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# A study of TIRADS classification system of ultrasonography with histopathology in evaluation of thyroid nodule

**Priti Dhoke[1], Kanchan Dhote[2], Vivek Harkare[3], Nitin Deosthale[4], Sonali Khadakkar[5]**

[1] Associate Professor, Department of ENT, N.K.P. Salve Institute of Medical Sciences & Research Centre, Nagpur, Maharashtra, India
[2] Senior Resident, Department of ENT, N.K.P. Salve Institute of Medical Sciences & Research Centre, Nagpur, Maharashtra, India
[3] Professor & HOD, Department of ENT, N.K.P. Salve Institute of Medical Sciences & Research Centre, Nagpur, Maharashtra, India
[4] Professor, Department of ENT, N.K.P. Salve Institute of Medical Sciences & Research Centre, Nagpur, Maharashtra, India.
[5] Senior Resident, Department of ENT, N.K.P. Salve Institute of Medical Sciences & Research Centre, Nagpur, Maharashtra, India

**Abstract**
**Aim:** To compare the findings of ultrasonographic diagnosis of solitary thyroid nodules(STN) by TIRADS classification with histopathological diagnosis.
**Methodology:** 62 euthyroid patient with clinically palpable STN more than 1cm were selected and subjected to detailed ENT including indirect laryngoscopy, systemic Examination and USG by TIRADS classification.They were subjected to definitive surgical procedure i.e Hemithyroidectomy or Total Thyroidectomy. Post-operative specimen was sent for histopathology. Data obtained was analysed using appropriate statistical test and inference drawn.
**Result:** We found that Sensitivity, specificity of USG by TIRADS classification for differentiating benign and malignant thyroid nodule were 85.7% and 96.36% respectively.
**Conclusion:** TIRADS classification is simple practical method of accessing thyroid nodule with high PPV for malignancy and justified on routine basis for management of STN.

**Keywords:** thyroidectomy, ultrasonography, histopathology

## Introduction

Thyroid nodules are one which can be symptomatic or asymptomatic, visible on inspection, or palpable or identified by imaging techniques, such as ultrasound. Benign thyroid nodules are highly prevalent in iodine deficient areas. Solitary nodules are one of the commonest presentations of thyroid disorder [1]. In India the prevalence of a palpable thyroid nodule in the community is about 12.2% [2]. A solitary nodule has a higher risk of malignancy than a multinodular goiter [3]. The incidence of malignancy in STN is 10- 30% [4, 5]. Solitary thyroid nodule is more common in females with female to male ratio being 6:1 [6]. When thyroid nodule is present in men, the risk of malignancy is twice that of female [7]. The incidence of unsuspected carcinoma is quite high in solitary thyroid nodule in euthyroid patient to justify exploration in all cases in which patient is fit for surgery [8]. The initial evaluation of thyroid nodules should always focus on exclusion of malignancy. Ultrasonography is the initial investigation along with FNAC and histopathology is considered gold standard to prove malignancy.

TIRADS classification for the assessment of solitary thyroid nodules is a relatively simple classification by ultrasonography. This can be easily adopted, just like Breast Imaging-Reporting and Data System (BIRADS) which has been successfully used for several years for assessment and management of breast lesions. [9] The terminology of TIRADS was first used by Horvath *et al*. [10] Thyroid Imaging Reporting and Data System (TIRADS) was further modified and described by Kwak *et al.* [11] On the basis of TIRADS classification, patients are classified into six categories ranging from normal thyroid to a malignant nodule [12].

This study was carried out with the aim to compare the findings of ultrasonographic diagnosis of solitary thyroid nodules by TIRADS classification compared to histopathological diagnosis which is a gold standard.

## Methodology

Ours was a descriptive study carried out from August 2017 to Sept 2019. Every consecutive patient of either sex attending E.N.T OPD and Surgery OPD, of a Tertiary Health Care Centre, fulfilling inclusion criteria was included in the study. Prior Institutional Ethical Committee clearance was obtained. Written informed was taken. The study comprised of 62 patients.

