ISSN: 0975-3583,0976-2833 VOL14, ISSUE 02, 2023

## ORIGINAL RESEARCH

# Ultrasonography based thyroid imaging reporting and data system (tirads) in risk stratification of malignancy in thyroid nodules

**[1]Dr. Poonam Ohri, [2]Dr. Rashmi Girdhar, [3]Dr. Bikramjit Singh, [4]Dr. Jaspreet Singh, [5]Dr. Manasi Kohli, [6]Dr. Parushi Kohli**

[1]Professor and Head, [2]Junior Resident, Department of Radiodiagnosis, Govt. Medical College, Amritsar, Punjab, India
[3]Professor, Department of Surgery, Govt. Medical College, Amritsar, Punjab, India
[4]Professor, Department of Pathology, Govt. Medical College, Amritsar, Punjab, India
[5]Medical Officer, Hargun Hospital, Batala Road, Amritsar, Punjab, India
[6]MBBS Student, SGRD University of Health Sciences, Amritsar, Punjab, India

**Corresponding author**
Dr. Rashmi Girdhar
Junior Resident, Department of Radiodiagnosis, Govt. Medical College, Amritsar, Punjab, India
**Email:** rashmigirdhar569@gmail.com

Received: 18 February, 2023 Accepted: 22 March, 2023

**Abstract**
**Aims and objectives**: 1) To categorise the thyroid lesions according to TIRADS (Thyroid Imaging Reporting and Data System) classification into benign and malignant based on gray scale sonography and color doppler findings.
2) To compare the thyroid categorized according to TIRADS with the findings of cyto/histopathology as gold standard
**Results**: The sensitivity, specificity, positive predictive value and negative predictive value of TIRADS in predicting malignancy was 100 %, 88.3%, 31.3 % and 100% respectively. The diagnostic accuracy of TIRADS was found to be 88.9 % in our study. ACR proposed TIRADS is a reliable, highly specific and accurate classification system for stratifying thyroid nodules according to their risk of malignancy based on their sonographic features.

## Introduction

A thyroid nodule is a discrete lesion within the thyroid gland that is radiologically distinct from surrounding thyroid parenchyma.
Ultrasound is the most extensively used imaging modality for assessing thyroid nodules and distinguishing between benign and malignant nodules. It's simple to do, generally available and doesn't expose you to radiation. Thyroid nodules area a manifestation of a gamut of thyroid disease, rather than a single disease.[7]
Pathologically thyroid nodules are classified into 5 types with distinct histological features: hypoplastic, neoplastic, colloid, cystic and thyroiditic nodules.
The American college of radiology proposed TIRADS classification in 2015. which was further modified in 2017. It uses a system based on allocating points for sonographic features of nodules in morphological categories (composition, echogenicity, margins, shape and echogenic foci). The committee divided nodules into five suspicion levels: benign (TR1), not suspicious (TR2), mildly suspicious (TR3), moderately suspicious (TR4), and highly suspicious (TR5).

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 02, 2023

Nodule composition, characteristics of cystic/solid components, echogenicity, shape, size/dimensions, borders, echogenic foci, halo and flow/doppler were initially defined as nine categories of terminology that may be applied to thyroid nodules. But finally only 6 final categories were considered i.e composition, echogenicity, shape, size, margins and echogenic foci. The nodules classified as TR1 and TR2 have <2% risk of malignancy hence do not require FNAC, whereas nodules under TR3, TR4 and TR5 are predicted to have a risk of malignancy of less than 5%, 5-20% and greater than 20% respectively, with FNAC recommended for nodules above the threshold size of 2.5, 1.5 and 1cm respectively.

## Material and methods

### Place of study

The study will be conducted in Government Medical College Amritsar in association with department of surgery and pathology.

### Study population

- **Inclusion Criteria:** All adult patients who were detected clinically or incidentally with nodular thyroid disease.
- **Exclusion Criteria:** All operated cases of thyroid nodules

### Study design

Cross sectional study

### Sample size

100 cases

### Duration of study

2years

Ethical clearance has been obtained from the Research and Dissertation Committee/ Ethical Committee of the institution for the study.

