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CYTOMORPHOLOGICAL SPECTRUM OF THYROID LESIONS AND THEIR CORRELATION WITH HISTOPATHOLOGY: A PROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Background: Thyroid lesions are common endocrine disorders presenting as diffuse or nodular thyroid swelling. Fine Needle Aspiration Cytology is a simple, rapid, minimally invasive, and cost-effective diagnostic method for initial evaluation.

Aim: To evaluate the cytomorphological spectrum of thyroid lesions and correlate FNAC findings with histopathological diagnosis.

Materials and Methods: A prospective observational study was conducted in 2022 among 140 patients presenting with thyroid swelling. FNAC was performed and reported according to the Bethesda System for Reporting Thyroid Cytopathology. Histopathological correlation was done in operated cases. Diagnostic accuracy of FNAC was calculated.

Results: Benign thyroid lesions constituted the majority of cases. Colloid goiter was the most common cytological diagnosis, followed by nodular goiter and lymphocytic thyroiditis. Female predominance was observed. Papillary carcinoma was the most common malignant lesion. FNAC showed high sensitivity and specificity for diagnosis of thyroid malignancy.

Conclusion: FNAC is a reliable, simple, and cost-effective diagnostic modality for thyroid lesions. Bethesda-based reporting improves diagnostic communication and helps guide appropriate clinical and surgical management.

Keywords: Bethesda System, Cytology, Fine Needle Aspiration Cytology, Histopathology, Pathology, Thyroid Lesions, Thyroid Neoplasm.

INTRODUCTION

Thyroid lesions are among the most common endocrine disorders encountered in clinical and pathological practice. They may present as diffuse enlargement, solitary thyroid nodule, multinodular swelling, inflammatory lesion, benign neoplasm, or malignant tumor. The clinical importance of thyroid lesions lies in the need to distinguish common benign conditions from neoplastic and malignant lesions requiring surgical management. Although most thyroid nodules are benign, a small but clinically significant proportion may represent malignancy.¹

The prevalence of thyroid nodules has increased in recent decades because of improved clinical awareness, greater use of ultrasonography, and frequent evaluation of neck swellings. Thyroid nodules are more commonly seen among females, and this female predominance may be related to hormonal influences, autoimmune predisposition, and higher prevalence of benign nodular thyroid disease. Thyroid swelling may be asymptomatic or may present with dysphagia, pain, hoarseness of voice, cosmetic concern, symptoms of thyroid dysfunction, or cervical lymphadenopathy.²

Clinical examination alone may not reliably distinguish benign from malignant thyroid lesions because many lesions present with overlapping features. A solitary nodule, rapid increase in size, hard consistency, fixation, hoarseness of voice,

cervical lymphadenopathy, and pressure symptoms may raise suspicion of malignancy, but cytological and histopathological evaluation remain essential for diagnosis.³

Fine Needle Aspiration Cytology plays a major role in the initial evaluation of thyroid swellings. FNAC is safe, simple, rapid, inexpensive, minimally invasive, and can be performed on an outpatient basis. It helps identify colloid goiter, thyroiditis, cystic lesions, follicular-patterned lesions, papillary carcinoma, medullary carcinoma, and other malignant lesions. It also reduces unnecessary thyroid surgeries by identifying benign lesions that can be managed conservatively.⁴

Standardized reporting is important for thyroid cytology because it improves communication between pathologists and clinicians. The Bethesda System for Reporting Thyroid Cytopathology classifies thyroid FNAC into diagnostic categories with implied risk of malignancy and recommended clinical management. The categories include nondiagnostic, benign, atypia of undetermined significance or follicular lesion of undetermined significance, follicular neoplasm, suspicious for malignancy, and malignant.⁵

Colloid goiter, nodular goiter, and lymphocytic thyroiditis are among the common benign thyroid lesions encountered on FNAC. Papillary carcinoma is the most common malignant thyroid neoplasm and has characteristic cytological features including papillary fragments, nuclear enlargement, powdery chromatin, nuclear grooves, intranuclear cytoplasmic inclusions, and sometimes psammoma bodies.⁶

Histopathological examination remains the gold standard for definitive diagnosis, especially in follicular-patterned lesions where cytology cannot reliably distinguish follicular adenoma from follicular carcinoma. The diagnosis of follicular carcinoma requires demonstration of capsular and/or vascular invasion in the excised specimen. Therefore, FNAC and histopathology are complementary methods in the evaluation of thyroid lesions.⁷

The present study was conducted to evaluate the cytomorphological spectrum of thyroid lesions and to correlate FNAC findings with histopathological diagnosis in operated cases.