All euthyroid patients with clinically palpable solitary nodule of more than 1 cm of either sex of age 18 and above were included in our study. Multinodular goitre on ultrasonography and previously operated cases were excluded from the study.

The selected patients were subjected to detailed history and complete ENT examination. A detailed history of thyroid swelling was inquired. Detailed clinical, systemic examination and local examination of neck was done. Indirect laryngoscopy using 70 degree endoscope was done to evaluate vocal cord mobility. Thyroid function test (T3, T4, TSH) was done to confirm euthyroid status.

Ultrasonography was done on OPD basis by a senior radiologist using Esote My lab 50 X vision machine with

higher resolution equipped with Linear probe of 7.5 MHz to 12MHz. With the help of clinical information, they evaluated the sonographic features such as the internal composition, echogenicity, margins, shape, presence and type of calcifications, vascularity and regional lymphadenopathy. Solid component, hypoechogenicity, microcalcification, taller than wider shape and irregular margins were considered high risk features. The radiologists then reviewed the ultrasound findings and determined the category of a particular lesion according to the TIRADS classification suggested by Kwak *et al*, [11] wherein, normal thyroid gland was classified under TIRADS 1 (negative), benign nodule under TIRADS 2, probably benign nodule (no suspicious ultrasound features) under TIRADS 3, a nodule with low suspicion under TIRADS 4A, a nodule with intermediate suspicion for malignancy (two suspicious ultrasound features with or without lymphadenopathy) under TIRADS 4B and a nodule highly suggestive of malignancy ( four or five suspicious ultrasound features with or without lymphadenopathy) under TIRADS 5[12].

Cervical lymph nodes were evaluated for their size, loss of the central acrogenic hilum, presence of irregular and indistinct margin, micro calcification, and necrotic changes.

For statistic convenience, TIRADS 2, 3 was grouped into benign category and TIRADS 4a, 4b and 5 was grouped into malignant category.

FNAC and if required ultrasonography guided FNAC was done on OPD basis using aseptic precaution. The results obtained were classified according to Bethesda classification.

CT scan was planned in those patients who were diagnosed to have malignancy on FNAC to know the extent and to stage the disease. Routine blood investigations, chest x-ray (PA view), neck x-ray lateral view was done.

Patients were subjected to definitive surgical procedures according to standard guidelines i.e. Hemithyroidectomy or Total thyroidectomy, with preservation of parathyroid gland depending upon USG by TIRADS classification and FNAC report and also after considering any high risk features for malignancy. Histopathology reporting was done and those patients who had benign lesion on histopathology were discharged and routine follow up of patients was done and those with malignancy were managed according to standard guidelines for head and neck malignancy.

Sensitivity, Specificity, positive and negative predictive value of each TIRADS group was calculated compared with the gold standard histopathology using appropriate formula. Fischer's exact test or Chi square test was used to analyze the significance of difference between frequency distribution of the data.

## Results and Discussion

The mean age in our study was 37.48 ± 10.60 years and Male: female ratio was 1: 5.8. Almost all patients came with complaints of neck swelling which was the primary concern. Sudden increase in size was observed in 8 (12.9%) patients. Change in voice was observed in 7 (11.29%) patients. 5 (8.04%) patients showed symptom of dysphagia. Only one subject had difficulty in breathing. 1 patient came with symptom of pain additionally. Patients were categorisized according to their respective TIRADS and BETHESDA grading as shown in the table 1

**Table 1:** Showing distribution of patient according to Bethesda system and TIRADS Classification (N=62)

| Classification System | | No. of patients | Percentage (%) |
|---|---|---|---|
| Bethesda System | Category 1 | 7 | 11.29 |
| | Category 2 | 41 | 22.58 |
| | Category 3 | 6 | 9.68 |
| | Category 4 | 4 | 6.45 |
| | Category 5 | 1 | 1.61 |
| | Category 6 | 3 | 4.84 |
| Total | | 62 | 100 |
| TIRADS Classification | TIRADS 2 | 40 | 64.52 |
| | TIRADS 3 | 14 | 22.58 |
| | TIRADS 4a | 3 | 4.84 |
| | TIRADS 4b | 3 | 4.84 |
| | TIRADS 5 | 2 | 3.23 |
| Total | | 62 | 100 |

Maximum number of patients in our study, that is 41(22.58%) of the patients belonged to category 2 of BETHESDA classification.