### Methodology

Clinical details such as age, sex, relevant clinical examination and laboratory findings of patients recorded. Each patient was examined by high resolution gray scale ultrasonography and color doppler. High resolution gray scale ultrasonography: Ultrasound examination of the thyroid gland was performed using Mindray DC-8 machine using high frequency probe (4-9MHz).

The patients will be examined in the supine position with their head in extended position. The number and size of the nodules will be recorded. Each nodule will be evaluated for five sonological features: composition, echogenicity, shape, margin, presence and type of echogenic foci in the lesion. Each feature was assigned point and a total score was calculated for each nodule and was assigned a specific TIRADS category. If multiple thyroid nodules were present in a patient, a maximum of four nodules with highest total score will be reported.

**Thyroid Imaging Reporting and Data System (TIRADS) Point Allocation Scheme.**

| **Composition (Choose 1)** | |
|---|---|
| Cystic or almost completely cystic | 0 |
| Spongiform | 0 |
| Mixed cystic and solid | 1 |
| Solid or completely solid | 2 |

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 02, 2023

| | |
|---|---|
| Cannot be determined due to calcification | 3 |
| **Echogenicity (Choose 1)** | |
| Anechoic | 0 |
| Hyperechoic or Isoechoic | 1 |
| Hypoechoic (compared to thyroid parenchyma) | 2 |
| Very Hypoechoic (compared to strap muscles) | 3 |
| Cannot be determined | 1 |
| **Shape (Choose 1)** | |
| Wider than Tall (AP<Transverse diameter) | 0 |
| Taller than wide (AP>Transverse) | 3 |
| **Margin (Choose 1)** | |
| Smooth | 0 |
| Ill defined | 0 |
| Lobulated or Irregular | 2 |
| Extra thyroidal extension | 3 |
| Cannot be determined | 0 |
| **Echogenic Foci (Choose All That Apply)** | |
| None or large comet tail artifacts(>1mm) | 0 |
| Macrocalcification | 1 |
| Peripheral (rim) calcification | 2 |
| Punctate echogenic foci(<1mm) | 3 |

| Points | ACR Tirads |
|---|---|
| 0 | TRI-Benign |
| 2 | TR2-Not Suspicious |
| 3 | TR3-Mildly Suspicious |
| 4-6 | TR4-Moderately Suspicious |
| >7 | TR5 Highly Suspicious |

**Color Doppler:** All the thyroid nodules will be examined and their vascularity pattern will be categorised into one of the following types: absent, peripheral, intranodular or mixed (peripheral and intranodular) correlation with cytopathological diagnosis: The diagnostic performance of ACR proposed TIRADS classification system will be evaluated with FNAC correlation in all patients. Reference Standard - Cytopathological findings will be considered gold standard in all cases.

**Case 1: Colloid nodule**

51 years old female patient presented with painless swelling on right of neck

**Fig. 1 (A): High resolution gray scale ultrasound of right lobe of thyroid reveals a**

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 02, 2023

**4.6cm (maximum diameter), oval smoothly marginated, anechoic almost cystic nodule. Few moving echoes are seen within it and eccentric echogenic nodule is also. No calcification is seen within this lesion. No vascularity was noted on color Doppler**

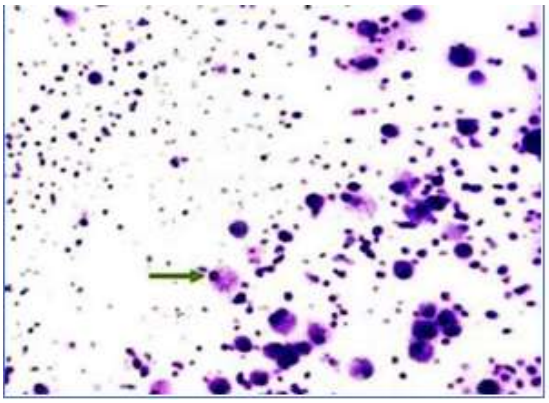


**Figure 1(B) Cytology: cytological evaluation of the nodule revealed benign follicular epithelial cells with foam cell macrophages in the background of abundant colloid s/o colloid nodule.**

