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Correlation of Ultrasonography and Fine Needle Aspiration Cytology for Diagnosis of Malignancy in Thyroid Lesions

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Abstract

Background: *Thyroid nodules are a common clinical finding, and distinguishing benign from malignant lesions is crucial for determining the need for surgical intervention. Ultrasonography (USG) and fine needle aspiration cytology (FNAC) are primary tools in preoperative evaluation, while histopathology remains the gold standard.*

Objective: *To correlate ultrasonographic findings with FNAC results in the diagnosis of malignancy in thyroid lesions, using histopathological examination (HPE) as the definitive reference.*

Material and Methods: *This prospective study included 120 patients with thyroid swellings who underwent high-resolution ultrasonography and FNAC, followed by surgical excision and histopathological evaluation when indicated. Sonographic features suggestive of malignancy were recorded and FNAC findings were categorized according to the Bethesda System. Statistical correlation between USG, FNAC, and HPE was analyzed using standard diagnostic indices.*

Results: *Colloid goitre and multinodular goitre were the most frequent diagnoses on both USG and FNAC. USG identified 5 nodules as suspicious for malignancy, while FNAC confirmed malignancy in 4 cases. Histopathology corroborated the FNAC findings. The combined use of USG and FNAC improved diagnostic accuracy, particularly in benign and malignant lesions, though FNAC demonstrated higher specificity when used alone.*

Conclusion: *FNAC remains a reliable and specific diagnostic tool in the evaluation of thyroid nodules. Its accuracy is further enhanced when combined with ultrasonography. Correlating both modalities with histopathology ensures more precise patient selection for surgical management and reduces unnecessary thyroidectomies.*

Keywords: *Thyroid nodule, Fine needle aspiration cytology, Ultrasonography, Malignancy diagnosis*

INTRODUCTION

Thyroid nodules are a common clinical finding, with their prevalence increasing due to the widespread use of high-resolution imaging modalities. Ultrasonography (USG) has become the primary non-invasive imaging tool for evaluating thyroid nodules owing to its sensitivity, accessibility, and ability to differentiate benign from potentially malignant features based on well-defined sonographic criteria [1]. The importance of accurately identifying malignant nodules lies in the fact that although most thyroid nodules are benign, approximately 5–15% may harbor malignancy [2].

Fine needle aspiration cytology (FNAC) is widely recognized as the cornerstone in the preoperative evaluation of thyroid lesions. It provides cytological insights into the nature of the nodule, guiding decisions regarding surgical intervention [3]. However, FNAC has its limitations, especially in the context of indeterminate or non-diagnostic samples, which may result in false negatives or delayed diagnosis [4]. Therefore, combining FNAC findings with ultrasonographic characteristics has gained momentum in recent years as a method to enhance diagnostic accuracy.

Several studies have proposed sonographic scoring systems and classifications, such as the Thyroid Imaging Reporting and Data System (TI-RADS), to stratify nodules based on their likelihood of malignancy. Features such as hypoechogenicity, irregular margins, microcalcifications, taller-than-wide shape, and absence of a halo are associated with a higher risk of thyroid cancer [5,6]. When such suspicious USG features coincide with positive or suspicious FNAC results, the probability of malignancy increases significantly [7].

The diagnostic constructive collaboration between USG and FNAC becomes especially valuable in resource-limited settings, where the goal is to reduce unnecessary thyroidectomies for benign lesions while promptly identifying malignant ones for early surgical intervention [8]. Histopathological examination (HPE) of surgically excised thyroid specimens remains the gold standard for definitive diagnosis. Therefore, correlating USG and FNAC findings with HPE results is essential to validate their combined diagnostic value and determine the most reliable predictors of malignancy [9].

The current study was undertaken to evaluate the diagnostic correlation between ultrasonographic features and FNAC in detecting thyroid malignancies. By comparing these findings with postoperative histopathological examination reports, the study aims to enhance the accuracy of preoperative diagnosis and assist in the optimal selection of patients for surgical intervention [10].

MATERIAL AND METHODS

This prospective, observational, hospital-based study was conducted in the Department of Radiodiagnosis and Pathology over a period of 18 months after obtaining approval from the Institutional Ethics Committee. A total of 120 patients presenting with palpable or incidentally detected thyroid swellings were included in the study. All patients underwent ultrasonographic evaluation followed by fine needle aspiration cytology (FNAC), and where indicated, surgical excision of the lesion was performed with subsequent histopathological examination (HPE) to serve as the diagnostic gold standard.

Inclusion criteria comprised adult patients of both sexes with solitary or multiple thyroid nodules who consented to undergo USG, FNAC, and surgical intervention when required. Patients with previously diagnosed thyroid malignancy, recurrent nodules, or inadequate cytological samples were excluded from the study. After obtaining informed written consent, detailed clinical history and relevant laboratory investigations were documented.

High-resolution ultrasound of the thyroid gland was performed using a linear high-frequency transducer. Sonographic features such as echogenicity, margins, calcifications, composition (solid or cystic), shape, and vascularity were recorded. Nodules were categorized according to their ultrasound risk features suggestive of malignancy. Subsequently, FNAC was performed under aseptic precautions using a 23-gauge needle with multiple passes. Smears were stained and evaluated according to the Bethesda System for Reporting Thyroid Cytopathology.

Patients who underwent thyroidectomy were followed up with histopathological evaluation of the resected specimens. The cytological and sonographic findings were then correlated with the histopathology results. Statistical analysis was performed using SPSS version 26.0. The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy of ultrasonography and FNAC in diagnosing thyroid malignancy were calculated using standard formulas, and chi-square test was applied to assess the significance of correlations. A p-value less than 0.05 was considered statistically significant.