On ultrasonography majority of the patients that is 40 (64.5%) were classified under TIRADS 2 having benign lesion. TIRADS 1 is considered normal thyroid gland while TIRADS 4b include highly suspicious lesion and TIRADS 5 suggests frank malignant lesions. All the patients were subjected to surgeries as per protocol as shown in table 2.

**Table 2:** Distribution of patients according to Surgery performed (N=62).

| Surgery performed | No of patients | Percentage (%) |
|---|---|---|
| Hemithyroidectomy | 55 | 88.71 |
| Total thyroidectomy with central compartment node clearance. | 4 | 6.45 |
| Hemithyroidectomy followed by Completion thyroidectomy and central compartment node clearance. | 3 | 4.84 |
| Total | 62 | 100.0 |

Hemithyroidectomy was performed in 55 (88.7%) patient. 4 (6.5%) patients who had follicular neoplasia on FNAC were found to have stage 2 thyroid malignancy on CT Scan, hence underwent total thyroidectomy with central compartment neck node clearance. 3 patient who were diagnosed to have benign lesion on FNAC but later their histopathology report showed malignancy, had to undergo completion thyroidectomy with central compartment neck clearance. In our study Colloid cyst was the most common histopathology finding (table 3).

**Table 3:** Distribution of subjects according to Histopathology findings in patients (N=62).

| Histopathology | No of patients | Percentage (%) |
|---|---|---|
| Colloid cyst/ goiter/ cystic nodule | 32 | 51.61 |
| Hasimotos thyroiditis | 1 | 1.61 |
| Follicular adenoma | 22 | 35.48 |
| Follicular Carcinoma | 2 | 3.23 |
| Follicular variant of papillary carcinoma | 2 | 3.23 |
| Papillary carcinoma | 3 | 4.84 |
| Total | 62 | 100.0 |

**Table 4:** Diagnostic utility of TI-RADS interpretation and histopathology interpretation in study subjects

| | | Histopathology interpretation | | Total |
|---|---|---|---|---|
| | | Benign | Malignant | |
| TI-RADS interpretation | Benign(2,3) | 53 | 1 | 54 |
| | Malignant(4a,4b,5) | 2 | 6 | 8 |
| Total | | 55 | 7 | 62 |

| | Sensitivity | Specificity | Positive predictive value | Negative predictive value | Accuracy | p Value |
|---|---|---|---|---|---|---|
| USG TIRADS | 85.7% | 96.36% | 75% | 98.14% | 95.16% | <0.0001 |

It was observed that USG by TIRADS classification, has a sensitivity of 85.7%, specificity of 96.36%, PPV of 75% and NPV of 98.14%. Its accuracy to diagnose malignancy is 95.16%(table 4). The P value observed is <0.0001 which is statically significant.

In India the prevalence of a palpable thyroid nodule in the community is about 12.2%. However, thyroid cancer is quite rare with incidence of 8.7 per 100000 people per year [13, 14]. Malignancy occur in about 5% of all thyroid nodules independent of their size [15].

Solitary thyroid nodules (STN) occur in 4 - 7% of the adult population with 10- 20% incidence of malignancy [16]. So, people should be educated to take early intervention. The main goal is to identify those STN with malignant potential as they are amendable to medical or surgical management. Hence it is become mandatory to develop a tool which can differentiate benign from malignant thyroid nodule. Thus, STN should be characterized properly for optimum management [15].