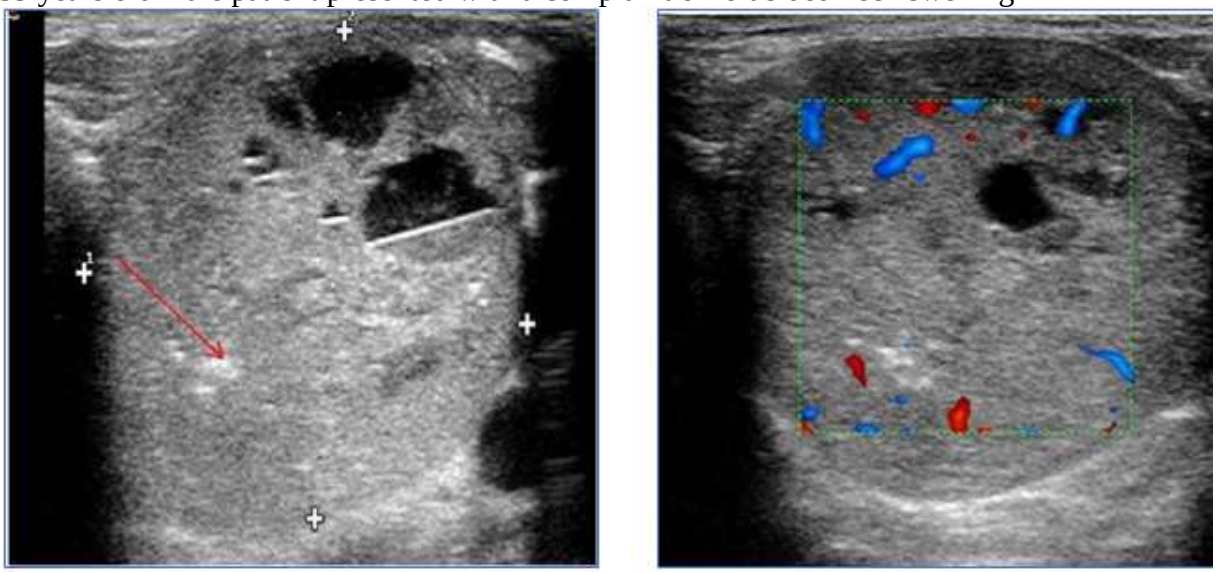
**TIRADS assessment**

1. Composition: almost cystic (score 0)
2. Echogenicity: anechoic (score 0)
3. Shape: wider than tall (score 0)
4. Margin: smooth (score 0)
5. Echogenic foci: absent (score 0)

TIRADS Points – 0
ACR-TIRADS Category: TR – 1

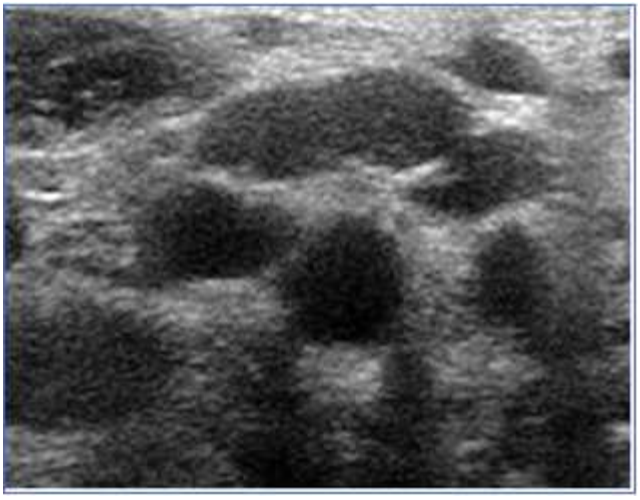
**Case 2: Medullary Carcinoma**

39 years old male patient presented with a complaint of left sided neck swelling



**(A)** **(B)**

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 02, 2023



**(C)**

**Figure (A): High resolution Ultrasound image shows an almost solid, very hypoechoic lesion with punctate echogenic foci (Red arrow) within it. (B) On color doppler, lesion shows mixed vascularity. (c) Suspicious lymph nodes are noted with loss of fatty hilum.**

