

**FINE NEEDLE ASPIRATION CYTOLOGY OF THYROID SWELLING WITH HISTOPATHOLOGICAL CORRELATION: EXPERIENCE FROM A TERTIARY CARE CENTRE**

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ABSTRACT **Objective:** To study the cytological spectrum of thyroid swellings on FNAC and correlate the findings with histopathological diagnosis in operated cases at a tertiary care centre. **Materials and Methods:** This retrospective observational study included all patients who underwent thyroid FNAC and subsequent thyroid surgery at Shija Hospitals from January 2025 to January 2026. Cytological findings were categorized according to the Bethesda System for Reporting Thyroid Cytopathology (BSRTC) and correlated with final histopathological diagnosis. Cases in which thyroid FNAC or surgery was not performed at Shija Hospitals were excluded. **Results:** A total of 60 patients were included. Female preponderance was noted (F:M = 19:1). Mean age was 42.4 ± 6.8 years (range 23–57 years), with peak incidence in the 40–49 year age group (56.7%). The overall malignancy rate on histopathology was 16.7% (10/60). FNAC demonstrated sensitivity of 60.0%, specificity of 100%, PPV of 100%, NPV of 92.6%, and overall accuracy of 93.3%. **Conclusion:** FNAC is a reliable first-line diagnostic tool for thyroid nodules with high specificity and accuracy. All false-negative results were confined to the free-hand FNAC group, where papillary microcarcinomas were missed within benign-appearing nodules. No false negatives occurred in the USG-guided group, underscoring the importance of ultrasound guidance in improving diagnostic accuracy.

KEYWORDS : FNAC, Thyroid Nodule, Bethesda System, Histopathology, Papillary Microcarcinoma, USG-guided FNAC

INTRODUCTION

Fine-needle aspiration cytology (FNAC) is a simple, minimally invasive and cost-effective first-line investigation for patients presenting with thyroid swelling, particularly in resource-constrained settings such as India.[2–4,7,8] Thyroid nodules are common in the general population and the majority are benign, so an accurate pre-operative test is essential to avoid unnecessary surgery while ensuring timely identification of malignancy. FNAC of the thyroid, especially when interpreted using the Bethesda System for Reporting Thyroid Cytopathology (BSRTC), has consistently been shown to offer high sensitivity, specificity and overall diagnostic accuracy, and it is now widely accepted as the standard initial diagnostic modality for evaluating thyroid lesions in routine clinical practice.

Despite major advances in ultrasonography and other imaging modalities, histopathological examination of excised thyroid tissue remains the gold standard for definitive diagnosis of both benign and malignant thyroid disease. Correlating pre-operative FNAC findings with post-operative histopathology allows objective assessment of the diagnostic performance of FNAC, including the calculation of sensitivity, specificity, positive and negative predictive values, and the determination of false-negative and false-positive rates. Such cyto-histological correlation not only validates FNAC as a screening and triaging tool but also helps refine patient selection for surgery, thereby optimising clinical decision-making and resource utilisation.

Cyto-histological correlation studies from different regions of India consistently demonstrate a predominance of non-neoplastic lesions, such as colloid goitre and thyroiditis, along with a clear female preponderance and peak incidence in the third to fifth decades of life. These demographic and clinicopathological trends are often attributed to underlying iodine deficiency, autoimmune thyroid disease and hormonal influences, and they highlight the significant public health burden of thyroid disorders in the Indian population. Recognising these patterns is important for planning screening strategies, allocating healthcare resources and counselling patients about prognosis and the likelihood of malignant disease.

However, important limitations of FNAC persist, including sampling errors, especially in small or deeply located nodules, interpretative

difficulties in follicular-patterned lesions and occasional discordance between cytology and histology. Follicular neoplasms, in particular, pose a diagnostic challenge because capsular and vascular invasion, which are required to distinguish adenoma from carcinoma, cannot be assessed on cytology smears and require histological evaluation of the excised specimen. Ultrasound guidance has been proposed and increasingly used to improve sample adequacy, target suspicious areas within complex nodules and reduce false-negative rates, but its impact may vary with operator expertise, needle technique and specific nodule characteristics such as size, location and presence of cystic degeneration.

