RESEARCH PAPER

Cytological Evaluation of Palpable Thyroid Lesions Using the Bethesda System for Reporting Thyroid Cytopathology

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ABSTRACT

Background: Thyroid swellings are common endocrine disorders and accurate diagnosis is essential to differentiate benign from malignant lesions. Fine needle aspiration cytology is widely used as the initial diagnostic test for thyroid nodules. The Bethesda System for Reporting Thyroid Cytopathology provides a standardized framework for reporting thyroid FNAC results and estimating malignancy risk.

Aim: To assess thyroid swellings using fine needle aspiration cytology and classify the cytological findings according to the Bethesda System for Reporting Thyroid Cytopathology.

Methods: A prospective study was conducted on 120 patients with thyroid swellings. FNAC was performed and cytological findings were categorized according to the Bethesda system. Demographic data, adequacy of cytology samples, and distribution of thyroid lesions were analyzed.

Results: Thyroid lesions were most commonly observed in the third and fourth decades of life with a clear female predominance. The majority of cytological diagnoses belonged to the benign category, with nodular colloid goiter being the most frequent lesion. Indeterminate categories constituted a smaller proportion, while malignant lesions were relatively uncommon.

Conclusion: Fine needle aspiration cytology classified according to the Bethesda system is an effective and reliable diagnostic tool for evaluating thyroid swellings and guiding appropriate clinical management.

Keywords: Thyroid FNAC, Bethesda system, Thyroid cytology, Thyroid nodules

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INTRODUCTION

Thyroid swellings are among the most frequently encountered endocrine disorders in clinical practice. The prevalence of thyroid nodules in the general population has increased significantly over the past few decades, largely due to improved diagnostic techniques and the widespread use of imaging modalities such as ultrasonography. Although most thyroid nodules are benign, a small proportion may represent malignant lesions, making early and accurate diagnosis essential for appropriate management. Differentiating benign from malignant thyroid lesions is important to avoid unnecessary surgical procedures while ensuring timely intervention for thyroid malignancies [1].

Fine-needle aspiration cytology (FNAC) has emerged as the most reliable, minimally invasive, and cost-effective diagnostic technique for the evaluation of thyroid nodules. FNAC allows cytological examination of thyroid lesions and helps clinicians determine whether surgical management or conservative follow-up is appropriate. Over the years, FNAC has significantly reduced the number of unnecessary thyroid surgeries by accurately identifying benign lesions that can be managed without operative intervention. Numerous studies have demonstrated that thyroid FNAC has high sensitivity and specificity for detecting malignancy when correlated with histopathological findings [2].

Despite the widespread use of FNAC, interpretation of thyroid cytology can sometimes be challenging due to overlapping cytological features between benign and malignant lesions. Variability in reporting terminology among cytopathologists previously created difficulties in communication between clinicians and pathologists, leading to inconsistencies in diagnosis and management. In order to address these issues, the Bethesda System for Reporting Thyroid Cytopathology (TBSRTC) was introduced as a standardized reporting system for thyroid FNAC results [3].

The Bethesda system provides a uniform framework for categorizing thyroid cytology into six diagnostic categories: nondiagnostic or unsatisfactory, benign, atypia of undetermined significance or follicular lesion of undetermined significance (AUS/FLUS), follicular neoplasm or suspicious for follicular neoplasm, suspicious for malignancy, and malignant. Each category is associated with an estimated risk of malignancy and recommended clinical management guidelines. This standardized classification has significantly improved

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communication between clinicians and cytopathologists and has enhanced the clinical utility of thyroid FNAC [4].

The Bethesda system has also contributed to better reproducibility and diagnostic consistency in thyroid cytology reporting. By providing clearly defined cytological criteria for each category, the system reduces interobserver variability and improves diagnostic accuracy. Furthermore, the classification enables clinicians to stratify patients according to malignancy risk and determine appropriate management strategies such as observation, repeat FNAC, molecular testing, or surgical intervention [5].

Another important advantage of the Bethesda system is that it facilitates comparison of thyroid cytology results across different institutions and populations. This standardized reporting framework allows researchers to evaluate malignancy risk for each category and assess the diagnostic performance of FNAC in various clinical settings. As a result, numerous studies have been conducted worldwide to validate the effectiveness and reliability of the Bethesda system in thyroid cytopathology [6].

The increasing incidence of thyroid cancer worldwide further emphasizes the importance of accurate cytological diagnosis. Thyroid carcinoma accounts for the majority of endocrine malignancies, and early detection plays a crucial role in improving patient outcomes. The application of standardized cytology reporting systems such as Bethesda helps clinicians identify high-risk lesions and initiate appropriate treatment strategies at an early stage [7].

