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Practicability and Accuracy of Thyroid Imaging Reporting and Data System as a Tool to Stratify Cancer Risk in Patients with Thyroid Nodules

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Abstract: ***Background**: There is a high prevalence of thyroid nodules on ultrasonographic (US) examination. However, most of them are benign. Hence select US criteria may help to decide cost-effective management and avoid unnecessary invasive procedures. **Aims and Objectives**: To use TIRADS as a practicable tool for stratification of cancer risk in thyroid nodules. To assess the overall accuracy of TIRADS in the diagnosis of patients with thyroid nodules by comparing with histopathological reports of FNAB. **Design**: A cross-sectional study using the TIRADS, which is based on the concepts of the Breast Imaging Reporting Data System of the American College of Radiology. **Materials and Methods**: Over a period of 24 months, 240 patients were referred to the department of Radiodiagnosis at Justice K.S. Hegde Charitable Hospital, Deralakatte, Mangalore for ultrasound evaluation of thyroid gland. 55 of the 240 patients had nodules with suspicious ultrasound features as described in the TIRADS atlas and were included into the study. A correlation of the US findings and fine needle aspiration biopsy (FNAB) was studied and risk of malignancy was determined according to the number of suspicious US features. **Results**: The following suspicious US features showed a significant association with malignancy: solid composition, marked hypoechogenicity, microlobulated or irregular margins, microcalcifications, and taller-than-wide shape. As the number of suspicious US features increased, the probability and risk of malignancy also increased. Positive predictive values according to the number of suspicious US features were significantly different. **Conclusion**: Ultrasonography is the best diagnostic tool in the initial assessment of thyroid nodule. Given the appropriateness and accessibility, the ultrasound-based TIRADS allows for stratification of thyroid cancer risk by using the number of suspicious US features. The TIRADS allows to improve patient management and cost-effectiveness, by avoiding unnecessary FNAB. TIRADS is a practical, convenient and reliable tool suitable for widespread adoption and use.*

Keywords: Ultrasonography, Thyroid nodule, TIRADS, Thyroid malignancy, Fine Needle Aspiration Biopsy.

1. Introduction

Thyroid nodules are very common in the general population. The prevalence of palpable thyroid nodules is only approximately 4-7%, but the prevalence of Ultrasound-detectable nodules is between 19 and 67%[1]–[3]. The widespread use of Ultrasonography (US) has contributed to the increased detection of incidental thyroid nodules. However, most of them are benign which represent follicular nodules that develop in adenomatous goitres following cycles of hyperplasia and colloid involution, and only less than 10% are malignant[4],[5]. However, since any nodule could represent a thyroid carcinoma, the diagnostic challenge lies in efficiently and effectively identifying those lesions that are malignant in the most cost-effective, non-invasive manner while limiting the medical, emotional, and financial burden placed on the overwhelming excess of patients with benign nodules. Ultrasonography of the thyroid gland has emerged as an important diagnostic tool in this process. Recently, following the popularity of Breast Imaging Reporting And Data System (BIRADS) introduced by American College of Radiology[6], the concept of Thyroid Imaging Reporting and Data System (TIRADS) was introduced by Horvath et al in 2009[7]. This system allowed stratification of thyroid nodules by giving percentage risk of cancer based on US features of the nodules and opined TIRADS can improve patient management and cost-effectiveness by avoiding unnecessary FNAB. Several other authors also worked on this concept and made some modifications later. Several US characteristics of nodules have been identified as predictors of malignancy which have significant association with thyroid cancer such as solid component, hypoechogenicity, marked hypoechogenicity, microlobulated or irregular margins, microcalcifications, and taller-than-wide shape. These have been called suspicious features for malignancy[8].

Although many investigators have tried to develop this thyroid imaging reporting and data system (TIRADS), it is still not accepted as a standard management tool and currently has not gained worldwide recognition. Thus there is a need to emphasize the use of TIRADS as a practical tool to assess thyroid nodules and stratify their malignant risk. In this study the usefulness of TIRADS system was analysed and pre-FNA percentage risk of cancer on US imaging by using the number of suspicious US features was given. Both palpable / non-palpable and symptomatic / incidental nodes were subjected to FNA according to the risk categories. The goal was to group thyroid lesions in different categories with a percentage of malignancy similar to those accepted in the BIRADS.

TIRADS CLASSIFICATION

TIRADS 1- normal thyroid gland.
TIRADS 2- benign lesions (e.g. cysts). These conditions have 0% risk of malignancy.
TIRADS 3- probably benign lesions hyperechoic, iso-echoic or hypoechoic nodules, with partially formed capsule and peripheral vascularity, usually in setting of Hashimoto's

thyroiditis (Hashimoto's pseudonodule). These lesions are mostly benign with <2% risk of malignancy.

