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Original Research Article

ROLE OF ULTRASOUND IN EVALUATION OF THYROID NODULE AND ASSESSMENT OF DIAGNOSTIC ACCURACY OF TIRADS CLASSIFICATION AND CORRELATION WITH BETHESDA CYTOPATHOLOGY CLASSIFICATION

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Abstract

Aim and objective: To identify the accuracy of ultrasound in determining malignant nodules and compare the Thyroid Imaging Reporting and Data System (TIRADS) of classifying thyroid nodules on ultrasound with the findings on fine-needle aspiration cytology (FNAC) reported using the Bethesda System of classification.

Material and Method: We conducted prospective, correlational study which enrolled 130 patients of all age group who had been referred to radiology department for assessment of thyroid nodule. The study was performed using 7-12 Hz linear frequency probe of E-saote ultrasound machine. High frequency thyroid ultrasound were performed in all cases and TIRADS score was noted which was later correlated with Bethesda score on FNAC.

Results: Study was done for a period of 1.5 year in patients who were sent to radiology department for assessment of thyroid nodule. The age group most commonly represented in study is 41-60 years. Benign as well as malignant nodules were more frequent in female than in male. We observed that TIRADS classification was significantly associated with BETHESDA classification and risk of the malignancy of a thyroid palpable nodule increases along with the TIRADS category.

Conclusion: TIRADS is a trustworthy categorization that harmonises the assessment of thyroid nodules on ultrasonography and makes it easier for specialists to understand one another. If the nodules are correctly categorised using ultrasound, TIRADS is strongly correlated with Bethesda.

1. INTRODUCTION

Thyroid nodules are commonly detected pathology. It is found in 4-8% of patients by palpation and 10-41% by ultrasound. Ultrasound has emerged as the very useful imaging modality for evaluation of these lesions as it is easily available, has superior resolution, helps classify lesions, detects non palpable nodules and guides for fine needle aspiration of suspicious nodules. The purpose of this study is to identify the accuracy of various imaging features in thyroid nodules that are associated with benignity and malignancy and the overall accuracy of ultrasound in determining malignant nodules[1]. There are numerous risk classification systems in thyroid imaging that have been created with the goal of not only

reducing interobserver variability but also establishing an effective communication system.[4] The most useful classification system is the thyroid image reporting and data system (TIRADS), which is comparable to the breast imaging reporting and data system (BIRADS) for breast lesions[5].The nodules are evaluated based on their shape, margins, echogenicity, presence of calcification, presence of circumferential halo, and internal composition.[1] In this study we will compare the Thyroid Imaging Reporting and Data System (TIRADS) categorization of thyroid nodules on ultrasonography with the Bethesda System classification of fine-needle aspiration cytology (FNAC).[6] The purpose of USG and Fine Needle Aspiration Cytology (FNAC) diagnosis workups now is to identify individuals for surgery who have a high probability of having cancer in the nodule. [2]

2. MATERIAL AND METHODS

This prospective and observational study conducted on 130 patients of all age groups and both sexes for a period of 1.5 years who were sent to radiology department for assessment of thyroid nodule. After clinical evaluation, once patient satisfied inclusion and exclusion criteria for this study, he or she was taken for sonographic evaluation thyroid nodule followed by FNAC correlation.

The inclusion criteria were patient of any age or sex with clinically palpable thyroid nodule who were to radiology department for further sonographic examination. The exclusion criteria were patients not giving consent and patients who were known case of thyroid malignancy.

STASTICAL ANALYSIS

TIRADS score given on sonographic examination was correlated with BETHESDA on FNAC . Data collected from USG and FNAC results was analysed for significant correlation between TIRADS score and BETHESDA classification using IBM SPSS software.

3. RESULTS

Out of the patients who had clinically palpable thyroid nodules identified by high-resolution ultrasound sonography between November 2020 and July 2022, 130 individuals were chosen, examined, and the findings of FNAC were correlated.

