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Comparative evaluation of thyroid imaging reporting and data system and cytopathological correlation in thyroid nodules

Muthanna BA[1], Satyendra Raghuwanshi[2], Sanjay Kumar[3], Yashvir Mathur[4], Nalin Singh[5], Rohit Aggarwal[6]

[1]Associate Professor, Department of Radiology, [5]Assistant Professor, Department of Pathology, Command Hospital, Chandimandir, Haryana, [2]Assistant Professor, Department of Radiology, Armed Forces Medical College, Pune, Maharashtra, [3]Associate Professor, Department of Psychiatry, Military Hospital, Namkum, Jharkhand, [4]Associate Professor, [6]Professor, Department of Radiology, Command Hospital, Pune, Maharashtra, India

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ABSTRACT

Background: With the increasing availability of ultrasound (USG) and concern for malignancy, there has been significant increase in the detection of thyroid lesions. However, there is no uniformity in the reporting pattern among radiologists, and hence, such USG reports are mostly inconclusive to exclude thyroid malignancy. Therefore, most of the patients have to undergo fine needle aspiration cytology or fine needle non-aspiration cytology (FNNAC), which is avoidable. The sonographic assessment of thyroid nodule can provide alternative method to this invasive modality of diagnosis. Therefore, the need was felt for establishing uniformity in USG reporting of thyroid nodules and risk stratification for malignancy with aim of reducing unnecessary FNNAC. Thyroid imaging reporting and data system (TIRADS) classification brings uniformity in reporting and reduces ambiguity in management of the patients. **Aims and Objectives:** The objective of the study was to perform comparative evaluation of TIRADS and cytopathological evaluation of thyroid nodules FNNAC in Indian scenario. **Materials and Methods:** Multicentric prospective study was conducted in the department of radio diagnosis and department of surgery at defence service hospitals of Jaipur and Chandimandir during the study period of July 01, 2017–October 31, 2022. **Results:** Out of the 208 nodules, 28 (13.5%) turned out to be malignant. The percentage of malignant thyroid nodules was higher in nodules with TIRADS scores 4 and 5. The percentage of malignant thyroid nodules was 1% and 2%, respectively, for TIRADS 2 and 3 categories. The most common finding of USG evaluation was diffuse thyroiditis. There was a significant correlation between the USG findings and FNNAC findings in TIRADS scoring system. **Conclusion:** Our study shows high degree of correlation between TIRADS classification and cytopathological evaluation of thyroid nodules. Hence, TIRADS can be used an effective tool for avoiding unnecessary FNNAC procedures.

Key words: Thyroid nodules; Sonography; Fine needle aspiration

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INTRODUCTION

The prevalence of thyroid nodules is very high amounting to nearly one third of adult population.[1,2] However, the incidence of neoplasia in these nodules is fortunately rare.[3,4] Fine needle aspiration cytology (FNAC) is performed in all cases before surgery to assess the type of nodules. FNAC under ultrasound (USG) guidance is an accepted technique for obtaining better results.

There have been many publications attempting reliable evaluation of thyroid nodules on USG.[1-6] Thyroid imaging reporting and data system (TIRADS) has been proposed for categorization of thyroid nodules on the lines of breast imaging reporting and data systems (BIRADS®)[7,8] which

Address for Correspondence:
Dr. Yashvir Mathur, Associate Professor, Department of Radiology, Command Hospital, Pune, Maharashtra, India.
Mobile: +91-7674807707. **E-mail:** yashvirmathur@gmail.com

popularly utilized for evaluation of breast lesions. TIRADS has classified thyroid nodules based on the USG features. It aims at reduction in interobserver variation.[9]

Aims and objectives

The objective of the present study is to perform comparative evaluation of TIRADS and cytopathology reporting of thyroid nodules in Indian scenario.

MATERIALS AND METHODS

This multicentric prospective study was conducted in the Department of Radio diagnosis, Department of Surgery, and Department of Pathology at defence service hospitals of Jaipur and Chandimandir during the study period of 01 July 2017–31 March 2022. Patients with age of 18 years or more were included in this study. Clearance was obtained from hospital ethical committee. The patients who were suspected to have thyroid nodules were evaluated clinically by qualified surgeons and referred for necessary investigations. 230 patients reported to the Department of Radiodiagnosis for USG evaluation and USG-guided fine needle non-aspiration cytology (FNNAC) of thyroid nodules with suspicion of thyroid nodules. Subsequently, USG was done for all the patients using Wipro general electronics (GE) Logiq P3 color Doppler USG machine GE and Wipro GE Logiq F8 Expert USG machine at Jaipur and Hisar centers, respectively. The nodules were categorized as per TIRADS category as given by the American College of Radiology (ACR) in 2017 (Tables 1 and 2).[10] TIRADS also provides recommendations for further management of the patients (Table 3).

