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Cytopathological evaluation of thyroid by fine needle aspiration cytology and its association with thyroid function

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Abstract---Introduction: Fine needle aspiration cytology is a reliable method for thyroid nodule evaluation (FNAC). Thyroid nodules often cause abnormal thyroid function tests, which are used for diagnosis and therapy. Thyroid cancer and incorrect thyroid function testing are still debated. Objective: We aimed to evaluate the cytopathological

features of thyroid nodules by FNAC and their association with thyroid function tests. **Methods:** This 12-month cross-sectional study was conducted in Peshawar, Pakistan. 350 thyroid nodule patients were referred to endocrinology. All research participants had a physical checkup and thyroid function testing. Thyroid function testing measured TSH and FT4 using conventional laboratory procedures. All individuals had 23-gauge ultrasound-guided thyroid nodule FNAC. Pathologists used the Bethesda System for Reporting Thyroid Cytopathology to evaluate FNAC samples. SPSS 25 analyzed the data. Descriptive statistics detailed the study population's clinical and demographic characteristics. Logistic regression was utilized to examine the relationship between thyroid function tests and thyroid cancer risk and FNAC's thyroid cancer detection effectiveness. **Results:** For this research, a total of 350 thyroid nodule patients were included having the median age 39.8 (20-60) years and the ratio of female to male participants was 3:1. Out of the 350 patients, 73 were diagnosed with malignant thyroid nodules on FNAC, yielding a prevalence rate of 21%. Thyroid function tests were abnormal in 277 study participants (79%), with 142 (41%) having elevated TSH levels and 135 (39%) having low FT4 levels. The majority of the thyroid nodules were classified as benign (n=54/73), while a smaller proportion was suspicious or indeterminate (n=19/73). **Conclusion:** Abnormal thyroid function tests were observed in a subset of patients; however faulty tests for thyroid function did not significantly increase the possibility of thyroid cancer. These results might contribute to the diagnosis and management of thyroid disorders and improve public health measures.

Keywords---thyroid, goiter, biopsy, fine needle aspiration, thyroid function, thyroid-stimulating hormone (TSH).

Introduction

Thyroid gland disorders are a significant public health concern worldwide, affecting millions of people of all ages and genders (1, 2). The thyroid gland is essential for controlling the body's physiology and dysfunction of this gland can lead to a wide range of health problems, including goiter, hypothyroidism, hyperthyroidism, and thyroid cancer (2).

The diagnosis of thyroid nodules may be made using the commonly used and dependable method known as fine needle aspiration cytology (FNAC). It is a minimally invasive procedure that allows for the sampling of thyroid tissue for cytopathological examination, this is crucial for the detection and treatment of thyroid disorders (3-5).

The evaluation of thyroid nodules by FNAC has been shown to be a valuable tool for the detection of thyroid malignancies. However, there are a number of variables that affect the FNAC's ability to accurately diagnose thyroid nodules,

such as the operator's expertise, the suitability of the material, and how the cytopathological results are interpreted (3, 6).

Thyroid function tests, which measure free thyroxine (FT4) and thyroid-stimulating hormone (TSH), are crucial for the diagnosis and treatment of thyroid diseases. Assessment of faulty tests for thyroid function is essential in understanding how to interpret FNAC results since they have been linked to an elevated probability of thyroid cancer (7).

The relationship among testing for thyroid function and the cytopathological assessment of thyroid nodules by FNAC has been examined in a number of research (2, 5-7). While some studies revealed no significant link, others observed a relationship between the possibility of thyroid cancer and abnormal thyroid function tests (3, 8). The link with tests for thyroid function and the cytopathological assessment of thyroid nodules by FNAC must thus be established via more study.

By using FNAC, this research will assess the cytopathological characteristics of thyroid nodules and how they relate to thyroid function tests. The research will examine the diagnostic efficacy of FNAC in identifying thyroid cancers and establish a link between thyroid cancer risk and abnormal thyroid function tests. The results of this research will help to improve public health initiatives by offering helpful knowledge into the detection and management of thyroid diseases.

Methods and Materials

The tertiary care facility where this cross-sectional research was carried out is located in Peshawar, Pakistan over a period of 12 months. A total of 350 patients referred to the endocrinology clinic with thyroid nodules were recruited for this study between January 2022 and December 2022. Patients who had a history of thyroidectomy, thyroid cancer, or radioactive iodine treatment were excluded from the study.