**TIRADS assessment**

1. Echogenicity: very hypoechoic (score 3)
2. Composition: solid (score 2)
3. Shape: wider than taller (score 0)
4. Margins: extrathyroidal extension (score 3)
5. Echogenic foci: punctate echogenic foci (score 3)

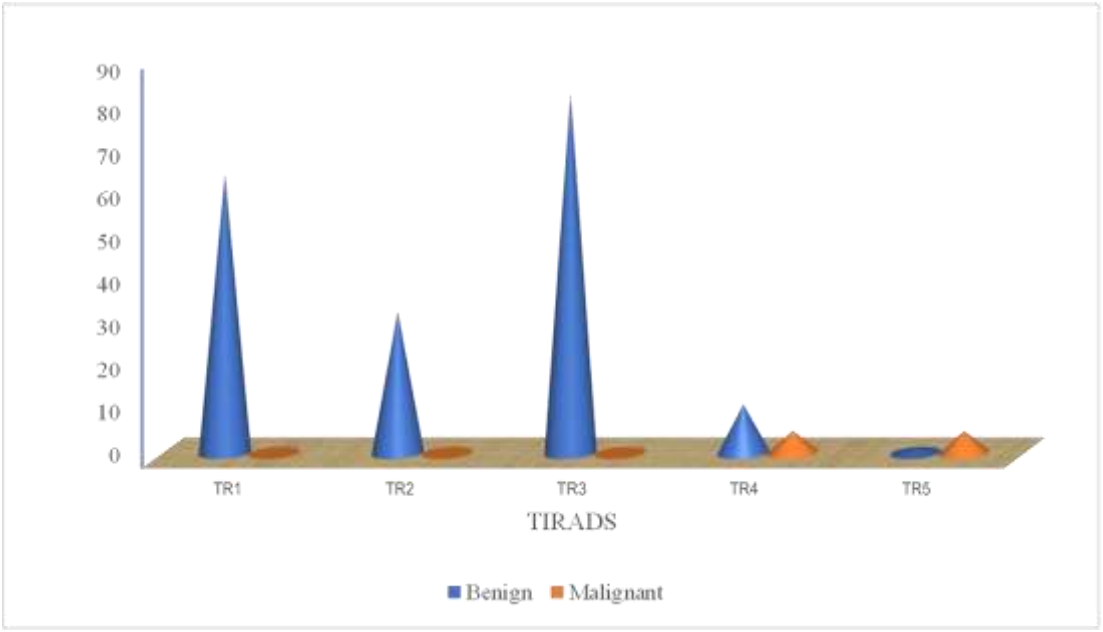
TIRADS score: 11
ACR TIRADS category: 5
Histopathological evaluation of the thyroid nodule reveals medullary neoplasm

**Results**

**Table 1: Association of tirads category with malignancy (N=198)**

| Tirads Category | Number of benign lesions | Number of malignant lesions | Total number of lesions | Risk of malignancy (%) |
|---|---|---|---|---|
| TR1 | 63 | 0 | 63 | 0.0% |
| TR2 | 32 | 0 | 32 | 0.0% |
| TR3 | 81 | 0 | 81 | 0.0% |
| TR4 | 11 | 5 | 16 | 31% |
| TR5 | 1 | 5 | 6 | 83.3% |
| TOTAL | 188 | 10 | 198 | |