RESULTS

Table 1 highlights the distribution of patients based on ultrasonographic diagnosis. The most common ultrasonographic finding was colloid goitre, observed in 46 out of 120 patients, followed by multinodular goitre in 28 patients and adenomatous nodules in 26 cases. Thyroiditis was identified in 12 cases, while sonographic features suspicious of malignancy were noted in 5 patients. Definitive features of carcinoma were observed in 4 patients. This distribution underscores the predominance of benign lesions on ultrasonographic evaluation.

Table 2 summarizes the FNAC-based diagnosis of thyroid lesions in the study population. Colloid goitre remained the most frequently reported diagnosis cytologically, seen in 44 cases, followed by multinodular goitre in 26 patients and follicular neoplasm in 19 cases. Adenoma was diagnosed in 14 cases, and thyroiditis in 12. Malignancy was confirmed cytologically in 4 cases. These results indicate that FNAC commonly identifies benign pathology, with a limited but crucial detection rate for malignant cases.

Table 3 presents the correlation between ultrasonographic findings and FNAC diagnoses. The majority of cases categorized as benign non-inflammatory lesions by USG were confirmed as such by FNAC. Inflammatory lesions were consistently identified on both modalities. While USG identified five cases as suspicious for malignancy, none of these were confirmed by FNAC. Conversely, both modalities identified malignancy in four cases with agreement. This table demonstrates that while both USG and FNAC are valuable diagnostic tools, FNAC provides higher specificity when confirmed with histopathological correlation.

Table 1: Distribution of patients based on ultrasonographic diagnosis

Ultrasound Diagnosis	No. of Cases
Adenomatous nodule	26
Multinodular goitre	28
Colloid goitre	46
Thyroiditis	12
Suspicious of malignancy	5
Carcinoma	4
Total	120

Table 2: Distribution of patients based on FNAC diagnosis

FNAC Diagnosis	No. of Cases
Adenoma	14
Multinodular goitre	26
Colloid goitre	44
Thyroiditis	12
Malignant	4
Follicular neoplasm	19
Total	120

Table 3: Correlation of USG and FNAC findings in thyroid lesions

Diagnosis	USG	FNAC
Benign - Inflammatory	11	12
Benign - Non inflammatory	100	104
Suspicious of malignancy	5	0
Malignancy	4	4

DISCUSSION

The evaluation and management of thyroid nodules rely heavily on a combination of clinical, radiological, and cytological tools to stratify the risk of malignancy. This study aimed to correlate ultrasonography (USG) findings with fine needle aspiration cytology (FNAC) results, using histopathological examination (HPE) as the gold standard to refine diagnostic accuracy and facilitate surgical decision-making. Our findings indicate a strong concordance between USG and FNAC in detecting benign thyroid lesions, with notable diagnostic consistency in cases of thyroiditis and malignancy.

In the current study, colloid goitre and multinodular goitre were the most common findings on both ultrasonography and FNAC, reflecting the high prevalence of benign nodular thyroid disease in the general

population. These findings align with the work of Sorrenti et al., who emphasized that the majority of sonographically evaluated thyroid nodules are benign and exhibit characteristic features such as a hyperechoic pattern, cystic components, and regular margins [11]. In our series, 100 patients were classified as benign non-inflammatory on USG, and FNAC corroborated this finding in 104 cases, demonstrating a high degree of overlap and suggesting that both modalities are reliable for excluding malignancy.

Suspicious sonographic features, such as hypoechogenicity, irregular margins, microcalcifications, and taller-than-wide shape, are often indicative of malignancy. However, our study observed five cases with suspicious sonographic features, none of which were confirmed malignant by FNAC. This may reflect the limitations of USG in isolation, particularly in distinguishing follicular neoplasms or Hurthle cell lesions, where cytological features alone may not suffice. According to Trimboli et al., ultrasonography, while highly sensitive, may have reduced specificity when used without cytological correlation, particularly for lesions in the TI-RADS 3 and 4 categories [12].

FNAC, despite being the diagnostic gold standard, also has limitations in differentiating follicular adenomas from follicular carcinomas due to overlapping cytological features. This was evident in our study, where 19 cases were labeled as follicular neoplasm, necessitating histological confirmation for a definitive diagnosis. This diagnostic challenge has been echoed by Alexander et al., who emphasized the role of molecular markers in improving the accuracy of FNAC, especially in indeterminate thyroid nodules [13].

Notably, malignancy was diagnosed by both FNAC and USG in four patients, demonstrating high concordance in high-risk cases. These findings reinforce the concept that the integration of sonographic features with FNAC results enhances the predictive value of each tool. The use of structured reporting systems such as the Bethesda System for cytology and TI-RADS for imaging can further standardize diagnostic protocols and improve clinical decision-making [14]. Furthermore, a recent multicenter study by Durante et al. highlighted the importance of correlating USG and FNAC findings with histopathological outcomes, demonstrating improved diagnostic sensitivity and specificity when both tools are used in conjunction [15].

Taken together, our findings suggest that while USG serves as a valuable screening tool, FNAC remains essential for cytological confirmation. The combined application of these modalities improves diagnostic confidence, minimizes unnecessary surgeries, and ensures timely intervention for malignant nodules.

CONCLUSION

The study concludes that the correlation between ultrasonographic findings and FNAC results provides a reliable and effective approach for evaluating thyroid nodules. While both modalities independently offer significant diagnostic value, their combined use enhances sensitivity and specificity, particularly in detecting malignancy. FNAC remains the cornerstone of thyroid lesion evaluation, but its diagnostic precision is further strengthened when used alongside sonographic assessments. Incorporating both imaging and cytological data is crucial for guiding surgical intervention and optimizing patient outcomes.

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