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Original Article

Comparison of Thyroid Imaging, Reporting and Data System (TI-RADS) classification with Fine Needle Aspiration Cytology (FNAC) for the Diagnosis of Thyroid Nodules

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ABSTRACT

Objective: To assess how effective the TI-RADS (Thyroid Imaging Reporting and Data System) classification system is in categorizing thyroid nodules compared to fine needle aspiration.
Study Design: Cross-sectional study
Place and Duration of Study: Armed Forces Institute of Radiology & Imaging, PEMH Rawalpindi, Pakistan, from Feb to Aug 2023.
Methodology: A total of 130 male and female patients who presented with thyroid nodules were enrolled. High-frequency linear probes were used for ultrasonography of the neck /thyroid; findings were correlated with the TI-RADS scoring system described by Horvath et al. Patients underwent basic ultrasonography, and TIRADS scoring was performed with ultrasound-guided FNAC. A 23G needle was used for FNAC that was attached to 2 ml disposable syringe for aspiration. Each lesion was aspirated twice and cytological examination was performed.
Results: Majority of the patients 69(53.1%) were between the age of 41-55 years. Most of the thyroid nodules were detected as TI-RADS-II 73(56.2%) by USG classification. The association was significant between TI-RADS classification and cytology findings of thyroid nodules (p<0.001).
Conclusion: The association between TI-RADS classification and cytological findings from FNAC is significant and plays an important role in the evaluation of thyroid nodules.

Keywords: Cytology, FNAC, Thyroid nodules, TI-RADS, Ultrasonography

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INTRODUCTION

Thyroid nodules are a common occurrence, with an estimated 50% of the population having at least one palpable nodule[1]. Thyroid cancer is the most common type of cancer among endocrine glands, accounting for 3.8% of all newly diagnosed cancer cases in the United States[2]. These nodules can be either solid or fluid-filled and are typically benign. However, in some cases, they may be cancerous or have the potential to become cancerous. Ultrasonography, commonly referred to as ultrasound, is a valuable non-invasive imaging technique used in the evaluation of thyroid gland lesions and the differentiation of these lesions from normal thyroid tissue by using high frequency sound waves[3]. Here's how it works and its role in thyroid evaluation. If a nodule is found, further testing may be necessary to determine whether it is benign or malignant.[4]

While nodules can be either benign or malignant, patient history and a physical examination are necessary for initial assessment[5]. Measuring serum TSH is the first step in laboratory tests, followed by a thyroid ultrasound to confirm the nodule and evaluate for additional nodules and cervical lymph nodes[6]. The likelihood of requiring thyroid surgery increases as the size of the nodule increases, and nodules over 4 cm are almost certain to require surgical treatment. However, even benign nodules may enlarge over time and require surgery[7].

It is important to note that the malignancy rate among thyroid nodules may change as number of factors involved like patient age, gender and size of nodule[8]. However, it appears that non-palpable nodules assessed via FNA have a higher malignancy rate (8-12%) than those detected through palpation (1.6%). This underscores the importance of regular thyroid screenings, particularly for individuals with risk factors such as a family history of thyroid cancer or exposure to radiation[9].

TI-RADS is used to classify and evaluate thyroid nodules before FNAC/FNA biopsy[10]. It helps identify

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patients at higher risk of thyroid cancer and may reduce unnecessary biopsies10. Studies show that TI-RADS can distinguish benign from malignant nodules, with malignancy significantly associated with higher TI-RADS categories on cytology. This suggests TI-RADS may reduce the need for routine FNAC and lower the risk of related complications.

Conducting this study comparing TI-RADS classification with FNAC for the diagnosis of thyroid nodules is essential to address clinical uncertainties, optimize patient care, and improve the efficiency of healthcare systems. It has the potential to guide clinical practice, reduce unnecessary invasive procedures, and ultimately enhance patient outcomes in the management of thyroid nodules.

