Cyto-Pathological Evaluation of Thyroid Lesion by Fine Needle Aspiration Cytology (FNAC) and Their Correlation with TSH, T3, T4: A Study in Pakistani Patients

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ABSTRACT

Background: Thyroid lesions are frequently evaluated using fine-needle aspiration cytology (FNAC) and thyroid function tests (TFTs). However, the correlation between these diagnostic methods remains unclear.

Objective: To assess the correlation between FNAC findings and TFT profiles (TSH, T3, and T4) in thyroid lesion management in a Pakistani patient population.

Methods: This descriptive cross-sectional study included 120 patients (60 males, 60 females) from Indus Hospital, Multan. FNAC was performed on thyroid nodules, and serum T3, T4, and TSH levels were measured using the ELISA technique. FNAC results were classified according to the Bethesda System. Data were analyzed using SPSS version 25, with a significance level set at 0.05.

Results: Benign Follicular Nodule (BFN) was the most common FNAC diagnosis (51.3%), followed by Lymphocytic Thyroiditis (24.8%). Subclinical hypothyroidism was observed in 4.16% of LT cases, while primary hypothyroidism was most prevalent in LT cases (10.8%). No significant correlation was found between FNAC diagnoses and TFT profiles.

Conclusion: FNAC and TFTs should be used concurrently for comprehensive thyroid lesion management, as no significant correlation exists between these two diagnostic methods.

INTRODUCTION

Fine-needle aspiration cytology (FNAC) is a critical diagnostic tool for the evaluation of thyroid lesions, offering a minimally invasive approach to differentiate between benign and malignant nodules. FNAC involves the extraction of cellular material through a fine needle, followed by cytological analysis, which plays a pivotal role in guiding clinical management by distinguishing between reactive, inflammatory, and neoplastic processes that may or may not require surgical intervention (2)(3). The thyroid gland, an essential endocrine organ, comprises numerous follicles that produce the hormones triiodothyronine (T3) and thyroxine (T4), which are regulated by thyroid-stimulating hormone (TSH) secreted by the anterior pituitary gland. Thyroid function tests (TFTs), which measure T3, T4, and TSH levels, are integral in classifying thyroid lesions into categories such as hyperthyroid, euthyroid, and hypothyroid, each of which carries significant clinical implications (7). FNAC is particularly useful in evaluating palpable thyroid nodules and has been standardized through the Bethesda System for Reporting Thyroid Cytopathology (BSRTC), which categorizes thyroid lesions into six diagnostic categories based on specific cytological criteria (9). This system has become the gold standard for reporting FNAC results, providing consistency and clarity in communication among clinicians.

The incidence of thyroid dysfunction is notably higher in females, and the prevalence of thyroid lesions varies across different age groups, with certain age ranges being more susceptible to specific types of thyroid pathology (5). The Bethesda classification not only aids in the accurate diagnosis of thyroid lesions but also assists in determining appropriate management strategies, whether surgical or non-surgical (10). However, while FNAC provides valuable cytological insights, it is essential to correlate these findings with the patient's hormonal profile obtained through TFTs, as the combination of both tests can enhance diagnostic accuracy and aid in the comprehensive management of thyroid disorders. For instance, thyroid carcinomas are often associated with disturbed TFTs, underscoring the importance of performing TFTs before or in conjunction with FNAC to ensure a thorough evaluation (12).

The present study focuses on the cytological evaluation of thyroid lesions using FNAC, classified according to the Bethesda system, and examines their correlation with thyroid function tests, including T3, T4, and TSH levels. The study seeks to determine whether FNAC diagnosis and TFT results independently contribute to the effective management of thyroid lesions or whether they should be considered together to provide a more accurate clinical picture. The findings of this study are expected to shed light on the relationship between these two diagnostic modalities and offer insights into optimizing the management of thyroid disorders in the Pakistani population. By analyzing both FNAC and TFT results, this study aims to enhance our understanding of the diagnostic

and prognostic implications of thyroid lesions, ultimately contributing to improved patient outcomes.

Material and methods

A descriptive and cross-sectional study was conducted over a period of four months, from March 2023 to June 2023, to evaluate thyroid lesions using fine-needle aspiration cytology (FNAC) and correlate these findings with thyroid function tests (TFTs), including T3, T4, and TSH levels. The study involved a total of 120 patients, consisting of 60 males and 60 females, who presented with thyroid nodules at the Indus Hospital, Multan. Blood and biopsy samples were obtained from each participant and processed at the Departmental Clinical Laboratories, including Histopathology and Biochemistry, at the same institution.

Participants were divided into two groups: Group A, comprising 60 females of varying ages with known thyroid function test profiles, and Group B, comprising 60 males with similar profiles. The thyroid function tests were conducted using an enzyme-linked immunosorbent assay (ELISA) technique, specifically designed for the quantitative measurement of T3, T4, and TSH levels in human serum. The Qm Lab Read Well Strip Elisa reader was employed for this purpose, ensuring accurate and reliable assessment of thyroid hormone levels.