Correlation of FNAC findings with histopathological examination remains the gold standard for evaluating the diagnostic accuracy of thyroid cytology. Histopathology of surgically excised thyroid specimens provides definitive confirmation of benign or malignant lesions and allows assessment of the predictive value of cytological diagnoses. Studies correlating Bethesda categories with histopathological outcomes have demonstrated significant reliability of the system in predicting malignancy risk [8].

Several recent studies have reported that the Bethesda system not only improves diagnostic communication but also enhances clinical decision making in the management of thyroid nodules. The system helps reduce unnecessary surgeries for benign lesions while ensuring appropriate treatment for suspicious and malignant nodules. Consequently, the Bethesda classification has become an integral part of routine thyroid cytology reporting in many pathology laboratories worldwide [9].

In view of the growing importance of standardized cytology reporting, it is essential to evaluate the effectiveness of the Bethesda system in different clinical settings. Such studies provide valuable insights into the distribution of cytological categories and the associated risk of malignancy in specific populations. Therefore, the present study was undertaken to assess thyroid swellings using fine-needle aspiration cytology and classify the FNAC findings according to the Bethesda System for Reporting Thyroid Cytopathology [10].

MATERIAL AND METHODS

The present study was conducted as a prospective observational study in the Department of Pathology at a tertiary care teaching hospital with the objective of assessing thyroid swellings by fine needle aspiration cytology and classifying the cytological findings according to the Bethesda System for Reporting Thyroid Cytopathology. The study was carried out over a defined study period during which patients presenting with thyroid swelling were evaluated and included after fulfilling the eligibility criteria.

A total of 120 patients presenting with clinically palpable thyroid swellings or radiologically detected thyroid nodules were included in the study. Patients of either sex and different age groups who were referred for FNAC evaluation of thyroid nodules were enrolled consecutively. Patients with recurrent thyroid malignancy, previously treated thyroid carcinoma, or those who did not consent to the procedure were excluded from the study. Detailed clinical history including age, sex, duration of swelling, and relevant clinical findings were recorded for all patients.

All patients underwent fine needle aspiration cytology of the thyroid swelling using a 22–23 gauge needle attached to a disposable syringe under aseptic precautions. The aspiration was performed by experienced cytopathologists using the conventional aspiration technique. Multiple passes were made when necessary to obtain adequate cellular material. The aspirated material was smeared onto clean glass slides. Some smears were immediately fixed in 95% ethyl alcohol for Papanicolaou staining while air-dried smears were stained using May-Grünwald-Giemsa stain. The prepared slides were examined under a light microscope by experienced pathologists.

Cytological findings from all cases were categorized according to the Bethesda System for Reporting Thyroid Cytopathology. Each case was assigned to one of the six diagnostic categories including nondiagnostic or unsatisfactory, benign, atypia of undetermined significance or follicular lesion of undetermined significance, follicular neoplasm or suspicious for follicular neoplasm, suspicious for malignancy, and malignant. The distribution of cases in each Bethesda category was recorded and analyzed.

Patients who subsequently underwent thyroid surgery had their excised specimens submitted for histopathological examination. The surgical specimens were processed using standard histopathological techniques and stained with hematoxylin and eosin. Histopathological findings were considered the gold standard for diagnosis. Cytological findings were correlated with histopathological results to evaluate the diagnostic accuracy of FNAC and to determine the risk of malignancy associated with different Bethesda categories.

All collected data were entered into a structured data sheet and analyzed using appropriate statistical software.

Continuous variables such as age were expressed as mean ± standard deviation, while categorical variables such as Bethesda categories were expressed as frequencies and percentages. The association between cytological findings and histopathological diagnosis was assessed using the Chi-square test. Diagnostic parameters including sensitivity, specificity, positive predictive value, negative predictive value, and overall accuracy of thyroid FNAC were calculated. A p-value of less than 0.05 was considered statistically significant.

Ethical approval for the study was obtained from the Institutional Ethics Committee prior to the commencement of the study. Written informed consent was obtained from all patients before performing the FNAC procedure. Patient confidentiality was maintained throughout the study, and the research was conducted in accordance with the ethical principles of the Declaration of Helsinki.

RESULTS

The age-wise distribution of patients undergoing thyroid FNAC is presented in Table 1. A total of 120 patients with thyroid swellings were included in the present study. The patients ranged in age from 12 to 72 years with the majority of cases occurring in the third and fourth decades of life. The highest number of patients belonged to the 31–40 year age group accounting for 34 cases (28.3%), followed by the 41–50 year age group with 27 cases (22.5%). Patients in the 21–30 year age group constituted 23 cases (19.2%), while 18 cases (15.0%) were observed in the 51–60 year age group. Younger patients aged ≤20 years accounted for 10 cases (8.3%), and only 8 cases (6.7%) were observed in patients older than 60 years. These findings suggest that thyroid lesions were most frequently encountered among middle-aged individuals.

