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ROLE OF ULTRASONOGRAPGY TO DIFFERENTIATE BENIGN AND MALIGNANT THYROID NODULES BY USING TIRADS AND CYTOPATHOLOGICAL CORRELATION- A PROSPECTIVE STUDY

Radio-Diagnosis

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ABSTRACT

Objectives: In this article, we investigated the correlation of TIRADS and fine-needle aspiration cytopathological findings by using high-resolution ultrasound in the thyroid nodules **Material and methods:** This descriptive type of observational study conducted in Dr. SN medical college and attached hospital from 2019 to 2020, includes 80 cases of thyroid nodules based on inclusion and exclusion criteria. Each nodule's characteristics (echogenicity, composition, shape, margin, and echogenic foci) were determined by using TIRADS on ultrasound. The USG findings were then compared with FNAC and data was analyzed statistically. **Results:** Of the 80 nodules examined, 6 (7.50 %) were found to be malignant on cytopathology. The malignant nodules demonstrated solid or predominantly solid composition (sensitivity 83.33 % and specificity 60.81 %); presence of micro-calcification (sensitivity 83.33 % and specificity 98.65 %); irregular or poorly defined margins (sensitivity 66.67 % and specificity 98.65 %); taller than wider (sensitivity 50 % and specificity 98.65 %); hypoechoic character (sensitivity 50 % and specificity 89.19 %). **Conclusion:** ACR- TIRADS classification is reliable, easier, and simpler than other classification systems for reporting. Ultrasonography (USG) features of thyroid nodules are useful to differentiate benign and malignant thyroid nodules. From our study, it is apparent that the USG findings of poorly defined margins, marked hypoechogenicity, microcalcifications, and a taller-than-wider shape have high diagnostic accuracy for identifying malignant thyroid nodules. in our study, the risk of malignancy increased as the TI-RADS level increases from TR1 to TR5.

KEYWORDS

INTRODUCTION

According to a recent study, in India the prevalence of a palpable thyroid nodule in the community is about 12.2%. These nodules can be either benign or malignant. However, thyroid cancer is quite rare, and the incidence is 8.7 per 100000.[1]

Ultrasound is an excellent tool that helps in the detection of early malignancy. A few of the features are suggestive of benignity of the nodule include halo around nodule, cystic nodule, spongiform pattern, avascularity, comet tail artifact and enlarged thyroid with multiple nodules. Features suggesting malignancy include microcalcifications / punctate calcifications, extension beyond thyroid margin, taller than wide in the transverse plane, markedly hypoechoic, cervical lymph nodal metastasis; less specific features include no halo around nodule, Ill-defined or irregular margin, solid, increased central vascularity.[2] But the imaging findings have to be ultimately confirmed by fine needle aspiration cytology (FNAC) or biopsy. These procedures are invasive and are associated with complications like hemorrhage and infections. Hence committee of American college of radiology (ACR) published a white paper on Thyroid Imaging, Reporting, And Data System (TIRADS) compiles all the features and gives the guidelines to differentiate the thyroid nodules into benign or malignant nodules. The committee also gave recommendations for fine needle aspiration (FNA) based on TIRADS grade and size of the nodule, hence reduce the need for invasive procedures like FNA or biopsy.

ACR TI-RADS uses five feature categories —Echogenicity, composition, shape, Margin, and echogenic foci to determine the risk level of malignancy which ranges from TR1 (benign) to TR5 (highly suspicious).[3]

Therefore, the main aim of our study is to differentiate thyroid nodule into benign or malignant based on ACR- TIRADS guidelines and compare the results with cytopathology reports.

Table-1

TI-RADS level	The sum of the points	Classification
TR1	0	Benign
TR2	2	Not suspicious
TR3	3	Mildly suspicious
TR4	4 to 6	Moderately suspicious
TR5	7 or more than 7	Highly suspicious

MATERIAL AND METHODS:

A 1-year hospital based Descriptive type of observational study was conducted in the department of Radio-diagnosis, on the patients who met the inclusion criteria and did not get excluded, from November 2019 to November 2020 in DR S. N. Medical college Jodhpur Rajasthan & Attached hospital

Inclusion criteria:

1. Patients with palpable thyroid masses
2. All patients with thyroid nodules suspicious of malignancy, irrespective of their size

Exclusion criteria:

- Patient is unwilling to undergo ultrasound examination or further cytopathologic evaluation of thyroid masses after ultrasound examination.
- Patient with history of bleeding disorders.
- Treated cases of thyroid malignancy
- Cases with indeterminate cytopathological results

Equipment: 2D grey scale & color Doppler USG Imaging equipment from ALOKA equipped with a 7.5–12 MHz high-frequency linear array transducer was used

Procedure:

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An informed consent was taken from all the subjects. With the patient supine and neck hyper-extended, the entire gland was examined. The neck was scanned in sagittal, transverse, and oblique sections to optimally visualize both lobes of the thyroid and isthmus.

