



ORIGINAL RESEARCH PAPER

Pathology

THE SPECTRUM OF THYROID LESIONS OF FINE NEEDLE ASPIRATION CYTOLOGY

KEY WORDS: Thyroid gland, endocrine organs, non-neoplastic hyperplasias, Fine needle aspiration, radiologic imaging.

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ABSTRACT

Background: Thyroid nodules are common endocrine disorders with a small but significant risk of malignancy, requiring accurate preoperative evaluation. Fine Needle Aspiration Cytology (FNAC) serves as a reliable, minimally invasive diagnostic tool, while the Bethesda system standardizes reporting and risk stratification, aiding effective clinical decision-making and management of thyroid lesions. **Aim:** to categorize thyroid FNAC using the Bethesda grading system and to correlate Bethesda grading with histopathological diagnosis. **Method:** This study included patients of all ages and genders with clinically or radiologically suspected thyroid lesions attending OPD or admitted wards. FNAC was performed for cytological evaluation. Both neoplastic and non-neoplastic cases were analyzed, ensuring a representative sample, enabling assessment of cytomorphological features across different age groups and clinical presentations. **Result:** Out of 100 cases, maximum patients were aged 31–40 years (29%) and females (88%). Category II predominated (73%), followed by Category VI (9%). Midline swelling was most common (40%). Papillary carcinoma constituted 88.89% of Category VI. Malignancy rates were 10% in Category V and 90% in Category VI, with significant association ($p < 0.001$). **Conclusion:** FNAC is a reliable, minimally invasive diagnostic tool for thyroid swellings, demonstrating high sensitivity and specificity. Bethesda categories show strong accuracy, particularly at benign and malignant extremes. Its routine use aids effective management. Further large-scale studies with advanced techniques are recommended to enhance diagnostic precision and clinical outcomes.

INTRODUCTION

The thyroid gland is a vital endocrine organ regulating metabolism, growth, and development. The term “thyroid,” derived from the Greek *thyreos* meaning “shield,” was introduced by Thomas Wharton due to its shape. Thyroid disorders are second only to diabetes mellitus in prevalence and are common in iodine-deficient regions. Epidemiological data show that over half the population may develop thyroid nodules, with incidence increasing with age.

Thyroid diseases comprise genetic, inflammatory, immunologic, developmental, and neoplastic conditions. Around 95% of lesions are benign, while a small proportion is malignant and requires early detection. These disorders are broadly classified into diffuse and nodular types.¹ Diffuse enlargement affects the entire gland, whereas nodular lesions appear as discrete swellings and may be neoplastic or non-neoplastic. Thyroid nodules occur in 4–7% of adults by palpation, with higher detection on imaging. Less than 5% are malignant, requiring accurate evaluation.²

Fine needle aspiration (FNA) is a minimally invasive and reliable diagnostic tool with sensitivity up to 93.4% and specificity of 74.9%.³ It is widely used for screening and diagnosis, helping distinguish cases requiring surgery from those managed conservatively. Additionally, FNA is cost-effective and improves diagnostic yield by reducing unnecessary surgeries while increasing malignancy detection. Despite advances in imaging and molecular diagnostics, no single noninvasive method surpasses FNA in accuracy and feasibility.⁴

Fine Needle Aspiration Cytology (FNAC) has become the diagnostic method of choice due to its simplicity, rapid results, and high patient acceptance. It effectively differentiates neoplastic from non-neoplastic lesions and guides treatment decisions. However, earlier inconsistencies in reporting necessitated standardization, leading to the

development of The Bethesda System for Reporting Thyroid Cytopathology (TBSRTC).⁵

TBSRTC is a six-tier system that standardizes reporting, assigns malignancy risk, and guides clinical management. It is widely accepted globally for evaluating thyroid nodules.⁶ Although FNAC is the benchmark diagnostic tool, histopathology remains definitive due to limitations such as sampling errors and operator variability.

This study aims to evaluate thyroid cytology in palpable nodules and assess the need for histopathological confirmation in management planning.

MATERIAL AND METHODS

This study, titled “Critical Evaluation of Bethesda Grading of FNAC in Thyroid Diseases with Histopathological Correlation,” was conducted in the Department of Pathology, Index Medical College, Indore. It included both retrospective and prospective components. A minimum of 100 cases of thyroid lesions were analyzed to assess cytological grading and its correlation with histopathology.

