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# CLINICOPATHOLOGICAL EVALUATION OF SOLITARY THYROID NODULES: CORRELATION OF ACR TI-RADS, FNAC AND HISTOPATHOLOGY FINDINGS

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**ABSTRACT** **Background:** Solitary thyroid nodules are common, but preoperative distinction between benign and malignant lesions remains difficult. Ultrasound-based TI-RADS and FNAC are widely used to improve risk stratification and reduce unnecessary surgery. **Patients and Methods:** This prospective analytical study was conducted in the surgical wards of Santhiram Medical College, Nandyal, over a period of one year from July 2024 to January 2026. The study included patients admitted with thyroid swellings, with data primarily collected from individuals attending the same institution during this period. A total of 50 patients clinically diagnosed with solitary thyroid nodules were included as the study sample. **Results:** Among the 50 patients, 44 were female and 6 were male. Ultrasound showed that 78% of nodules were mixed cystic-solid, 66% were hyper/isoechoic, 94% were wider-than-tall, and 96% had smooth or ill-defined benign-appearing margins. TI-RADS categorized most nodules as TR2 or TR3, while FNAC was benign in 72% of cases. Final histopathology showed predominantly benign lesions, with papillary carcinoma as the malignant diagnosis in the malignant subset. TI-RADS demonstrated high specificity and diagnostic accuracy, with reported sensitivity of about 80%, specificity of 95.5%, PPV of 66%, and NPV of 97% for malignancy prediction. **Conclusion:** ACR TI-RADS is a useful non-invasive tool for evaluating solitary thyroid nodules and can help reduce unnecessary FNAC and surgery in nodules with benign sonographic features. When combined with FNAC, it improves preoperative risk stratification and better guides surgical decision-making.

**KEYWORDS:** Thyroid Nodules, ACR TI-RADS, Fine Needle Aspiration Cytology (FNAC).

## INTRODUCTION

Thyroid diseases, with a prevalence of 4–7%, are common endocrine disorders [1], and thyroid nodules are frequently encountered in clinical practice. Their incidence has increased due to lifestyle changes and exposure to goitrogens. Patients typically present with neck swelling, toxic symptoms, or compressive features. Thyroid pathologies range from benign goiter and nodules to thyroiditis and malignancies [2].

Females are affected about four times more than males. In iodine-replete areas, palpable nodules are found in ~5% of women and 1% of men [3,4]. The incidence of thyroid nodules is 2–6% clinically, 19–68% on ultrasound, and up to 65% in autopsy studies [5,6]. Most nodules are benign, with goiter being the most common (≈8.5% in India), and many do not require intervention.

However, solitary thyroid nodules carry a higher malignancy risk (~15%). Indications for surgery include suspicion of malignancy, hyperfunction, and compressive symptoms [7]. Ultrasound is useful for detection and characterization but cannot reliably distinguish benign from malignant nodules. Histopathological examination remains the gold standard for diagnosis [8].

### Aims and Objectives

The aim of the ACR TI-RADS classification is to reduce unnecessary Fine Needle Aspiration Cytology (FNAC) and avoid unwarranted surgical interventions in patients with thyroid nodules by improving risk-based decision making.

The objectives are to enhance the diagnostic accuracy of thyroid nodule evaluation by correlating ultrasound findings based on TI-RADS with cytological results reported using the Bethesda System for Reporting Thyroid Cytopathology, and further validating both with final postoperative histopathology. Additionally, the study aims to establish effective risk stratification of solitary thyroid nodules (STN) and assess the reliability of ultrasonography in distinguishing benign from malignant lesions.

## PATIENTS AND METHODS

This prospective analytical study was conducted in the surgical wards of Santhiram Medical College, Nandyal, over a period of one year from July 2025 to January 2026. The study included patients admitted with thyroid swellings, with data primarily collected from individuals attending the same institution during this period. A total of 50 patients clinically diagnosed with solitary thyroid nodules were included as the study sample.

**Inclusion Criteria:**

- Patients aged 18–65 years
- Either sex
- Who had given consent for treatment
- Presenting with a solitary thyroid swelling arising from any lobe of the thyroid gland as identified by clinical palpation.

**Exclusion Criteria:**

- Patients younger than 18 years or older than 65 years
- Prior history of thyroid surgery
- Patients with clinically diagnosed multinodular or diffuse goiter
- Patients who had not given consent for participation.

