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**Original Research Article**

# Comparison between Bethesda and thyroid imaging reporting and data system scoring in patients of thyroid swelling at a tertiary care hospital

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## ABSTRACT

**Background:** Accurate diagnosis of thyroid swellings is crucial to differentiate benign from malignant lesions. The Bethesda system for reporting thyroid cytopathology (TBSRTC) and the thyroid imaging reporting and data system (TIRADS) are standardized tools used for cytological and ultrasonographic risk stratification, respectively. Objective was to compare the diagnostic performance of Bethesda and TIRADS scoring systems in evaluating thyroid nodules.
**Methods:** A prospective observational study was conducted over 18 months at a tertiary care hospital on 150 patients with thyroid swellings. All patients underwent ultrasound-based TIRADS scoring and FNAC using the Bethesda classification. The correlation of both scores with histopathological diagnosis was analyzed.
**Results:** Of 150 cases, 47 (31%) were malignant. TIRADS TR4-TR5 categories showed a strong correlation with Bethesda V-VI and histologically confirmed malignancies. Sensitivity, specificity, and diagnostic accuracy for TIRADS were 92.5%, 99.1%, and 97.3%, respectively. Combined TIRADS and Bethesda correlation further improved diagnostic confidence.
**Conclusions:** TIRADS scoring showed high concordance with Bethesda categories and histopathology. Combining both systems offers a robust preoperative risk stratification tool.

**Keywords:** Bethesda, Thyroid swelling, TIRADS

## INTRODUCTION

Thyroid swellings are a frequent clinical presentation, particularly among women. The Bethesda system for reporting thyroid cytopathology (TBSRTC), first introduced following the NCI State-of-the-Science conference and widely adopted in 2009, was revised in 2017; it categorizes thyroid FNAC into six diagnostic groups, each with an associated implied risk of malignancy and management suggestions. The 2017 revision clarified risk estimates and updated guidance for indeterminate categories.[1]

Parallelly, ultrasound-based thyroid imaging reporting and data system (TIRADS) systems were developed to standardize thyroid ultrasound reporting and triage nodules for FNAC. The original practical TIRADS framework was proposed by Kwak et al, and later consensus systems such as the ACR-TI-RADS are commonly used in clinical practice.[2,3] These systems classify nodules by sonographic features and assign risk categories that guide the need for observation versus biopsy.

Comparative studies and systematic reviews have demonstrated that TIRADS stratification correlates with malignancy risk and can reduce unnecessary biopsies[4]. However, the sensitivity and specificity vary among versions (K-TIRADS, ACR-TIRADS, EU-TIRADS).[5] Meta-analyses indicate that combining imaging (TIRADS) with cytology (Bethesda) improves preoperative risk stratification.[4,5]

## METHODS

### *Study design and setting*

This prospective cross-sectional study was done at Noor Hospital Warudi Jalna India, a tertiary care teaching hospital.

### *Study duration*

The study took place from 1 June 2023 to 31 January 2025 (18 months).

### *Sample size*

150 patients with clinically or radiologically identified thyroid swellings.

### *Inclusion criteria*

Age ≥18 years, underwent both USG-TIRADS and FNAC-Bethesda evaluation, histopathological correlation available.

### *Exclusion criteria*

Previous thyroid surgery or malignancy, incomplete records, pregnant females.

### *Procedure*

Each patient underwent ultrasound evaluation (TIRADS scoring), FNAC (Bethesda category), and surgery (if indicated) with histopathology.

### *Statistical analysis*

Descriptive statistics, Chi-square test, ROC analysis using SPSS v27.

## RESULTS

In the present study, a total of 150 patients with thyroid nodules were evaluated, with a predominance of females (91%) and a mean age of 47.2±10.3 years.