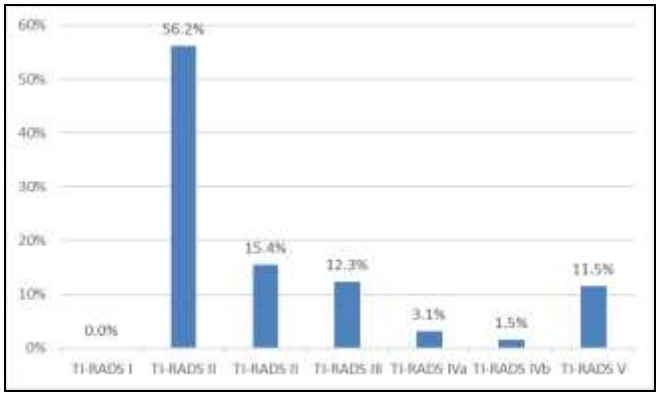

Figure: Classification of Thyroid Imaging Reporting and Data System of thyroid nodules on USG

METHODOLOGY

This study was conducted at Armed Forces Institute of Radiology and Imaging, Rawalpindi, Pakistan, from Feb to Aug 2023. Permission of study was granted by ethical review committee of hospital (IERB No. 014). Sample size was calculated by using openepi.com, an online sample size calculator with 95% CI, 80% power of study and clinical success TI-RADS IVa 4.90%[14] as described in a previous study.

Inclusion Criteria: A total of 130 patients of both genders, ultrasonographically detected thyroid nodules, TIRADS II-V, and who were scheduled for fine needle aspiration (FNAC) were enrolled.

Exclusion Criteria: Patients with TIRADS class I or normal scan or already diagnosed thyroid pathology were excluded from study.

A consultant radiologist having minimum five-year experience was allocated for high resolution B ultrasound scanning (model KX5000), a linear array of transducers simultaneously scans a plane through the body that can be viewed as a two-dimensional image on screen) of all patients. Classification of thyroid nodules was done by using TI-RADS proposed by Horvath et al in year of 2009.

After ultrasonography of the thyroid gland, ultrasound-guided FNAC was performed by same consultant radiologist after taking written consent. A 23G needle was used that was attached to a 2 ml disposable syringe for aspiration. Each lesion was aspirated twice, and specimens were sent to the laboratory for cytological examination. Data was recorded on Statistical Package for Social Sciences version 20, and analysis was done for mean (SD) and frequency (percentages). Chi square test was used, a *p*-value less than or equal to 0.05 was taken as significant.

RESULTS

Overall, 130 patients were included in this study, both male and female. The distribution of age and gender was shown in Table-I.

Table-I: Demographics of study patients (n=130)

Variable	Values
Gender	
Male	92(70.8%)
Female	38(29.2%)
Age (years) Mean±SD	42.93±8.86
25-40	51(39.2%)
41-55	69(53.%1)
56-70	10(7.7%)

Most of the thyroid nodules were detected as TI-RADS II 73(56.2%) by USG classification. Whereas 20(15.4%) in TI-RADS II, 16(12.3%) in TI-RADS III, 4(3.1%) in TI-RADS IVa, 2(1.5%) in TI-RADS IVb, 15(11.5%) in TI-RADS V and none of the patient in TI-RADS I. (Figure). According to cytology findings of thyroid nodules 94(72.3%) patients in benign nodules, 19(14.6%) in malignant nodules, 9(6.9%) in malignancy suspicion, 4(3.1%) in papillary carcinoma and 4(3.1%) cystic fluid. Most of the patients had TI-RADS class II and benign nodules 66(70.2%) whereas only one patient had TI-RADS class IVc as well as benign malignant nodules. Further, the association was significant between TI-RADS classification and cytology findings of thyroid nodules (p<0.001). (Table-II).

DISCUSSION

The study revealed a relationship between the Thyroid Imaging Reporting and Data System (TI-

Table-II: Thyroid Imaging Reporting and Data System class and cytology of thyroid nodules (n=130)

TI-RAD class	Cytology Findings					Total	*p*-value
	Benign nodules	Malignant nodules	Malignancy Suspicion	Papillary carcinoma	Cystic fluid		
II	66 (70.2)	7 (36.8)	0 (0.0)	0 (0.0)	0 (0.0)	73 (56.2)	<0.001
III	13 (13.8)	0 (0.0)	3 (33.3)	0 (0.0)	4 (100.0)	20 (15.4)	
Iva	9 (9.6)	5 (26.3)	2 (22.2)	0 (0.0)	0 (0.0)	16 (12.3)	
IVb	2 (2.1)	2 (10.5)	0 (0.0)	0 (0.0)	0 (0.0)	4 (3.1)	
IVc	1 (1.1)	1 (5.3)	0 (0.0)	0 (0.0)	0 (0.0)	2 (1.5)	
V	3 (3.2)	4 (21.1)	4 (44.4)	4 (100.0)	0 (0.0)	15 (11.5)	
Total	94 (100.0)	19 (100.0)	9 (100.0)	4 (100.0)	4 (100.0)	130 (100.0)	

Column-wise percentage was calculated, n (%)

**TI-RAD - Thyroid Imaging Reporting and Data System*

RADS) classification and cytological findings from fine needle aspiration cytology (FNAC) of thyroid nodules. Sub-categories of the nodules were also explicitly delineated by TI-RADS. The study also showed that the frequency of nodular presentation was dominant in males ranging between 41 and 55 years of age.