Table 1: Age and gender wise distribution

	Male		**Female**	
	Frequency	**Percentage**	**Frequency**	**Percentage**
<20	0	0	3	3.57
21-30	0	0	7	8.33
31-40	9	19.57	19	22.62
41-50	12	26.09	27	32.14
51-60	14	30.43	25	29.76
>60	11	23.91	3	3.57

Among 130 patients, 64.6% were females, whereas 35.4% were males, as observed in our study sample. He/she was categorised based on age group distribution, which was shown in Table: 1.Among males, we observed the highest percentage in the age group of 51–60 years (30.43%), whereas the highest percentage in the age groups was 41–50 years (32.14%) in females.

Table 2: BETHESDA code and TIRADS distribution

		TIRADS				**Total**
		II	**III**	**IV**	**V**	
BETHESDA	I	7	0	1	1	9
	II	78	29	4	0	111
	III	1	1	0	0	2
	IV	0	1	1	1	3
	V	0	0	1	2	3
	VI	0	0	1	1	2
Total		86	31	8	5	130

We selected 130 thyroid palpable nodule detected patients based on high-quality ultrasound sonography. These patients were further evaluated based on FNAC studies. A cross tabulation of TIRADS and Bethesda was prepared [Table 2].

Out of 130 patients, the highest number of patients had a Bethesda grade II classification (N = 111). Among 111 patients, 78 patients had Grade II TIRADS, 29 patients had Grade III TIRADS, and 4 patients had Grade IV TIRADS.

Out of the 130 nodules, 86 were categorised under TIRADS 2, 31 were classified under TIRADS 3, 8 were classified under TIRADS 4, and 5 were classified under TIRADS 5. Among the TIRADS classifications, highest number of patients was observed with Grade II TIRADS (N =86).Among 86 patients, 78 patients had a Grade II Bethesda classification and7 patients had a Grade I Bethesda classification.

We observed that TIRADS classification is strongly significantly associated with Bethesda classification. Data were analysed by Chi-square test or Fisher's exact test for categorical variables of benign and malignant nodules ($P < 0.001$)

Table 3: Categorical classification of benign and malignant module

	BETHESDA		**Total**
TIRADS	**Benign**	**Malignant**	
Benign	116	1	117
Malignant	6	7	13
Total	122	8	130

The nodules classified as Bethesda I and II were considered benign, and those nodules classified as Bethesda IV–VI were considered malignant, whereas TIRADS scores 4 and 5 were considered positive for malignancy, while scores 1–3 were considered negative for malignancy.

Table 4: Risk of malignancy rate

TIRADS	**Risk of Malignancy Rate**
1	0%
2	0%
3	3.23%
4	37.5%
5	80%
6	100%

On comparing TIRADS result with Bethesda system of classification, the risk of malignancy for TIRADS 2, TIRADS 3, TIRADS 4, and TIRADS 5 was 0, 3.23%, 37.5, and 80%, respectively.

4. DISCUSSION

The prevalence of palpable thyroid nodules is about 5% in the general population, and it rises with age and among women.

Age Distribution

In our study group which included patients between 16 and 70years of age, the mean age of presentation was found to be 47.02 ± 11.63 and the most common age group of presentation was 41 – 60 years. We were found similar study having similar age observation in their study as followings:

	Range	**Mean ± SD**
Xu et al, 2017[37]		46.8±13
Regmi S et al,2018[38]	17-88	50.74±17.8
Alshaikh R et al,2022[39]	15-86	49.1 ± 14.9 years
Fawzy Maha et al, 2021[40]	19-80	45.67
Present Study	16-70	47.02± 11.63

Sex Distribution

Out of the total of 130 nodules, 84 were female patients and 46 were male patients. Pathologically, 117 were benign and 13 were malignant. Among the malignant cases, 3 (23.08%) were males and 10 (76.92%) were females. Among the benign cases, 43(36.75 %) were males and 74 (63.25%) were females. Although the incidence of both benign and malignant thyroid lesions was more in female patients, the male patients with thyroid nodules should be also evaluated with greater suspicion. We were found similar study having similar age observation in their study as followings:

	Female	**Male**
Vargas-Uricoechea et al,2017[41]	78.3%	21.7%
Periakaruppan G et al ,2018[10]	84.78%	15.22%
Fawzy Maha et al, 2021[40]	83.16%	16.84%
Present Study	64.62%	35.38%

On the basis of previous studies as well as our study, we could be said as females having more chance to thyroid cases compared to males.