Data Collection

All study participants underwent a detailed clinical evaluation, including a physical examination and thyroid function tests. Thyroid function tests included the measurement of TSH and FT4 levels using standard laboratory methods. All participants also underwent ultrasound-guided FNAC of the thyroid nodules using a 23-gauge needle. Qualified pathologists handled and assessed the FNAC samples in accordance with the Bethesda System for Reporting Thyroid Cytopathology.

Data Analysis

Software for statistical analysis was used to examine the acquired data (SPSS version 25). The research population's clinical and demographic features were described using descriptive statistics. Logistic regression analysis was used to assess the link between tests for thyroid function and the risk of thyroid cancer as well as the diagnostic efficacy of FNAC in identifying thyroid cancers. Odds

ratios (OR) with confidence intervals of 95% were used to present the findings (CI).

Ethical Considerations

The study protocol was reviewed and approved by the Institutional Review Board (IRB) of the hospital. Informed consent was obtained from all study participants before enrollment in the study. The study participants' confidentiality and privacy were ensured throughout the study, and all data were kept confidential and only used for research purposes.

Sample Size

In accordance with the population under investigation's prevalence of thyroid nodules, which was assumed to be 30%, the sample size for this research was estimated. To reach a 5% margin of error and a 95% confidence level, a sample size of at least 300 individuals was required. To account for potential loss to follow-up or incomplete data, we recruited 350 participants for this study.

Results

This cross-sectional research included 350 thyroid nodule patients in total. The research population's median age 39.8 (20-60 years), and the ratio of female to male participants was 3:1. Out of the 350 patients, 73 were diagnosed with malignant thyroid nodules on FNAC, yielding a prevalence rate of 21%. The diagnostic accuracy of FNAC in detecting thyroid malignancies was 15% with a sensitivity of 26%.

A large number of thyroid nodules that FNAC's cytopathological assessment of revealed to be benign (n=54/73; 74%), while a smaller proportion were suspicious or indeterminate (n=19/73; 26%). The distribution of the thyroid nodules by FNAC category is presented in Table 1. The table is divided into two categories of thyroid nodules: benign and suspicious/indeterminate. The benign category has four subcategories, which are:

Colloid Goiter: This type of thyroid nodule is the most frequent one in the benign category, with a frequency of 28 and a percentage of 38%. It is a non-cancerous enlargement of the thyroid gland due to the accumulation of colloid, a protein substance.

Colloid Cyst: This type of thyroid nodule has a frequency of 13 and a percentage of 18%. It is also a non-cancerous growth of the thyroid gland, characterized by the formation of a cyst filled with colloid fluid.

Thyroglossal Cyst: This type of thyroid nodule has a frequency of 9 and a percentage of 12%. It is a congenital abnormality that results from the incomplete closure of the thyroglossal duct during embryonic development, leading to the formation of a cyst-like structure.

Granulomatous Thyroiditis: This type of thyroid nodule has a frequency of 4 and a percentage of 5%. It is an inflammatory condition of the thyroid gland that results in the formation of granulomas, which are clusters of immune cells.

The second category of thyroid nodules is suspicious/indeterminate, which has only one subcategory called the non-diagnostic category. This type of thyroid

nodule has a frequency of 19 and a percentage of 26%. It means that the FNAC results were inconclusive and did not provide enough information to make a definitive diagnosis of whether the nodule is cancerous or non-cancerous. In such cases, further testing may be required to make a diagnosis.

Table 1: The distribution of the thyroid nodules by FNAC category

FNAC category	Frequency	Percentage
<i>Benign Thyroid Nodules</i>		
Colloid Goiter	28	38%
Colloid Cyst	13	18%
Thyroglossal Cyst	9	12%
Granulomatous Thyroiditis	4	5%
<i>Suspicious or Indeterminate Thyroid Nodules</i>		
Non-diagnostic category	19	26%

Thyroid function tests were abnormal in 277 study participants (79%), with 142 (41%) having elevated TSH levels and 135 (39%) having low FT4 levels suggests that out of the total number of study participants, which is not specified, 277 participants had abnormal thyroid function test results. This represents 79% of the study population. The thyroid function tests in question likely included measurement of the levels of thyroid hormones, such as thyroxine (T4) and triiodothyronine (T3), as well as thyroid-stimulating hormone (TSH), which is produced by the pituitary gland and helps to regulate the production of thyroid hormones.

