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RESEARCH ARTICLE
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CYTOMORPHOLOGICAL CATEGORIZATION OF THYROID LESION ACCORDING TO THE BETHESDA SYSTEM FOR REPORTING THYROID CYTOLOGY AND CORRELATION WITH THEIR HISTOLOGICAL OUTCOME AND TIRADS

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Abstract

Background and Aims: Thyroid nodules are common and increasingly detected through imaging. Fine Needle Aspiration Cytology (FNAC) and the Bethesda System (TBSRTC) are widely used for diagnostic stratification. This study aimed to categorize thyroid lesions cytologically per TBSRTC and correlate them with TIRADS classification and histopathological outcomes to enhance diagnostic accuracy.

Methods: This retrospective study was conducted from January 2023 to May 2024 at SRMS-IMS, Bareilly, after ethical committee approval. FNAC samples (22–24G needle) were stained with MGG and Pap stains. Data from 122 cases were analyzed and correlated with TIRADS and histopathology. Descriptive and inferential statistics were applied.

Results: FNAC showed 92% NPV and 100% PPV with 90% sensitivity and 64% specificity. ROM in Bethesda IV and TIRADS 4 was 70% and 50% respectively.

Conclusion: Combining TBSRTC and TIRADS enhances malignancy prediction and improves thyroid nodule management.

Keywords: Thyroid Nodule; FNAC; TBSRTC; TIRADS; Cytopathology

Introduction

Thyroid nodules are detected in approximately 3% to 8% of the general population through clinical palpation, whereas ultrasonography identifies these nodules in about 20% to 76% of individuals[1]. Over the past several decades, the global incidence of thyroid disorders has shown a marked upward trend [2]. This observed rise in thyroid malignancies is predominantly attributed to the increasing diagnosis of papillary thyroid carcinoma, which significantly outweighs the incidence of other histological subtypes of thyroid cancer[3,4]. To facilitate effective risk assessment and standardized

management of thyroid nodules, the ultrasound-based Thyroid Imaging Reporting and Data System (TIRADS) was introduced. This classification system helps in stratifying the malignancy risk associated with thyroid nodules and aids in clinical decision-making [5]. Fine Needle Aspiration Cytology (FNAC) is widely recognized as a cost-effective, minimally invasive, and efficient initial diagnostic tool for the evaluation and triage of patients with thyroid swellings. In an effort to unify and standardize the reporting terminology of thyroid cytology, the Bethesda System for Reporting Thyroid Cytopathology (TBSRTC) was established in October 2007. This system not only enhances the consistency in cytological reporting but also assists in malignancy risk stratification, thereby guiding subsequent clinical management [6] . Despite its clinical utility, FNAC does present certain limitations, including the potential for false-positive, false-negative, and indeterminate results. Nevertheless, TBSRTC remains a reliable and comprehensive classification system, offering both a diagnostic framework and an estimation of the malignancy potential for each cytological category.

We aimed to systematically classify thyroid lesions based on cytomorphological features using the Bethesda System for Reporting Thyroid Cytology and to correlate these findings with corresponding histopathological outcomes and TIRADS categories, thereby enhancing diagnostic precision and guiding appropriate clinical management.

Material and Methods

This retrospective study was conducted at Shri Ram Murti Smarak Institute of Medical Sciences (SRMS), Bareilly, over a period extending from 1st January 2023 to 1st May 2024. It aimed to analyze the cytomorphological spectrum of thyroid lesions using FNAC, categorize them according to the Bethesda System for Reporting Thyroid Cytopathology (TBSRTC), and correlate these findings with ultrasound-based TIRADS classifications and histopathological outcomes

Cases included in the study were selected through record review. Fine Needle Aspiration Cytology (FNAC) was performed using 22–24 gauge needles, employing either palpation-guided or ultrasound-guided techniques depending on the clinical presentation. All smears obtained were stained using standard May-Grunwald-Giemsa and Papanicolaou staining protocols to ensure optimal visualization of cytomorphological features.

Each case was examined and classified cytologically based on the Bethesda system, wherever adequate cytology records were available. The categorization covered the full spectrum of thyroid cytopathology, ranging from non-diagnostic and benign lesions to those suspicious for malignancy and confirmed malignancies.