Method of collection of data: The study included patients of all ages and genders presenting with clinically or radiologically suspected thyroid lesions. Cases were obtained from ENT and Surgery OPD or admitted wards. Both neoplastic and non-neoplastic lesions were included to ensure a representative sample. Exclusion criteria comprised patients unwilling for FNAC, poorly prepared or stained smears, autolyzed specimens, and metastatic lesions, ensuring diagnostic accuracy and homogeneity.

Sample size: A total of 100 thyroid FNAC cases and corresponding biopsies collected over 18 months were included as a representative cohort.

Sampling procedure: FNAC was performed using aspiration

and non-aspiration techniques under aseptic conditions by trained pathologists. A 23–25 gauge needle with a 10 cc syringe was used. Multiple site aspirations improved adequacy. Smears were prepared and stained using Leishman, H&E, and MGG stains for detailed cytomorphological evaluation. Findings were correlated with clinical, radiological, and biochemical parameters.

Histopathological examination: Thyroidectomy specimens were fixed in 10% buffered formalin, followed by gross examination assessing size, nodules, and capsular invasion. Representative sections were processed, embedded in paraffin, and stained with H&E. Microscopic evaluation was done by experienced pathologists to confirm diagnosis and enable cyto-histopathological correlation.

Statistical analysis: Data were tabulated in Microsoft Excel and analyzed using SPSS version 26.0. Descriptive statistics included frequencies, proportions, and means. Inferential analysis used Chi-square tests for categorical variables and Student's t-test for continuous variables. A p-value <0.05 was considered statistically significant, ensuring reliability and validity of results.

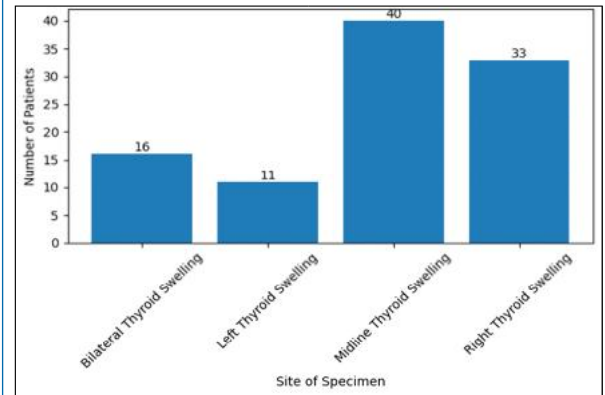
RESULT AND OBSERVATIONS

Among 100 cases, maximum patients were aged 31–40 years (29%) and 41–50 years (26%), with female predominance (88%). Category II lesions were most common (73%). Midline swelling (40%) was most frequent. Weakness (53%) and weight loss (36%) were common symptoms. Papillary carcinoma constituted 88.89% of Category VI. Malignancy rate was 10% in Category V and 90% in Category VI. Duration was highest between 1–5 years (39%).

Table 1: distribution of age.

Category	1–10	11–20	21–30	31–40	41–50	51–60	61–70	71–80	Total (No.)	%
CAT I	0	1	1	1	2	0	1	0	6	6%
CAT II	0	5	18	19	20	6	3	2	73	
CAT III	0	0	1	1	1	0	0	0	3	3%
CAT IV	0	1	0	2	3	1	1	0	8	8%
CAT V	0	0	0	1	0	0	0	0	1	1%
CAT VI	0	0	2	5	0	1	1	0	9	9%
Total	0	7	22	29	26	8	6	2	100	

The table shows the distribution of thyroid FNAC cases according to Bethesda categories across different age groups. The majority of cases were observed in the 31–40 years age group (29%), followed by 41–50 years (26%) and 21–30 years (22%). Category II constituted the largest proportion (73%), predominantly seen in 21–50 years. Category VI accounted for 9% cases, mainly in 31–40 years. Other categories had lower frequencies. A statistically significant association was observed between age groups and Bethesda categories ($p < 0.05$).



Graph 1: distribution of patients according to site of specimen.

The distribution of thyroid swelling showed that midline swelling was most common, accounting for 40% of cases, followed by right-sided swelling (33%) and bilateral involvement (16%). Left-sided swelling was least frequent (11%). This indicates a predominance of centrally located thyroid enlargements in the study population.

Table 2: histopathological findings.