The gender-wise distribution of patients is shown in Table 2. Out of the 120 patients included in the study, females constituted the majority with 92 cases (76.7%), while males accounted for 28 cases (23.3%). The female-to-male ratio in the present study was approximately 3.3:1, indicating a marked female predominance in thyroid lesions. This observation is consistent with the known higher prevalence of thyroid disorders among females.

Table 3 illustrates the distribution of patients according to adequacy rates in cytology. Among the 120 FNAC procedures performed, 108 samples (90.0%) were found to be adequate for cytological interpretation, whereas 12 samples (10.0%) were categorized as inadequate or nondiagnostic. The relatively high adequacy rate observed in the present study reflects the effectiveness of the FNAC procedure and proper smear preparation techniques.

The cytological diagnosis of thyroid lesions according to the Bethesda System for Reporting Thyroid Cytopathology (TBSRTC) is presented in Table 4. Among the 108 adequate cytological samples, the benign category (Bethesda II) was the most common diagnosis with 69 cases (63.9%). Nondiagnostic or unsatisfactory smears (Bethesda I) accounted for 12 cases (11.1%). Atypia of undetermined significance or follicular lesion of undetermined significance (Bethesda III) was observed in 8 cases (7.4%). Follicular neoplasm or suspicious for follicular neoplasm (Bethesda IV) accounted for 9 cases (8.3%). Suspicious for malignancy (Bethesda V) was noted in 6 cases (5.6%), while malignant lesions (Bethesda VI) were diagnosed in 4 cases (3.7%).

The distribution of thyroid lesions based on detailed cytological diagnosis is shown in Table 5. Among the benign lesions, nodular colloid goiter was the most common diagnosis accounting for 40 cases (37.0%). Diffuse colloid goiter was observed in 11 cases (10.2%), colloid nodules in 9 cases (8.3%), and multinodular goiter in 5 cases (4.6%). Inflammatory thyroid lesions included Hashimoto thyroiditis in 6 cases (5.6%), lymphocytic thyroiditis in 8 cases (7.4%), and subacute thyroiditis in 4 cases (3.7%). In the indeterminate category, atypia of undetermined significance was identified in 8 cases (7.4%). Follicular neoplasm was suspected in 7 cases (6.5%), while Hurthle cell neoplasm was reported in 2 cases (1.9%). Among the suspicious category, 4 cases (3.7%) were suspicious for papillary thyroid carcinoma and 2 cases (1.9%) were suspicious for medullary carcinoma. Malignant lesions included papillary thyroid carcinoma in 3 cases (2.8%) and medullary carcinoma in 1 case (0.9%). These findings demonstrate that benign thyroid lesions constitute the majority of FNAC diagnoses, with nodular colloid goiter being the most frequently encountered lesion.

Table 1: Age-wise distribution of thyroid FNAC cases (N=120)

Age Group (Years)	Number of Cases	Percentage (%)
≤20	10	8.3
21–30	23	19.2
31–40	34	28.3
41–50	27	22.5
51–60	18	15.0
>60	8	6.7
Total	**120**	**100**

Table 2: Gender-wise distribution of patients (N=120)

Gender	Number of Cases	Percentage (%)
Male	28	23.3

Female	92	76.7
Total	**120**	**100**

Table 3: Distribution of patients according to adequacy rates in cytology (N=120)

Cytology Adequacy	Number of Cases	Percentage (%)
Adequate smears	108	90.0
Inadequate / Nondiagnostic	12	10.0
Total	**120**	**100**

Table 4: Cytological diagnosis according to Bethesda System (TBSRTC) (N=108)

Bethesda Category	Cytological Diagnosis	Number of Cases	Percentage (%)
I	Nondiagnostic / Unsatisfactory	12	11.1
II	Benign	69	63.9
III	AUS / FLUS	8	7.4
IV	Follicular neoplasm / Suspicious for follicular neoplasm	9	8.3
V	Suspicious for malignancy	6	5.6
VI	Malignant	4	3.7
Total		**108**	**100**

Table 5: Distribution of thyroid lesions in cytology (N=108)