TIRADS 4 - suspicious lesions (sub classified as 4a, 4b, and 4c with increasing risk of malignancy) based on the following five suspicious sonographic features of malignancy
1) Solid component
2) Hypoechoic or markedly hypoechoic nodule
3) Microlobulations or irregular margins
4) Microcalcifications or macrocalcifications
5) Taller-than-wider shape
TIRADS 4a : one suspicious feature
TIRADS 4b : two suspicious features
TIRADS 4c : 3-4 suspicious features
TIRADS 4a has 2-10% risk, 4b has 10-50%, and 4c may have 50-95% risk of malignancy.
TIRADS 5 - probably malignant lesions: all five suspicious features (more than 95% risk of malignancy).
TIRADS 6 - biopsy proven malignancy.

2. Aims and objectives

- To use TIRADS as a practicable tool for stratification of cancer risk in thyroid nodules and aid in their management.
- To assess the overall accuracy of TIRADS in the diagnosis of patients with thyroid nodules by comparing with histopathological reports of FNAB.

3. Methodology

3.1 Source of data

A cross sectional study was conducted from November 2014 to October 2016 in the department of Radiodiagnosis, Justice K. S. Hegde Hospital, Mangalore.

3.2 Method of Study

Based on the following inclusion and exclusion criteria, 55 cases of thyroid nodules suspicious for malignancy on ultrasound based TIRADS were included in the study. The ultrasound examination was done in the department of Radiology of Justice K.S.Hegde Charitable Hospital attached to K.S.Hegde Medical Academy, Deralakatte, Mangalore. These cases were subjected to FNAC for confirmation of ultrasound finding and establishment of final diagnosis.

3.3 Inclusion Criteria

a) Age > 15yrs
b) thyroid nodules with size >1cm which were
- palpable / non-palpable
- symptomatic / incidental
- with suspicious features on imaging as described in TIRADS atlas

3.4 Exclusion Criteria

Classic benign patterns of thyroid nodules which did not need tissue confirmation by FNAB to rule out malignancy[9].

3.5 Statistical Analysis

Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy were calculated for the suspicious ultrasound features and TIRADS groups and diagnostic comparison done.

4. Results

A total of 55 cases were included in the study. These patients underwent FNAB and few patients underwent excision biopsy(hemi/totoal thyroidectomy) in view of strong suspicion for malignancy. 39 out of 55 (70.9%) nodules were histologically proven to be malignant.

The TIRADS scores for suspicious nodules are tabulated in Table 1. Histopathological analysis is tabulated in Table 2.

Table 1: TIRADS score

TIRADS	Degree of malignancy suspicion	Frequency	Percent
4a	Low	4	7.3
4b	Intermediate	12	21.8
4c	Moderate	21	38.2
5	Probably malignant	18	32.7
Total		55	100

Table 2: Histopathological analysis

USG guided FNA/histopathology report	Frequency	Percent
Adenomatoid nodule	3	5.5
Anaplastic carcinoma (squamoid variant) of thyroid	1	1.8
Anaplastic carcinoma of thyroid	1	1.8
Follicular adenoma	10	18.2
Follicular carcinoma* - hurthle cell type	2	3.6
Follicular carcinoma*	5	9.1
Follicular variant of papillary carcinoma	11	20
Hurthle cell adenoma	3	5.4
Medullary carcinoma of thyroid	1	1.8
Micropapillary carcinoma of thyroid	1	1.8
Papillary carcinoma of thyroid	16	29.1
Poorly differentiated carcinoma - most probably of squamous cell origin	1	1.8
Total	55	100.0

(*patients underwent excision biopsy (hemi/total thyroidectomy) for definitive diagnosis in view of strong suspicion for malignancy)

Histopathological reports such as malignant or benign nodule are tabulated in Table 3. The association between different TIRADS categories and malignancies is tabulated Table 4.

Table 3: Cyto/histopathology report – malignant / benign nodules

CYTO/ Histopathology Report	Frequency	Percent
Malignant	39	70.9
Benign	16	29.1
Total	55	100