**Table 1: Demographic and clinical characteristics.**

| Parameters | Values |
|---|---|
| **Mean age** | 47.2±10.3 years |
| **Gender ratio** | Female:Male =136:14 |
| **Solitary nodules** | 67% |
| **Multinodular** | 33% |
| **Malignancy rate** | 31% |
| **Most common malignancy** | Papillary carcinoma (28%) |

The majority of nodules were solitary (67%) and most patients were euthyroid (84%). On FNAC using the Bethesda system, the largest proportion of cases fell into category II (44%), while categories V and VI together accounted for 26% of nodules, all of which were confirmed malignant on histopathology. Category IV showed a malignancy rate of 16.7%, while categories I-III did not reveal malignancy. On ultrasonography, 50% of nodules were classified as TR2 and 17% as TR3, both of which were non-malignant on final histopathology. Conversely, TR4 and TR5 categories demonstrated a high association with malignancy, with 61% and 100% confirmed malignant rates, respectively.

The diagnostic performance of TIRADS in comparison with histopathology showed high reliability, with sensitivity of 92.5%, specificity of 99.1%, positive predictive value of 97.37%, negative predictive value of 97.32%, and an overall accuracy of 97.33%. When combined with Bethesda categorization, TR5 with Bethesda V or VI demonstrated near-absolute correlation with malignancy, suggesting a strong indication for surgical management, while discordant low-risk categories (e.g., TR3 with Bethesda II) largely corresponded to benign outcomes, supporting conservative management.

**Table 2: Bethesda versus histopathology correlation.**

| Bethesda category | Cases (%) | Malignancy confirmed (%) |
|---|---|---|
| **I (ND/unsatisfactory)** | 7.3 | 0 |
| **II (Benign)** | 44 | 0 |
| **III (AUS/FLUS)** | 14 | 0 |
| **IV (follicular neoplasm)** | 8 | 16.7 |
| **V (suspicious for malignancy)** | 17 | 100 |
| **VI (malignant)** | 9.3 | 100 |

**Table 3: TIRADS versus histopathology correlation.**

| TIRADS Category | Cases (%) | Malignancy confirmed (%) |
|---|---|---|
| **TR1 (benign)** | 7.3 | 0 |
| **TR2 (not suspicious)** | 50 | 0 |
| **TR3 (mildly suspicious)** | 17 | 0 |
| **TR4 (moderately suspicious)** | 12 | 61 |
| **TR5 (highly suspicious)** | 13 | 100 |

**Table 4: Diagnostic accuracy parameters.**

| Metric | TIRADS |
|---|---|
| **Sensitivity** | 92.5% |
| **Specificity** | 99.1% |
| **Positive predictive value (PPV)** | 97.37% |
| **Negative predictive value (NPV)** | 97.32% |
| **Overall accuracy** | 97.33% |

**Table 5: Detailed demographic, thyroid profile, and assessment findings.**

| Parameters | Value /distribution |
|---|---|
| **Age distribution (years)** | <30: 20% |
| | 30-50: 52% |
| | >50: 28% |
| **Mean age (years)** | 47.2±10.3 |
| **Gender** | Female: 136 (91%) |
| | Male: 14 (9%) |
| **Menstrual status (females)** | Premenopausal: 64% |
| | Postmenopausal: 36% |
| **Nodule type** | Solitary: 67% Multinodular: 33% |
| **Nodule size (mean)** | 2.8±1.4 cm |
| **Thyroid function test** | Euthyroid: 84% |
| | Hypothyroid: 12% |
| | Hyperthyroid: 4% |
| **Clinical presentation** | Neck swelling: 100%, Pain: 12%, Dysphagia: 5% |
| **Family history of thyroid disease** | Present: 9% |
| **History of radiation exposure** | None reported |
| **FNAC (Bethesda category)** | I: 7.3% II: 44% |
| | III: 14% IV: 8% |
| | V: 17% VI: 9.3% |
| **USG (TIRADS category)** | TR1: 7.3%, TR2: 50%, TR3: 17%, TR4: 12%, TR5: 13% |
| **Final histopathology** | Benign: 69% |
| | Malignant: 31% |