**Methods of Collection of Data:** Data were collected prospectively from patients meeting the inclusion criteria who were admitted with solitary thyroid swelling during the study period. A detailed clinical history was obtained, including duration of swelling, symptoms of thyroid dysfunction, and presence of compressive features. This was followed by a thorough clinical examination of the thyroid gland. All patients underwent ultrasonography of the neck, and findings were categorized using the ACR TI-RADS system. Subsequently, fine needle aspiration cytology was performed, and results were reported according to the Bethesda System for Reporting Thyroid Cytopathology.

Patients who underwent surgery had their specimens sent for histopathological examination, which served as the gold standard for diagnosis. The ultrasound and FNAC findings were then correlated with the final postoperative histopathology results to assess diagnostic accuracy, risk stratification, and the reliability of ultrasonography in differentiating benign and malignant solitary thyroid nodules.

## OBSERVATIONS AND RESULTS

Among the 50 patients, 44 were female and 6 were male. Ultrasound showed that 78% of nodules were mixed cystic-solid, 66% were hyper/isoechoic, 94% were wider-than-tall, and 96% had smooth or ill-defined benign-appearing margins. TI-RADS categorized most nodules as TR2 or TR3, while FNAC was benign in 72% of cases. Final histopathology showed predominantly benign lesions, with papillary carcinoma as the malignant diagnosis in the malignant subset. TI-RADS demonstrated high specificity and diagnostic accuracy, with reported sensitivity of about 80%, specificity of 95.5%, PPV of 66%, and NPV of 97% for malignancy prediction.

**Table 1. Patient Profile**

| Variable | Finding |
|---|---|
| Total patients | 50 |
| Female | 44 (88%) |
| Male | 6 (12%) |
| Mean age | 42.82 years |
| Peak age group | 31–40 years |

**Table 2. Key Diagnostic Findings**

| Investigation | Main finding |
|---|---|
| TI-RADS | TR2: 23<br>TR3: 21<br>TR4: 5<br>Tr5: 1 |
| FNAC | Benign: 36<br>Non-diagnostic: 3<br>AUS/FLUS: 3<br>FN: 2<br>Suspicious for malignancy: 3<br>Malignancy: 3 |
| Histopathology | Benign lesions predominated; papillary carcinoma accounted for all malignant cases in the final specimen set |

## DISCUSSION

Evaluation of a solitary thyroid nodule is performed using a systematic four-step approach that includes thyroid function tests, ultrasound examination, ultrasound-guided FNAC based on ACR TI-RADS features, and detailed clinical assessment. This approach is comparable to the triple assessment used in breast lesions and provides a structured method for accurate diagnosis and management. Ultrasound is the first-line investigation for thyroid nodules, as it helps in detecting nodules, assessing their characteristics, and identifying suspicious features suggestive of malignancy. However, due to the high prevalence of thyroid nodules in the general population, it is neither practical nor necessary to perform FNAC in all patients. FNAC remains a simple, minimally invasive, and cost-effective diagnostic tool for detecting malignancy, but appropriate case selection is essential. Risk stratification systems such as TI-RADS play a crucial role in guiding decision-making by identifying nodules that require further evaluation, thereby reducing unnecessary procedures and surgeries.

In the present study, most patients were in the fourth and fifth decades of life, with a marked female predominance. The application of TI-RADS demonstrated high diagnostic performance, with good sensitivity, very high specificity, and excellent negative predictive value, making it particularly useful in ruling out malignancy in benign-appearing nodules. This helps in avoiding unnecessary surgical interventions and supports conservative management with regular follow-up in low-risk cases. Individual ultrasound features such as composition, echogenicity, margins, shape, and echogenic foci showed variable sensitivity but relatively high specificity. No single feature alone was sufficient to reliably differentiate benign from malignant nodules; however, when combined under the TI-RADS scoring system, the overall diagnostic accuracy improved significantly. FNAC further enhanced diagnostic reliability with high sensitivity, specificity, and overall accuracy. The risk of malignancy was observed to increase progressively with higher TI-RADS categories, reinforcing its importance in effective risk stratification and guiding appropriate clinical management of solitary thyroid nodules.

## CONCLUSION

ACR TI-RADS is a useful non-invasive tool for evaluating solitary thyroid nodules and can help reduce unnecessary FNAC and surgery in nodules with benign sonographic features. When combined with FNAC, it improves preoperative risk stratification and better guides surgical decision-making.

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