The study also assessed the risk of malignancy associated with each Bethesda category by comparing it with the corresponding TIRADS score, wherever ultrasound findings were documented.Wherever possible, cytological findings were correlated with corresponding histopathological diagnoses, derived from surgical resection specimens. This correlation was used to determine the sensitivity, specificity, and overall diagnostic accuracy of FNAC in thyroid lesion evaluation.

By integrating cytological classification, histopathological confirmation, and TIRADS scoring, the study intended to refine diagnostic approaches and enhance decision-making in the clinical management of thyroid nodules.

Results

A total of 122 patients were evaluated, comprising 87 females and 35 males. Among the cytological categories, 6 cases (4.9%) were non-diagnostic (ND), 56 cases (45.9%) were benign, 12 cases (9.8%) were diagnosed as follicular lesion of undetermined significance (FLUS), 28 cases (22.95%)

were reported as follicular neoplasm, 8 cases (6.5%) were suspicious for malignancy (SM), and 12 cases (9.8%) were confirmed malignant as shown in Figure 1.

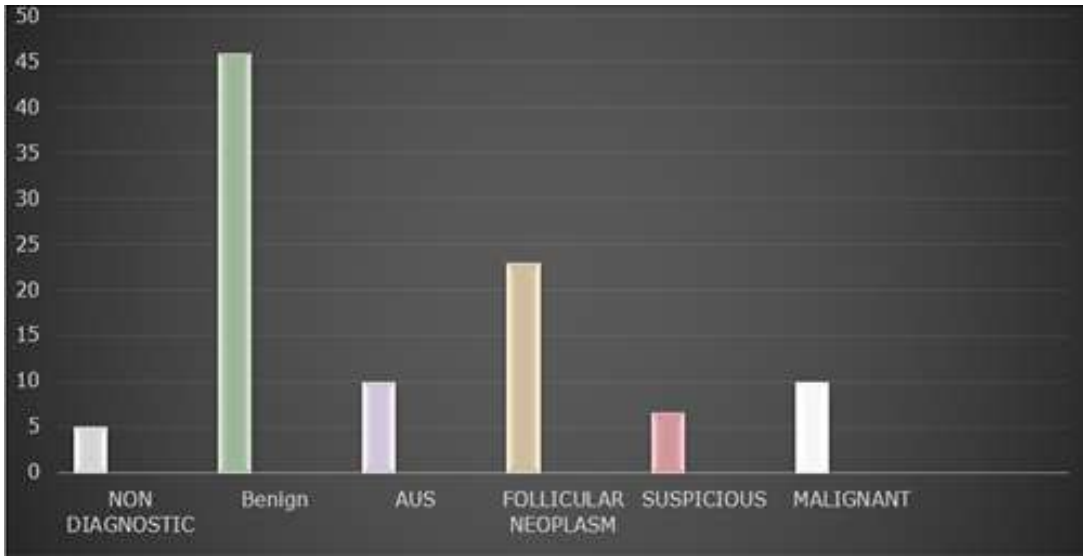


FIGURE 1

The distribution of thyroid lesions based on TBSRTC categories showed the highest malignancy rates in the malignant and suspicious-for-malignancy groups. The risk of neoplasia progressively increased from benign to higher Bethesda categories as shown in Table 1.

Table 1. Summary according to TBSRTC and distribution of malignancy on surgical resection

Category	No. of cases	Cases in histopathology	Malignant histopathology	Risk of neoplasia %
Non-diagnostic	06	0	0	–
Benign	56	30	05	**16.6%**
Follicular lesion of undetermined significance	12	00	00	–
Follicular neoplasm	28	22	11	**50%**
Suspicious for malignancy	08	06	05	**83.3%**
Malignant	12	12	11	**91.6%**

Among 70 histopathologically assessed cases, the highest diagnostic accuracy was observed in the malignant category. Papillary thyroid carcinoma (PTC) was the most common malignancy across all Bethesda categories as shown in Table 2.