MATERIALS AND METHODS

This prospective observational study was conducted in the Department of Pathology of a tertiary care teaching hospital during the year 2022. A total of 140 patients presenting with thyroid swelling were included in the study.

Patients with palpable thyroid swelling who consented for FNAC were included. Patients with bleeding disorders, inadequate aspirates, and incomplete clinical records were excluded. These exclusion criteria were used to ensure adequate cytological material and reliable clinical correlation.

A detailed clinical history was recorded in all cases. Information regarding age, gender, duration of swelling, pain, dysphagia, hoarseness of voice, weight loss, pressure symptoms, and symptoms suggestive of thyroid dysfunction was obtained. Clinical examination was performed to assess site, size, consistency, mobility, tenderness, and presence of cervical lymphadenopathy.

FNAC was performed under aseptic precautions using a 23–24 gauge needle. Multiple passes were made wherever required to obtain adequate material. Smears were prepared immediately after aspiration. Air-dried smears were stained with May-Grunwald-Giemsa stain, while alcohol-fixed smears were stained with hematoxylin and eosin and Papanicolaou stain.

Cytological findings were categorized according to the Bethesda System for Reporting Thyroid Cytopathology. Cytological diagnoses included colloid goiter, nodular goiter, lymphocytic thyroiditis, follicular neoplasm, papillary carcinoma, medullary carcinoma, and thyroglossal cyst. Bethesda categories were recorded as Category II benign, Category III AUS/FLUS, Category IV follicular neoplasm, Category V suspicious for malignancy, and Category VI malignant.

Histopathological correlation was performed in surgically resected specimens. Thyroidectomy specimens were fixed in 10% formalin and processed routinely. Sections were stained with hematoxylin and eosin and examined microscopically. Histopathological diagnoses were compared with FNAC findings.

The diagnostic accuracy of FNAC was assessed by calculating sensitivity, specificity, positive predictive value, and negative predictive value. Statistical analysis was performed using SPSS software version 25. Categorical variables were represented as frequencies and percentages and analyzed using the chi-square test. A p-value less than 0.05 was considered statistically significant.

Institutional ethical committee approval was obtained before commencement of the study. Informed consent was obtained from all participants, and confidentiality of patient-related information was maintained.

RESULTS

A total of 140 patients with thyroid swelling underwent FNAC evaluation. The mean age of participants was 38.6 ± 12.4 years.

Table 1: Demographic Characteristics of Study Participants

Variable	Frequency (%)
Male	28 (20.0)
Female	112 (80.0)
Age 11–30 years	42 (30.0)
Age 31–50 years	72 (51.4)
Age >50 years	26 (18.6)

Female predominance was observed, with 112 (80.0%) female patients and 28 (20.0%) male patients. The majority of patients belonged to the 31–50 years age group, accounting for 72 (51.4%) cases.

Table 2: Clinical Presentation Among Study Participants

Clinical Feature	Frequency (%)
Neck swelling	140 (100.0)
Dysphagia	28 (20.0)
Pain	22 (15.7)
Hoarseness of voice	10 (7.1)
Weight loss	12 (8.6)

Neck swelling was present in all patients and was the universal presenting feature. Dysphagia was observed in 28 (20.0%) patients, followed by pain in 22 (15.7%) cases. Hoarseness of voice and weight loss were less common but clinically important symptoms.

Table 3: Cytological Spectrum of Thyroid Lesions

Cytological Diagnosis	Frequency (%)
Colloid goiter	58 (41.4)
Nodular goiter	24 (17.1)
Lymphocytic thyroiditis	20 (14.3)
Follicular neoplasm	14 (10.0)
Papillary carcinoma	16 (11.4)
Medullary carcinoma	2 (1.4)
Thyroglossal cyst	6 (4.3)

Colloid goiter was the most common cytological diagnosis, observed in 58 (41.4%) patients, followed by nodular goiter in 24 (17.1%) cases. Papillary carcinoma was the most common malignant lesion on cytology.