Thyroid nodules were assessed for swelling, size, shape, location, and mobility. Radiological interpretation of thyroid nodules was done, guided by the ACR TI-RADS Criteria including evaluation of five categories: echogenicity, composition, shape, margin, and echogenic foci.

The committee recommends that no more than four nodules with the highest ACR TI-RADS point scores that fall below the size threshold for FNA should be followed.

Skin is painted with povidone iodine and it is draped. Then the lesion is focused on a high frequency linear Ultrasound probe.

A 23 to 27-gauge needle is used which is attached to a 10 ml syringe. The transducer is placed over the thyroid gland and the lesion is localized and its relation to an adjacent vessel is identified. The needle is advanced parallel or perpendicular to the probe and into the lesion and then aspirated. In cases of multiple nodules, the nodules which had the most suspicious sonographic findings or maximum score for malignancy were selected for fine needle aspiration. Materials obtained from aspiration biopsy are smeared on a glass slide and immediately placed in 95% ethanol for Papanicolaou staining. Then the specimen is sent to pathology for reporting. [7]

RESULTS

80 patients were included in the study, 13 males (17.5%) and 67 females (82.5%). The mean patient age was 46.45 ± 15.56 years old (range 25–69 years). 32 patients (52.5%) had a solitary nodule while 48 patients (47. 5%) had more than one nodule (the thyroid nodule with the highest TI-RADS score was included in the study). Out of the 80 nodules included in the study, 74 nodules (92.5 %) were benign and 6 nodules (7.5 %) were malignant nodules. Cytology in 22 patients revealed eight colloid cysts/goiters with cystic degeneration, 2 colloid cysts with hemorrhage, two, and seven benign nodular hyperplasia, 0ne benign follicular nodule.

Regarding malignant nodules, cytology in 6 patients revealed 5 papillary carcinomas and 1 with follicular carcinoma.

In our study, there was a statistically highly significant increase in the incidence of solid thyroid nodules, hypoechoic/very hypoechoic thyroid nodules, taller than wider nodules, nodules having lobulated/ irregular margins/extrathyroidal extension, and thyroid nodules with punctate echogenic foci in the malignant group than in the benign group with P values 0.144, <0.001,<0.001, <0.001, and <0.001 respectively.

Table 2: Thyroid Lesions According To TIRADS Category With FNA Results Correlation

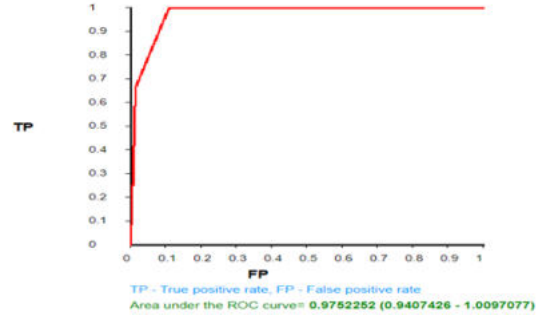
TIRADS category	Malignant	%	Benign	%	Total	%
TIRADS 1	0	0.00	16	100.00	16	20.00
TIRADS 2	0	0.00	22	100.00	22	27.50
TIRADS 3	0	0.00	28	100.00	28	35.00
TIRADS 4	2	22.22	7	77.78	9	11.25
TIRADS 5	4	80.00	1	20.00	5	6.25
Total	6	7.50	74	92.50	80	100.00

Table 3: Summary Of Statistical Evaluation Of Major USG Features In Predicting Malignancy

	Irregular margin	Taller than wide	Microcalcification	Hypoechogenicity	Solid consistency
Sensitivity	66.67	50	83.33	50	83.33
SP	98.65	98.65	98.65	89.19	60.81
PPV	80	75	83.33	27.27	14.71
NPV	97.83	96.05	98.65	95.65	97.83
Accuracy	96.5	95	97.50	86.25	62.50
P value	<0.001	<0.001	<0.001	<0.001	0.144

Table 4: TIRADS Grades And Their Statistical Parameters

	TIRADS 2 & above	TIRADS 3 & above	TIRADS 4 & above	TIRADS 5& above
Sensitivity	100	100	100	66.67
Specificity	21.62	51.35	89.19	98.65
PPV	9.37	14.29	42.86	80
NPV	100	100	100	97.33
Accuracy	27.5	55	90	96.25



Graph 1: ROC curve

The ultrasound diagnosis was compared with the pathological diagnosis and the sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy of ultrasound and four sonographic features (shape of the nodule [taller than wide], marked hypoechogenicity, microcalcifications and poorly defined margins) in predicting malignancy in a thyroid nodule were calculated using the statistical formulas. The P values were calculated for each of the sonographic features using Chi-square test, and P-value was found to be statistically significant (P < 0.0001).