Only 202 of these 230 patients underwent FNNAC. Rest of the patients refused to give consent for the procedure or was lost to follow-up. USG-guided FNNAC was carried out for 208 nodules in these 202 patients. Therefore, the sample size was taken to be 208. Two slides for each sample were prepared and subsequently sent to pathology laboratory for evaluation and reporting by the pathologist. This prospective study included all consecutive patients reporting for USG and FNNAC of nodules to the hospital.

USG technique

Gray-scale sonography using a linear 7.5–12 MHz probe was performed by the radiologists. Color Doppler mode was also employed wherever felt necessary. The images were analyzed on real-time basis using both B mode and color Doppler. Representative images were saved in digital imaging and communications in medicine format in the USG machine. The scan area involved both the lobes and isthmus with the patient in the supine position with neck in hyperextended position. The neck area was also evaluated for cervical lymphadenopathy. Color Doppler was carried out wherever necessary. Size, shape, internal contents, echogenicity, margins, calcific foci, mural nodules, and septations were evaluated in the thyroid lesions. In those patients who had more than one nodule, all the nodules were examined by USG and findings documented. Internal contents of the lesions were categorized as solid, cystic, or mixed.

FNNAC technique

FNNAC was performed by trained radiologists under USG guidance using 24 gauge (24G) needle along with a 10 mL syringe. All these procedures were performed after written informed consent. A pathologist was always present during these FNNACs so that the samples are evaluated for quality and adequacy and also so that the slides are prepared properly. The patient was made to lie down supine in a hyperextended position. Aseptic precautions were ensured by cleaning the region of interest with betadine solution and leaving contact time of 5 min. Subsequently, the region was cleaned with sterillium solution using a gauge piece. A prepacked sterile gel was utilized for acoustic gel. The linear transducer probe was kept vertical. The needle was introduced at an angle perpendicular to the skin and the probe in the plane of the USG probe. The tip of the needle was always kept in the plane of scan. A 22 gauge needle with non-cutting and beveled edge was used. Non-aspiration technique was employed. The needle was maneuvered to obtain samples from the predominantly solid areas. Sample thus obtained was handed over to the pathologist for making slides and ascertaining adequacy of the samples. On average, two specimen slides were made for each nodule.

Table 1: ACR-TIRADS system for the evaluation of thyroid nodules

TIRADS	Definition	USG features	Risk of malignancy
1	Negative	Normal thyroid	Nil
2	Benign	Benign features	Nil
3	Probably benign	Without suspicious features	<5% malignancy
4A	Low suspicion	One suspicion feature	5–10%
4B	Intermediate suspicion	Two suspicion features	11–80%
4C	Moderate suspicion	Three or four suspicion feature	44.4–72.4%
5	High suspicion	Five suspicion features	>80%
6	Known proved malignancy	Confirmed malignancy	Biopsy proven malignancy

ACR: American College of Radiology, TIRADS: Thyroid imaging reporting and data system

Table 2: Based on the ACR-TIRADS system, a simplified reporting format was devised to streamline reporting of thyroid nodules based on their characteristics[10]

Criteria	Categories with points	
Composition	Cystic or almost completely cystic	0
	Spongiform	0
	Mixed solid and cystic	1
	Solid or almost completely solid	2
Echogenicity	Anechoic	0
	Hyperechoic or isoechoic	1
	Hypoechoic	2
	Very hypoechoic	3
Shape	Wider-than-tall	0
	Taller-than-wide	3
Margin	Smooth: 0 points	0
	Ill-defined: 0 points	0
	Lobulated/irregular	2
	Extrathyroidal extension	3
Echogenic foci	None	0
	Large comet tail artifacts	0
	Macrocalcifications	1
	Peripheral/rim calcifications	2
	Punctate echogenic foci	3

ACR: American College of Radiology, TIRADS: Thyroid imaging reporting and data system

Table 3: Various management recommendations based on the TIRADS score[10]