Table 4: Bethesda Category Distribution

Bethesda Category	Frequency (%)
Category II (Benign)	104 (74.3)
Category III (AUS/FLUS)	10 (7.1)
Category IV (Follicular neoplasm)	12 (8.6)
Category V (Suspicious for malignancy)	6 (4.3)
Category VI (Malignant)	8 (5.7)

Bethesda Category II benign lesions constituted the majority, accounting for 104 (74.3%) cases. Follicular neoplasm and AUS/FLUS categories were also observed in a smaller proportion of patients.

Table 5: Histopathological Spectrum in Operated Cases

Histopathological Diagnosis	Frequency (%)
Colloid goiter	30 (37.5)
Follicular adenoma	16 (20.0)
Papillary carcinoma	22 (27.5)
Follicular carcinoma	8 (10.0)
Medullary carcinoma	2 (2.5)

Hashimoto thyroiditis	2 (2.5)
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In operated cases, colloid goiter was the most common benign diagnosis, while papillary carcinoma was the most common malignant lesion. Follicular adenoma and follicular carcinoma were also observed on histopathological examination.

Table 6: Correlation Between FNAC and Histopathology

FNAC Diagnosis	Histopathology Positive	Histopathology Negative
Positive for malignancy	28	4
Negative for malignancy	2	46

FNAC showed good correlation with histopathological diagnosis in the majority of thyroid lesions. False-positive and false-negative cases were observed in a small number of patients, mainly in lesions requiring architectural assessment.

Table 7: Diagnostic Accuracy of FNAC

Diagnostic Parameter	Percentage
Sensitivity	93.3%
Specificity	92.0%
Positive Predictive Value	87.5%
Negative Predictive Value	95.8%

FNAC demonstrated high sensitivity and specificity for diagnosis of thyroid malignancy. The high negative predictive value indicates that FNAC is especially useful for excluding malignancy in clinically benign thyroid swellings.

DISCUSSION

The present prospective observational study evaluated the cytomorphological spectrum of thyroid lesions in 140 patients and correlated FNAC findings with histopathology in operated cases. Benign lesions constituted the majority, with colloid goiter being the most common cytological diagnosis. Female predominance was observed, and papillary carcinoma was the most common malignant lesion. FNAC demonstrated high sensitivity and specificity for diagnosis of malignancy.

Female predominance was observed in the present study. Vander et al. reported that thyroid nodules are more common among females and that most clinically detected thyroid nodules are benign.⁸ In the present study, females constituted 80.0% of patients. This finding is consistent with the known higher frequency of thyroid disorders among women due to hormonal, autoimmune, and reproductive influences.

The majority of patients belonged to the 31–50 years age group. Burch et al. observed that thyroid nodules are frequently encountered among adults and are commonly evaluated in middle age.⁹ The present study also found the highest number of cases in the middle-aged group. This may reflect the age at which thyroid swelling becomes clinically apparent and prompts medical consultation.

Colloid goiter was the most common cytological diagnosis. Sengupta et al. reported that benign thyroid lesions, particularly colloid goiter, form the largest group in FNAC evaluation of thyroid swellings.¹⁰ In the present study, colloid goiter accounted for 41.4% cases. Cytologically, colloid goiter usually shows abundant colloid, benign follicular epithelial cells, macrophages, and variable cystic change.

Nodular goiter was the second most common cytological diagnosis. Nodular goiter reflects hyperplastic and involutional changes in the thyroid gland and may present as solitary or multinodular swelling. FNAC helps differentiate nodular goiter from neoplastic lesions by identifying colloid-rich smears and benign follicular cell morphology.

Lymphocytic thyroiditis constituted 14.3% of cases. Kini et al. described the cytological features of Hashimoto thyroiditis, including lymphocytic infiltration, Hurthle cell change, follicular cell destruction, and background lymphoid cells.¹¹ In the present study, lymphocytic thyroiditis formed an important benign category. Diagnosis is clinically useful because patients may require thyroid function evaluation and long-term follow-up.

