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Original Research Article

A STUDY ON ASSESSMENT OF MALIGNANT POTENTIAL OF THRYOID NODULES USING ULTRASOUND EXAMINATION AND TIRADS SCORING SYSTEM

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ABSTRACT

Background: The thyroid gland plays a crucial role in metabolism regulation, and in India, with thyroid disorders being the second most common endocrine disorder early detection of malignancy potential is crucial. This study aims to categorize thyroid nodules using the Thyroid Imaging Reporting and Data System (TIRADS) and correlate ultrasound features with pathological findings to assess malignancy risk.

Materials and Methods: This prospective study, conducted from April 2023 to March 2024, analyzed 100 thyroid nodules using ultrasonography and fine needle aspiration cytology (FNAC) to assess malignancy risk. Statistical analysis was performed to evaluate the sensitivity, specificity, and predictive value of ultrasound features, with nodules classified using the Thyroid Imaging Reporting and Data System (TIRADS).

Results: Most of the patients being female and aged between 20-40 years. The majority of nodules were benign, with characteristics such as wider-than-taller shape, iso- or hyperechogenicity, mixed content, and smooth margins indicating a lower risk of malignancy, while taller-than-wider shape, marked hypoechogenicity, microcalcifications, and microlobulated margins were strongly associated with malignancy.

Conclusion: Ultrasound examination is highly effective in assessing the malignant potential of thyroid nodules by identifying key features such as nodule shape, echogenicity, calcifications, and margins. It provides a non-invasive, real-time evaluation that significantly aids in distinguishing between benign and malignant nodules, often guiding the need for further diagnostic procedures.

Keywords: Thyroid lesions; malignancy; ultrasound examination; TIRADS scoring system.

INTRODUCTION

The thyroid gland, located in the neck, is pivotal in regulating metabolism through the secretion of hormones such as tri-iodothyronine (T3) and thyroxine (T4). In India, thyroid disorders are widespread, affecting approximately 42 million people, with iodine deficiency and autoimmune diseases being significant contributors.

The role of ultrasonography (USG) in evaluating thyroid swellings is critical due to its non-invasive nature, safety, and effectiveness. USG allows for real-time imaging of the thyroid gland, enabling the assessment of nodules' size, shape, composition, and vascularity without exposing patients to ionizing radiation. High-resolution ultrasound can identify key characteristics of thyroid nodules that may indicate malignancy, such as irregular margins, hypoechogenicity, and microcalcifications.[1,2] These features are essential for differentiating between benign and malignant nodules.

The Thyroid Imaging Reporting and Data System (TIRADS) further standardizes the evaluation

process by categorizing nodules based on ultrasound characteristics into five levels of suspicion for malignancy.[3] This system assists clinicians in deciding whether to monitor a nodule or proceed with a fine needle aspiration biopsy (FNAC).[4]

TIRADS criteria emphasize specific ultrasound features that correlate with malignancy risk, such as the presence of micro-calcifications and hypoechoic texture.[4,5] As the incidence of thyroid disorders continues to rise in India, there is an urgent need for comprehensive studies evaluating thyroid swellings based on TIRADS.

This study aims to classify thyroid nodules into the Thyroid Imaging Reporting and Data System (TIRADS) categories based on suspicious ultrasound features, and to compare these features with pathological findings to analyze their risk of malignancy.

MATERIALS AND METHODS

This prospective study was conducted from April 2023 to March 2024 at SVS Medical College and Hospital. Patients above 18 years of age with thyroid-related symptoms who were referred for thyroid ultrasonography were included. Patients with secondary thyroid disorders, systemic or CNS involvement, pregnant women, psychiatric patients, and those unwilling to undergo FNAC or give consent were excluded.

A total of 100 thyroid nodules were analyzed, of which 75 underwent fine needle aspiration cytology (FNAC), and 25 were surgically excised for further examination.

Primary data such patient demographics and clinical history was collected from patients during their ultrasound evaluations. Patients were selected based on clinical histories and the application of inclusion and exclusion criteria.

High-resolution ultrasonography was performed to evaluate thyroid nodules for features such as shape, echogenicity, content, calcification, and margins. Nodules were classified using the Thyroid Imaging Reporting and Data System (TIRADS). Suspicious nodules identified on ultrasound were further evaluated by FNAC. The procedure was performed under aseptic conditions using a 23-gauge needle, and samples were fixed in isopropyl alcohol for cytological analysis. FNAC results were compared with ultrasound findings. If FNAC results were indeterminate, surgical excision and histopathological analysis were performed. The association between ultrasound features and malignancy risk was evaluated using TIRADS categories.

Statistical analysis was conducted using EPI INFO version 7 to assess the sensitivity, specificity, and predictive values of ultrasound features in differentiating between benign and malignant nodules.

RESULTS

A total of 100 patients with primary thyroid-related complaints were analyzed using ultrasonography and fine needle aspiration cytology (FNAC) to evaluate thyroid nodules.

The mean age of patients was 43.5 years with females: males ratio of 4:1. Most of the patients belonged to the age group of 20-40 years (67%).

Key ultrasound features such as shape, echogenicity, content, calcification, and margins were assessed, and the results are as follows

The shape of the nodules reveals that 95% were wider-than-taller, of which 85 (94.1%) were benign, while the remaining 10 (5.9%) were malignant. All 5 nodules that were taller-than-wider were malignant (100%). [Table 1]

75 nodules were either iso- or hyperechogenic, and all of these were benign (100%). Among the 15 hypoechogenic nodules, 10 (66.7%) were benign, while 5 (33.3%) were malignant. All 10 nodules with marked hypoechogenicity were malignant (100%).