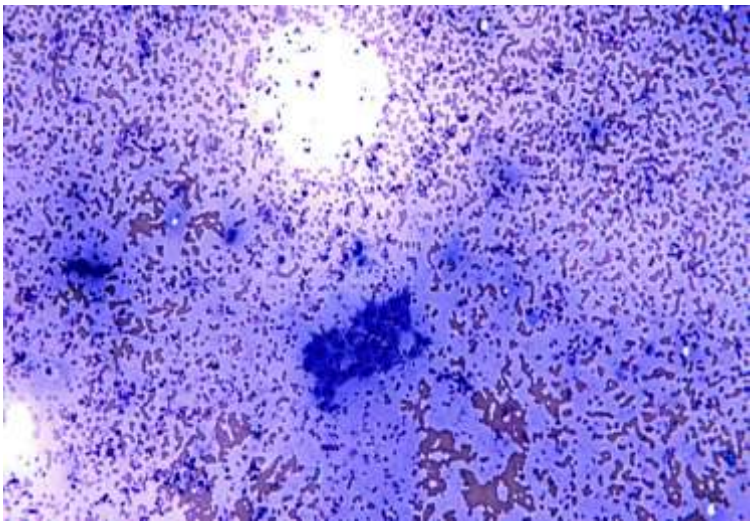
Table 2: Details of cases with their available final histopathologic diagnosis

Diagnostic TBSRTC Category	Malignant (total 70)	Final Diagnosis as Malignant lesions	Final Diagnosis as Benign lesions
Benign	5 of 30	5 PTC	10 colloid goiter, 5 multinodular goiter
Follicular Neoplasm	11 of 22	5 PTC, 2 Hurthle cell carcinoma, 3 FVPTC, 1 well-differentiated ca	4 follicular adenoma, 10 lymphocytic thyroiditis, 2 follicular adenoma, 2 Hashimoto thyroiditis
Suspicious for malignancy	5 of 6	2 PTC, 2 Follicular carcinoma, 1 Medullary carcinoma	1 Hashimoto's thyroiditis
Malignant	11 of 12	6 PTC, 2 Follicular carcinoma, 1 Hurthle cell carcinoma, 1 anaplastic carcinoma	1 Chronic lymphocytic thyroiditis

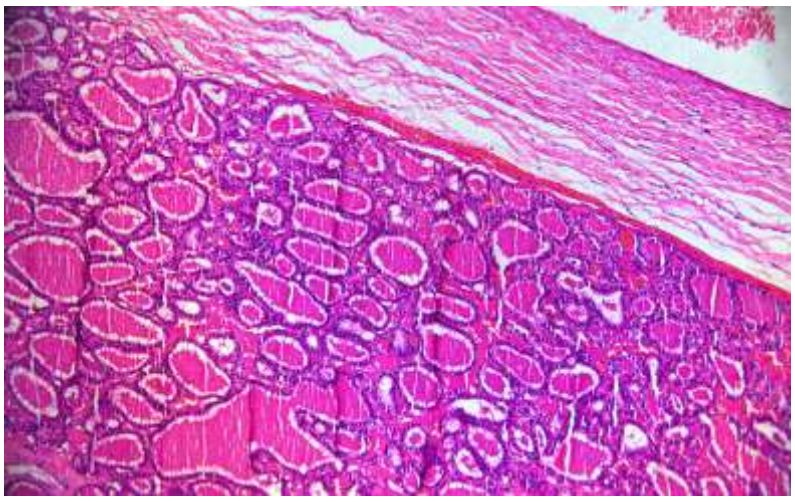
The risk of malignancy increased with higher TIRADS categories, with TIRADS 5 showing 100% malignancy. TIRADS 4 also showed a significant correlation with malignant lesions, especially papillary and follicular carcinomas, as shown in Table 3.

Table 3: TIRADS and BETHESDA system of reporting cytopathology

TIRADS	Cases	Benign	Malignant	Risk of Malignancy
2	24	08 colloid goiter, 10 multinodular goiter, 2 Hashimoto thyroiditis, 2 adenomatous goiter	2 PTC	8.3%
3	22	09 follicular adenoma, 07 adenomatous goiter, 1 Hashimoto thyroiditis, 2 colloid goiter	3 PTC	13.63%
4	20	4 follicular adenoma, 2 adenomatous goiter	10 PTC, 3 follicular carcinoma, FVPTC, 1 Hurthle cell ca.	70%
5	04	0	2 anaplastic ca., 2 PTC	100%