Literature has proven that Thyroid Imaging Reporting and Data System (TIRADS) classification in differentiating papillary thyroid cancers (PTCs) from benign lesions is efficient.[11] The worldwide prevalence rate of thyroid nodules is increasing every day, with reported rates ranging from 19% to 67%.[12] However, only 5-15% of these nodules are found to be malignant. The percentage of malignant thyroid nodules in the Pakistani population is estimated to be between 11% to 14.35%.[13] A study conducted by Malik et al., found that TI-RADS class V and malignancy on FNAC are associated significantly, but benign nodules are usually TI-RADS II and above.[14]

In this study, it was observed that the majority of the benign lesions were TR-2,3, and 4a, while malignant lesions were TR-5. Similarly, a study conducted by Dy *et al.*,[15] involved a retrospective analysis of 149 thyroid nodules affected patients. The majority of the patients in their study were female (87%). The researchers compared the Thyroid Imaging Reporting and Data System (TI-RAD) classification with fine-needle aspiration biopsy (FNAB) results. Their findings indicated that a higher TI-RAD class was associated with an increased risk of malignancy[15].

The study conducted by Zhuang *et al.*, aimed to develop a practical TI-RAD (Thyroid Imaging Reporting and Data System) system and evaluate its accuracy by comparing it with fine-needle aspiration biopsy (FNAB) results in 153 patients. The researchers found that the TI-RADS findings were 97% accurate in predicting malignancy.16 Thattarakkal *et al.*, developed a practical TI-RADS scoring system based on the BI-RADS categories. The scoring system includes category 3 for nodules without any suspected features, category 4a for nodules with one suspicious characteristic, category 4b for nodules with two suspicious characteristics, and category 4c for nodules with three to four suspicious characteristics. This simplified scoring system has been effective in facilitating the risk stratification of malignant thyroid nodules.[17]

The study conducted by Vargas-Uricoechea et al., aimed to evaluate the concordance between TIRADS and Bethesda cytology criteria. The study included patients with a mean age of 57 years, with a female predominance of 75%.[18] The results indicated that the highest concordance between TIRADS and cytology was observed in TIRADS class II. The authors concluded that the TIRADS classification of benign nodules can complement the cytology results, which can aid in avoiding unnecessary interventions in such patients, so these results are same for our study.

Regmi et al., found that most of nodules observed under USG examination were benign in nature having TIRADS II (85.2%) [19] and Periakaruppan *et al.*, also observed in a study that association between benign nodules and TIRADS II 63.5%.[20] This suggests that the criteria used for determining the TR 2 category may differ between studies and highlights the importance of standardized criteria for accurate diagnosis and management of thyroid nodules.

The study concluded that TI-RADS (Thyroid Imaging Reporting and Data System) classification system has proven to be efficient and effective tool in categorizing thyroid nodules compared to fine needle aspiration. This conclusion has been supported by the literature hence, affirming that TI-RADS can be utilized as a valid and reliable diagnostic tool globally.

LIMITATION OF STUDY

A small sample is the main limitation of this study; it is quite difficult to predict the actual incidence of thyroid

nodules' malignancy and TIRADS prediction about malignancy on a small sample size.

CONCLUSION

There is a significant association between the Thyroid Imaging Reporting and Data System (TI-RADS) classification and cytological findings from fine needle aspiration cytology (FNAC) of thyroid nodules. This indicates that TI-RADS is a reliable diagnostic modality for detecting thyroid lesions and can potentially reduce the burden of unnecessary biopsies. In fact, the TI-RADS classification is highly reproducible and appropriate for assessing thyroid nodules.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

MH & MAS: Data acquisition, data analysis, critical review, approval of the final version to be published.

MUA & GA: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

RRH & SA: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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