Category	Points	Suspicion	Recommendation
TIRADS 1	0	Benign	No FNAC
TIRADS 2	2	Not suspicious	No FNAC
TIRADS 3	3	Mildly suspicious	If >2.5 cm: FNA If >1.5 cm: Follow up at 1, 3, 5 years
TIRADS 4	4–6	Moderately suspicious	If >1.5 cm: FNA If >1 cm: Follow up at 1, 3, 5 years
TIRADS 5	7or more	Highly suspicious	If >1 cm: FNA If >0.5 cm follow annually for 5 years

TIRADS: Thyroid imaging reporting and data system

USG findings were classified in TIRADS and FNNAC which were reported by pathologist. Results were analyzed and compared statistically using statistical analysis which was carried out using the Statistical Package for the Social Sciences for Microsoft Windows 7. ODDs ratio were calculated and $P<0.05$ was considered as statistically significant.

RESULTS

Out of the 202 patients included in the study, 52 of the total patients were male (25.74%) and 150 were female (74–25%). Gender distribution is shown in Figure 1. 191 of the total patients were <40 years of age. The youngest patient was 18 years of age and the oldest was 50 years of age. Total number of 208 thyroid nodules was evaluated by both USG and FNAC. One patient had 4 nodules, two patients had three nodules, and six patients were detected to have two nodules. Demographic distribution of the patients is given in Table 4. The size range of the thyroid nodules in our study was 3 mm to 47 mm. Figure 2 depicts the various types of nodules seen in the study.

Table 4: Demographic distribution of the study population

Age group	Number of patients	Percentage (%)
<10 years	Nil	0
18–20	9	4.45
21–30	32	15.84
31–40	150	74.25
41–50	11	5.45
51 and above	Nil	0

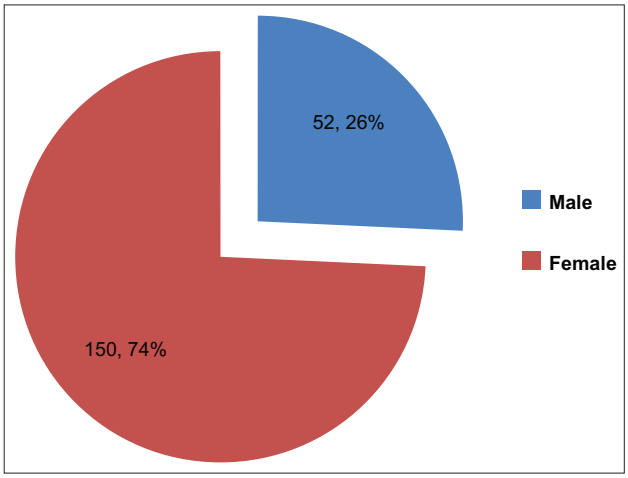

Figure 1: Gender distribution of study population

Out of the 208 nodules, 28 (13.5%) were found to be malignant. The percentage of malignant thyroid nodules was higher in nodules with TIRADS scores 4 and 5. The percentage of malignant thyroid nodules was 1% and 2%, respectively, for TIRADS 2 and 3 categories. The most common finding was diffuse thyroiditis. There was a significant correlation between the USG findings and FNNAC findings in TIRADS scoring system (Table 5).

DISCUSSION

Thyroid lesions are getting detected more and more recently because of increasing availability of USG and concern for malignancy.[11,12] Most of the cases of thyroid lesions are referred for USG scanning. However, due to the lack of uniformity in the reporting among radiologists, such USG reports do not conclusively exclude thyroid malignancy. At present, there have been attempts to standardize the reporting pattern for various organs such as breast, liver,

Table 5: Comparison and correlation between USG TIRADS category and FNNAC reports

TIRADS classification	Number of nodules	Benign on FNAC (%)	Malignant on FNAC (%)	OR (95% CI)	P-value
TIRADS–1	20	20 (100)	0 (0)	7.28 (0.428–123.81)	0.169
TIRADS–2	45	44 (97.7)	1 (2.3)	8.23 (1.153–66.16)	0.035
TIRADS–3	83	81 (97.5)	2 (2.5)	10.636 (2.450–46.164)	0.0016
TIRADS–4 (4A+4B+4C)	38	34 (89.5)	4 (11.5)	0.2774 (0.1086–0.7089)	0.007
TIRADS–5	22	1 (4.5)	21 (95.5)	0.0259 (0.0086–0.781)	<0.001
Total	208	180 (86.5)	28 (13.5)		