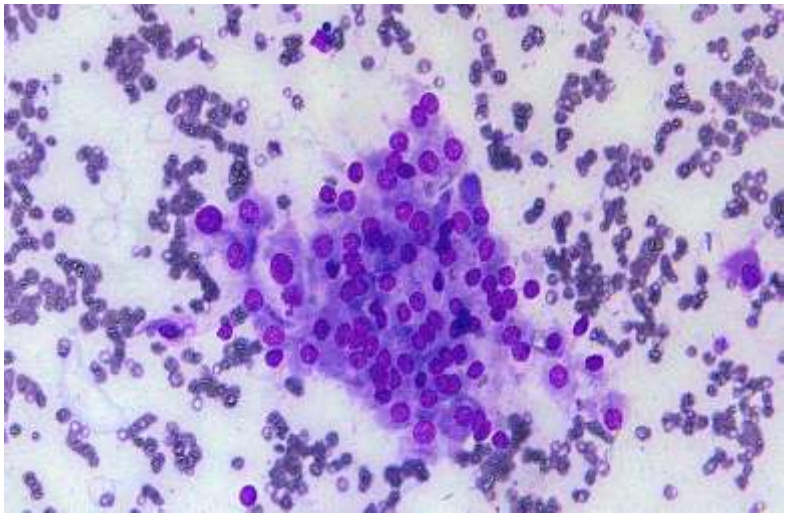


Cytology (PAP stain 40X Microphotograph show abundant colloid and follicular cell in monolayer sheet)

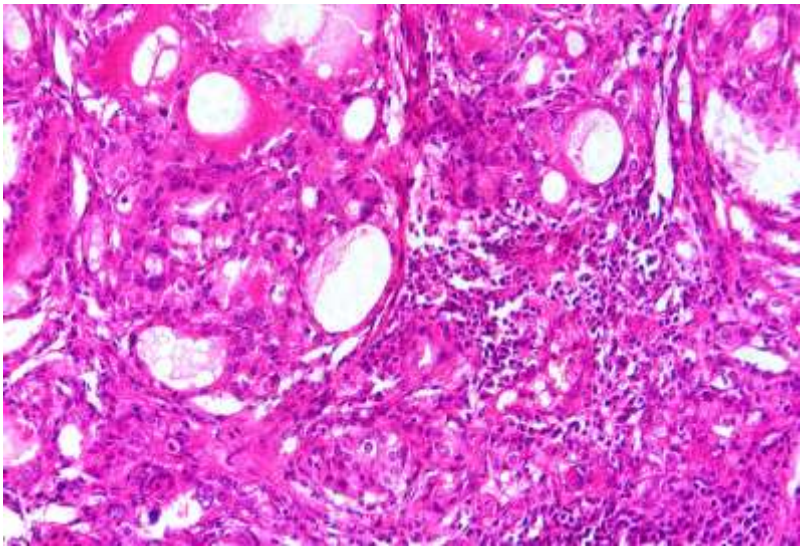


Histopathology (H&E stain 40x microphotograph show variable-sized dilated follicles filled with colloid)

FIGURE 2: COLLOID GOITER

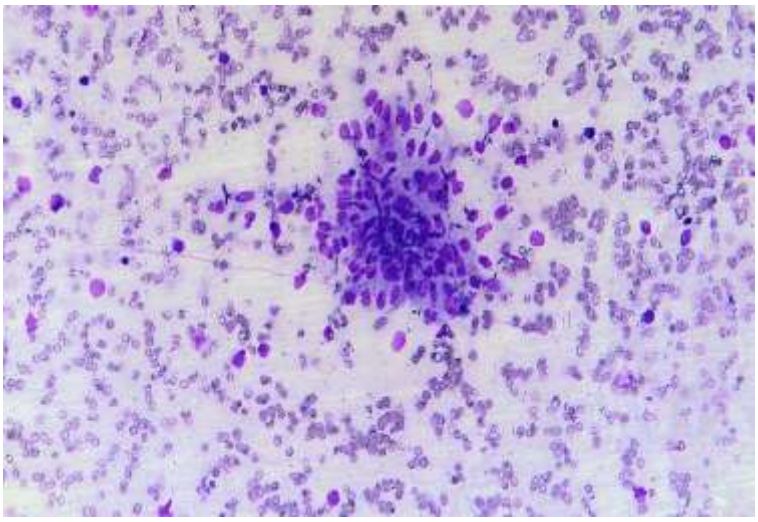


Cytology (PAP stain 40X microphotograph shows excess lymphoid cells along with thyroid follicle)