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 02, 2023



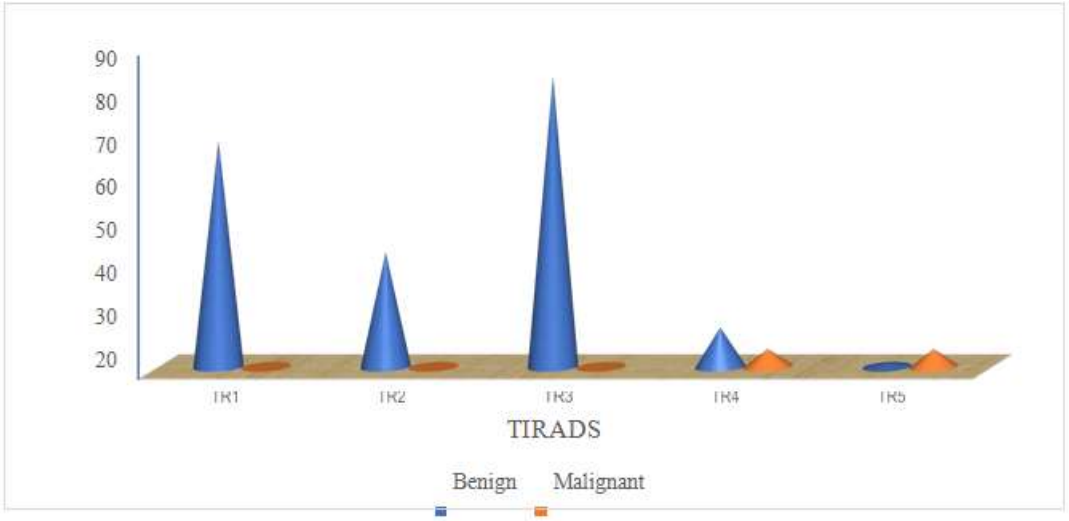

None of the thyroid TR1, TR2, TR3 nodules were malignant. The risk of malignancy was 0% among TR1, TR2 and TR3 nodules

Only 5 of the 11 TR4 nodules were malignant. Risk of malignancy was 31%. Risk of malignancy among TR5 nodules were found to be highest (83.3%).

According to ACR-TIRADS TR4 and TR5 nodules are moderately and highly suspicious they risk of malignancy being 5-20% and >20% respectively. The risk of malignancy TR1, TR2 and TR3 nodules is <5%. Hence, for the purpose of analysis TR4 and TR5 category malignant and TR1, TR2 and TR3 are benign.

**Table 2: Diagnostic performance of suspicious sonographic features of tirads**

| Sonographic features | Sensitivity (%) | Specificity (%) | PPV (%) | NPV (%) |
|---|---|---|---|---|
| Solid Composition | 100.0 | 62.8 | 12.5 | 100 |
| Hypoechoic echotexture | 70.0 | 97.3 | 58.3 | 98.4 |
| Very hypoechoic echotexture | 30.0 | 99.4 | 75.0 | 96.4 |
| Lobulated margin | 20.0 | 100.0 | 100.0 | 95.9 |
| Extrathyroidal extension | 40.0 | 100.0 | 100.0 | 96.9 |
| Punctate echogenic foci | 50.0 | 98.4 | 62.5 | 97.4 |



ISSN: 0975-3583,0976-2833 VOL14, ISSUE 02, 2023

**Table 3: Diagnostic performance of tirads**

| Sensitivity (%) | Specificity (%) | PPV (%) | NPV (%) | Accuracy (%) |
|---|---|---|---|---|
| 100 | 88.3 | 31.3 | 100 | 88.9 |

The most sensitive sonographic feature for malignancy was solid composition (Sn 100%), followed by hypoechoic echotexture (Sn 70%).

The sensitivity, specificity, positive predictive value, negative predictive value of ACR-TIRADS was found to be 100%, 88.3%, 31.3% and 100% respectively. The overall accuracy of TIRADS in detecting malignancy was found to be 88.9%.

## Conclusion and summary

The study was conducted in the Department of Radiodiagnosis, Government Medical College, Amritsar. A total of 100 adult patients of either sex with nodular thyroid disease were included in the study. The present study was undertaken to evaluate the role of ACR (American College of Radiology) proposed TIRADS (Thyroid Imaging Reporting and Data System, 2017) in the risk stratification of malignancy in thyroid nodules and henceforth determine its diagnostic accuracy in differentiating benign from malignant thyroid nodules. A total of 198 thyroid nodules in 100 patients were assessed using high resolution gray scale ultrasound and color doppler imaging. All the thyroid nodules were scored as per ACR-TIRADS. In case of multiple thyroid nodules in a patient, ACR-TIRADS recommends formal reporting of up to four thyroid nodules with the highest total points.