51 nodules were solid, of which 43 (84.3%) were benign, and 8 (15.7%) were malignant. All 49 mixed-content nodules were benign (100%). Nodules without calcification had a 97.7% benign rate. Nodules with macrocalcification were 100% benign, whereas nodules with micro-calcification had a malignancy rate of 62.5%.

70 nodules with smooth margins were mostly benign, with 68 (98.6%) benign and only 2 (1.4%) malignant. In contrast, nodules with irregular margins had a higher malignancy rate of 23.1%. All 4 nodules with micro-lobulated margins were malignant.

Most of the nodules belonged to TIRADS 3 category (70%) of which 97.14% were benign and only 2.8% were malignant. Next most common category was TIRADS 4b (20%), of which 85% were benign and 15% were malignant. [Table 3]

Table 1: Characteristic of the nodule

Characteristic of the nodule		Total	Benign	Malignant
Shape	Wider than taller	95	85 (94.1%)	10 (5.9%)
	Taller than wider	5	0	5 (100%)
Echogenicity	Iso /Hyper-echogenic	75	75 (100%)	0
	Hypo-echogenic	15	10 (66.7%)	5 (33.3%)
	Marked hypo-echogenic	10	0	10 (100%)
Content	Solid	51	43 (84.3%)	8 (15.7%)
	Mixed	49	49 (100%)	0
Calcification	No calcification	76	72 (97.7%)	4 (2.3%)
	Macro-calcification	8	8 (100%)	0
	Micro-calcification	16	6 (37.5%)	10 (62.5%)

Margins	Smooth margins	70	68 (98.6%)	2 (1.4%)
	Irregular margins	26	20 (76.9%)	6 (23.1%)
	Micro-lobulated margins	4	0	4 (100%)

Table 2: TIRADS classification

TIRADS classification	total	benign	malignant
3	70	68 (97.14%)	2 (2.8%)
4a	6	5 (83.3%)	1 (16.7%)
4b	20	17 (85%)	3 (15%)
5	4	0	4 (100%)

DISCUSSION

Thyroid nodules are very common, with about 5-10% of adults having palpable nodules and up to 70% having nodules detected on ultrasound. The vast majority of these nodules are benign, non-cancerous growths. However, a small percentage (about 5-15%) of thyroid nodules is malignant. Ultrasound is the primary imaging modality used to evaluate thyroid nodules, as it can detect the presence, size, and characteristics of nodules.

In the current study, 100 patients with primary thyroid-related complaints were assessed through ultrasonography and fine needle aspiration cytology (FNAC) to evaluate thyroid nodules. The study focused on key ultrasound characteristics such as shape, echogenicity, content, calcification, margins, and TIRADS classification to determine the risk of malignancy.

One of the key observations was that nodules with a taller-than-wider shape were associated with a 100% malignancy rate, similar to the findings of Moifo et al.9 who also reported an odds ratio of 19.5 for malignancy in taller-than-wider nodules. The current study found a nearly identical odds ratio of 19.4, affirming that this sonographic feature remains a strong predictor of thyroid malignancy. Kwak et al.10 also highlighted the predictive value of taller-than-wider nodules, with their study reporting an even higher odds ratio of 24.478.

In this study, nodules with marked hypoechogenicity had a malignancy risk with an odds ratio of 47. This is significantly higher than the 12.75 odds ratio reported by Moifo et al,[9] This variation could be attributed to factors such as inter-observer variation in assessing hypoechogenicity or differences in patient demographics and nodule characteristics. Kwak et al,[10] also found an increased malignancy risk associated with marked hypoechogenicity, reporting an odds ratio of 69.756, which underscores its critical role in malignancy prediction.

Nodules with irregular margins had a malignancy rate of 23.1%, while those with microlobulated margins were 100% malignant. These results align with Moifo et al,[9] who found that irregular margins were a strong predictor of malignancy with an odds ratio of 22.4. However, the current study reported a lower odds ratio for irregular margins (1.71), suggesting some variation, potentially due to differences in imaging interpretation. Kwak et al. further emphasized the predictive value of irregular and microlobulated margins, with odds ratios of 113.828 and 20.135, respectively, again reinforcing their association with malignancy.

In this study 62.5% of nodules had microcalcifications being malignant. The odds ratio for malignancy in nodules with microcalcifications was 20.35, which is higher than the 15.24 reported by Moifo et al,[9] Kwak et al,[10] also highlighted microcalcifications as a strong indicator of malignancy, reporting an odds ratio of 25.871.

The TIRADS classification system used in this study also provided valuable insight into the risk of malignancy. Most nodules (70%) fell into TIRADS category 3, which had a malignancy rate of only 2.8%, similar to the findings of Horvath et al,[11] who reported less than 5% malignancy risk in this category. However, the malignancy risk in TIRADS category 4a was slightly higher in the present study (16.7%) compared to Moifo et al,[9]'s 5.9%. This could be due to inter-observer variability in assessing the margins of the nodules or differences in the patient population. The findings for TIRADS 4b and TIRADS 5 were more consistent with previous studies, with the latter showing a 100% malignancy risk, as both Moifo et al,[9] and Horvath et al,[11] also reported.

CONCLUSION

The study concludes that specific ultrasound features, such as irregular margins, hypo-echogenicity, micro-calcifications, and increased vascularity, are associated with a higher risk of malignancy. These features can help guide clinicians on whether to perform a fine needle aspiration biopsy to further evaluate a suspicious nodule.

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