In this context, further systematic evaluation of FNAC of thyroid swellings with histopathological correlation in local Indian populations is necessary to validate its diagnostic accuracy, delineate its limitations and identify the causes of discordant cases. Such studies can help define institution-specific or region-specific malignancy risks for each BSRTC category, guide the development of refined reporting and management protocols, and provide feedback for improving sampling techniques and cytological interpretation. Ultimately, continuous audit and cyto-histological correlation will contribute to better risk stratification of thyroid nodules, more judicious use of surgery and improved patient outcomes in resource-limited settings

MATERIALS AND METHODS

This was a retrospective observational study conducted at the Department of Pathology, Shija Hospitals and Research Institute, Imphal, Manipur for the period of 1 year (January 2025 to January 2026). The study included all patients who underwent thyroid FNAC and subsequent thyroid surgery at the institution. Cytological findings were categorized using the Bethesda System for Reporting Thyroid Cytopathology (BSRTC) and correlated with histopathological diagnosis of the resected specimens. Cases in which thyroid FNAC or surgery was not performed at the institution were excluded from the study.

FNAC was performed either as a free-hand procedure guided by palpation, or under real-time ultrasound guidance (USG-guided FNAC), depending on the clinical and radiological characteristics of the nodule. Histopathological sections of the resected specimens were

stained with haematoxylin and eosin (H&E) and examined by experienced pathologists. Diagnostic accuracy parameters — including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy — were calculated using standard formulae, with histopathology as the gold standard.

RESULTS

In our study out of the 60 patients, 57 were female (95.0%) and 3 were male (5.0%), giving a female-to-male ratio of 19:1. This marked female preponderance is consistent with the well-established higher prevalence of thyroid disorders in women, attributed to hormonal and immunological factors.

The 40–49 year age group was the most common, comprising 34 patients (56.7%), followed by the 30–39 year age group with 19 patients (31.7%). The 50–59 year age group accounted for 5 patients (8.3%), while the 20–29 year age group had the fewest cases with only 2 patients (3.3%). The mean age was 42.4 ± 6.8 years (range 23–57 years), indicating that thyroid nodular disease predominantly affected middle-aged individuals in the fourth and fifth decades of life. Of the 60 FNAC procedures, 36 (60.0%) were performed as free-hand FNAC and 24 (40.0%) under USG guidance. The higher proportion of free-hand FNACs reflects the palpable nature of most nodules in the study population.

The majority of cases were classified as Bethesda II (51 cases, 85.0%). Bethesda V accounted for 5 cases (8.3%), all of which were confirmed malignant on histopathology (100% malignancy rate). The single Bethesda VI case was also confirmed malignant (100%). Four cases in the Bethesda II category (7.8%) harboured malignancy on histopathology, all representing papillary microcarcinoma. (Table 2).

Colloid goiter was the most common cytological diagnosis (28 cases, 46.7%), followed by lymphocytic thyroiditis (21 cases, 35.0%). Suspicious for papillary carcinoma accounted for 5 cases (8.3%), while follicular neoplasm and hyperplastic nodule were each seen in 2 cases (3.3%). (Table 3)

On histopathology, colloid nodule (24 cases, 40.0%) and chronic lymphocytic thyroiditis (17 cases, 28.3%) were the most frequent diagnoses. Papillary carcinoma and papillary microcarcinoma each accounted for 5 cases (8.3%). The overall malignancy rate was 16.7% (10/60). (Table 4)

FNAC demonstrated a sensitivity of 60.0%, specificity of 100%, PPV of 100%, NPV of 92.6%, and overall accuracy of 93.3%. The perfect specificity and PPV indicate the absence of false-positive results. The four false-negative cases were all papillary microcarcinomas arising within a background of colloid goiter, misclassified as Bethesda II on cytology. (Table 5)

Table 1: Demographic and Clinical Profile (n = 60)

Variable	n	%
Sex		
Female	57	95.0%
Male	3	5.0%
Total	60	100%
Age Group (years)		
20–29 yrs	2	3.3%
30–39 yrs	19	31.7%
40–49 yrs	34	56.7%
50–59 yrs	5	8.3%
Total	60	100%
Mean age $\pm$ SD: 42.4 ± 6.8 years Range: 23–57 years		
USG-Guided FNAC		
USG-Guided	24	40.0%
Free-hand	36	60.0%
Total	60	100%