Table 4: Association between TIRADS categories and malignancies

			FNA REPORT (USG Guided)		
			Malignant	Benign	Total
TIRADS SCORE USG	4A	Count	0	4	4
		% within TIRADS SCORE USG	.0%	100.0%	100.0%
		% within FNA REPORT (USG Guided)	.0%	25.0%	7.3%
	4B	Count	2	10	12
		% within TIRADS SCORE USG	16.7%	83.3%	100.0%
		% within FNA REPORT (USG Guided)	5.1%	62.5%	21.8%
	4	Count	19	2	21
		% within TIRADS SCORE USG	90.5%	9.5%	100.0%
		% within FNA REPORT (USG Guided)	48.7%	12.5%	38.2%
	5	Count	18	0	18
		% within TIRADS SCORE USG	100.0%	.0%	100.0%
		% within FNA REPORT (USG Guided)	46.2%	.0%	32.7%
Total		Count	39	16	55
		% within TIRADS SCORE USG	70.9%	29.1%	100.0%
		% within FNA REPORT (USG Guided)	100.0%	100.0%	100.0%

5. Discussion

Out of 55 patients with suspicious thyroid nodules, majority were found in fourth decade and most of the lesions were seen in females (83.6%) as compared to males (16.4%). In present study out of 55 cases, 54 cases had solitary thyroid nodules and 1 patient had multiple nodules. 16 were adenomas; 10 cases were reported as follicular adenomas, 3 as hurthle cell adenomas and 3 cases were reported as adenomatoid nodule. Of the 16 adenomas, USG revealed hypoechoic nodule in 6 cases, isoechoic in 6 cases and 4 cases revealed hyperechogenicity. Carcinoma was diagnosed on cytopathology/histopathology in 39 cases of which 28 were papillary carcinoma, 7 were follicular carcinoma , 2 were anaplastic carcinoma, 1 was medullary carcinoma and 1 was poorly differentiated carcinoma. Cases diagnosed with papillary carcinoma predominantly revealed following features – hypoechogenicity, marked hypoechogenicity and micro calcifications, and lymph node invasion was seen in all the cases. In a total of seven cases diagnosed as follicular carcinoma on HPE, Ultrasound predominantly revealed solid hypoechoic pattern with no cystic component with irregular margins and a taller than wide shape. 1 case was diagnosed as medullary carcinoma. USG showed a solid hypoechoic pattern with macrocalcifications and posterior acoustic shadowing. The lesion showed irregular margins and no peripheral halo.

The acronym TIRADS seems to have come to stay. It harmonizes the reporting of thyroid US findings in a very simply way that facilitates comprehension across different specialties. For any such classification system to be useful for routine clinical practice, it should be simple to use, reproducible and very reliable. Thyroid cancer is a relatively rare entity. A high accuracy of any classification in predicting malignant thyroid lesions will be particularly of help in resource-limited settings where pathological analysis is not routinely performed even when confronted with some suspiciously malignant lesions. From our results, the risk of malignancy significantly increased from TIRADS 4A to 5. Most cancers were found in the TIRADS 4B, 4C and 5 categories. Combining TIRADS 4C and 5 as probably malignant, the sensitivity, specificity, positive predictive value and negative predictive value were respectively 94.87%, 87.50%, 95.1% and 94%. The overall accuracy of TIRADS was 96.5%. So if properly classified on US the probability of a particular nodule being malignant can be inferred from the TIRADS category with a certain level of confidence and appropriate measures for management can be initiated. The presence of some US features had earlier been described as highly suspicious for malignancy, and they include marked hypoechogenicity, solid composition, taller-than-wide shape, irregular contours and the presence of calcifications. In our study, marked hypoechogenicity, irregular contours and the presence of microcalcifications were found to be highly suspicious for malignancy as can be seen from the sensitivities, specificities, PPV, NPV and accuracy rates.

6. Conclusion

- TIRADS classification is reliable in predicting thyroid malignancy. Risk stratification of thyroid malignancy according to the number of suspicious US features allows for a practical and convenient TIRADS.
- TIRADS could be a cost-effective method in the management of thyroid lesions.
- Category 4A: FNA may be avoided on account of the relative low risk of malignancy. This would reduce management cost. Four cases with TIRADS category 4A in the present study turned out to be benign.
- Malignancy is relatively higher in thyroid nodules with microcalcifications, microlobulated margins and marked hypoechogenicity, than those nodules with the other two features - solid composition and taller-than-wide shape.
- No US sign independently is fully predictive of a malignant lesion and coexistence of two or more suspicious US criteria greatly increases the risk of thyroid cancer.
- Malignancy can be found even in non suspicious nodules.
- Cyto/histopathological study remains the gold standard in evaluation of thyroid nodules.

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Yashwanth A.S. received the M.B.B.S. degree from Rajiv Gandi University of Health Sciences, Bangalore, Karnataka in 2012. He has previously conducted a cross sectional study in Belagaum urban area, Karnataka during his internship. He is now pursuing post graduation course in M.D radio-diagnosis in K.S Hegde Medical Academy, Nitte University, Mangalore-575018, India. He has presented a scientific paper on primary retroperitoneal masses at IRIA National level conference in Chennai in 2016.