In our study a higher risk of malignancy was seen in the higher scored features. Risk of malignancy for the individual higher scored features were found to be:

Solid composition - 12.5%; Hypoechoic echotexture- 58.3%; Very hypoechoic echotexture - 75%, Lobulated margin - 100 %, Extra thyroidal extension - 100%, Punctate echogenic foci – 62.5%.

The results of our study showed that all the malignant thyroid nodules were solid with either hypoechoic or very hypoechoic echotexture and hence, malignant nodules were allocated higher points than the benign ones which were either cystic/mixed cystic solid/ solid with anechoic/isoechoic/hyperechoic echotexture.

The risk of malignancy increased form TR1 to TR5 TIRADS level. According to our study the risk of malignancy for each TIRADS level was: TR1- 0.0%, TR2 - 0.0%, TR3 - 0.0%, TR4 - 31% TR5 - 83.3%.

To summarise, ultrasonography based ACR-TIRADS is an easy to use and highly specific reporting system for stratifying thyroid nodules according to their risk of malignancy. Use of a standardized a lexicon for reporting thyroid nodules is an effective step towards reducing confusion among the referring physicians and radiologists. Furthermore, following the ACR-TIRADS recommendations for management of thyroid nodules can safely avoid unnecessary FNACs in a significant number of benign thyroid nodule.

## Bibliography

1. Cooper DS, Doherty GM, Haugen BR, Kloos RT, Lee SL, Mandel SJ et al. Revised American Thyroid Association management guidelines for patients with thyroid nodules and differentiated thyroid cancer: the American Thyroid Association (ATA) guidelines taskforce on thyroid nodules and differentiated thyroid cancer. Thyroid. 2009;19(11):1167-214.
2. Unnikrishnan AG, Kalra S, Baruah M, Nair G, Nair V, Bantwal G et al. Endocrine Society of India management guidelines for patients with thyroid nodules: A position statement. Ind J Endocrinol Metabol. 2011;15(1):2.
3. Kwak JY, Han KH, Yoon JH, Moon HJ, Son EJ, Park SH et al. Thyroid imaging reporting and data system for US features of nodules: a step in establishing better

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 02, 2023

stratification of cancer risk. Radiol. 2011;260(3):892-9.
4. Grant EG, Tessler FN, Hoang JK, Langer JE, Beland MD, Berland LL et al. Thyroid ultrasound reporting lexicon: white paper of the ACR thyroid imaging, reporting and data system (TIRADS) committee. J Am Coll Radiol.2015;12(12):1272-9.
5. Tessler FN, Middleton WD, Grant EG, Hoang JK, Berland LL, Teefey SA et al. ACR thyroid imaging, reporting and data system (TI-RADS): white paper of the ACR TI-RADS committee. J Am Coll Radiol. 2017;14(5):587-95.
6. Middleton WD, Teefey SA, Reading CC, Langer JE, Beland MD, Szabunio MM et al. Multi-institutional analysis of thyroid nodule risk stratification using the American College of Radiology Thyroid Imaging Reporting and Data System. Am J Roentgenol. 2017;208(6):1331-41.
7. Middleton WD, Teefey SA, Reading CC, Langer JE, Beland MD, Szabunio MM et al. Comparison of performance characteristics of American College of Radiology TI-RADS, Korean Society of Thyroid Radiology TIRADS, and American Thyroid Association guidelines. Am J Roentgenol. 2018; 210(5):1148-54.
8. Huh S, Lee HS, Yoon J, Kim EK, Moon HJ, Yoon JH et al. Diagnostic performances and unnecessary US-FNA rates of various TIRADS after application of equal size thresholds. Sci Rep. 2020;10(1):1-9.
9. Chakrabartty DK, Islam MI. Ultrasonographic Evaluation of Thyroid NodulesUsing ACR-TIRADS. 2021;09(02);87-95.
10. Sankaran R, Sidhu Ganesh R, Prabu Dhanasingh D, Venkateshwaran A. Validity Of TIRADS In Diagnosing Malignant Thyroid Nodules With Histopathological Correlation. J Pharma Neg Results. 2022:1237-42.