USG: Ultrasound, TIRADS: Thyroid imaging reporting and data system

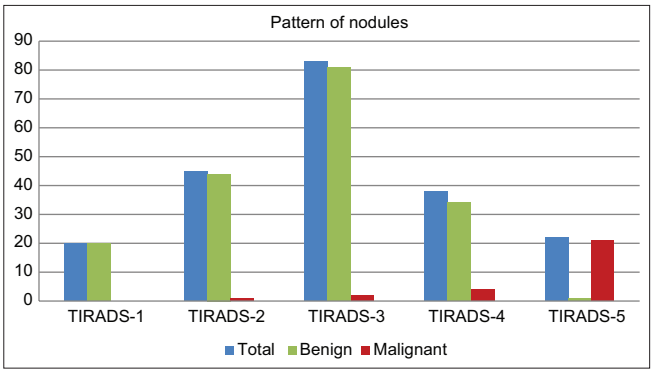

Figure 2: Comparison between ultrasound TIRADS category and FNNAC reports

prostate, and thyroid, which has led to the development of BIRADS, LIRADS, PIRADS, and TIRADS.[13-16]

In a study by Horvath et al., an initial classification was proposed for reporting of thyroid nodules which included increasing risk of malignancy with increasing score.[17] ACR proposed TIRADS scoring system which provides objective method of assessing thyroid nodules based on their characteristics, stratifies risk, and provides treatment guidelines.[9] Our study shows significant correlation of higher TIRADS score with histopathological findings. Similar results were seen studies of Junior et al.,[18] and Srinivas et al.[19] In our study, female patients constituted about 74% of the total patients which is consistent with high incidence of thyroid nodules in females. Most of the patients were in the age bracket of 30–40 years. Similar findings were also reported by a study conducted by Gharib and Papini.[20]

As the TIRADS category increases, the likelihood of malignancy in TIRADS scoring also increases. Furthermore, TIRADS provides the recommendation of whether to go ahead with FNNAC or not. Although FNNAC is being recommended in most of the cases of thyroid nodule, it is an invasive procedure. With the use of TIRADS scoring system, the number of avoidable FNACs can be reduced.[17-20] Since thyroid malignancies are slow-growing lesions, a long-term follow-up is often required. TIRADS also provides management guidelines for thyroid lesions which includes follow-up or FNAC.

Limitations of study

Our study suffers limitation of small sample size. Furthermore, demographic distribution was restricted as the health-care services were provided only to the defence service personnel and their dependents.

CONCLUSION

Thyroid nodules are very common and are having increasingly high incidence. FNAC or FNNAC is most often carried out for thyroid nodules. Such investigation not only is invasive but also needs repetition in many patients. USG is non-invasive, inexpensive and serves as available alternative to FNNAC. However, before introduction of TIRADS, there was a lack of uniformity and reproducibility for thyroid nodules. The use of TIRADS is an effective tool in reducing avoidable invasive procedures. TIRADS classification brings uniformity in reporting and reduces ambiguity in management of the patients. Our study shows high degree of correlation between TIRADS classification and HPE diagnosis. TIRADS can be used an effective tool for avoiding unnecessary invasive procedures.

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Authors Contribution:
MBA- Definition of intellectual content, literature survey, prepared first draft of manuscript, implementation of study protocol, data collection, data analysis; **SR-** Concept, design, clinical protocol, manuscript preparation, editing, and manuscript revision; **SK-** Design of study, statistical analysis and interpretation; **YM-** Concept, design, clinical protocol, manuscript preparation, editing, and manuscript revision and submission of article; **NS-** Concept, design, clinical protocol, literature survey and preparation of figures; **RA-** Review manuscript.

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Command Hospital Chandimandir, Haryana, India and Military Hospital Jaipur, Rajasthan, India.

Orcid ID:
Dr. Muthanna BA - https://orcid.org/0000-0002-3763-7633
Dr. Satyendra Raghuwanshi - https://orcid.org/0000-0002-3954-6786
Dr. Sanjay Kumar - https://orcid.org/0009-0008-3855-1250
Dr. Yashvir Mathur - https://orcid.org/0000-0003-0370-0064
Dr. Nalin Singh - https://orcid.org/0000-0001-7766-9149
Dr. Rohit Aggarwal - https://orcid.org/0000-0003-3480-4608

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