DR, Braunstein GD. Thyroid incidentalomas prevalence by palpation and ultrasonography. Arch Intern Med. 1994; 154(16):1838– 1840.
5. Kadam PN, Siddiqui NA, Sadhu DS. Evaluation of Bethesda System for Reporting Thyroid Cytology with Histopathological Correlation. J Med Sci Clin Res. 2020;8(1):573-80.
6. Acharya K, Shrivastav S, Tripathi P, Gyawali BR, Kharel B, Baskota DK, et al. The Bethesda System for Reporting Thyroid Cytopathology: Validation at Tribhuvan University Teaching Hospital. Int Arch Otorhinolaryngol. 2022;26(1):e97–e102.
7. Cibas ES.Fine -needle aspiration in the work-up of thyroid nodules.Otolaryngol Clin North Am.2010; 43:257-71.
8. OzlukY, Pehlivan E, Gulluoglu MG, Poyanli A,Salmaslioglu A,Colak N,et al.The use of the Bethesda terminology in thyroid fine-needle aspiration results in a lower rate of surgery for non-malignant nodules: A report from a reference centre in Turkey.Int J Surg Pathol.2011;19:761-71.
9. Shiksha, Ankita, Patel PK. The Bethesda System for Reporting Thyroid Cytopathology and its Histopathological Correlation. Int J Pharm Clin Res. 2022;14(8):443-9.
10. Sahana SN, Balaji TG, Shashikala P. Cytological study of thyroid lesions using the Bethesda system and histopathological correlation. J Med Sci Health. 2025;11(3):321–326. doi:10.46347/jmsh.v11.i3.24.444.
11. Malukani K, Nandedkar SS, Dixit M, Varma AV, Gambhir S. Evaluation of thyroid lesions by Zne-needle aspiration cytology according to bethesda system and its histopathological correlation. International Journal of Applied and Basic Medical Research. 2018;8(2):76–82.
12. Banik A, Neethu GV, Preethi CR, Nikethan B. Cytohistological correlation of thyroid Zne-needle aspiration cytology with emphasis on discordant cases: A tertiary care center study. Indian Journal of Health Sciences and Biomedical Research (KLEU). 2023;16(2):259–263.
13. Bongiovanni M, Spitale A, Faquin WC, Mazzucchelli L, Baloch ZW. The Bethesda System for Reporting Thyroid Cytopathology: a meta-analysis. Acta Cytol.

2012;56(4):333–339.
14. National Cancer Institute Thyroid Fine Needle Aspiration State of the Science Conference. Diagn Cytopathol. 2008;36(6):425–37.
15. Cibas ES, Ali SZ. The Bethesda System for Reporting Thyroid Cytopathology. 2nd ed. Cham: Springer; 2017.
16. Mishra H, Alexander M, Bommanahalli B. Assessment of thyroid lesions using Zne-needle aspiration cytology in accordance with The Bethesda System and its histopathological correlation - A prospective study. Journal of Pathology of Nepal. 2023;13(1):2013–2017.
17. HallTL, LayfieldLJ, PhilippeA, RosenthalDL. Sources of diagnostic error in fine needle aspiration of the thyroid. Cancer 1989;63:718-25
18. YehMW, DemircanO, ItuarteP, ClarkOH. False-negative fine-needle aspiration cytology results delay treatment and adversely affect outcome in patients with thyroid carcinoma. Thyroid 2004;14:207-15.
19. Pandey P, et al. Evaluation of thyroid nodules by FNAC and correlation with histopathology. J Cytol. 2012;29(4):237–41
20. Yang J, et al. Fine needle aspiration of thyroid nodules: a study of diagnostic accuracy. Diagn Cytopathol. 2007;35(9):570–5.
21. Bamanikar SA, et al. Cyto-histological correlation of thyroid lesions: a retrospective study. Clin Cancer Investig J. 2014;3(3):208–12.

How to cite this article: Dr. Pushpinder Kaur, Dr. Akshita Rattan, Dr. Abhinandan Arora, Dr. Abhipsa Vats, DIAGNOSTIC ACCURACY OF BETHESDA SYSTEM FOR REPORTING THYROID CYTOLOGY WITH HISTOPATHOLOGICAL CORRELATION, Asian J. Med. Res. Health Sci., 2026; 4 (2):2277-2283.
Source of Support: Nil, Conflicts of Interest: None declared.