Table 2: Bethesda Classification vs Histological Outcome

Bethesda Category	Description	Total (n)	% of Total	Malignant on Histology
Bethesda II	Benign	51	85.0%	4
Bethesda III	Atypia / FLUS	1	1.7%	0
Bethesda IV	Follicular Neoplasm	2	3.3%	0

Bethesda V	Suspicious for Malignancy	5	8.3%	5
Bethesda VI	Malignant	1	1.7%	1
Total		60	100%	10

FLUS = Follicular Lesion of Undetermined Significance

Table 3: Distribution of FNAC Diagnoses

FNAC Diagnosis	n	%
Colloid Goiter	28	46.7%
Lymphocytic Thyroiditis	21	35.0%
Suspicious for Papillary Carcinoma	5	8.3%
Hyperplastic Nodule	2	3.3%
Follicular Neoplasm	2	3.3%
Follicular Lesion of Undetermined Significance (FLUS)	1	1.7%
Papillary Carcinoma Thyroid	1	1.7%
Total	60	100%

Table 4: Distribution of Histopathological Diagnoses

Histopathological Diagnosis	n	%
Colloid Nodule	24	40.0%
Chronic Lymphocytic Thyroiditis	17	28.3%
Papillary Carcinoma Thyroid	5	8.3%
Microcarcinoma (Papillary)	5	8.3%
Hashimoto Thyroiditis	3	5.0%
Multinodular Goiter	2	3.3%
Follicular Adenoma	2	3.3%
Subacute Thyroiditis	1	1.7%
Follicular Carcinoma	1	1.7%
Total	60	100%

Table 5: Diagnostic Accuracy of FNAC for Detection of Malignancy

Parameter	Value
True Positive (TP)	6
False Positive (FP)	0
False Negative (FN)	4
True Negative (TN)	50
Sensitivity	60.0%
Specificity	100.0%
Positive Predictive Value (PPV)	100.0%
Negative Predictive Value (NPV)	92.6%
Overall Accuracy	93.3%
Overall Malignancy Rate	16.7% (10/60)

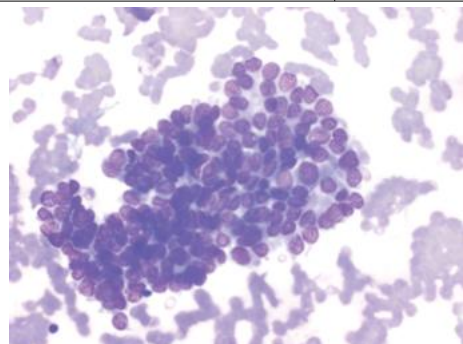


Figure 1: Papillary carcinoma thyroid cytologic pattern (FNAC)

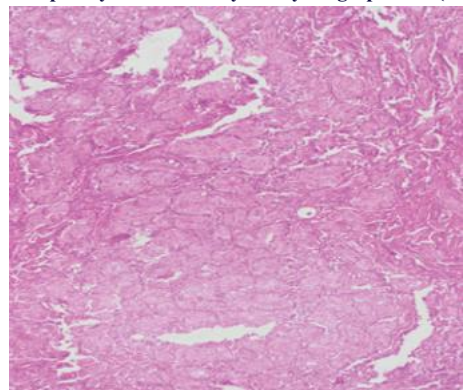


Figure 2: Papillary carcinoma thyroid (Microcarcinoma) H&E

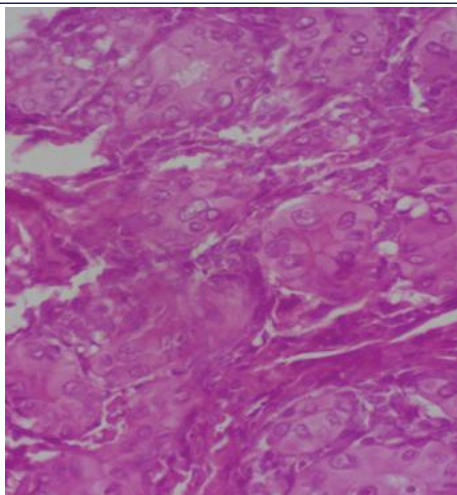


Figure 3 : Papillary carcinoma thyroid (Nuclear features) H&E

DISCUSSION

Thyroid nodules are a common clinical problem, and fnac remains the most widely used pre-operative diagnostic tool for their evaluation. The present study assessed the cytological spectrum of thyroid swellings using the bsrtc and correlated the findings with final histopathological diagnosis in 60 operated patients at a tertiary care centre.