According to Bhatnagar *et al*, [17] out of sixty patients with STN, distribution of cases according to TIRADS classification system was, 10 patients, 29 patients, 12 patints,5 patients and 4 patients in TIRADS class 2, 3, 4a, 4b and class 5 respectively. Chandramohan *et al*. [18] reported that out of 346 patients, 66 and 122 patients were in TIRADS class 2 and 3 respectively out of which 3 and 30 patients were found to have malignancy respectively. Patients in Class 4a, 4b, 4c and 5 were 49, 27, 35 and 47 respectively out of which 14, 14, 16 and 41 patients were malignant.

Our findings can be correlated with study by Jena *et al.* [19] in which hemithyroidectomy was performed in benign nodules by FNAC report. In those cases where postoperative HPE was reported as malignant, completion thyroidectomy of the remaining lobe was done. Total thyroidectomy was done in those cases where FNAC was reported as malignant.

In our study, distribution of patients was done according to histopathology findings. It was found that majority of the patients that is 32 (51.61%) patients had colloid goitre / cystic nodule as diagnosis followed by 22 (35.48%) patients who had follicular adenoma. 1 (1.61%) patient had hashimoto's thyroiditis. Thus it was observed that, benign lesions were present in 55 (88.71%) of the total study patients. Papillary carcinoma was observed in 3 (4.84%) patients. While, 2 (3.23%) patients each had follicular carcinoma and follicular variant of papillary carcinoma. These findings were in accordance with the study by Keh *et al*, [20] in which majority 37.7% of patients of STN had follicular adenoma followed by colloid nodule in 19.7% patients. In this study, it was observed that USG by TIRADS classification, have a sensitivity of 85.7%, specificity of 96.36%, Positive predictive value (PPV) of 75% and Negative predictive value (NPV) of 98.14%. Its accuracy to diagnose malignancy is 95.16%. The P value observed was (<0.0001) which is statically significant. Similarly, according to Macedo *et al*. [21], The sensitivity, specificity, NPV and accuracy of the TI-RADS were 100, 61.6, 100, and 63% respectively. Also Chandramohanetal [22] concluded that the diagnostic performance of TIRADS considering categories 4a, 4b, 4c, and 5 as malignant and categories 2 and 3 as benign was- Sensitivity = 72%, specificity = 68.8%, PPV = 63.9%, negative predictive value (NPV) = 76.2%, and accuracy = 70.2%.Bhatnagar *et al* [17] also revealed that the sensitivity and specificity for Irregular contours were 44.4% and 94.12%, for taller than wide were 22.22% and 100%, for micro calcification were 33.3% and 94.12%, for marked hypo echogenicity were 78% and 70.89% and for solid consistency were 89 and70.5% respectively. The risk of malignancy was found to increase from TIRADS 3 to TIRADS5.According to study by Zhang *et al*, [23] the sensitivity, specificity, PPV, NPV and accuracy of TIRADS were 97%, 90%, 40%, 99%, and 91%, respectively similar to this study. In accordance with our study, Wei *et al* [24] reported that pooled sensitivity and specificity were 0.79 and 0.71 respectively. In a study by Srinivas *et al*. [25] The risk of malignancy in TIRADS categories 1 and 2 was found to be 0%, 0.64% in category 3, 4.76% in category 4A, 66.67% in category 4B, 83.33% in category 4C, and 100% in category 5. A study by Delfim *et al.* [26] sensitivity was (82.0%) and specificity was (87.6%).

## Conclusion

In our study It was observed that in three cases in which malignancy was missed on FNAC, all these 3 cases were under malignant group of TIRADS classification. Thus if TIRADS classification was considered for management, second surgery in those patient could have been avoided. It was observed that USG by TIRADS classification have good sensitivity, specificity, positive and negative predictive value being 85.7%, 96.36%, 75% and 98.14 % respectively. In our study USG TIRADS have a good accuracy rate to diagnose malignancy.

USG is a non-invasive, cheap, easily accessible and accurate modality to diagnose malignant thyroid lesion and TIRADS classification have good ability to differentiate between benign and malignant nodules, thus can help the clinician in management of STN on routine basis thus avoiding second thyroid surgery which carries high mortality and morbidity.

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