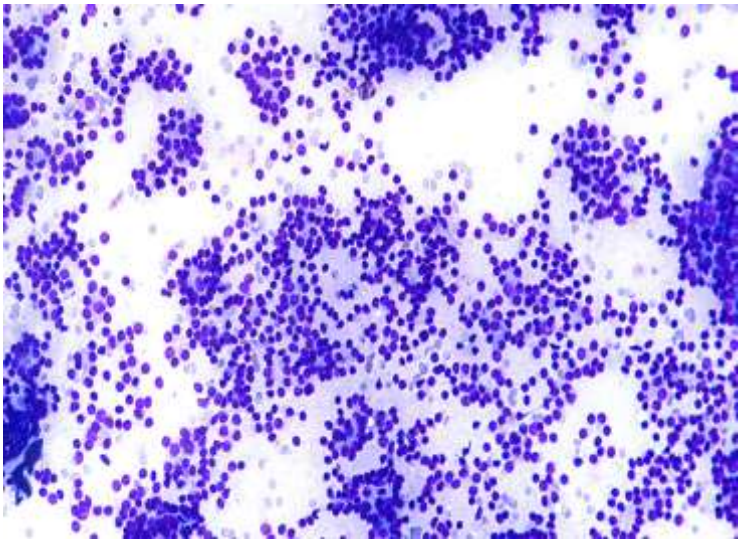
Histopathology (H&E stain 40x microphotograph show diffuse infiltration of thyroid parenchyma with lymphocyte and plasma cell.)

FIGURE 3: CHRONIC LYMPHOCYTIC THYROIDITIS/ HASHIMOTO'S THYROIDITIS



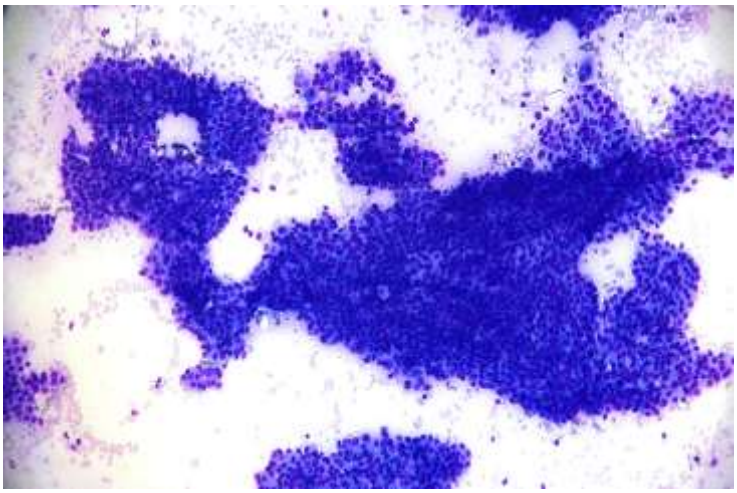
Cytology (Scant colloid with lymphocyte and oncocytic cells)

FIGURE 4: HASHIMOTO THYROIDITIS

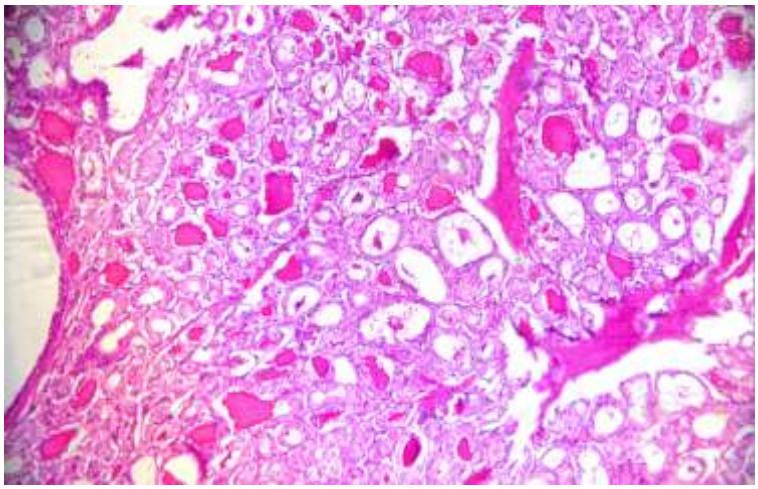


Cytology (PAP stain 40X microphotograph shows prominent micro follicular pattern Rosette syncytial groups and equal size cell clusters in repetitive manner, nuclear crowding and overlapping.)