Histopathological Findings	No.	%
Anaplastic carcinoma	1	1.00%
Adenomatous hyperplasia	1	1.00%
Benign adenomatous goiter	1	1.00%
Benign nodular goiter	1	1.00%
Colloid goiter	51	51.00%
CN	1	1.00%
Follicular lesion of undetermined significance	1	1.00%
Follicular neoplasm	8	8.00%
Follicular lesion of undetermined significance	1	1.00%
Granulomatous thyroiditis	1	1.00%
Hyperplastic goiter	2	2.00%
Hyperplastic nodule	1	1.00%
Hashimoto's thyroiditis	13	13.00%
Lymphocytic thyroiditis	1	1.00%
Multinodular goiter (MNG)	2	2.00%
Medullary thyroid carcinoma	1	1.00%
Non-diagnostic	1	1.00%
Nodular goiter	2	2.00%
Papillary carcinoma thyroid	9	9.00%
Thyroid adenoma	1	1.00%
Grand Total	100	100.00%

The histopathological distribution of thyroid lesions showed that colloid goiter was the most common finding, accounting for 51% of cases. This was followed by Hashimoto's thyroiditis (13%) and papillary carcinoma (9%). Follicular neoplasm constituted 8% of cases. Other lesions such as hyperplastic goiter, multinodular goiter, and nodular goiter were less frequent (2% each), while the remaining conditions, including anaplastic carcinoma and medullary carcinoma, were rare (1% each).

Table 3: diagnostic accuracy of correlation between cytopathology and histopathology of thyroid lesions.

Category	Cytological Diagnosis	Number of Patients	Total
Concordance	Benign	88	88
	Malignant	10	
Discordance	Benign	10	12
	Malignant	2	

The cyto-histopathological correlation showed concordance in 88% cases, including 88 benign and 10 malignant diagnoses, while discordance was observed in 12% cases. Diagnostic parameters revealed sensitivity of 83.33%, specificity of 88.64%, and overall accuracy of 88%, indicating FNAC as a reliable tool for thyroid lesion evaluation.

DISCUSSION

FNAC is a safe, minimally invasive, and reliable first-line diagnostic tool for thyroid lesions, aiding in differentiation of benign and malignant conditions and guiding management. In this study, lesions were classified using TBSRTC for standardized reporting. Cyto-histopathological correlation assessed diagnostic accuracy, highlighting FNAC's effectiveness in evaluation, reducing unnecessary surgeries, and improving clinical decision-making.

The majority of thyroid lesions were observed in the 31–40 years (29%) and 41–50 years (26%) age groups, with minimal cases in children, indicating higher vulnerability in middle

age. **Goel N et al.**⁷ reported maximum cases in 41–50 years (33.87%) followed by 31–40 years (21.77%). Similarly, **Raniwal A et al.**⁸ found highest incidence in 41–60 years (~50%), with lowest in <20 and >60 years (6.67%), supporting predominance in middle age groups.

The distribution of patients according to site of specimen showed improved diagnostic adequacy with fewer unsatisfactory smears in the present study. **Ji Hye Park et al.**⁹ reported higher rates of nondiagnostic smears, indicating variability in sampling adequacy. Similarly, **Vickie Y Jo et al.**¹⁰ also observed increased Category I cases. In contrast, the current study showed better specimen adequacy, likely due to repeat FNAC in inadequate cases, enhancing diagnostic yield and reducing indeterminate reporting.

Histopathological findings showed high concordance with FNAC, with overall agreement of 88% in the present study, confirming its diagnostic reliability. **Sandeep R Mathur et al.**¹¹ reported a concordance rate of 97.01%, demonstrating excellent cyto-histological correlation. Similarly, **Kunori et al.**¹² observed a concordance of 98.00%, indicating very high diagnostic accuracy. These findings support FNAC as an effective preoperative tool, although minor discrepancies may occur due to sampling errors and limitations in follicular lesions.

The study showed 0% malignancy in Category II, 10% in Category IV, and >90% in Category VI, confirming effective risk stratification by Bethesda system. **Sandeep R Mathur et al.**¹¹ also demonstrated high diagnostic reliability with strong cyto-histopathological agreement. Similarly, **Bagga PK et al.**¹³ reported a concordance of 96.2%, supporting accurate malignancy prediction. These findings highlight FNAC as a dependable tool for distinguishing benign and malignant thyroid lesions and guiding appropriate management.

CONCLUSION

Thyroid swellings pose diagnostic challenges, but FNAC shows reliable sensitivity (83.22%) and specificity (88.64%), making it an essential preoperative tool. Bethesda Categories I and II show high accuracy, while Category VI demonstrates strong diagnostic precision. Larger studies with bigger sample sizes and advanced diagnostic techniques are recommended to further improve evaluation and management of thyroid lesions.

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