The fine-needle aspiration cytology (FNAC) procedure was performed by a qualified radiologist, who was responsible for obtaining the cellular material from the thyroid nodules. Before the procedure, a histotechnologist was called upon to prepare the slides for microscopic examination. The slides were stained using hematoxylin and eosin (H&E) staining techniques to facilitate detailed cytological analysis. FNAC results were then classified according to the Bethesda System for Reporting Thyroid Cytopathology, which provides a standardized approach to diagnosing and categorizing thyroid lesions (9).

Ethical approval for the study was obtained from the institutional review board of Indus Hospital, Multan, ensuring that the research adhered to the principles outlined in the Declaration of Helsinki. Informed consent was obtained from all participants prior to their inclusion in the study, and confidentiality of patient data was strictly maintained throughout the research process.

The collected data were analyzed using the Statistical Package for the Social Sciences (SPSS), version 25. Descriptive statistics were used to summarize the baseline demographic and clinical characteristics of the study participants, while inferential statistics were employed to assess the correlation between FNAC findings and thyroid function test results. The significance level was set at 0.05, and all tests were conducted with a two-tailed approach. Results were presented in the form of tables and figures to facilitate a clear and comprehensive understanding of the findings.

This study was designed to provide a detailed evaluation of thyroid lesions using FNAC, and to explore the relationship between cytological findings and thyroid hormone profiles. By adhering to rigorous methodological standards and ethical guidelines, the research aimed to contribute valuable insights into the management of thyroid disorders in the Pakistani population.

RESULTS

A total of 120 patients were included in the study, comprising an equal number of males and females. The baseline demographics and clinical features of the subjects are summarized in Table 1. The mean age across different age groups ranged from 10.57 years in the youngest group to 62.57 years in the oldest group, with the highest concentration of patients falling within the 21-30 and 31-40 age groups.

Table 1: Baseline Demographic and Clinical Features of Subjects

Age Group (years)	Mean ± SD	Number of Patients (%)
0-20	10.57 ± 6.34	1 (0.8%)
21-30	23.57 ± 5.34	13 (10.8%)
31-40	34.57 ± 6.34	13 (10.8%)
41-50	44.57 ± 6.34	12 (10%)
51-60	53.57 ± 3.81	8 (6.7%)
>60	62.57 ± 3.81	6 (5%)

Table 2: FNAC Diagnosis of Total Patients

FNAC Diagnosis	Number of Patients (%)
Non-Diagnostic	6 (5.0%)
Benign BFN	62 (51.3%)
Benign LT	29 (24.8%)
Benign SAT	6 (5.0%)
FN/SFN	8 (6.8%)
FN, HCT	1 (0.9%)
Suspicious of PTC	5 (4.3%)
Malignant of PTC	1 (0.9%)
Malignant ACT	1 (0.9%)
Benign others	1 (0.9%)

Subclinical hypothyroidism and primary hypothyroidism were further analyzed in relation to the FNAC diagnosis, as shown in Table 3. Primary hypothyroidism was most commonly observed in patients with Lymphocytic

Thyroiditis (10.8%) and Benign Follicular Nodules (5.83%). Subclinical hypothyroidism was also present in a notable proportion of patients with Benign Follicular Nodules (3.33%) and Lymphocytic Thyroiditis (4.16%). accounting for 24.8% of cases. Other less frequent diagnoses included Subacute Thyroiditis (SAT), Follicular Neoplasm (FN), and

Suspicious Papillary Thyroid Carcinoma (PTC) The FNAC diagnosis results for all patients are detailed in Table 2. Of the total 120 patients, 51.3% were diagnosed with Benign Follicular Nodules (BFN), making it the most prevalent thyroid lesion observed in this study. Lymphocytic Thyroiditis (LT) was the second most common diagnosis.

Table 3: Subclinical Hypothyroidism and Primary Hypothyroidism After FNAC Diagnosis

FNAC Diagnosis	Subclinical Hypothyroidism (%)	Primary Hypothyroidism (%)
Non-Diagnostic	1 (0.83%)	1 (0.83%)
Benign BFN	4 (3.33%)	7 (5.83%)
Benign LT	5 (4.16%)	13 (10.8%)
Benign SAT	0 (0.0%)	0 (0.0%)
FN/SFN	0 (0.0%)	0 (0.0%)
FN, HCT	0 (0.0%)	0 (0.0%)
Suspicious of PTC	1 (0.83%)	1 (0.83%)
Malignant of PTC	0 (0.0%)	0 (0.0%)
Malignant ACT	0 (0.0%)	0 (0.0%)
Benign others	1 (0.83%)	0 (0.0%)

The analysis of subclinical hyperthyroidism and primary hyperthyroidism after FNAC diagnosis is presented in Table 4. Primary hyperthyroidism was predominantly observed in

patients with Lymphocytic Thyroiditis (3.33%) and Benign Follicular Nodules (3.33%), with subclinical hyperthyroidism noted in a smaller subset of these groups.