In our study, there was no statistically significant difference found between the benign and the malignant groups regarding the spongiform thyroid nodules, the nodules with anechoic, isoechoic or hyperechoic texture, nodules with comet tai artifact, and nodules with macrocalcifications, and peripheral calcifications.

Figure 1- USG revealed multiple nodules. The nodule with highest score had following features - Wider than taller shape, anechoic, cystic content, comet tail artifacts, smooth margin. TIRADS score of 0 was given. FNAC showed it to be colloid cyst- Tirads-1

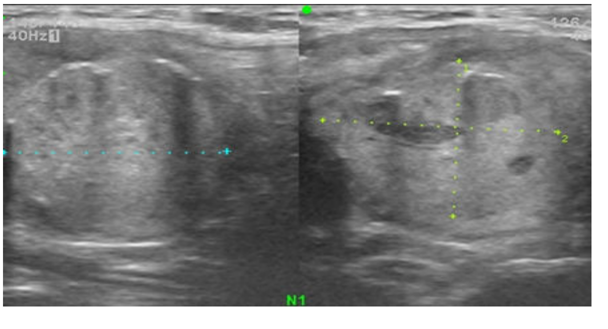


Figure 2- USG revealed a solitary nodule. The nodule had following features - Wider than taller shape, isoechogenicity, solid content, peripheral wall calcification, smooth margin. TIRADS score of 4 was given. FNAC showed it to be adenomatous hyperplasia- TIRADS 4

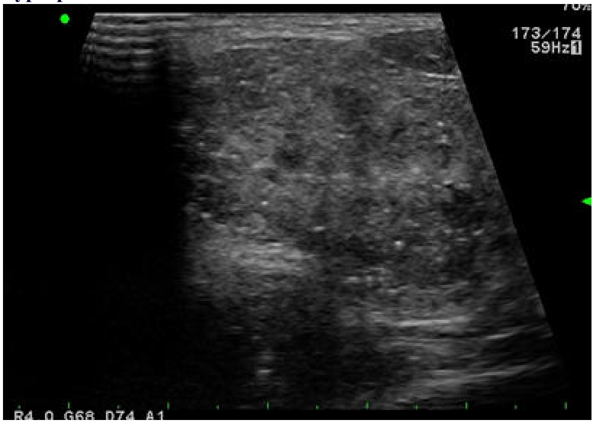


Figure 3- USG revealed a solitary nodule. The nodule had following features - Wider than taller shape, hypoechogenicity, solid Content, microcalcification, lobulated margin. TIRADS score of 9 was given. FNAC showed it to be papillary carcinoma- TIRADS 5.

DISCUSSION:

Ultrasonography is the most common modality used for the evaluation of thyroid nodules. The guidelines for systematic evaluation of thyroid nodules were provided by the committee by American College of Radiology, by which the nodules are be stratified into 5 categories (TIRADS 1 to TIRADS 5) depending on the possibility of risk for malignancy and also recommend the criteria for biopsy. The nodules were evaluated based on 5 characteristics (composition, echogenicity, shape, margin, and presence of echogenic foci) and TIRADS score is assigned depending on the probability of malignancy.

Our study was conducted on 80 thyroid nodules, and sonographic assessment was done based on ACR-TIRADS template to determine the score and assign the nodule into the benign or malignant category. The findings were then correlated with the histological report following FNA or surgical excision.

Our study included 80 patients, of which 67 (83.75 %) were females and the rest 13 (16.25%) were males and the mean age of the patients being 46.45±15.56 years.

Out of 80 nodules, 92.50 % (74 nodules) of them were benign and 7.50 % (6 nodules) were malignant. 5 out of 6 malignant nodules had solid composition and only one had mixed composition. All the nodules with cystic composition were benign. Similar results were found with the study conducted by Azab et al.[4] Which show wed all the cystic nodules to be benign and a high incidence of malignancy in solid nodules.