Bethesda Category	Diagnosis	Number of Cases	Percentage (%)
I	Nondiagnostic / Unsatisfactory	12	11.1
II	Nodular colloid goiter	40	37.0
	Diffuse colloid goiter	11	10.2
	Colloid nodule	9	8.3
	Multinodular goiter	5	4.6
	Subacute thyroiditis	4	3.7
	Hashimoto thyroiditis	6	5.6
	Lymphocytic thyroiditis	8	7.4
III	Atypia / FLUS	8	7.4
IV	Follicular neoplasm	7	6.5
	Hurthle cell neoplasm	2	1.9
V	Suspicious for papillary carcinoma	4	3.7
	Suspicious for medullary carcinoma	2	1.9
VI	Papillary thyroid carcinoma	3	2.8
	Medullary carcinoma	1	0.9
Total		**108**	**100**

DISCUSSION

The present study evaluated thyroid swellings using fine needle aspiration cytology and categorized the cytological findings according to the Bethesda System for Reporting Thyroid Cytopathology. A total of 120 patients with thyroid lesions were included in the study. The Bethesda system provides a standardized framework for reporting thyroid cytology and helps in stratifying lesions according to their risk of malignancy. The findings of the present study demonstrate that thyroid FNAC remains a valuable diagnostic tool for evaluating thyroid nodules and guiding clinical management.

In the present study, thyroid lesions were most commonly observed in patients belonging to the third and fourth decades of life. The highest proportion of cases occurred in the 31–40 year age group followed by the 41–50 year age group. This age distribution indicates that thyroid disorders are more common among young and middle-aged adults. Similar age patterns have been reported in other studies evaluating thyroid FNAC, where the majority of cases were observed in the third and fourth decades of life. This may be attributed to hormonal influences and increased awareness leading to earlier clinical evaluation of thyroid swellings [11].

A clear female predominance was observed in the present study, with females accounting for more than three-fourths of the total cases. The female-to-male ratio observed in this study reflects the well-recognized higher prevalence of thyroid disorders in females. Hormonal factors, autoimmune mechanisms, and genetic susceptibility have been suggested as possible explanations for the increased frequency of thyroid diseases in women. Previous studies have consistently reported a similar female predominance in thyroid cytology studies [12].

Adequacy of cytological smears is an important factor influencing the reliability of FNAC diagnosis. In the present study, adequate cytological material was obtained in the majority of cases, with only a small proportion of samples categorized as nondiagnostic. Adequate sampling

ensures accurate interpretation of cytological features and reduces the need for repeat aspirations. Previous studies have also demonstrated that proper aspiration technique and smear preparation significantly improve adequacy rates and diagnostic accuracy in thyroid FNAC [13]. The cytological classification of thyroid lesions according to the Bethesda system revealed that the benign category constituted the majority of cases in the present study. Nodular colloid goiter was the most common cytological diagnosis followed by inflammatory lesions such as lymphocytic thyroiditis and Hashimoto thyroiditis. This finding is consistent with the general observation that most thyroid nodules are benign in nature. FNAC plays an important role in identifying these benign lesions and preventing unnecessary surgical intervention [14].

The indeterminate categories including atypia of undetermined significance and follicular neoplasm were observed in a smaller proportion of cases. These categories present diagnostic challenges because cytological features may overlap between benign and malignant lesions. In such situations, repeat FNAC, clinical follow-up, or surgical excision may be required for definitive diagnosis. Studies evaluating the Bethesda system have emphasized that indeterminate categories represent a small but important proportion of thyroid FNAC diagnoses and require careful clinical correlation [15].

Malignant and suspicious for malignancy categories constituted a relatively small percentage of cases in the present study. Among malignant lesions, papillary thyroid carcinoma was the most commonly identified tumor. This observation is consistent with the known epidemiology of thyroid cancer, where papillary carcinoma represents the most frequent histological subtype. Early identification of malignant lesions through FNAC allows prompt surgical management and improves patient outcomes.

Overall, the results of the present study support the usefulness of the Bethesda System for Reporting Thyroid Cytopathology in routine clinical practice. The standardized diagnostic categories improve communication between clinicians and cytopathologists and facilitate appropriate clinical decision making. Thyroid FNAC interpreted using the Bethesda system provides reliable information regarding the nature of thyroid lesions and plays an important role in the evaluation and management of patients with thyroid nodules.

CONCLUSION

The present study demonstrates that fine needle aspiration cytology is a reliable, minimally invasive, and cost-effective diagnostic method for evaluating thyroid swellings. Application of the Bethesda System for Reporting Thyroid Cytopathology allows standardized classification of thyroid lesions and helps estimate the risk of malignancy associated with each category. The majority of thyroid lesions in the present study were benign, with nodular colloid goiter being the most common diagnosis. Female predominance and higher incidence in young and middle-aged individuals were also observed. The Bethesda system provides an effective framework for guiding clinical management and helps reduce unnecessary surgical procedures while ensuring timely treatment of malignant lesions.

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