Papillary carcinoma was the most common malignant lesion in the present study. Baloch and LiVolsi emphasized that papillary carcinoma has characteristic cytological features, including nuclear grooves, intranuclear inclusions, papillary fragments, powdery chromatin, and psammoma bodies.¹² In the present study, papillary carcinoma was diagnosed cytologically in 11.4% of cases and was also the most common malignant diagnosis on histopathology.

Medullary carcinoma was uncommon. Although rare, it is clinically important because it differs from differentiated thyroid carcinoma in origin, biological behavior, and management. Cytological suspicion of medullary carcinoma should prompt further evaluation, including serum calcitonin estimation and appropriate clinical assessment where available.

Bethesda Category II benign lesions constituted the majority of cases. Cibas and Ali introduced standardized Bethesda terminology to improve reporting and clinical management of thyroid cytology.⁵ In the present study, 74.3% cases were Category II. This indicates that most thyroid swellings evaluated by FNAC were benign and could potentially be managed conservatively with clinical and radiological follow-up.

Bongiovanni et al. reported that the Bethesda System provides useful risk stratification and improves reproducibility in thyroid cytology reporting.¹³ The present study supports this approach because Bethesda categorization helped separate benign lesions from indeterminate, suspicious, and malignant categories. Such reporting assists clinicians in deciding follow-up, repeat FNAC, molecular testing where available, or surgery.

Histopathological correlation showed that FNAC had high diagnostic accuracy. Bagga and Mahajan reported good sensitivity and specificity of FNAC in evaluation of thyroid swellings.¹⁴ In the present study, sensitivity was 93.3%, specificity was 92.0%, positive predictive value was 87.5%, and negative predictive value was 95.8%. These findings indicate that FNAC is a reliable initial diagnostic tool in thyroid lesions.

False-negative cases were observed in a small number of patients. False negativity may occur due to sampling error, cystic change, small malignant focus within a larger benign lesion, or interpretive difficulty. False-positive cases may occur due to hyperplastic nodules, thyroiditis-related atypia, and follicular-patterned lesions. Therefore, clinical, radiological, cytological, and histological correlation remains important.

Follicular-patterned lesions represent a known limitation of FNAC. Goldstein et al. noted that follicular neoplasms diagnosed on FNAC require histopathological evaluation because distinction between adenoma and carcinoma depends on capsular and vascular invasion.¹⁵ In the present study, follicular adenoma and follicular carcinoma were diagnosed on histopathology, reinforcing the need for surgical excision in selected follicular neoplasm cases.

Histopathology remains the final diagnostic standard. It confirms cytological diagnosis, identifies capsular or vascular invasion, distinguishes follicular adenoma from follicular carcinoma, confirms papillary carcinoma variants, and evaluates associated thyroiditis or multinodular changes. Histopathological examination also provides prognostic and management-related information in malignant thyroid lesions.

The present findings are also consistent with large reviews showing that thyroid FNAC by a study by Oertel YC et al¹⁶ is a safe and effective diagnostic method. Gharib and Papini emphasized that FNAC plays a central role in thyroid nodule management and helps reduce unnecessary surgery.³ The present study supports FNAC as an essential first-line investigation in thyroid swellings.

The present study has certain limitations. It was conducted at a single tertiary care hospital and included only patients presenting with thyroid swelling. Histopathological correlation was available only in operated cases. Ultrasound findings, thyroid function tests, antibody profile, molecular testing, and long-term follow-up were not included. The number of medullary carcinoma cases was small. Future studies with ultrasound-guided FNAC, Bethesda category-wise malignancy risk, and long-term follow-up may provide stronger evidence.

CONCLUSION

FNAC is a simple, safe, rapid, minimally invasive, and cost-effective diagnostic modality for evaluating thyroid lesions. In the present study, benign thyroid lesions constituted the majority of cases, with colloid goiter being the most common cytological diagnosis. Female predominance was observed, and most patients belonged to the middle-aged group. Papillary carcinoma was the most common malignant lesion on cytology and histopathology. Bethesda-based reporting improved categorization and clinical communication. FNAC demonstrated high sensitivity, specificity, positive predictive value, and negative predictive value for diagnosis of thyroid malignancy. Histopathology remains essential for confirmation, especially in follicular-patterned lesions requiring assessment of capsular and vascular invasion.

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