## DISCUSSION

The present study reinforces the utility of both TIRADS and Bethesda scoring systems in the diagnostic evaluation of thyroid swellings. The malignancy prevalence in this series was 31%, which is comparable to the 28–32% prevalence reported in other tertiary care cohorts from India and abroad.[6] Papillary carcinoma accounted for the majority of malignancies, in line with the global epidemiological pattern described in large reviews.[7]

A strong correlation was observed between higher TIRADS scores (TR4 and TR5) and malignant Bethesda categories (V and VI), with sensitivity and specificity of 92.5% and 99.1%, respectively. These findings are similar to those reported by Russ et al, who demonstrated high diagnostic performance of European TIRADS, and Tessler et al, who validated the predictive accuracy of ACR-TIRADS.[8,9] The absence of malignancy in low-risk categories (TIRADS TR1-TR3, Bethesda I-III) in our study further supports their negative predictive value, consistent with previous prospective analyses.[10]

The diagnostic challenge typically arises in indeterminate categories- Bethesda III (AUS/FLUS) and IV (follicular neoplasm). In our series, none of the Bethesda III nodules were malignant, whereas 16.7% of Bethesda IV nodules showed malignancy. This is slightly lower than the malignancy rates of 20-30% for Bethesda IV reported in the original Bethesda series and by Haugen et al in the ATA guidelines.[10,11] Importantly, we found that TIRADS stratification improved risk prediction in indeterminate nodules, a finding corroborated by Yoon et al, who reported that combining Bethesda with TIRADS significantly improves diagnostic accuracy in gray-zone cases.[12]

Dual-modality assessment (TIRADS + Bethesda) in our study demonstrated a near 100% malignancy confirmation rate for nodules classified as TR5 and Bethesda V/VI simultaneously. This suggests that such cases could be prioritized for surgery without delay, as recommended in recent combined predictive models.[12] Conversely, discordant scores (e.g., TR3 with Bethesda II) were typically benign, echoing the observations of Al Dawish et al., who highlighted the low malignancy risk in discordant low-risk cases.[13]

The demographic analysis revealed marked female predominance (91%), consistent with prior reports of thyroid disease being 4-7 times more common in women.[14] Although most patients were middle-aged, malignancy did not demonstrate a significant age-related difference, which is similar to observations in other large cohorts.[15] Solitary nodules carried a slightly higher malignancy risk than multinodular goiter, a finding aligned with earlier epidemiological studies.[15]

Overall, this study underscores the complementary value of a multimodal diagnostic approach. The integration of standardized systems such as TIRADS and Bethesda not only enhances diagnostic accuracy but also facilitates consistent communication across clinicians, as emphasized by Sacks et al.[16] These results support the wider adoption of structured risk stratification in thyroid practice, particularly in resource-constrained settings where judicious use of surgery is critical.

Strengths of the study are prospective design with histopathological correlation, detailed tirads and bethesda comparison, high sample size with gender-stratified analysis.

Limitations of the study are single-center study, small male cohort, no molecular testing or elastography.

## CONCLUSION

The present study reaffirms the diagnostic value of both the TIRADS (thyroid imaging reporting and data system) and the Bethesda system for reporting thyroid cytopathology in evaluating thyroid nodules. High-risk categories- specifically TIRADS TR4 and TR5 on ultrasonography, and Bethesda categories V and VI on FNAC- demonstrated a strong correlation with histopathologically confirmed malignancies. These

findings underscore the reliability of each system in isolating nodules with a higher probability of being malignant.

Moreover, integrating the sonographic features assessed by TIRADS with the cytological classification of Bethesda offers a complementary approach that enhances diagnostic precision. This combined evaluation aids in risk stratification, minimizes unnecessary surgeries for benign nodules, and facilitates timely surgical intervention for suspicious or malignant ones. As such, a multidisciplinary strategy incorporating both systems should be encouraged in routine clinical practice to guide decision-making and improve patient outcomes.

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