Demographic Profile

The study demonstrated a marked female preponderance with a female-to-male ratio of 19:1, consistent with findings reported in several indian studies. Chandanwale et al. Reported a female-to-male ratio of 9:1, while singh et al. And bhatia et al. Observed similar female dominance in their series. The higher prevalence of thyroid disorders in women is attributed to oestrogen-mediated effects on thyroid follicular cells, autoimmune susceptibility and differences in iodine metabolism. The mean age of 42.4 ± 6.8 years, with peak incidence in the 40–49-year age group, is comparable to other published series from india, which consistently report the maximum number of cases in the fourth and fifth decades of life.

Bethesda Classification

The majority of cases were classified as bethesda category ii (85.0%), consistent with published literature reporting bethesda ii rates of 60–80% in similar institutional studies. The risk of malignancy in bethesda v and vi categories in this study was 100%, in keeping with the expected malignancy rates of 60–75% and 97–99% for these categories as defined by the bsrtc 2017 guidelines.

FNAC and Histopathological Diagnoses

Colloid goitre was the most common cytological diagnosis (46.7%), followed by lymphocytic thyroiditis (35.0%), reflecting the endemic nature of goitre in north-east india. On histopathology, colloid nodule (40.0%) and chronic lymphocytic thyroiditis (28.3%) mirrored the cytological distribution. The overall malignancy rate on histopathology was 16.7%, reflecting the selection bias inherent to a purely operated cohort.[2–5,8,9]

Diagnostic Accuracy

Fnac demonstrated a sensitivity of 60.0%, specificity of 100%, ppv of 100%, npv of 92.6% and overall accuracy of 93.3% for detection of malignancy. These values are comparable to studies by gharib et al. (sensitivity 65–98%, specificity 72–100%) and dey et al. (accuracy 94.6%). The perfect specificity and ppv confirm the absence of false-positive results. The sensitivity of 60.0% is explained by the four false-negative cases — papillary microcarcinomas arising within a background of colloid goitre — representing a well-recognised diagnostic pitfall in thyroid cytology, as malignant cells may be scant, obscured by abundant colloid or located in a non-sampled region of the nodule.

Role of USG Guidance

A critical finding of this study is that all four false-negative results occurred exclusively in the free-hand fnac group. No false negatives were identified among the 24 patients who underwent usg-guided fnac. This strongly supports the utility of ultrasound guidance in improving

sampling accuracy, particularly for heterogeneous nodules or those with small suspicious foci not identifiable on palpation. Danese et al. And gharib et al. have similarly demonstrated that usg-guided fnac significantly reduces inadequate sample rates and improves overall diagnostic accuracy. Wider adoption of usg-guided fnac is therefore recommended, especially for nodules with heterogeneous echotexture or those not clearly palpable on clinical examination

CONCLUSION

Fnac is a reliable, cost-effective, and minimally invasive first-line diagnostic tool for thyroid nodules, demonstrating high specificity (100%), positive predictive value (100%), and overall diagnostic accuracy (93.3%) in the present study. The overall malignancy rate on histopathology was 16.7% (10/60), with papillary carcinoma and papillary microcarcinoma being the most common malignant diagnoses.

All four false-negative FNAC results were observed exclusively in the free-hand group, where papillary microcarcinomas were missed within benign-appearing large colloid goiter nodules — a limitation attributable to palpation-guided sampling. No false negatives occurred in the USG-guided group, underscoring the importance of ultrasound guidance in improving diagnostic accuracy. Wider adoption of USG-guided FNAC, particularly for large nodules with heterogeneous echotexture or those harbouring small suspicious areas not appreciable on clinical examination, is strongly recommended in routine practice.

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