The most of the nodules in the present study are hyperechoic followed by isoechoic and hypoechoic. Only a nodule was found to be markedly hypoechoic and is exclusively found in malignant thyroid nodule (1 out of 6; 16.66%). This indicates that presence of marked hypoechogenicity is a good predictor of malignancy in thyroid nodule on USG. The present study shows sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of marked hypoechogenicity in predicting malignancy of thyroid nodule is 50%, 89.19%, 27.27%, 95.65%, and 86.25%, respectively. In our study, 100 % of the nodules with anechogenecity or hyperechogenecity were benign and one nodule which was very hypoechoic was malignant. However, there was no significant difference in the benignity or malignancy in the nodules with iso or hypoechogenicity.

Middleton et al.[5] stated that 12.9% of nodules that had smooth margins and 44.7% of nodules that had lobulated or irregular margins were malignant. Our study is comparable to the previous study and in our study, 75 % of the malignant group nodules showed irregular margins. The extra-thyroidal extension is also an important indicator of malignancy. In our study, one nodule had extra-thyroidal extension and was found to be malignant. In our study, sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of poorly defined margins for diagnosing malignant nodules was found to be 66.67%, 98.65%, 80%, 97.83%, and 96.50% respectively.

Regarding the shape of the nodule, the nodules with taller than wide shape are more suspicious of malignancy. In our study, we found that 75 % (three out of four) nodules which had taller than wide shape was malignant. The shape of the nodule has been studied as a USG marker of malignancy. Most of the malignant nodules in the present study showed shape that is taller than wide. In our study, the sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of the shape of the nodule being taller than wide in predicting malignancy is 50%, 98.65%, 75%, 96.05% and 95%, respectively. These findings confirm that shape of the nodule has a relatively poor positive predictive value. However, its high specificity, negative predictive value, and accuracy make it a reliable feature in ruling out malignancy in a thyroid nodule on USG.

Our study showed that 83.33 % nodules with punctuate calcifications had malignancy. In our study, all the nodules with comet tail, rim calcifications and macrocalcifications were benign. The current study showed that microcalcifications were exclusively seen in malignant nodules though not present in all cases of malignant thyroid nodules (seen in 5 out of 6 cases). In the present study, microcalcifications were found to have the highest diagnostic accuracy (97.50%), specificity (98.65%), and negative predictive value (98.65%) compared to other sonographic characteristics on USG. Hence, it can be used as a reliable criterion in differentiating benign and malignant thyroid nodules on USG.

A significant statistical relationship was observed between risk of malignancy and echogenicity, shape, margins and echogenic foci with p values of 0.144 and <0.001 (shape, margins and echogenic foci) respectively. As the score in each category increased, there was an increase in the chance of malignancy. These findings were corresponding to the study conducted by Middleton et al [5]. However, there was no significant statistical association between echogenicity of the nodules with malignancy. This can be explained by the fact that there could be inter-observer variation in assessment of the echogenicity, also the echogenicity is subject to histological composition of the nodules [10].

In the current study, all the nodules with TIRADS grade TR1, TR2 & TR3 were benign, 77.78 % (7) nodules in TR4 category were benign & rest 22.22 % (2) nodules were malignant. 80 % (4) nodules in TR5 category were malignant & only one nodule 20 % nodule was benign. There was a statistically significant increase in the chance of malignancy from TR1 to TR 5 category with p value of <0.001.

Overall, according to the present study, the best cut-off point to differentiate benign and malignant nodules according to the ACR-TIRADS system is TR4, and the ACR TI-RADS system has a sensitivity and specificity of 100% and 89.19% respectively in differentiating benign and malignant nodules and TR5 ACR TI-SRADS system has a sensitivity and specificity of 66.67 % and 98.65 % respectively in differentiating benign and malignant nodules. This is in correspondence with study by Azab et al.[5]

CONCLUSION:

The study is based on ACR TI-RADS system to categorized the nodules into TR1 to TR5 categories based on various features which could predict the benignity, minimally suspicious, moderately suspicious, or highly suspicious malignancy and to correlate the findings with histopathological reports.

TIRADS can be considered an appropriate system in the assessment of thyroid nodules, in order to avoid unnecessary FNAC. The method is simple and easily applicable in evaluation of the thyroid nodules in daily practice. This system has proven to have sensitivity and specificity of 100% and 89.19% respectively in differentiating benign and malignant nodules according to the present study. According to the present study, there was an increased risk of malignancy from TR1 to TR5 category.

The main limitation of the present study was the small study group, and the study needs to be conducted on a larger group for more accuracy.

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