Sensitivity and Specificity of TIARDS classification with Bethesda Classification

The ACR TIRADS diagnostic performance was calculated using BETHESDA as the gold standard test and found to have an overall specificity of 87.5%, sensitivity of 95.08%, positive predictive value of 53.85%, negative predictive value of 99.15% and overall diagnostic accuracy of 94.62%. As illustrated in the table below with several studies:

	Present Study	**Periak-aruppan G et al , 2018[10]**	**Vargas-Uricoechea et al, 2017[41]**	**Moifo et al, 2013[14]**	**Horvath et al, 2009[12]**
Sensitivity	87.5%	92.3%	88%	98.3%	88%
Specificity	95.08%	94.15%	49%	52.17%	49%
NPV	99.15%	99.38%	88%	97.32%	88%
PPV	53.85%	54.54%	49%	60%	49%
AUC	0.913	0.932	-	-	

We obtained similar sensitivity as well as specificity with previous studies when evaluate diagnostic accuracy with TIRADS classification based on BESTHEDA classification.

Risk of Malignancy

	TIRADS1	**TIRADS2**	**TIRADS3**	**TIRADS4**	**TIRADS5**	**TIRADS6**
Present Study	0%	0%	3.23%	37.5%	80%	100%
Horvath et al (2009)[12]	0%	0%	3.4%	27%	87%	100%
Kawak et al (2011)[13]	0%	0%	1.7%	44.7%	87.5%	100%
Moifo et al (2013)[14]	0%	0%	2.2%	57.9%	100%	100%
Fernandez Sanchez (2015)[42]	0%	0%	2.2%	48%	85%	100%
Srinivas et al (2016)[16]	0%	0%	1.5%	63%	100%	100%
Vargas Uricoechea et al, (2017)[41]	0%	6.15%	38.46%	97.56%	100%	100%

Periakaruppan G et al , 2018[10]	0%	0%	2.2%	38.5%	77.8%	100%
Patil Y et al. (2020)[43]	0%	0%	6.8%	21.3%	80%	100%

In the present study, the risk of malignancy for the TIRADS categories 2 , 3, 4and 5 were 0%,3.23%,37.5% , 63%, 80% and 100% respectively which infers that the risk of the malignancy of a thyroid nodule increases along with the TIRADS category. This correlated well with the studies conducted by Horvath et al[12] , Mofito et al[14], Fernandez-Sanchez et al[42] and Srinivas et al[16], Periakaruppan G etal, 2018[10].

5. CONCLUSION

Our study produced positive findings using the risk classification of thyroid nodules as benign or malignant using ACR TIRADS 2017 criteria. There were very few differences between the TIRADS and Bethesda groups, and our study's diagnostic accuracy was determined to be 94.62%, demonstrating excellent agreement. Although in our study we did not see 100% sensitivity for the detection of benign nodules on USG, this may have been due to operator error.

When separating benign from malignant thyroid nodules, the TIRADS classification provides a high degree of sensitivity, specificity, and diagnostic accuracy.

As a result, the TIRADS is a trustworthy categorization that harmonises the assessment of thyroid nodules on ultrasonography and makes it easier for specialists to understand one another.

In conclusion, if the nodules are correctly categorised using ultrasound, the ultrasound-based TIRADS system can be used to figure out with a certain level of confidence how likely it is that a particular
nodule is cancerous. At the end of our study, none of the nodules classified underTIRADS 2 turned out to be malignant; therefore, it can be safely assumed that FNA may be deferred at least in patients having TIRADS 2 nodules, which contribute to the majority of newly detected cases and thereby avoid unnecessary surgeries. We observed that TIARDS classification was significantly associated with BETHESDA classification.
In the present study, the risk of malignancy for the TIRADS
categories 2 , 3, 4, 5 and 6 were 0%, 3.23%, 37.5 % , 80% and 100% respectively which infers that the risk of the malignancy of a thyroid palpable nodule increases along with the TIRADS category.

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