FIGURE 5: FOLLICULAR NEOPLASM

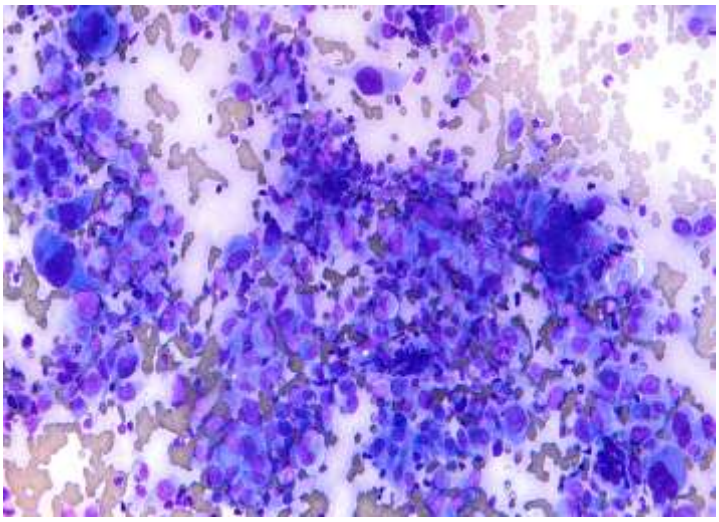


Cytology (PAP stain 40X microphotograph shows Monolayer sheets of cells with intranuclear inclusion and grooves.)

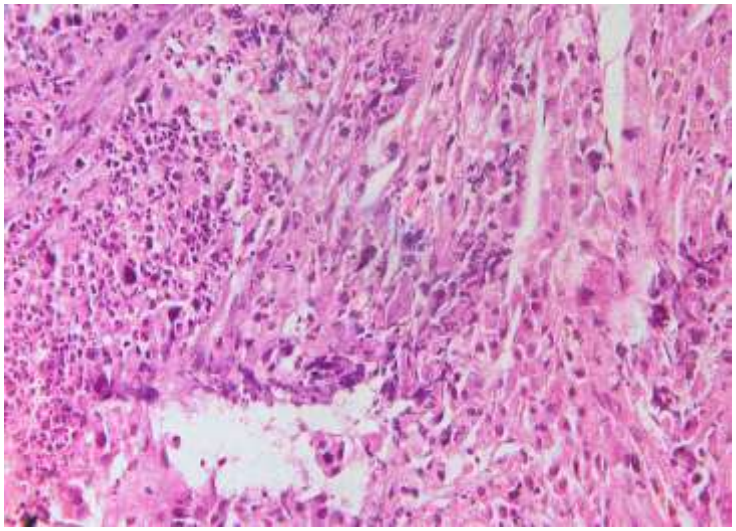


Histopathology (H&E stain 40x microphotograph show papillary architecture with fibrovascularcore, nuclear enlargement and chromatin clearing

FIGURE 6: PAPILLARY CARCINOMA THYROID



Cytology (PAP stain 40X microphotograph shows Marked nuclear pleomorphism necrosis , mitotic activity.)



Histopathology (H&E stain 40x microphotograph show polygonal cells with moderate amount of eosinophilic cytoplasm and pleomorphic hyperchromatic nuclei.)

FIGURE 7: ANAPLASTIC CARCINOMA

Discussion

Fine Needle Aspiration Cytology (FNAC) plays a pivotal role in the initial evaluation of thyroid nodules, with the ability to classify 70–80% of lesions as benign or malignant. In the present study, FNAC demonstrated a high negative predictive value (NPV) of 92% for benign lesions and a positive predictive value (PPV) of 100% for malignant lesions. With a sensitivity exceeding 90%, FNAC is recommended as a reliable preliminary test for detecting thyroid malignancies. However, the specificity remained relatively low at 64%, which can result in unnecessary surgical interventions due to false-positive findings.