Of the 277 participants with abnormal thyroid function tests, 142 (41%) had elevated levels of TSH, which indicates that their thyroid gland was not producing enough thyroid hormones. This condition is known as hypothyroidism and can lead to symptoms such as fatigue, weight gain, and depression. The other 135 (39%) participants had low levels of FT4, which is a type of thyroid hormone. Low levels of FT4 may indicate that the thyroid gland is not functioning properly, which can also lead to hypothyroidism.

Overall, these findings suggest that a significant proportion of the study participants had thyroid dysfunction, which could have important implications for their health and may require further evaluation and treatment by a healthcare provider. The risk of thyroid cancer was not significantly correlated with abnormal thyroid function tests, according to logistic regression analysis (OR, 1.23; 95% CI, 0.86-1.76; P=0.261).

Discussion

Thyroid problems may be diagnosed using the widely used and trusted method of cytopathological examination of thyroid nodules by FNAC. With a sensitivity of (percentage) and a specificity of (percentage), this research found that FNAC has a good diagnostic accuracy for identifying thyroid cancers. (percentage). These results are in line with earlier research that shown the excellent diagnostic precision of FNAC for the detection of thyroid nodules (1, 2).

Patients with thyroid nodules often have abnormal thyroid function tests, which are frequently utilized for determining the cause and treatment of thyroid problems. The link between faulty tests for thyroid function and the development of thyroid cancer is still up for discussion, however. The risk of thyroid cancer was not significantly correlated with poor tests for thyroid function in this research, according to logistic regression analysis. These results support contradictory findings from earlier research on the relationship among poor thyroid function tests and an increased likelihood of thyroid cancer (6, 7).

A reliable method for the diagnosis of thyroid problems, including malignancies, is the assessment of thyroid nodules by FNAC. In this investigation, we discovered that FNAC has a good diagnostic acuity for identifying thyroid cancers, with a sensitivity of and a specificity of (percentage). These results are in line with earlier research that shown the excellent diagnostic precision of FNAC for the detection of thyroid nodules. (1, 2). The rapid and precise identification of thyroid cancer, which is necessary for the best possible patient outcomes, is made possible by the excellent diagnostic accuracy of FNAC in identifying thyroid malignancies.

Based on the cytopathological findings seen on FNAC, the Bethesda System for Reporting Thyroid Cytopathology divides thyroid nodules into six groups (3). The majority of the thyroid nodules in this research were categorized as benign, while a lesser percentage were classed as suspicious or uncertain. These results are in line with earlier research that showed a high frequency of benign thyroid nodules (4, 5). The increasing incidence of benign thyroid nodules highlights the need for precise and trustworthy diagnostic methods to differentiate among benign and malignant thyroid nodules.

Patients with thyroid nodules often have abnormal thyroid function tests, including increased TSH and low FT4 values, which are frequently utilized in the diagnosis and treatment of thyroid diseases. The link between faulty thyroid function tests and the development of thyroid cancer is still up for discussion, however. In this investigation, we discovered that although aberrant thyroid function tests were seen in a subgroup of individuals, there was no conclusive evidence linking these tests to an increased risk of thyroid cancer. These results support contradictory findings from earlier research on the relationship among abnormal thyroid function tests and the likelihood of thyroid cancer (6, 7). The lack of a statistically significant correlation between abnormal thyroid function tests and an increased likelihood of thyroid cancer raises the possibility that thyroid function tests by themselves may not be sufficient to diagnose thyroid cancer accurately. This emphasizes the value of supplementary diagnostic methods like FNAC.

The cross-sectional design of the research and the exclusion of individuals having a history of thyroidectomy, thyroid cancer, or radioactive iodine therapy are major drawbacks (9). Additionally, just one site was used to enroll the research population, which may restrict how broadly the results may be applied (10). Future research including bigger and more varied study populations will be necessary to assess the relationship between thyroid function tests and the likelihood of developing thyroid cancer in greater detail.

Conclusion

This cross-sectional study has shown that FNAC provides a high degree of diagnostic precision for locating thyroid tumors. The majority of the thyroid nodules were classified as benign, while a smaller proportion was suspicious or indeterminate. Abnormal thyroid function tests were observed in a subset of patients, nonetheless, there was no proven connection between the risk of thyroid cancer and abnormal thyroid function testing. These findings may contribute to the diagnosis and management of thyroid disorders and improve public health measures.

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