Table 4: Subclinical Hyperthyroidism and Primary Hyperthyroidism after FNAC Diagnosis.

FNAC Diagnosis	Subclinical Hyperthyroidism (%)	Primary Hyperthyroidism (%)
Non-Diagnostic	1 (0.83%)	0 (0.0%)
Benign BFN	4 (3.33%)	4 (3.33%)
Benign LT	2 (1.66%)	4 (3.33%)
Benign SAT	0 (0.0%)	2 (1.66%)
FN/SFN	0 (0.0%)	2 (1.66%)
FN, HCT	0 (0.0%)	0 (0.0%)
Suspicious of PTC	1 (0.83%)	0 (0.0%)
Malignant of PTC	0 (0.0%)	0 (0.0%)
Malignant ACT	0 (0.0%)	0 (0.0%)
Benign others	0 (0.0%)	0 (0.0%)

Overall, the study revealed that while there is a clear pattern in the distribution of thyroid lesions diagnosed via FNAC, the correlation between these cytological findings and thyroid function test profiles remains complex. The most common thyroid lesion identified was Benign Follicular Nodule (BFN), with Lymphocytic Thyroiditis also being significant. The distribution of hypo- and hyperthyroid states across different FNAC diagnoses highlights the need for a combined approach in the evaluation and management of thyroid lesions.

DISCUSSION

The findings of this study provided significant insights into the evaluation and management of thyroid lesions through fine-needle aspiration cytology (FNAC) and thyroid function tests (TFTs). The most prevalent thyroid lesion identified in this cohort was Benign Follicular Nodule (BFN), followed by Lymphocytic Thyroiditis (LT), which is consistent with previous research that reported a higher incidence of benign lesions in thyroid evaluations using FNAC (5)(13). The distribution of lesions across different age groups, with the majority of cases occurring in individuals aged 20-50 years,

aligns with prior studies that have shown a similar age range as the most susceptible to thyroid disorders (15).

One of the strengths of this study was its comprehensive approach, which included both cytopathological and hormonal evaluations, allowing for a more nuanced understanding of thyroid lesion characteristics. The use of the Bethesda System for Reporting Thyroid Cytopathology (BSRTC) provided a standardized framework for categorizing thyroid nodules, thereby enhancing the reliability and comparability of the findings (9). The correlation of FNAC results with TFTs offered valuable insights into the functional status of thyroid lesions, though it became evident that these two diagnostic modalities should be interpreted together rather than in isolation. This reinforces the recommendations from previous studies that have highlighted the importance of integrating FNAC with TFTs for optimal clinical decision-making (12).

However, the study also had certain limitations that warrant consideration. The sample size, while sufficient for exploratory analysis, was relatively small, and the study was confined to a single center, which may limit the generalizability of the findings. The cross-sectional design also precluded the ability to assess the long-term outcomes

of patients based on their initial FNAC and TFT results, which is a significant limitation given the potential for changes in thyroid status over time. Additionally, the study did not account for potential confounding factors such as iodine intake, family history of thyroid disorders, or the presence of autoimmune conditions, which could have influenced both FNAC and TFT results.

The results demonstrated a lack of significant correlation between FNAC diagnoses and TFT profiles, particularly in cases of benign thyroid nodules, where the hormonal profiles often remained within normal ranges. This finding underscores the complexity of thyroid pathology and suggests that while FNAC is invaluable for distinguishing between benign and malignant lesions, it may not fully capture the functional status of the thyroid gland. This is particularly relevant in cases of subclinical thyroid disorders, where TFTs alone might not reflect the underlying cytological abnormalities detected by FNAC (7)(14).

In light of these observations, the study recommended that both FNAC and TFTs be employed concurrently in the evaluation of thyroid lesions to ensure a comprehensive assessment. This combined approach is particularly important in clinical scenarios where the cytological findings are ambiguous or when managing patients with borderline or subclinical thyroid dysfunction. Future research should aim to address the limitations of this study by incorporating larger, multi-center cohorts and by exploring the long-term implications of initial FNAC and TFT findings on patient outcomes. Furthermore, it would be beneficial to investigate the role of additional diagnostic tools, such as ultrasound elastography and molecular testing, in conjunction with FNAC and TFTs, to enhance the accuracy and predictive value of thyroid lesion assessments.

CONCLUSION

In conclusion, this study highlighted the importance of an integrated diagnostic approach in the management of thyroid lesions. While FNAC remains a cornerstone in the cytological evaluation of thyroid nodules, its findings should be interpreted alongside TFTs to provide a more comprehensive picture of thyroid health. The study's findings contribute to the growing body of evidence supporting the combined use of cytopathological and hormonal assessments in the diagnosis and management of thyroid disorders, particularly in a clinical setting where accurate and timely decision-making is crucial.

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