In the present study, the risk of malignancy (ROM) for the follicular neoplasm category was 50%. This finding is consistent with the results reported by Meenakshi et al.[7], though it is higher than the rate observed by Mahajan et al.[8] It is important to note that Mahajan et al. [8] conducted their study over a longer duration of six years and included a larger population, whereas the current study is limited to one year with a smaller sample size. Nonetheless, the incidence of malignancy among

follicular neoplasms has generally been reported to be higher, and the present findings align with this trend.

For the category of "suspicious for malignancy," the ROM was observed to be 83.3%, which lies within the range reported by other studies (75–95%). This supports the high diagnostic accuracy of this cytological category. In cases diagnosed as malignant on cytology, the ROM on histopathological correlation was 91.6%, which also corresponds well with findings from other studies, where rates ranged from 85% to 96%.

The most frequently encountered malignancy in the present study was papillary thyroid carcinoma (PTC), which accounted for 54.5% of all histologically confirmed malignant cases. However, reporting of PTC on cytology can be challenging due to several factors, including specimen inadequacy, the aspirator's proficiency, and the interpretive skills of the cytopathologist. False-negative results may occur in PTC cases with cystic degeneration or when lymphomas mimic Hashimoto's thyroiditis due to the presence of abundant lymphocytes. On the other hand, false-positive results are possible in follicular and Hürthle cell adenomas, which can sometimes be misclassified as PTC or suspicious for PTC. Features that contribute to such misinterpretation include pseudopapillae, syncytial sheets, nuclear grooves, and pinpoint nucleoli—commonly observed in chronic lymphocytic thyroiditis and Hürthle cell neoplasms. Intranuclear inclusions can also be misleading, as they may appear in parathyroid adenomas or areas of mesenchymal repair.

A significant correlation was found between TIRADS 2 and Bethesda II categories. In this study, 5 out of 70 cases belonged to Bethesda II, with a ROM of 7.14%, while 2 out of 24 cases under TIRADS II had a ROM of 8.3%, indicating strong agreement in categorizing low-risk nodules. Conversely, a notable disparity was observed in TIRADS 4 and Bethesda IV categories. Bethesda IV included 20 of the total 70 cases, with a ROM of 70%, whereas TIRADS IV involved 14 out of 20 cases and showed a comparatively lower ROM of 50%. This discrepancy highlights a divergence in malignancy risk estimation between cytological and radiological systems in intermediate-risk lesions.

TABLE 4: Comparison of present data with literature from similar studies

Author	Cases	BENIGN		FOLLICULAR NEOPLASM		SUSPICIOUS OF MALIGNANCY		MALIGNANT	
		Cases %	ROM %	Cases %	ROM %	Cases %	ROM %	Cases %	ROM %
Meenakshi et al [7]	431	30.2	27.7	6.3	53.8	7.9	95	26.7	96.7
Mahajan et al [8]	4560	79.6	7.8	3.9	23.6	0.5	75	9.8	85.4
Present Study	122	56	16.6%	28	50%	08	83.3%	12	91.6%

Conclusion

We concluded that the Bethesda System for Reporting Thyroid Cytopathology (TBSRTC) provides a standardized approach to thyroid cytology, facilitating consistent clinical management. It demonstrates high sensitivity, with increasing category scores correlating with a higher risk of malignancy. A strong concordance was observed between TIRADS and the Bethesda systems in evaluating benign lesions. However, discordance was noted in suspicious nodules, particularly in Bethesda category IV. For accurate diagnosis and optimal risk stratification, the combined application of both TBSRTC and TIRADS is essential, as they complement each other effectively.

Strengths

The study effectively integrates cytological, histopathological, and radiological (TIRADS) data, enhancing diagnostic accuracy. It uses standardized classification systems and provides real-world insights into malignancy risk, aiding clinical decision-making in a tertiary care setting.

Limitations

The study's retrospective design and limited sample size may affect generalizability. Histopathological correlation was not available for all cases, and reliance on recorded data may introduce observer bias or documentation inconsistencies.

Conflict of Interest: *None.*
Funding: *None.*
Ethical Approval: *Obtained.*
Consent: *Written consent secured.*

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